IOWA FISH AND FISHING

State Conservation Commission

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It is the purpose of this book to help Iowans enjoy more fully the fishing opportunities offered in this state. In pursuing this aim, the authors have pointed at three major objectives: WHERE TO FISH, IDENTIFICATION OF FISH CAUGHT, and HOW TO CATCH THEM.

The major fishing waters, including rivers, trout streams, artificial lakes, natural lakes, and river oxbows, are located and described. All fish found in the state are described and their life stories presented, with especial emphasis on angling species and bait minnows.

(Continued on back flap)

IOWA
FISH AND FISHING

PLATE 1

GREEN SUNFISH ***Lepomis cyanellus*** **Rafinesque**

PUMPKINSEED ***Lepomis gibbosus*** **(Linnaeus)**

ORANGE SPOTTED SUNFISH ***Lepomis humilis*** **(Girard)**


Maynard Reece

IOWA FISH AND FISHING

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IOWA FISH AND FISHING

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PREFACE

It is the purpose of this book to help Iowans enjoy more fully the fishing opportunities offered in this state and to answer under one cover the multitude of fish and fishing questions that reach the Conservation Commission each year. In pursuing this aim, the authors have pointed at three major objectives, where to fish, identification of fish caught, and how to catch them.

The major fishing waters, including rivers, trout streams, artificial lakes, natural lakes, and river oxbows, are located and described. All fish found in the state are described and their life stories presented, with special emphasis on angling species and bait minnows.

Strange as it may seem, fisheries biologists have found that a great majority of adult fish in Iowa waters are not caught by fishermen, but die of old age. They have learned that many of our waters are overcrowded with fish, especially panfish, bullheads and small channel catfish. With the thought of helping anglers catch as many of these fish as possible, *Iowa Fish and Fishing* goes into primer detail on how to catch fish that will bite the hook.

Iowa Fish and Fishing is written in layman's language, except for an outstanding new key to identification by Dr. Reeve M. Bailey. All material, to the best of our knowledge, is scientifically correct.

The 63 color illustrations by Maynard Reece are confidently presented as among the best fish identification plates ever published.

It is impossible to give credit to all individuals and institutions who contributed to this book. The authors do wish, however, to express their appreciation to all of their co-workers of the State Conservation Commission, and especially to the Conservation Officers and the members of the Fisheries, Biology and Engineering Sections: Bruce F. Stiles, Director of the Commission, K. M. Krezek, Chief of the Division of Administration; R. W. Beckman, Chief of the Division of Fish and Game; George Worley, Superintendent of Public Relations; K. M. Madden, Superintendent of Fisheries, and to the late R. B. Cooper, former Superintendent of Fisheries; to Dr. Kenneth D. Carlander, Associate Professor of Zoology, Iowa State College, for critical review of the manuscript and use of the data in his valuable book *Handbook of Freshwater Fishery Biology;* to Dr. Reeve M. Bailey, Curator of Fishes, University of Michigan, for preparation of the excellent keys to the fishes and review of the manuscript; to Messrs. H. M. Harrison, R. E. Cleary, E. T. Rose, W. H. Tate, Tom Moen, John Madson, Ries Tuttle, Jack Musgrove and Dr. H. H. Knight for their splendid contributions on angling and fish foods; and to colleagues and friends for encouragement and help with the book.

The art work and layout, with the exception of some sketches of water animals and the drawings used to illustrate the keys, are by Maynard Reece. The fish key figures were drawn by Staff Artist Brudon of the University of Michigan, the drawings in the chapter on fish foods are by Jim Sieh of the State Conservation Commission, and the drawings on baits and fishing tackles are by Dycie and John Madson, and Contributions of Iowa State College. The photographs of fish are by Jim Sherman, Conservation Commission photographer.

To be commended are R. R. Donnelley & Sons Co. for their excellent execution of the four-color fish plates.

The authors would be indeed ungrateful if they omitted credit for the fine stenographic and secretarial help of Barbara Griglione, Mrs. Lois Recknor and Mrs. Evelyn Boucher, associate editor of the *Iowa Conservationist.*

ARTIST'S FOREWORD

By Maynard Reece

The fish shown in the color plates of this book were painted from live specimens collected in Iowa. They were placed in an aquarium and were front-lighted with flood lights to show the colors to best advantage. A separate piece of plate glass was used as a divider and moved forward to bring the fish close to the front of the aquarium where they could move vertically and horizontally. This presented a side view at all times and made it possible to examine the specimen at close range.

Several fish of each kind were collected and brought into the studio so that typical examples could be selected for color and configuration. Average specimens were used in each case to eliminate the possibility of selecting fish that were not typical of the region in which they were collected.

As a general rule males were selected since they were more colorful than females of the same species. Fish have a considerable range of color pattern and shapes, depending on the individual and upon the time of the year collected and the waters from which they are taken. Specimens coming from muddy or roily water, for example, are usually lighter in color than those taken from clear water. After a few days in the aquarium the lighter colored fish often became darker and frequently the dark colored ones would become lighter.

Although there are slight differences in the shape of individual fish, many species take on abnormal characteristics principally during the breeding season. In the case of the male catfish, for example, there may be considerable swelling about the head, and some members of the minnow family acquire spine-like projections on the head and body called breeding tubercles.

Some fish have only slight color variation between the breeding season and other seasons of the year, but others change from drab to very brilliant coloration during the spawning period. Good examples of this are represented by the redbelly dace and the darters p. 89 and 147.

Actually there are some differences in fishes from one part of the state to another, and considerable differences may exist in the same fish when found in different sections of the United States. Since it is impossible to paint one fish that is representative of its kind in all waters, an attempt was made to reproduce typical examples of Iowa fish in each instance.

It should be pointed out that since all fish illustrated in this book were painted alive in the aquarium the colors may appear somewhat different than when held in the hand by an angler. Reflection from a blue sky will sometimes show blue highlights that do not actually exist in the color pattern of the fish itself. Other accents may or may not appear. The delicate rays and spines of the fins can be closely studied under water and they appear quite differently than when held in the hand, even though they may be mechanically extended with the fingers.

Some of the colors, especially silver, are difficult to depict in a painting and at the same time show the true shape of the fish. Silver in the shadow becomes either blue or purplish-green depending on the iridescent reflections from objects near the fish, either from the floor of the aquarium or rocks in the natural habitat.

The minnows and small fish were painted from specimens taken in October and November. In a few cases they transformed into typical breeding colors after a few days in the aquarium. This was especially true of the red-bellied dace and some of the shiners.

It was interesting to note that the fish, when excited, often changed color. In some cases the color in the eye became greatly intensified, some of the markings, including the lateral line in the mid-section of the body, or stripes on the sides of the fish, became more brilliant. A decrease of oxygen in the aquarium frequently caused the fish to appear much lighter in color. The color would return shortly after the supply of oxygen had been increased.

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Chapter I

IOWA'S FISHING WATERS

Within a few miles of the residence of every Iowan there is fishing water of one kind or another. Our angling waters include the truly beautiful glacial lakes of northwest Iowa and the clear, cold bass and trout streams of the northeast, as well as the less attractive but often equally productive rivers, reservoirs, and industrial pits of the south.

We have 15,000 miles of fishable streams, 45,000 acres of natural lakes, 3,500 acres of state-owned artificial lakes, immense numbers of gravel pits and reservoirs, an ever-increasing number of farm ponds, and truly astronomical numbers of permanent and temporary river oxbows and bayous.

Each type of water and each section of the state provides angling that is different.

In this chapter the major fishing waters of the state are located. They will be listed as natural lakes, rivers, trout streams, major oxbows, reservoirs on which public fishing agreements are in effect, and artificial lakes. Industrial pits, oxbow lakes, and miscellaneous fishing waters are numerous and are important, for the most part, locally, but because of their abundance, diversity, private character and, in many instances, impermanence, are not included in this book.

Natural Lakes

Iowa's natural lakes, except for oxbows, which will be treated under that title, were formed by glacial action. These lakes lie in the north central and northwest part of the state. The basins were formed by the scouring action of the great ice sheets and filled when the glaciers melted and retreated.

For the most part our glacial lakes are middle-aged, having been partially filled over long periods of time by windblown and water-carried silt, accumulations of vegetative remains of water plants, and by erosion of the shore lines. Our marshes are old lakes in which the siltation has progressed almost to the extinction of water areas. Thousands of our original shallow lakes and marshes have been drained for agriculture and have become rich Iowa corn land.

In order to prolong the life of some of our middle-aged lakes, the "Report on the Iowa Twenty-five Year Conservation Survey," commonly called the "Twenty-five Year Plan," advocated the removal of silt accumulations in 38 of these water bodies. A dredging program has been underway since 1934. North Twin, Black Hawk, Manawa, Storm, Cornelia, Five Island, Brown's, Blue, Silver, and Little Wall lakes have been dredged. Other lakes are scheduled for dredging in the future.

In most of the natural lakes anglers may expect to find bullheads, large-mouth bass, crappie, bluegill, walleyes, perch, carp, and in some instances other species, including silver bass, northern pike, and channel catfish. On most of the major lakes boats and bait are available during the season, and on several rental cabins may be obtained.

Four of our natural lakes contain 3,000 acres or more of water. The largest, Spirit Lake, contains 5,684 acres, West Okoboji 3,939, Clear Lake 3,643, and Storm Lake 3,060. Acreages for other large natural lakes are: East Okoboji, 1,875, Trumbull 1,190, Lost Island 1,260, Silver Lake at Lake Park, 1,058, West Swan in Emmet County 1,038, Black Hawk 957, Five Island 945, and Eagle Lake 906.

Size of the lakes does not determine the quality of the fishing. While it is true that our four largest lakes provide good fishing year in and year out, 1,190-acre Trumbull Lake, for instance, cannot compare with 900-acre Black Hawk and Five Island Lakes.

In the following lake listing, after the name of the county is the figure 1, 2 or 3. The figures are the authors' estimate of the comparative value for fishing of the lakes listed, with number 1 indicating the best lakes year in and year out, 2 next best, and 3 lowest in angling value.

Spirit Lake, Dickinson County (1)

Area 5,684 acres. Depth 20 to 25 feet. Clear, open water with generally well-defined shores. Glacial boulders numerous on shore line. Many sandy beaches. Numerous small lakes and sloughs connected, providing spawning areas and food sources for game fish. Excellent fishing all lake species. Boats, bait and cottages available.

West Okoboji, Dickinson County (1)

Area 3,939 acres. Maximum depth 132 feet. High, rocky, wooded banks. Water clear and cool. Very important recreational lake. Provides excellent fishing for lake species. Recent studies in this lake have revealed that during hot weather the oxygen content of the water is often zero below a depth of 60 feet. As a result, fishing below this depth is unproductive. Boats, bait and cottages available.

Clear Lake, Cerro Gordo County (1)

Area 3,643 acres. Maximum depth 20 feet. Saucer-shaped lake, a little over four miles long. Water clear and relatively cold. Sand beaches, some wooded and rocky shores. One of the most highly-valued recreation lakes. Noted in recent years for outstanding yellow bass fishing. Excellent for all lake species. Boats, bait and cabins available.

Storm Lake, Buena Vista County (1)

Area 3,080 acres. Depth 7 to 9 feet. Two hundred eighteen acres dredged 12 to 20 feet. Open water lake with windstorms making water roily. Very few rock reefs. Sand bottom limited to adjacent shores. Highly productive of fish life. Exceptional walleye producer. Boats, bait and cabins available.

East Okoboji, Dickinson County (1)

Area 1,875 acres. Depth 8 to 24 feet. This narrow lake is about six miles long. Forms the outlet of Spirit and West Okoboji. Banks are high and well-timbered. Shore line with considerable rocky stretches. Sand bottom in some areas. This lake provides excellent crappie, walleye and bullhead fishing, with other pan and game fish adding to its recreational value. Boats, bait and cabins available.

Lost Island Lake, Palo Alto County (1)

Area 1,260 acres. Depth 12 feet. This lake is almost round and of uniform depth throughout the main body. It is an attractive lake with generally high banks with some timber fringe. Lost Island has long been known as an outstanding bullhead lake, with walleye, northern pike, and other fish present in some numbers. Boats, bait and cabins available.

Trumbull Lake, Clay County (2)

Area 1,190 acres. Depth 5 feet. This shallow lake is a clear body of water with gravelly shores and generally well-defined wooded banks. Its limited depth makes maintenance of fish population difficult, with bullhead and northern pike fishing and other pan and game fish present during favorable water periods.

Silver Lake, Dickinson County (1)

Area 1,058 acres. Depth 5 to 8 feet. This lake is a beautiful body of water with high, wooded banks. Considerable rocky shore and sandy beaches present. Rather heavily-silted in some areas. Provides good walleye, bullhead and crappie fishing. Boats and bait available.

West Swan Lake, Emmet County (2)

Area 1,038 acres. Depth 6 to 8 feet. Irregularly shaped lake about two and one-half miles long. Banks are sharp and covered with timber. Large marsh inlet at southwest end. Principal fishing, bullheads and northern pike.

Tuttle Lake, Emmet County (2)

Nine hundred eighty-one acres of this lake are in Iowa. Almost 2,000 acres lie in Minnesota. Depth 5 to 6 feet. Shore sandy. Banks high and wooded in many places. Other sections banks are low and pastured. Principal fishing, bullheads and northerns.

Black Hawk Lake, Sac County (1)

Area 957 acres. Depth 6 to 7 feet, with 105 acres dredged to 9 to 16 feet. This is an irregularly shaped lake about two and one-half miles long. Well-defined banks with several groves of timber. One of the more popular fishing lakes with excellent crappie and bullhead fishing. Considerable numbers of crappie, largemouth, walleyes, bullheads and other pan fish. Boats, bait and cabins available.

Five Island Lake, Palo Alto County (1)

Area 945 acres. Depth 3 to 5 feet. Dredged area 9 to 12 feet. This lake, formerly called Medium Lake, is irregularly shaped and about four miles long. It has generally good banks with scattered growth of timber, and several wooded islands. Provides excellent bullhead and perch fishing with other species of game and pan fish common. Boats and bait available.

Eagle Lake, Hancock County (3)

Area 906 acres. Depth 4 to 5 feet. This is a shallow lake with considerable low marshy land along shore. Some timber on higher banks along west side. A deep deposit of silt and decaying plants on the bottom. Limited bullhead fishing during favorable water periods.

Big Wall Lake, Wright County (3)

Area 935 acres. Depth 2 to 5 feet. Of minor fishing value.

Pickerel Lake, Buena Vista County (3)

Area 176 acres. This shallow, open water lake has rocky, wooded shores. During favorable years it produces bullheads and walleyes.

North Twin Lake, Calhoun County (1)

Area 569 acres. Depth 6 to 8 feet, with 135 acres dredged to 9 to 15 feet. This is a narrow lake about two and one-half miles long. The north end shores are low and flat. The south and southeast shores are well marked, with some timber. This is a popular lake. Provides good pan fishing, with northern pike present in numbers. Boats and bait available.

South Twin Lake, Calhoun County (2)

Area 600 acres. Depth 5 feet. Generally low banks with few trees. Lies immediately south of North Twin Lake. Provides bullhead and pan fishing. Boats and bait available.

Dan Green Slough, Clay County (3)

Area 285 acres. Depth 2 to 3 feet. Long, narrow lake with rather well-marked banks on east side. West side low. Heavily silted bottom. Unimportant as a fishing lake.

Elk Lake, Clay County (3)

Area 261 acres. Depth 5 feet. This is an attractive lake with gently sloping banks with some timber. Is heavily silted. Provides limited pan fishing.

Silver Lake, Delaware County (3)

Area 12.97 acres. Provides bullhead fishing.

Center Lake, Dickinson County (2)

Area 264 acres. This little lake in the Great Lakes region is almost overlooked by most anglers. It is a saucer-shaped lake with a maximum depth of about 8 feet. Provides bullheads, bass in abundance, with other pan fish present.

Diamond Lake, Dickinson County (3)

Area 166 acres. Used primarily as a nursery lake for walleye fry. Provides some bullhead and pan fish fishing.

Welch Lake, Dickinson County (3)

Area 75 acres. A shallow lake used primarily as a nursery lake.

Marble Lake, Dickinson County (2)

Area 175 acres. This lake is adjacent to Spirit Lake. Provides good bullhead and largemouth bass fishing during favorable water periods.

Little Spirit Lake, Dickinson County (2)

Area 214 acres. Provides good bullhead fishing. Boats, bait and cabins available.

Swan Lake, Dickinson County (2)

Area 371 acres. A shallow lake. Provides bullhead, bass, bluegill and perch fishing.

Prairie Lake, Dickinson County (3)

Area 136 acres. Unimportant as a fishing lake.

Pleasant Lake, Dickinson County (3)

Area 82 acres. Not important as a fishing lake.

Jemmerson Slough, Dickinson County (3)

Area 100 acres. Unimportant as a fishing lake.

Four Mile Lake, Emmet County (3)

Area 219 acres. Not important as a fishing lake.

High Lake, Emmet County (2)
Area 467 acres. Provides bullhead, walleye and pan fishing.

Iowa Lake, Emmet County (2)
Area 308 acres. Provides bullhead and pan fishing and some northern pike.

Twelve Mile Lake, Emmet County (3)
Area 290 acres. Bass and bullhead fishing.

Ingham (Mud) Lake, Emmet County (2)
Area 421 acres. Provides bullhead, bass, walleye, and pan fishing.

Little Wall Lake, Hamilton County (2)
Area 273 acres. Provides bullhead, bass and northern pike fishing.

Crystal Lake, Hancock County (2)
Area 238 acres. Bullheads and some pan fishing.

East Twin Lake, Hancock County (3)
Area 193 acres. Bullheads and some pan fishing.

West Twin Lake, Hancock County (3)
Area 109 acres. Provides bullhead fishing.

Goose Lake, Kossuth County (3)
Area 103 acres. Not important as a fishing lake.

Swag Lake, Kossuth County (3)
Area 46 acres. Not important as a fishing lake.

Rush Lake, Osceola County (3)
Area 359 acres. Provides bullhead fishing.

Iowa Lake, Osceola County (3)
Area 116 acres. Provides some bullhead fishing.

Silver Lake, Palo Alto County (2)
Area 638 acres. Provides bullheads, pan fishing, some northerns and walleyes.

Rush Lake, Palo Alto County (Mallard) (3)
Area 460 acres. Provides bullheads, northern pike and pan fishing.

Virgin Lake, Palo Alto County (3)
Area 200 acres. Bullheads and pan fish.

Clear Lake, Pocahontas County (3)
Area 187 acres. Provides bullhead and perch fishing.

Lizard Lake, Pocahontas County (3)
Area 268 acres. Provides bullhead and perch fishing.

Rice Lake, Worth and Winnebago Counties (2)
Area 612 acres. Provides bullheads, bluegills and northern pike.

Duck Lake, Winnebago County (3)
Area 72 acres. Not important as a fishing lake.

Lake Cornelia, Wright County (2)
Area 274 acres. One hundred thirty acres have been dredged to 8 to 10 feet. Provides bullhead, walleyes, bass, and crappie fishing.

Elm Lake, Wright County (3)
Area 463 acres. Provides bullhead fishing.

Twin Sisters Lake, Wright County (3)
Area 108 acres. Provides bullhead fishing.

PLATE 2

WHITE CRAPPIE *Pomoxis annularis* Rafinesque

BLACK CRAPPIE *Pomoxis nigromaculatus* (LeSueur)


Maynard Reece

Rivers

Surveys reveal that more than half the angling in Iowa is done along our 15,000 miles of streams. Part of the popularity of our rivers and streams is due to the fact that most of our cities, therefore our greatest population, is adjacent to the rivers. Stream fishing has a particular fascination to people who like elbow room, enjoy wildlife parades in never-ending variety, and a different angling problem to solve around each bend.

With the exception of our major rivers, most of the streams headwater within the state, and a large majority of them reach parent streams within the confines of our boundaries. Most of our streams flow through some of the richest and most intensively cultivated soils in the world. Because of the nature of our soils, intensive cultivation and drainage, our flowing waters are subject to violent fluctuations, flooding their valleys during periods of heavy rain and diminishing greatly in volume in late summer. These fluctuations, plus heavy loads of silt from agricultural land, have caused a decline in certain species of fish with a corresponding increase in those more tolerant to water changes.

In spite of some unfavorable aspects, our streams are rich in nitrogen and production of water life is great. Possibly our streams produce a greater poundage of fish than when our pioneers first knew them, with the small-mouth bass and other less tolerant species giving way to catfish, carp, suckers, and other fish that feed by touch and taste rather than by sight. During the last hundred years silt loads caused by agriculture have changed the character of many of our streams. The lighter soils have carried away with the heavier particles of sand remaining in the channel, covering valuable food-producing riffles and filling the sheltering holes.

Generally speaking, the headwaters of our streams are clear, less subject to siltation and water fluctuation, the lower reaches more turbid with increased pollution and consequently fewer of the larger sight-feeding fish.

The Mississippi

The Mississippi is one of the greatest rivers in the world. The drainage of this river and its tributaries embraces one-third of the land surface of the United States. It is more than 4,000 miles in length from the headwaters of its Missouri River tributary to its mouth in the Gulf of Mexico.

The river was discovered by DeSoto in 1541. Marquette and Joliet were the second white men to see the Mississippi when they reached the mouth of the Wisconsin River in 1673. These voyagers were warned by the Indians before going onto the river that it was inhabited by river demons and giant fish that would certainly destroy them.

Mark Twain believed that the Indian traditions were based on the presence of giant sturgeon, paddlefish, and catfish. In *Life on the Mississippi* he writes of having seen catfish "six feet long, weighing 250 pounds." Even today traditions survive among the river people of monster fishes and other undiscovered river creatures of fabulous size.

When white men first saw Iowa, the Mississippi was a source of fish food for the native Indians. The great mounds of the Mississippi River contain evidence that the prehistoric Indians depended greatly on the Father of Waters for staple food supplies of fresh-water mussels and fishes.

The Mississippi River borders Iowa for more than 300 miles, entering the state between precipitous limestone bluffs four to six hundred feet above the river level. The bluffs diminish in size and spectacular appearance from Dubuque south. The river meanders east and west across its two to six-mile valley and is considerably wider along our boundary but not as deep as it is in the lower part of the Mississippi Valley. The river bed is primarily sand

and mud, with a few bedrock outcroppings, the most notable of which are the chain of rocks at LeClaire and Dubuque and the falls above the mouth of the Des Moines River.

The waters of the Mississippi become muddy during flooding conditions. Much of the time, however, as it skirts our boundary, it is quite clear, this being especially true in late summer, fall and winter. Our part of the river falls an average of six inches per mile of stream. Its current flows some two miles an hour during normal water stages to as much as five in high water periods.

The Mississippi River in its original condition consisted of a series of pools separated by shoals, bars and rapids, with a channel or channels between much like our inland streams. These channels were obstructed by rocks and snags, and during low water stages the flow into the shoals separated into many chutes of narrow width and very little depth.

The first engineering on the Mississippi occurred in 1824 when Congress authorized improvement for navigation by removal of snags. As early as 1836 improvements were carried on by removal of snags and steamboat wrecks from the rapids at Keokuk and Rock Island. Shortly after this date a canal and locks were placed in the river at Keokuk. In 1905 an act of Congress permitted construction of the Keokuk power dam. In 1907 an act authorized provision of a six-foot channel from the Missouri River to Minneapolis by "construction works, dredges, dredging, diking, canals and locks." An act of 1935 authorized a nine-foot channel from Minneapolis to the Missouri River by means of locks and dams supplemented by dredging. The present dams now controlling the river are the result of this legislation.

Eleven permanent nine-foot channel dams affect the river bordering Iowa, beginning upstream with Dam No. 9 at Lynxville downstream to Dam No. 19 at Keokuk. The Iowa dams include: No. 9, Lynxville; No. 10, Guttenberg; No. 11, Dubuque; No. 12, Bellevue; No. 13, Clinton; No. 14, LeClaire; No. 15, Rock Island; No. 16, Muscatine; No. 17, New Boston; No. 18, Burlington; and No. 19, Keokuk.

Commercial fishing became a means of livelihood with the first settlements on the Mississippi. There were no laws governing fishing, and all species provided food for the river towns.

The river originally was the home of unbelievably large numbers of clams (fresh-water mussels) of various kinds. The abundance of clams was responsible for the establishment of the pearl button industry, the largest in the world, centered at Muscatine. Prior to the building of the Mississippi dams millions of tons of shells were taken, but since the nine-foot channel system was established suitable habitat for these mollusks largely had disappeared under heavy blankets of silt, and the remaining button industry is supported primarily from shells imported from other rivers.

From an infant industry in the early river settlements, commercial fishing grew as the Middle West's population built up. Rapid transportation facilities and refrigeration, plus the introduction and establishment of carp, put commercial fishing on the Mississippi River into the big leagues.

The fishery industries on the Mississippi support wholly or in part many families on the Iowa border. The average annual catch for the five-year period 1943-48 was 3 million pounds, the catch being made up of 47 per cent carp, 22 per cent buffalo, 15 per cent catfish, 10 per cent sheepshead, and 6 per cent miscellaneous.

Most of the commercial fishes along the Mississippi River are taken by nets and seines, although relatively large numbers of catfish are taken on trot lines both in the river proper and its backwaters and chutes. Commercial fishing on the Mississippi is strictly regulated, with fishermen being required to license all equipment and make an annual report of numbers and kinds taken.

Prior to channelization of the Mississippi River, angling was much the same as that carried out on the larger inland streams at the present time.

In constructing the six-foot channel in 1907, large numbers of wing dams jutting out from the shore into the current to deepen the channel were built. This changed the original angling picture. Considerable fishing was done out on the wing dams, where large numbers of smallmouth bass, crappies, northern and walleyes were taken. These wing dams, along with shore riprapping, provided lush feeding grounds for the fish, and they had a tendency to congregate in these areas where prey species found shelter.

The six-foot channel development had very little effect on angling in the rapid chutes between the Mississippi islands. Here, too, game fishes in great quantities congregated to feed and were a source of excellent fishing for the pole-and-liners.

With the establishment of the nine-foot channel dams, most of the wing dams were submerged. Also, most of the rapid chutes between islands and even the islands themselves were covered by the backwaters, destroying many of the formerly productive game fishing grounds.

With the high dams creating a series of lake-type pools in the river, there was a decided change in the make-up of fish populations with a decrease in the fast water species, such as the smallmouth bass, and an increase in fishes whose favorite environment was more pondlike, these latter including especially crappies, bluegills, walleye, carp, buffalo and others of the sucker family. The new channel dams also changed favorite locations for the anglers. Although some of the wing dams and jetties are still present in some of the upper reaches of the pools and are in some instances quite heavily and successfully fished, the main lake behind each of the dams is for the most part, poor for pole-and-line fishing, although crappie, bluegill, and largemouth bass are taken in large numbers in some of the sloughs and backwaters. The best fishing on the Mississippi River proper at the present time, especially for walleyes, is immediately below the various dams.

The popularity of fishing below the dams is accounted for by several basic reasons. In the first place, the dams themselves during much of the year act as a physical barrier to fish moving upstream. For some distance below the dams the stream is scoured out, giving a particularly favorable bottom environment with fast, highly oxygenated water flowing in true Mississippi River fashion. These conditions afford excellent environment for forage fishes and many other forms of fish food. Game fish therefore concentrate in these man-made fish havens.

Most of the dams are relatively accessible from highways and surfaced roads as well as by boat, and are more convenient to anglers than many of the back stretches of the river, which are practically inaccessible by any overland route.

Mississippi Tributary Streams

Upper Iowa River and Tributaries

The Upper Iowa River rises in Mower County, Minnesota, at an elevation of 1,315 feet above sea level. It flows in an easterly direction for 135 miles where it joins the Mississippi below New Albin at an elevation of 615, a fall of 700 feet. There are 1,057 square miles in the Upper Iowa drainage basin.

This river has carved its channel through the deepest valley in Iowa. Some of the limestone cliffs are more than 400 feet from the valley floor. The bluffs are well-timbered with some good stands of native white pine, juniper and hardwoods. Its valley is one of the most beautiful in the entire state. The stream bottom is largely limestone rubble, limestone outcroppings and sand, with frequent riffles of various lengths. The stream is relatively shallow with some deeper stretches and deeper holes. It is fed by numerous springs, some of large size, and numerous small spring-fed tributaries.

The stream for most of its length is cool and usually crystal-clear. It is an excellent stream for canoeing from the Minnesota border to its mouth during the early summer months before water stages get too low. There are few portages needed even during good water stages because of natural obstructions. There are three dams, one in Howard County and two in Winneshiek.

Smallmouth bass are the principal game fish in the upper reaches of this beautiful stream, with a few trout also occasionally found. The lower reaches contain catfish, smallmouth bass, walleyes, sauger, and miscellaneous pan fish. The Upper Iowa is considered one of the state's better smallmouth black bass streams, as well as being one of its most interesting from a scenic, geologic, and archaeologic standpoint.

Aside from trout streams that will be taken up in a special section, there are no important tributaries to this river.

Turkey River and Tributaries

The Turkey River rises in Howard County 1,300 feet above sea level and flows southeasterly 135 miles, where it enters the Mississippi near Guttenberg at 560 feet above sea level. Its watershed contains 1,700 square miles.

In its upper reaches the Turkey River flows through flat terrain. It then enters the unglaciated area of northeast Iowa and cuts much of its lower channel through limestone rock. Much of the Turkey River valley contains rugged bluffs with considerable hardwood timber interspersed with red cedar. Some of our most famous Indian mounds are found in its valley, including the famous Turkey River Mound series. It flows over rocky limestone bottoms and stretches of sand with fine silt along some sections.

The Turkey is productive of smallmouth bass, rock bass, catfish, suckers and chubs, with important numbers of other species, including northern pike and crappies, being present.

Volga River

The Volga is formed by the union of its two branches in Fayette County and flows 33 miles to its union with the Turkey. It has a drainage area of 408 square miles. In the lower reaches its rock-walled valleys are typical of northeast Iowa streams. Near Mederville its rock gorge is 100 feet wide and 300 feet deep.

The Volga is a comparatively shallow stream with frequent rock riffles and deep holes with some sand and silt stretches. It is one of the clearer streams during normal water periods. It is an excellent smallmouth bass stream with good populations of channel cat, rock bass, chubs and suckers.

Little Turkey River

The Little Turkey rises in Howard County and flows southeast 48 miles to its junction with the Turkey in Fayette County. It has a drainage area of 354 square miles. Its topography and characteristics are similar to that of its parent stream. The kinds of fish are similar to those found in the Volga.

Crane Creek

Crane Creek rises in Howard County and flows 44 miles southeast to its junction with the Little Turkey in Fayette County. Its topography, landscape and angling are similar to its parent stream. Otter Creek, Elk Creek and Roberts Creek provide bass and catfishing in their lower reaches.

Yellow River and Its Tributaries

The Yellow River rises in Winneshiek County at an elevation of 1,160 and flows 35 miles east into the Mississippi River in Allamakee County north of Marquette. The Yellow River flows through a hilly, rugged terrain, much of it heavily timbered. Many of its bluffs are surmounted by ancient Indian mounds. The stream receives its name from the yellow clays carried in suspension much of the time. It is a comparatively shallow stream with limestone rock riffles, sand and clay bottom. This beautiful stream has an extremely rapid fall, averaging almost 15 feet per mile. In one section it falls 27 feet per mile. The canyon through which it flows is narrow and steepsided.

Principal fishing in the Yellow River is provided by smallmouth bass and catfish, with the upper reaches containing some trout and the lower most of the fish found in the lower reaches of streams entering the Mississippi.

Yellow River Tributaries

The principal tributaries of the Yellow River are West Fork, Williams Creek, and Suttle Creek, all of which provide limited fishing in their lower reaches.

Maquoketa River and Its Tributaries

The Maquoketa River rises in Fayette County at 1,160 feet above sea level and flows in a southeasterly direction into the Mississippi River two miles north of Green Island. Its length is 134 miles with a fall of about three and one-half feet per mile. Its drainage basin contains 2,563 square miles.

The Maquoketa River valley is one of the most beautiful in the state. Through much of its valley it skirts rugged limestone bluffs some 140 feet above the valley floor. Ancient hardwoods and tall white pines, in places, fringe the stream. Its unusual beauty is testified to by the fact that three of Iowa's state parks are located along its banks. Numerous large springs are found in the valley, and the rock walls contain many caves carved by ancient waters.

The floor of the stream in many stretches is solid limestone, with limestone rubble and sand predominating its entire course. The Maquoketa in normal water periods is a canoe-angler's paradise.

The stream is productive of smallmouth, rock bass, catfish, suckers and crappies with important numbers of other species being present.

North Fork

North Fork is the principal tributary of the Maquoketa River. It drains 587 square miles, joining the main river about 30 miles above its mouth. The North Fork is a rapid stream and falls about 536 feet in a distance of 72 miles. Fishing in the North Fork is predominately for smallmouth bass, catfish and suckers with some other fishes being present.

Smaller tributaries of the Maquoketa include LaMont, Prairie and Silver creeks.

Wapsipinicon River and Its Tributaries

The Wapsipinicon River rises in the southeast corner of Mower County, Minnesota, at an elevation of 1,250. It falls 685 feet in its 255-mile journey to the Mississippi River five miles above Princeton. Its drainage basin contains 2,563 square miles. It is the largest river in northeast Iowa and the fifth largest draining into the Mississippi from this state, exceeded in size only by the Des Moines, Cedar, Iowa and Skunk. It flows through a wide valley dotted with ponds and marshland.

The Wapsipinicon, though not as fast as the Maquoketa, is another of our more beautiful rivers. The upper part of the Wapsi valley is not as rugged as the central portion, which contains many weathered rock outcroppings with precipitous cliffs and old trees similar to those in Wapsipinicon State Park.

Much of the Wapsipinicon valley is timbered, the stream itself flowing over many stretches of limestone rubble and gravel. Fishing in the Wapsipinicon is excellent, with smallmouth bass, channel cat, flatheads, walleyes and northern pike being found. The Wapsipinicon basin is narrow and it has few large tributaries. Important tributaries include Buffalo Creek, Little Wapsie, East and Middle Branch, all fairly good catfish and smallmouth streams.

Cedar River and Its Tributaries

The Cedar River headwaters in the marshy area near Hayfield, Minnesota, at 1,310 feet above sea level. It falls 740 feet during its 300-mile course to Columbus Junction. The Cedar has a total drainage of 7,870 square miles and is one of our most important inland streams.

The Cedar River enters the state of Iowa in Mitchell County. Through much of the upper valley limestone bluffs border the stream, and there are numerous stream bank and stream bed springs. Hardwood trees and cedars aid in making the upper Cedar valley area spectacularly beautiful. Much of the Cedar valley floor contains rock rubble with shifting sand bars. Except in low water periods, the Cedar is an excellent canoeing stream. There are however, many dams that require portages. In the lower part of its valley the Cedar loses much of its rugged character and is similar to central Iowa streams such as the Skunk.

The upper reaches of the Cedar provide excellent smallmouth bass and sucker fishing, with catfish, walleyes and northerns adding to the anglers' take. Below Charles City channel cat are the principal fish, with flatheads common below Cedar Rapids.

Small tributaries include Deer and Rock creeks in Mitchell County and Sugar and Rock creeks in Cedar County. All are excellent smallmouth bass streams.

Other important tributaries to the Cedar River are Black Hawk Creek, entering the Cedar at Waterloo, Wolfe Creek near LaPorte City, and Prairie Creek below Cedar Rapids. These streams provide some smallmouth and good catfishing during favorable water periods. Lime, Bear and Indian creeks are good smallmouth streams and contribute much in the way of spawning grounds for the Cedar River smallmouth bass.

Little Cedar River

The Little Cedar has its source in Mower County, Minnesota, and joins the Cedar at Nashua. It drains a basin of 315 square miles. It is a picturesque stream with rock and shifting sand bottom. Principal fishing is for smallmouth bass and channel catfish.

Shellrock River

The Shellrock rises in Albert Lea Lake, Minnesota, and empties into the Cedar about five miles above Cedar Falls. It drains a basin of 2,660 square miles. The Shellrock is a beautiful stream with limestone borders along much of its course. It is probably the best producer of the fresh-water mussel (commonly called clam) in the state. Limestone rubble and sand make up much of the floor. It has a fall of more than three feet per mile. The Shellrock is one of Iowa's outstanding smallmouth bass streams and is excellent for channel catfish and walleyes.

The Shellrock has two important tributaries, the West Fork and Lime Creek (Winnebago River), each having a drainage of over 700 square miles. These, along with other minor tributaries, provide excellent smallmouth bass fishing, as well as channel catfishing and northern pike in many stretches.

Iowa River and Its Tributaries

The Iowa River flows from Crystal Lake in Hancock County at an elevation of 1,265 feet. In its 329-mile course southeast toward the Mississippi it falls a distance of 685 feet, entering the Mississippi at Toolesboro. It has a drainage basin, including the Cedar drainage, of 12,640 square miles and is our second largest inland stream.

The headwaters of both the East and the West branches of the Iowa move slowly through the marshy areas of Hancock County. The West Fork is dredged to carry the water from Crystal and Eagle lakes in the upper 32 miles. The Iowa meanders through the rich prairie farmlands in its upper reaches, with a fall of only one and one-half feet per mile. As it approaches the Franklin County line it speeds up to seven and one-half feet per mile, cutting through sandstone and lime rock. Gradually the fall tapers off until, in its lower reaches, it again crawls along with a fall of one and one-half feet. From its confluence with the Cedar River at Columbus Junction to the Mississippi, the Iowa is a slow, wide river with numerous willow-covered islands.

The Iowa is an important angling stream. Catfish are predominant throughout its entire length with the exception of the extreme upper portions. Excellent smallmouth bass fishing is found in portions of the middle river, with walleyes and northern pike found in good numbers in the fast rocky reaches. In the lower half of the stream large flathead catfish are taken in considerable numbers.

English River

Other than the Cedar, the English River is the most important tributary to the Iowa. It has a length of 85 miles, joining the Iowa in Washington County below Iowa City. The English River is a good catfishing stream in its lower reaches.

Skunk River and Its Tributaries

The Skunk River rises in northeastern Hamilton County at 1,200 feet above sea level. Through much of its journey to the Mississippi it parallels the valley of the Des Moines. The Skunk falls a total of 680 feet in its 264-mile journey. Its drainage basin contains 4,325 square miles.

In its headwaters the Skunk flows through rich agricultural land that was formerly marsh. It has been ditched to provide drainage. After the Skunk enters Story County, it follows through a broad flood plain in which exposed sandstone, shale and limestone occur. Much of the stream has been straightened through Story, Polk, Jasper, and part of Mahaska County. Through this area the Skunk carries considerable amounts of silt with drift sand predominating on the bottom in the straightened areas. Through Keokuk, Washington, Jefferson and Henry counties and between Lee and Des Moines counties, the Skunk runs over limestone bedrock and winds through wooded bottomlands, entering the Mississippi about nine miles above Fort Madison.

In some of the upper reaches of the Skunk, smallmouth bass fishing is good along with channel catfishing. In much of the dredged area fishing is generally poor, although during certain years even in the shallow straightened section of stream, catfishing is good. In the lower reaches of the Skunk, beginning in Keokuk County, some of the finest catfishing in the entire state is found, flathead catfish being especially numerous in the vicinity of the Oakland Mills dam.

Skunk River Tributaries

North Skunk is the principal tributary. It joins the main stream in Keokuk County 90 miles above the junction of the Skunk with the Mississippi. It is 114 miles long and drains an area of 860 square miles.

Cedar Creek rises in southeastern Mahaska County and flows 76 miles southeast to its junction with the Skunk below Rome. The Cedar has a basin of 560 square miles.

Other tributaries of some fishing importance include Squaw Creek, Bear Creek, Clear Creek, Sugar Creek, Indian Creek, Buck Creek, Church Creek and Walnut Creek.

Des Moines River and Its Tributaries

The Des Moines River is Iowa's largest and most important inland stream. It rises in the meadows of Murray and Pipestone counties in southwestern Minnesota at an elevation of 1,850 feet. It flows southeast a distance of 535 miles, entering the Mississippi near Keokuk. It has a fall of 1,375 feet in its 500-mile journey. Its drainage basin contains 14,540 square miles.

The Des Moines River is a slow-flowing stream. During high water it carries an extremely heavy load of silt. Through much of its course its channel is choked with drift sand, and mud bars are common.

The Des Moines River from its mouth to the city of Des Moines naturally falls into three divisions with varying characteristics. The lower division, from the mouth to St. Francisville, Missouri, 15 miles, lies in the flood plain of the Mississippi and is affected by backwater from this river. The channel is very changeable, narrow and tortuous and is obstructed at many points by snags. The soil of the valley is dark loam, four feet or more in thickness, underlaid with sand, which offers little resistance to erosion. The adjacent bottomlands are very fertile, but cut up by sloughs and old river channels.

The middle division, from St. Francisville, Missouri, to Ottumwa, 79 miles, lies in what may be called a gorge. The width of the valley is rarely more than a mile and frequently less than a quarter of a mile. With the exception of the great bend at Keosauqua, the river has practically a straight course with a width of from 600 to 900 feet between solid banks of from 15 to 25 feet in height. Flat ledge rocks form the bottom of the river and large boulders frequently occur in the channel. The bars are flat and consist of gravel, sand and mud, but are not numerous. From Croton to the mouth, deep water is common with fine flathead fishing in the spring.

The upper division of the Des Moines, from Ottumwa to the mouth of the Raccoon River at Des Moines, 107 miles, lies in an alluvial valley from one to four miles wide, the river winding from bluff to bluff in a series of sharp bends. The soil is a dark loam four to eight feet in thickness, underlaid with sand. In many places the channel of the river has moved back and forth across the valley, and many horseshoe lakes and sloughs have resulted. The width of this part of the river between banks which are from 12 to 15 feet above low water is from 350 to 500 feet; however, encroaching sand bars frequently reduce the width to 100 feet at low water. With the exception of the vicinity of Chillicothe and Bellfontaine, rock is rarely found under the river bed.

From Des Moines north numerous rock outcroppings occur, with many stretches of the river containing quantities of glacial boulders and coarse gravel.

Much of the flood plain of the Des Moines is wooded. During low water periods large numbers of sand bars are emergent. The Des Moines River is an excellent canoe stream throughout most of its length, except in periods of extreme low water.

Most of the Des Moines River provides excellent fishing. Pollution in some stretches is, however, a major deterrent, being especially bad for considerable distance below the city of Ottumwa. The lower reaches of the Des Moines River contain most of the fishes found in the Mississippi. Principal angling, however, from the mouth to Des Moines is for channel catfish and flathead catfish. From Des Moines north, in addition to these species, smallmouth bass, walleyes and northern pike are found in important numbers.

Des Moines River Tributaries

The East Fork of the Des Moines rises in Tuttle Lake on the Minnesota-Iowa border at an elevation of 1,350, drains 1,290 square miles and is 120 miles in length. It enters the Des Moines River in Humboldt County. The East Fork is an excellent fishing stream, with channel catfish, smallmouth bass, crappies, bullheads and northern pike, as well as walleyes, found in the fisherman's catch.

Boone River

The Boone River heads in Hancock County at an elevation of 1,230 feet, drains an area of 900 square miles, and has a length of 100 miles. It joins the Des Moines River near Stratford. The Boone contains channel catfish and is one of the most important producers of smallmouth bass in the Des Moines River basin.

Raccoon River

The Raccoon River heads in Buena Vista County at an elevation of 1,325 feet. It falls 550 feet in its 200-mile length. It drains an area of 3,640 square miles and joins the Des Moines River in Polk County. The upper reaches of the Raccoon flow through the flat prairies of Buena Vista County. Some of its upper length has been dredged and provides little angling. The undredged lower reaches flow through rich agricultural land, and the stream contains large quantities of glacial rocks and gravel. Most of its lower length is well timbered.

In spite of the fact that the Raccoon carries an extremely heavy silt load and fluctuates violently, it is an excellent fishing stream for channel catfish with many stretches producing fine smallmouth bass and walleye fishing.

South Raccoon River

The South Raccoon heads in Audubon County at an elevation of 1,400 feet. It falls 550 feet in its 82-mile course and drains an area of 1,150 square miles. The South Coon provides good channel catfishing during favorable water periods.

Middle Raccoon River

The Middle Raccoon heads in Carroll County and drains 610 square miles. It is 76 miles in length and joins the Raccoon in Dallas County. Excellent channel catfishing may be found during good water levels in the lower part of this stream.

North River

The North River rises in Guthrie County near Menlo and flows first in a southeasterly direction for about 41 miles, where it then bends northward and follows a crooked path northeast for 25 miles more to its confluence with the Des Moines River in Polk County. Fair to good fishing for channel catfish is experienced during the early part of the season.

Middle River

Middle River heads in Guthrie County at 1,400 feet. It falls 600 feet in its 105-mile journey. It drains 560 square miles and enters the Des Moines River in Warren County. Much of the lower reaches of Middle River has been dredged, and it is of minor importance for fishing.

South River

South River heads in Clarke County at an elevation of 1,150 feet. It has a fall of 400 feet in 53 miles. It drains 590 square miles and joins the Des Moines River in Warren County. Some 15 miles of the lower part of this stream has been dredged, and it is of limited angling importance.

Whitebreast Creek

This stream rises in the east central part of Clarke County, flows in a northeasterly direction to its confluence with the Des Moines River in Marion County. Although this stream has been straightened in places, the unstraightened reaches provide bullhead, channel catfish and some pan fish fishing.

Missouri River

Three rivers, the Jefferson, Madison and Gallatin, join at Three Forks, Montana, to form the source of the Great Missouri. The Missouri River, known throughout the civilized world as the Big Muddy, flows in a southeasterly direction 2,464 miles to its confluence with the Mississippi above St. Louis. Much of its writhing course is through rich farm lands in seven states. It forms approximately two-thirds of the western boundary of Iowa, and is the western boundary of Woodbury, Monona, Harrison, Pottawattamie, Mills and Fremont counties.

The bluffs along our section of the river rise from 150 to 300 feet above the valley floor and are wind-blown deposits from the west known as loess. The valley, from the steep bluffs that rise from the bank of the river at Sioux City to the spectacular knobs and knife-shaped ridges in the lower reaches of the Iowa portion of the stream, is a thing of beauty.

The Missouri is steeped in Indian lore and history. Well-defined village and grave sites mark the use of the region by nations of historic and prehistoric Indians. Marquette and Joliet discovered the mouth of the Missouri in 1673, although they knew the river itself only by word of mouth from the Indians. Great Indian tribes, including Dakota, Iowa, Oto, Winnebago, Potawatomi, Sac, and Fox made use of the lush hunting and fishing grounds found in the Missouri River valley in Iowa. In addition to these roving nomads of the prairies, explorers, traders, trappers, and rivermen ascended the river in quest of adventure and wealth.

Sixty years before the famous Lewis and Clark expedition, the French explorer, Verendrye, had visited the Mandans 1,500 miles above the mouth of the Missouri. The first Spanish subject to ascend the river was Jacques d' Eglise, in 1790. Later the Spanish sent James MacKay, a Scot, up the river as far north as the Nebraska shores. Perrin duLac ascended the Missouri to the White River in South Dakota, and published his works, "Voyage dans deux Louisianes," in 1805, the year before Lewis and Clark returned.

Many fur companies established trading posts at strategic points along the Missouri. There was great rivalry among the fur companies and between England, France, Spain, and the United States over the wealth of the Missouri River country.

Thomas Jefferson, later to become the third president of the United States, was the moving spirit of the Lewis and Clark expedition into the northwest territory. In the beginning of the plans, this vast area belonged to France. Before the expedition actually started, however, it became the property of the United States under the Louisiana Purchase. Mr. Jefferson selected his secretary, Captain Meriwether Lewis, to head the expedition. Lewis in turn selected Lieutenant William Clark as co-leader. Plans were cloaked in the deepest secrecy. Although many white men had ascended the river to different points, the Lewis and Clark expedition was the first to go all the way up the Missouri and down the Columbia River to the Pacific.

In the days of the California gold rush, Council Bluffs, then a rowdy river town of log cabins and tents, served as an important point of embarkation for the "forty-niners" who traveled by inland waterways.

The much persecuted Mormons camped along the river in 1846-7 at the site known as "Winter Quarters" that later became Omaha.

When the early pioneers settled along the banks of the Big Muddy and established their farms and homesteads, buffalo, elk and deer were still abundant, as well as wild turkey, prairie chickens, ducks, geese and other small game. Fish were plentiful in the river and constituted an important part of the diet of both the white and red man.

Today it seems incredible that fish could live in the turbid, boiling waters of this great river. While the turbidity of the water is usually referred to as "mud", a large part is actually fine, shifting sand that will quickly settle to the bottom when the water is placed in a container. Contrary to popular conception, many species of fish are found in considerable abundance. Game fishes include the largemouth bass, sauger, crappie (mostly white crappie), sunfish, catfish and others. There is a considerable number of some of our primitive fishes like the sturgeon and paddlefish. Many western forms, principally minnows, are found in the Missouri drainage that are not known in most parts of Iowa.

Angling, and for that matter commercial fishing, is more difficult in the Missouri than the Mississippi because of the ever-changing position of the current and unstable bars, islands and shore line. Where 10 feet of water exists today there will appear a fine, white sand bar almost overnight. To those who know the river, however, there are fine catches of excellent fish to be taken.

Fishing is most productive in early spring and late summer. Although there is considerable pole and line fishing along the cut banks and in the eddies of the river, the most popular tackle is the trot line. These trot lines, usually baited with chubs, crayfish, cut bait, shrimp, frogs, "sand toads" or other meat baits, are set parallel to the cutting banks on the current side of the river, in large eddies or over shallow reefs. Channel catfish are most important in the catch, with large blue and flathead catfish coming into the catch more frequently in the lower river. Pole and line anglers using worms, nightcrawlers and minnows also take considerable numbers of crappies, sunfish, bullheads, and an occasional bass, walleye or northern pike.

Commercial fishing on the Missouri is largely confined to drift nets of various kinds, since set nets are too difficult to operate in the current and shifting sands. Trammel nets are most popular and the catch, ranging from about 50,000 to 80,000 pounds, is composed largely of carp, catfish and buffalo.

The first engineering works on the river were made under the Rivers and Harbors Act as early as 1876, but the improvement project was not adopted until 1882. Serious channel stabilization work was undertaken in the late 1920's and early 1930's with much of the work accomplished by use of emergency funds. The channel stabilization work has continued, as funds were made available, more or less continuously since about 1930 and is still being carried on. With the authorization for flood control and power development on the river above Sioux City the channel stabilization and navigation work has assumed increased importance. Barge traffic now reaches Omaha in quantity and with flow controls being exercised by means of the large reservoirs above Sioux City on the main stem, considerable barge traffic also reaches Sioux City. The degree of control now being exercised on the river will undoubtedly affect the fishing favorably, for the most part, although the nine-foot channel on the Missouri has many perplexing problems in shifting stream bed not experienced on the Mississippi River. Construction is proceeding on the numerous reservoirs upstream from Sioux City and it is very likely that even more rigid control of the river will be effected in the future and with the river management plan in full operation relatively lower river stages will result.

Missouri Tributary Streams

Big Sioux River

The Big Sioux forms the western boundary of Iowa for nearly 100 miles along Lyon, Sioux and Plymouth counties. The river rises at an altitude of 1,765 feet in South Dakota and flows 390 miles to its junction with the Missouri at Sioux City. This is western Iowa's largest and most beautiful stream and except for heavy pollution might well be one of our best angling waters. Its course is a succession of sweeping curves with cut banks and sand and gravel bars alternating from side to side. The stream is a series of riffles and pools with huge boulders of glacial origin dispersed from place to place. Trees border the river along its entire course, while the soils of the flood plain farther back are deep and rich for agricultural purposes.

Fishing for channel catfish ranges from good to excellent.

Rock River

The Rock River rises in Minnesota, enters Iowa in Lyon County, and flows for approximately 39 miles in this state to its junction with the Big Sioux River. This pretty little stream flows through a rather narrow flat valley and offers the best habitat for fish of any stream tributary to the Missouri River in Iowa.

Channel catfish and smallmouth bass may be caught in goodly numbers, with walleyes, perch, northern pike and bullheads also being taken at times.

Floyd River

The Floyd River rises in O'Brien County at an elevation of 1,460 feet above sea level. It flows southwesterly for 110 miles, emptying into the Missouri River at Sioux City at an elevation of 1,090. Over its course it falls 3.7 feet per mile. Its valley is narrow and deep, and the bottom of the river is heavily silted. The lower reaches have been canalized.

Principal fishing is for channel catfish and for bullheads, which is regarded as poor except for local areas in the upper reaches of the river.

Little Rock River

The Little Rock River rises in southern Minnesota and flows about 50 miles through Lyon County, emptying into the Rock River southwest of Doon. Siltation has spoiled this stream for smallmouth bass, yet many boulders from which it receives its name remain uncovered. The Little Rock is an excellent bait minnow stream and offers good channel catfishing.

Otter Creek

The headwaters of Otter Creek are in Minnesota. It enters Iowa in Osceola County and flows in a south and westerly direction for 41 miles to its confluence with the Little Rock River near the town of George in Lyon County. The stream is dredged in its upper reaches.

Otter Creek is an excellent bait minnow stream; however, catfish and bullheads are occasionally caught.

Ocheyedan River

The Ocheyedan River rises in Nobles County in Minnesota, and enters Iowa in Osceola County. From here it flows in a southeasterly direction to Spencer, where it empties into the Little Sioux. The Ocheyedan is 44 miles long in Iowa, and much of it has been dredged.

This is an excellent bait stream, with chubs abundant. Bullheads are caught frequently, while channel catfish and northern pike are taken rarely.

Little Sioux River

The Little Sioux River is the largest of the inland streams draining into the Missouri River in Iowa. It rises at 1,405 feet above sea level in swampy southwestern Minnesota. Its drainage basin is 4,260 square miles. It enters Iowa in Dickinson County west of the Okobojis, flows in a southwesterly direction and joins the Missouri River halfway between Sioux City and Council

Bluffs at an elevation of 1,014. The river is 236 miles long, falling less than 400 feet during its entire journey.

The Little Sioux River is a typical prairie stream. At its source the channel is shallow and meandering. Farther downstream in Clay, Buena Vista, Cherokee and Woodbury counties, the stream has carved deeply into the glacial deposits, gradually widening and deepening. In the lower portion of the river which is on a very flat slope, the stream has been straightened and now enters the Missouri via the Harrison-Monona drainage ditch.

The stream runs over a floor of glacial gravel and sand. Through the middle course of the stream much of the valley is timbered.

The Little Sioux River is an outstanding catfish stream, except in its upper and lower reaches and where it has been straightened. The Little Sioux provides good walleye fishing, with numerous other species commonly found in the Iowa Lakes system, which drains into the Sioux, found in some numbers.

Mill Creek

This stream has its origin in O'Brien County. It flows 12 miles southwest and 19 miles southeast to its junction with the Little Sioux a little above the town of Cherokee. The stream bed is composed largely of sand and gravel, with boulders being present in a few places. Mill Creek is heavily silted and loses much of its flow in early summer.

Catfishing is fair to good in the early months of the fishing season.

Maple River

The Maple begins in Buena Vista County. It flows 70 miles southwest, where it empties into the Little Sioux in the central part of Monona County. It flows in a narrow deep valley for most of its course and is a very silty stream. Because of the vast deposits of silt which go into suspension during high water, only tolerant fish can inhabit the stream. The Maple River is of limited value for fishing.

Soldier River

Arising in Ida County at 1,190 feet above sea level, the Soldier flows generally southwest for 72 miles to its confluence with the Missouri River near Pisgah. Much of the river has been straightened and its bottoms are heavily silted.

Except for the very lower reaches of the river, it is of minor value for fishing.

Willow River

This stream originates in Monona County about 10 miles west of Denison. It is 60 miles long and tributary to the Boyer. The Willow River flows through a deep valley and is heavily silted. For this reason fish populations are low and angling is at a minimum.

Boyer River

The Boyer River rises in Buena Vista County not far from Storm Lake at an elevation of 1,440. It flows 125 miles southwest, entering the Missouri River some 15 miles above Council Bluffs. Like the Nishnabotna, the Boyer River is a drainage ditch throughout nearly two-thirds of its length and has cut a deep channel through the easily erodable soil.

There is some bullhead and channel catfish fishing in this stream.

Nishnabotna River

The East and West Nishnabotna rivers headwater only 10 miles apart in the western part of Carroll County, at an elevation of 1,350. The streams flow south and slightly west, uniting to form the Nishnabotna River near Riverton about nine miles above the Iowa line. Turkey and Troublesome creeks are tributary to the East Nishnabotna. In all but a few reaches these two stream channels have been straightened in the course of drainage operations, and they appear to be ditches rather than natural streams. Because of channel straightening, the streams have deepened their channels until almost vertical banks as much as 20 feet high are common along their courses. During favorable water stages, the Nishnabotnas and their principal tributaries provide some bullhead and channel catfish fishing.

Tarkio Creek

The Tarkio basin contains two streams, East and West Tarkio creeks. Both have their source in central Montgomery County and flow southward parallel, uniting in Missouri and emptying into the Missouri River. These streams provide some catfishing during favorable water conditions.

Nodaway River

The West Nodaway flows southward across Montgomery and Page counties. The lower 30 miles of the stream have undergone channel straightening south from the Cass County line. Its principal tributaries are East and Middle Fork and Seven Mile Creek. Considerable channel straightening has been done on all three branches. The valley is fertile and heavily farmed with practically no timber. Along some sections during favorable water stages, important numbers of channel catfish are taken.

Platte River

The Platte River rises in the vicinity of Creston in Union County and flows slightly southeast across Union, Ringgold, and the southeast corner of Taylor County, to enter Missouri near Athelstan. It has one major tributary in Iowa, the 102 River, which joins it in Missouri. Both of these streams have some channel straightening done in the extreme lower end north of the Missouri line.

During favorable stages, some sections of both the Platte and 102 rivers provide channel catfish and bullhead fishing.

Grand River (Thompson River)

Grand River has its source in southeastern Adair County and follows a southeasterly course across Union County to enter Decatur County. This stream is less sluggish than the Chariton, and only the lower five miles have been straightened. Its principal tributaries are the Weldon River, East Fork and West Fork of the Grand, all of which join the main stream in Missouri.

Channel catfish and bullheads are the principal game fishes. Fishing is good during periods of normal flow of water.

Chariton River

The Chariton is a tributary of the Missouri River and drains an area of 925 square miles. It has its source in the southeast corner of Clarke County and is 80 miles from source to its mouth in Missouri. It flows across southern Lucas County and through the corner of Wayne County, entering Appanoose at the northwest corner. From this point it flows diagonally across Appanoose County in a southeasterly direction, entering the state of Missouri near the southeast corner of the county. The banks vary from five feet in height in the upper reaches to 25 feet in the lower part of the stream. The channel is choked and the stream sluggish. There has been little straightening of the channel in Lucas County, but it has been straightened the last 20 miles of its course in Appanoose County. The South Chariton River is its chief tributary and has had much channel straightening. The Chariton River provides bullhead and channel catfish fishing.

Oxbow Lakes

Oxbow lakes are river cut-offs formed in stream valleys by a change in the course of the river. There are literally thousands of oxbows in the state. Those that are deep enough and hold water the year around provide good to excellent fishing. To enumerate the oxbows, even on the Cedar, Wapsi or Des Moines Rivers, would be almost an impossibility; however, three of the most important Missouri River oxbows and one on the Mississippi River are here included.

Lake Manawa

Lake Manawa contains 670 acres of water surface area, 130 acres of which were dredged by the State Conservation Commission in 1937-38. Lake water supply in the past has been from controlled overflow of the Missouri River, pumping from underground supplies and more recently by direct pumping from the River. These methods of water supply were never entirely satisfactory or dependable and became prohibitive by reason of operating costs. A project is now under construction to divert the relatively silt free low flows from Mosquito Creek into Lake Manawa as a permanent source of supply. It is expected this diversion project will greatly assist in providing a static pool level for the Lake and offset the present serious seepage losses from the lake to the Missouri River.

The lake is bordered by numerous cottages and homes on the northeast shore. It lies one mile south of Council Bluffs and one-half mile from the Missouri River proper. Boats and bait are available. Bluegill, crappie, and largemouth bass, as well as some very large land-locked catfish, are caught.

Blue Lake

Blue Lake in Monona County contains 918 acres at normal pool elevations. The tip of the west bow is one-half mile from the Missouri River, two miles west of Onawa. Blue Lake is fed from seepage and runoff but the lake level is likely to be lower because of the lower general controlled river stages. About 85 acres of the lake were dredged to an average depth of nine feet in 1950. Because of the lowering pool level some consideration has been given recently to a diversion project from Cleghorn ditch to offset the seepage losses occurring from the lake to the Missouri River.

Brown's Lake

Brown's Lake containing 840 acres is in Woodbury County two miles west of Salix. The lake was fed in the past by high flows on the Missouri River but this is no longer possible because of the controlled river at lower stages. The Hoovers Island area has been acquired by the State recently. About 70 acres were dredged in 1949 to an average depth of 11 feet but survival of this lake will, ultimately, depend on locating an adequate source of water supply.

Lake Odessa

Lake Odessa is in the Mississippi River bottoms approximately 5 miles northeast of Wapello in Louisa County and contains about 3,000 water surface acres. The lake is located in an abandoned drainage and pumping district. Permanent type water control structures and other improvements were completed in 1954 to permit regulation of the water level of the pool. Lake Odessa provides excellent largemouth bass fishing, with crappies of one to two pounds being commonly caught.

Trout Streams

Iowa's trout waters are located in nine northeast Iowa counties, where they rise from limestone bluffs which line their individual valleys. The streams are 43 in number and vary from less than a mile to 15 miles in length. Not all

PLATE 3

NORTHERN PIKE ***Exos lucius*** **Linnaeus**

FRESHWATER DRUM ***Aplodinotus grunniens*** **Rafinesque**

MOONEYE ***Hiodon tergisus*** **LeSueur**


Maynard Reece

portions of the streams designated trout streams are suitable trout waters, but in them there are approximately 150 miles of water capable of supporting trout populations throughout the fishing season. They lie in the most scenic section of the state, often referred to as Iowa's "little Switzerland." They are bordered by rocky limestone exposures, timber and pasture along most of their length. The water during normal periods is crystal clear and cold, and during this time much of the stream flow comes from springs of various sizes and seepages. Most of the streams have a rapid fall, with the clear waters flowing over limestone rubble and sand bottom.

The prime requirement of trout water lies in the quantity and quality of the water itself, water which has a maximum summer temperature of 75° to 80° F. and is devoid of pollution. To sustain a population of trout the stream should provide the following physical and biological features: adequate volume of flow and gradation; suitable pools, riffles and shelter; minimum turbidity and erosion, plus shade, aquatic vegetation and food.

None of our cold-water streams have all of these features and, as a result, present serious limiting factors, principally in adequate reproduction ability. For this reason Iowa's trout program has resolved into a "put and take" proposition, with the Conservation Commission stocking the stream "under the rod" and principally for the creel.

The accompanying table of trout streams does not pin-point trout waters sufficiently for the "first-timer" to locate them exactly. Merchants in the town mentioned as nearest to the particular fishing water will be helpful in advising the exact locations.

Iowa Trout Streams

Length of Trout Water	Name of Stream	County	Near
4.5 miles	French Creek	Allamakee	Waukon
8.5 miles	Waterloo Creek	Allamakee	Dorchester
3.0 miles	Clear Creek	Allamakee	Lansing
1.0 mile	Wexford Creek	Allamakee	Lansing
2.4 miles	Little Paint Creek	Allamakee	Waterville
8.0 miles	Village Creek	Allamakee	Lansing
4.5 miles	Hickory Creek	Allamakee	Postville
1.0 mile	Livingood Springs	Allamakee	Postville
2.0 miles	Teeple Creek	Allamakee	Waukon
7.5 miles	Paint Creek	Allamakee	Waterville
6.5 miles	South Bear Creek	Winneshiek	Highlandville
7.0 miles	North Bear Creek	Winneshiek	Highlandville
3.0 miles	West Canoe Creek	Winneshiek	Burr Oak
2.3 miles	Trout River	Winneshiek	Decorah
2.5 miles	Trout Run	Winneshiek	Decorah
1.0 mile	Twin Springs	Winneshiek	Decorah
3.0 miles	Bohemian Creek	Winneshiek	Spillville
2.5 miles	Coldwater Creek	Winneshiek	Burr Oak
1.5 miles	Bigalk Creek	Howard	Cresco
2.0 miles	Chihak Creek	Howard	Cresco
2.0 miles	Spring Creek	Mitchell	Orchard
2.5 miles	Wapsie River	Mitchell	McIntyre
1.5 miles	Turtle Creek	Mitchell	St. Ansgar
9.1 miles	Bloody Run	Clayton	McGregor
1.0 mile	Plum Creek	Clayton	No. Buena Vista
2.4 miles	Joy Springs	Clayton	Strawberry Pt.
8.0 miles	Buck Creek	Clayton	Garnavillo
1.5 miles	Cedar Creek	Clayton	Garnavillo
3.5 miles	South Cedar Creek	Clayton	Garnavillo
1.5 miles	Ensign Hollow	Clayton	Volga
1.5 miles	Glovers Creek	Fayette	West Union
2.0 miles	Mink Creek	Fayette	Wadena
1.0 mile	Grannis Creek	Fayette	Fayette
1.5 miles	Otter Creek	Fayette	West Union
4.0 miles	Swiss Valley	Dubuque	Dubuque
4.6 miles	Maquoketa River	Delaware	Backbone Park
1.2 miles	Richmond Springs	Delaware	Backbone Park
3.5 miles	Elk Creek	Delaware	Greeley
2.0 miles	Turkey Creek	Delaware	Colesburg
7.6 miles	Big Mill Creek	Jackson	Bellevue
4.5 miles	Little Mill Creek	Jackson	Bellevue
5.0 miles	Brush Creek	Jackson	Maquoketa
0.5 acre	Dalton Lake	Jackson	Preston

Artificial Lakes

The artificial lake program in Iowa has evolved from the recommendations contained in the "Report on the Iowa Twenty-five Year Conservation Plan," prepared for the Iowa Board of Conservation and the Iowa Fish and Game Commission by Jacob L. Crane, Jr., in 1933. The report contains this statement:

"The south half of Iowa is lakeless; and the streams are muddy and polluted. The logical means to provide good fishing is by the construction of artificial lakes. * * *

"For fishing purposes, the first artificial lakes should be spaced about forty miles apart in each direction, all across the south half of Iowa. This will make the average distance of driving to a lake by road about fifteen miles and the maximum distance about twenty-five miles. This is a short haul and the first lake projects need not be spaced closer than forty miles apart. But they must be located in a fairly even geographic distribution, and the distribution must also recognize the prospective tributary population, the present fisheries situation, and a proper relationship to other projects such as existing lakes, state parks and preserves, etc.

"The specifications for the artificial state lakes, derived from a careful study of all the requirements in the Iowa situation, and with a view to keeping the total cost within a reasonable range are: A depth of fifteen to thirty feet at the dam; a watershed large enough to insure an adequate water supply, but not much larger; a watershed as largely wooded or pastured as possible; woods around the lake site; cheap land; a good dam site and good material for dam construction; and accessibility by all-weather roads and preferably by a primary highway."

To date 24 artificial lakes have been built or acquired and are in public use.

Fishing below 15 feet during the hot months in the artificial lakes is generally unproductive. Because of a lack of oxygen at this depth fish seek the more shallow areas of the lakes. The artificial lakes, for the most part, provide largemouth bass and pan fishing, with some bullheads and channel catfish being taken.

Name	Location	Acreage	Date Constructed
Allerton	Wayne County	115	1913
Williamson	Lucas County	25	1913
Swan	Carroll County	130	1935
Springbrook	Guthrie County	27	1935
Three Fires	Taylor County	125	1936
Ahquabi	Warren County	130	1935
Red Haw Hill	Lucas County	72	1935
Keomah	Mahaska County	82	1934
Wapello	Davis County	287	1933
Lacey-Keosauqua	Van Buren County	30	1935
Macbride	Johnson County	138	1934
Backbone	Delaware County	125	1935
Upper Pine	Hardin County	72	1935
Lower Pine	Hardin County	65	1923
Beeds	Franklin County	130	1936
Mill Creek	O'Brien County	25	1937
Union Grove	Tama County	128	1940
Darling	Washington County	302	1950
Geode	Henry County	205	1950
Nine Eagles	Decatur County	62	1951
Cold Springs	Cass County	16	1951
Rock Creek	Jasper County	640	1951
Green Valley	Union County	400	1952
Not Named	Montgomery County	150	1956

Reservoirs

Most of Iowa's reservoirs are found in the south half of the state, and most of the larger ones were built to provide municipal water supplies. Also in this classification are railroad ponds and industrial water impoundments. These water supply lakes, because of their wide distribution and the fact that they are of necessity built near population centers, are of great angling importance, although for the most part locally. Too, these lakes produce some of the largest largemouth bass to be found in the state, as well as great quantities of crappies and bluegills. Bullheads are not common as is generally believed; however, channel catfish are stocked in some of the lakes on which cooperative agreements are held and often reach a weight of 15 pounds or more. Flathead catfish have been stocked in a few of the lakes and have been taken weighing as much as 50 pounds.

The reservoirs listed below include only the major water supply lakes on which the Conservation Commission and the title-holders have reached a cooperative agreement. Under the agreement the owners allow public fishing during open seasons and the Conservation Commission manages the fish population to insure the best angling.

County	Reservoir	Acreage
Adair	Greenfield City Reservoir (Nodaway Lake)	70
Adams	Old Corning City Reservoir	13
	New Corning City Reservoir (Binder)	60
Appanoose	Upper City Reservoir, Centerville	100
	Lower City Reservoir, Centerville	20
	Airport Pond, Centerville	1
	Moulton City Reservoir	10
Cass	Atlantic City Pond	1½
Clarke	Osceola City Reservoir, East	40
	Osceola City Reservoir, West	150
Davis	Lake Fisher, Bloomfield	90
	Reservoir No. 1, Drakesville	1
	Reservoir No. 2, Drakesville	2
Fremont	Hi-Way Road Impoundments	70
Harrison	Dunlap Hi-Way Gravel Pit	½
Howard	Cresco Pond	30
Iowa	Amana Lily Lake	150
Jefferson	Fairfield City Reservoir No. 1	100
	Fairfield City Reservoir No. 2	100
	Fairfield School Pond	1
Lucas	Chariton City Reservoir (Morris)	200
	Chariton City Reservoir (Ellis)	110
	Lucas City Pond	3
Mahaska	Edmundson Park Lake (Oskaloosa)	2
Mills	Glenwood Reservoir (Park Lake)	15
	Malvern City Pond (Swanson Pond)	3
Monroe	Albia City Reservoir (Upper)	40
	Albia City Reservoir (Lower)	40
Polk	Des Moines City Park Lakes Estimate	10
	Des Moines Raccoon Valley Gravel Pits Estimate	25
	Des Moines—West Des Moines Sand Co. Estimate	25
	Commerce Lake (Des Moines City Res.) Estimate	150
Poweshiek	Montezuma City Reservoir	130
Ringgold	Mt. Ayr City Reservoir (Loch Ayr)	95
	Mt. Ayr City Reservoir (Old Reservoir)	12
Tama	Cherry Lake, Tama	150
Taylor	Lenox City Reservoir, East	25
	Lenox City Reservoir, West	18
Union	Afton City Reservoir	18
	Creston City Reservoir	50
Wapello	Eldon Fairground Pond	2
Wayne	Harvard Pond	8½
	Humeston City Reservoir	14
	Corydon City Reservoir	50
	Seymour City Reservoir	30

STATE OWNED PUBLIC ACCESS TO FISHING WATERS

COUNTY	NAME OF AREA	LOCATION NEAREST TOWN	LOCATION ON LAKE	AREA OF ACCESS*
Allamakee	French Creek	8 mi. W. and 2 m. No. of Lansing	Trout Stream	461.5 acres
Allamakee	Lansing Fish Hatchery	River front, Lansing	Center Pool No. 9, Miss. River	½ acre
Allamakee	Yellow Riv. State Forest	10 m. N. of McGregor	Yellow River State Forest	Entire sh. line
Appanoose	Sharon Bluffs	Iowa 2, 3½ mi. S.E. Centerville	Chariton R. Traverses Park	143 acres
Benton	Dudgeon Lake	1 mi. N. of Vinton	Cedar River	700 acres
Benton	Minne Estema	7 mi. N. Vinton, 1½ mi. E. Mt. Auburn	Cedar River	60 acres
Black Hawk	Husman Riffle Access	1½ mi. E. of LaPorte City	Cedar River	75.0 acres
Black Hawk	Josh Higgins	U. S. 20, adjoins Cedar Falls	Adjoins Cedar River	543 acres
Boone	Ledges	Iowa 164, 3 mi. S. Boone	Des Moines R. Traverses Park	860 acres
Bremer	Sweet's Marsh	2 mi. N.E. of Tripoli	Wapsie River and Plum Creek	600.0 acres
Buchanan	Cutshaw Bridge	1½ W. and ½ N. of Littleton	Wapsipinicon River	27.0 acres
Buchanan	Otterville Bridge	1 mi. W. of Otterville	Wapsipinicon River	180.0 acres
Buena Vista	Pickerel Lake	3 mi. E., 4 mi. N. of Marathon	Road access on north shore	
Buena Vista	Little Storm Lake Access	1 mi. W. of Storm Lake	Between Storm and Little Storm	34 acres
Buena Vista	Storm Lake	Adjoins town of Storm Lake	Partial access east side	55 acres
Butler	Beaver Meadows	Iowa 14, ½ mi. N. of Parkersburg	Partial access Beaver Creek Lake	74 acres
Butler	Big Marsh	5 mi. N. of Parkersburg	West Fork River	2546.0 acres
Butler	Heery Woods	Iowa 188, ½ mi. S. Clarksville	Shellrock R. Traverses Park	380 acres

* Does not include water acreage

STATE OWNED PUBLIC ACCESS TO FISHING WATERS (Cont'd)

COUNTY	NAME OF AREA	LOCATION NEAREST TOWN	LOCATION ON LAKE	AREA OF ACCESS*
Calhoun	Rainbow Bend Access	2 mi. S. and 1½ mi. E. Lake City	Coon River	19.22 acres
Calhoun	Twin Lakes	Iowa 17, 124, 4 mi. N. Rockwell City	Partial access E. and W. Sides	19 acres
Carroll	Coon River Access, Carroll Co.	1½ mi. S. of Lanesboro	Coon River	40 acres
Carroll	Swan Lake	County Road 3 mi. S.E. Carroll	Complete Acess	89 acres
Cass	Cold Springs	U. S. 6 Iowa 92, 2 mi. S. Lewis	Complete Access	92 acres
Cerro Gordo	Clear Lake Access	Clear Lake, S.E.	Clear Lake—Southeast shore	.25
Cerro Gordo	Clear Lake Access (Garner Beach Access)	5 mi. W. of Clear Lake	West central shore of Clear Lake	Road access
Cerro Gordo	Clear Lake Access	Ventura	North shore—west	6.88 acres
Cerro Gordo	Clear Lake	Iowa 106, 2 mi. S. Clear Lake	Southeast side	70 acres
Cerro Gordo	Clear Lake Hatchery	Clear Lake north shore	North shore—center	½ acre
Cerro Gordo	McIntosh Woods	U. S. 18, ¾ mi. E. Ventura	Partial access N. side Clear Lake	60.0 acres
Cerro Gordo	Ventura Marsh	At Ventura	Entire shore	60 acres
Chickasaw	Chickasaw Mills	2½ mi. W. of Ionia	Little Cedar River	15.69
Clay	Barringer Slough	3 mi. N.W. of Ruthven	S. W. Corner of Lost Island	280.0 acres
Clay	Dan Green Slough	4½ mi. E. Langdon	Road Access So. side	Road access
Clay	Ocheyedan Marsh	4 mi. N. of Spencer	Ocheyedan River	100 acres
Clay	Round Lake	7 mi. N.W. of Ruthven	Entire shore line	39.92

Clay	Smith's Slough	6 miles N.W. of Ruthven	East side of Trumbull Lake	150.0 acres
Clay	Trumbull Lake	9 mi. N.W. of Ruthven	West side outlet	40 acres
Clay	Wanata	Iowa 10, ½ mi. S. Peterson	Adjoins Little Sioux River	160 acres
Clayton	Turkey River Mounds	U. S. 52, 4 mi. S. Guttenberg	Adjoins Mississippi River	37 acres
Dallas	Earlham Access	1 mi. E. Earlham and 4 mi. So.	Coon River	7 acres
Davis	Lake Wapello	Iowa 273, 6 mi. W. Drakesville	Complete Access	856 acres
Davis	Eldon Game Area	3 mi. S. of Eldon	Access to Soap Creek and 3 Farm ponds ½ acre each	622.71
Decatur	Nine Eagles	County Road 3½ mi. S.E. Davis City	Complete Access	1024 acres
Delaware	Backbone	Iowa 19, 4 mi. S. W. Strawberry Pt.	Complete access Backbone Lake Maquoketa River Traverses Park	1286 acres
Delaware	Silver Lake	Iowa 38, adjoins town of Delhi	(Partial Access)	13 acres
Des Moines and Henry	Geode	4 mi. S.W. Danville	Complete Access	1369 acres
Des Moines	Skunk River Access (2)	At Augusta and 1 mi. No.	North Bank of Skunk River	63 acres
Des Moines	Tama Beach Access	4 mi. N. of Burlington	Pool No. 19, Miss. River	3.21 acres
Dickinson	Biology Building	Arnolds Park	S.W. end of East Okoboji	.25 acres
Dickinson	Center Lake	2 mi. S. and 1 mi. W. of Spirit Lake	South shore	3 acres
Dickinson	Crandall's Beach	4 mi. N.W. Orleans	N.W. shore, Spirit Lake	5.68 acres
Dickinson	Diamond Lake	2 mi. N. of Montgomery	Entire lakeshore	270.0 acres
Dickinson	East Okoboji Access	S.E. of Spirit Lake ¾ mi.	Narrows (East)	.50 acre
Dickinson	Emerson Bay Access	1 mi. W. 2 mi. N. West Okoboji	S.W. corner of lake	127 acres

* Does not include water acreage

STATE OWNED PUBLIC ACCESS TO FISHING WATERS (Cont'd)

COUNTY	NAME OF AREA	LOCATION NEAREST TOWN	LOCATION ON LAKE	AREA OF ACCESS*
Dickinson	Gar Lake Access	½ mi. S. of Arnolds Park	W. side Gar Lake	9.0 acres
Dickinson	Garlock Slough	1 mi. W. West Okoboji	S.W. Corner W. Okoboji Lake	30.0 acres
Dickinson	Gull Point	Iowa 32, 5 mi. N.W. Milford	Partial access W. side W. Okoboji	59 acres
Dickinson	Hottes	3 mi. N.W. Orleans, S. Spirit Lake	Southeast shore	1 acre strip
Dickinson	Inn Area	Adjoins town of Okoboji	Partial access E. Side W. Okoboji	7 acres
Dickinson	Jemmerson Slough	½ mi. W. Spirit Lake	Entire area	110.0 acres
Dickinson	Little Spirit	W. Shore of Spirit at Minn. Line	South and East shore	Road Strip & 2 acres
Dickinson	Marble	2½ mi. N.W. Orleans	North and East shore	183.47 acres
Dickinson	Marble Beach Access	2 mi. N.W. Orleans	Southwest shore Spirit Lake	62.83 acres
Dickinson	Mini-Wakan	Iowa 276, 6 mi. N.E. Orleans	Partial access N. shore	20 acres
Dickinson	Minnewashta Lake Acc.	Arnolds Park	South outlet of Minnewashta	2 acres
Dickinson	Orleans Access	At Orleans	S. side of Spirit Lake	.3 acres
Dickinson	Pikes Point	Adjoins town of Okoboji	Partial access E. side W. Okoboji	13 acres
Dickinson	Pleasant Lake	3 mi. E. and 1½ mi. S. Spirit Lake	Access North shore	7 acres
Dickinson	Prairie Lake	2 mi. E. and 1 mi. N. Arnolds Park	North shore	10 acres
Dickinson	Silver Lake Access	2 mi. S. and 1 mi. W. Lake Park	South shore, Silver Lake	
Dickinson	Silver Lake Access	2½ mi. W. of Lake Park	West shore, Silver Lake	
Dickinson	To Silver Lake Trappers Bay Access	1 mi. W. Lake Park	Northwest side of Silver Lake	57.23

Dickinson	Spirit Lake Fish Hatch.	Orleans	No. end—East Okoboji	30 1/3
Dickinson	Spirit Lake N. Grade and Inlet	6 mi. N. Orleans	No. shore Minnesota line	1 mile
Dickinson	Sunken Lake	3 mi. N.W. Orleans	East and North shores	1 acre strip
Dickinson	Swan Lake	2 mi. N. of Superior	Road grade center and north shore	Road strip and 5 A.
Dickinson	Trappers Bay	Adjoins town of Lake Park	Partial access to Silver Lake	57 acres
Dickinson	Welch Lake	4 mi. W. and 2 mi. E. Orleans	South shore	Road access
Dubuque	Swiss Valley	3 mi. S.W. of Dubuque	Swiss Valley trout stream	17.29 acres
Emmet	Ingham-High Area	6 mi. E. of Wallingford	North side Ingham Lake N.W.S. and E. side High Lake	100.0 acres 20.0 acres
Emmet	Okamanpedan	County Road, 3 mi. N.E. Dolliver	Partial acc. S. shore Tuttle Lake	18 acres
Emmet	West Swan Lake	2 mi. S.W. of Maple Hill	South and North	36.0 acres
Franklin	Beeds Lake	3 mi. N.W. of Hampton	Complete Access	160 acres
Fremont	Riverton Area	1 mi. W. of Riverton	E. and W. Nishnabotna rivers	721 acres
Greene	Dunbar Slough	2 mi. S. and 2 mi. W. Scranton	Entire Shore	170.0 acres
Greene	Rippey Area	4 mi. W. and 2 mi. So. Rippey	Coon River	30.5 acres
Greene	Spring Lake	2 mi. W., 4 mi. N. of Grand Jct.	Complete Access	191 acres
Guthrie	Lakin Slough	1½ mi. E. Yale	Entire shore	80.0 acres
Guthrie	Lennon Mill	Adjoins Panora	Middle Raccoon R. Traverses P.	20 acres
Guthrie	Lennon Mill	¼ mi. W. Panora	Access to Raccoon River	20.92 acres
Guthrie	Springbrook	Iowa 25, 384, 7 mi. N. Guthrie Cen.	Complete Access	653 acres

* Does not include water acreage

STATE OWNED PUBLIC ACCESS TO FISHING WATERS (Cont'd)

COUNTY	NAME OF AREA	LOCATION NEAREST TOWN	LOCATION ON LAKE	AREA OF ACCESS*
Hamilton	Little Wall Lake	1½ mi. W. Jewell	Little Wall Lake	Road strip acc
Hancock	Eagle Lake	4 mi. N.E. Britt	Partial access W. side	20 acres
Hancock	East Twin Lake	3 mi. E. Kanawha	Entire shore	116.0 acres
Hancock	Pilot Knob	4 mi. E., 1 mi. S. Forest City	Complete access Dead Man Lake	368 acres
Hardin	Pine Lake	Iowa 118, ½ mi. N.E. Eldora	Access Iowa River and Pine Lakes	415 acres
Hardin	Steamboat Rock	Adjoins town of Steamboat Rock	Adjoins Iowa River	4 acres
Harrison	Nobles Lake	5 mi. W. Loveland	East shore	2 acres
Harrison	Round Lake	3 mi. N. Mondamin	Access to all of Round Lake	110
Henry	Oakland Mills	Iowa 133, 4 mi. S.W. Mt. Pleasant	Adjoins Skunk River on S. Side	84 acres
Henry	Oakland Mills Access	4 mi. S. W. Mt. Pleasant	No. shore Skunk River	Can double with parks
Howard	Turkey River Access	1½ mi. So. of Cresco	Turkey River	87 acres
Humboldt	Bradgate Access Area	2 mi. S.E. Bradgate	Acc. S. bank W. Fork D. M. River	108.52
Humboldt	Dakota City Access	E. edge of Dakota City	East Fork, Des Moines River	.60 acres
Humboldt	Frank A. Gotch	2 mi. S. E. Humboldt	Forks of Des Moines River	57 acres
Humboldt	Humboldt Fish Hatchery	Humboldt	W. Des Moines River	9.6 acres
Ida	Washta Access	4½ mi. N.E. Correctionville	Ashton Creek	44
Iowa	Randolph Access Area	3 mi. S. and 2 mi. E. Belle Plaine	Iowa River	398.0 acres
Jackson	Dalton Lake	1½ mi. S.E. Preston	Trout pond	5 acres

Jackson	Green Island	2 mi. E. Green Island	Entire shore and Miss. R.	100.0 acres
Jackson	Sabula Fish Hatchery	So. edge Sabula	Pool No. 13, Miss. R. and River L.	.50
Jasper	Rock Creek	County Road, 3½ mi. N.E. Kellogg	Complete Access	845 acres
Jasper	Rock Creek	3 mi. N. 2 mi. E. Kellogg	North end of lake	265.0 acres
Jefferson	MacCoon Access Area	4 mi. N. Lockridge	Access West bank of Skunk Rivei	71.37
Johnson	Lake MacBride	Iowa 382, 2½ mi. W. Solon	Complete Access	675 acres
Johnson	Swan Lake	4 mi. W., 1½ mi. N. North Liberty	Shallow bull head lake	44.00
Jones	Pictured Rock	4 mi. S.E. Monticello	Both sides—4 mi. Maquoketa R.	302 acres
Jones	Wapsipinicon	U. S. 151 adjoins Anamosa	Wapsipinicon R. Traverses Park	248 acres
Kossuth	Ambrose A. Call	Adjoins Algona	Adjoins E. Fork Des Moines R.	129 acres
Linn	Matsell Bridge Access	3 mi. N. Viola	S. shore Wapsipinicon	15.0 acres
Linn	Palisades Kepler	U. S. 30. 3½ mi. W. Mt. Vernon	Cedar River Traverses Park	688 acres
Louisa	Klum Lake	2 mi. E., 1 mi. S. Grandview	Entire lakeshore	676.0 acres
Louisa	Lake Odessa Access	5 mi. E. Wapello	Access to Lake Odessa	4.66
Louisa	Lake Odessa	3 mi. E. Wapello	Miss. R. and S. and W. shore L. Odessa	60.0 acres
Lucas	Brown's Slough	4 mi. S. and 2 mi. E. Russell	Entire shoreline 100 ac. pond	570.0 acres
Lucas	Colyn Area	4 mi. S. Russell	Ponds, 100 ac. and 200 ac. shores of ponds and Chariton River	400.0 acres
Lucas	Lucas Unit—Stephens State Forest	2 mi. S. W. Lucas	7 acre pond	7 acres
Lucas	Red Haw Lake	U. S. 34, 1 mi. E. Chariton	Complete Access	347 acres

* Does not include water acreage

STATE OWNED PUBLIC ACCESS TO FISHING WATERS (Cont'd)

COUNTY	NAME OF AREA	LOCATION NEAREST TOWN	LOCATION ON LAKE	AREA OF ACCESS*
Lucas	Williamson Pond	2 mi. E. Williamson	Entire shoreline 26 ac. pond	100.0 acres
Lyon	Gitchie Manitou	9 mi. N.W. Larchwood	Adjacent Big Sioux River	91 acres
Madison	Pammel	Iowa 92, 162, 5 mi. S.W. Winterset	Middle River Traverses Park	281 acres
Mahaska	Lake Keomah	Iowa 371, 6 mi. S.E. Oskaloosa	Complete Access	283 acres
Mitchell	Pioneer	County Road, 7 mi. S.W. Riceville	Adjoins Little Cedar River	14 acres
Monona	Blue Lake	1½ mi. W. Onawa	Access S. and W. part of Lake	982.71 land and water
Monona	Lewis and Clark	Iowa 165, 2 mi. W. Onawa	Partial access W. side Blue Lake	285 acres
Monroe	La Hart Area	2 mi. W. and 2 mi. S. of Lovilia	Shoreline of 30 ac. water	106 acres
Muscatine	Keokuk Lake	4 mi. S.W. Muscatine	Access Keokuk Lake, 2,000 acres of slough area	429.45 land and water
Muscatine	Muscatine Slough	5 mi. E. Wapello	Access to old river bed slough	1,513.16 land and water
Muscatine	Weise Slough	2 mi. E. Atalissa	Access to 20 ac. Spring fed bayou	422.90
O'Brien	Mill Creek	Iowa 10, 1 mi. E. Paullina	Complete Access	132 acres
Osceola	Rush Lake	2 mi. E. and ½ mi. N. of Ocheyedan	S. shore of lake	16 acres
Palo Alto	Five Island Access	1 mi. N. Emmetsburg	Access W. side of Five Island L.	4.39
Palo Alto	Kearny	Adjoins Emmetsburg	Partial Access W. side Five Island Lake	20 acres
Palo Alto	Lost Island	County Road, 2½ mi. N.E. Ruthven	Partial access E. side Lost Island Lake	31 acres

Palo Alto	Rush Lake	County Road, 6 mi. N. Laurens	S. shore, East shore	62 acres
Palo Alto	Silver Lake Access	2 mi. W. Ayrshire	East Shore	17 acres
Palo Alto	Virgin	1½ mi. So. Ruthven	N.E. road corner access	Road Strip
Pocahontas	Little Clear Lake	10 mi. W. Pocahontas	Access to E. side lake	2.00
Pocahontas	Lizard Lake	2 mi. W. and 4 mi. S. Gilmore City	Access to west side of lake	1.00 acre
Polk	Del Rio	1 mi. N. and 3 mi. W. Polk City	W. shore Des Moines River	22.77 acres
Polk	Flint Access Area	1 mi. N. Des Moines	North shore Des Moines River	30 acres
Polk	Walnut Woods	Iowa 90, 6 mi. S.W. Des Moines	Adjoins Raccoon River	260 acres
Pottawattamie	Lake Manawa	Iowa 192, 1 mi. S. Council Bluffs	Total Access	919 acres
Ringgold	Mt. Ayr Area	1 mi. N., 1 mi. E. Delphos	10—½ acre ponds	1130 acres
Ringgold	Mt. Ayr Hatchery	2 mi. N. and ¾ mi. W. Mt. Ayr	So. dam shore Lock Ayr	8 acres
Sac	Arrowhead Lake	So. edge Lake View	Entire shoreline	116.08 acres
Sac	Black Hawk Lake	In town of Lake View	Partial access—several areas	266 acres
Sac	Hallets Pits	1 mi. S. Lake View	Entire shoreline	40 acres
Sac	Sac City Access	So. edge Sac City	Raccoon River	23.39 acres
Sioux	Oak Grove	County Road, 4 mi. N.W. Hawarden	Adjoins Big Sioux River	101 acres
Story	Soper Mills Access	3½ mi. E. Gilbert Station	Skunk River	18.29 acres
Tama	Union Grove Lake	County Road, 3 mi. S. W. Gladbrook	Complete Access	128 acres
Taylor	Lake of Three Fires	Iowa 49, 3 mi. N.E. Bedford	Complete Access	260 acres
Union	Green Valley	County Road, 2½ mi. N.W. Creston	Complete Access	598 acres

* Does not include water acreage

STATE OWNED PUBLIC ACCESS TO FISHING WATERS (Cont'd)

COUNTY	NAME OF AREA	LOCATION NEAREST TOWN	LOCATION ON LAKE	AREA OF ACCESS*
Van Buren	Lacey Keosauqua	Iowa 1, adjoins Keosauqua on S.	Complete access to Lake Adjoins Des Moines River	1623 acres
Warren	Banner Area	5 mi. N. Indianola	40 acres of strip pits	210 acres
Warren	Hooper Area	5 mi. S., 1 mi. W. Indianola	6—½ acre ponds	323 acres
Warren	Lake Ahquabi	Iowa 349, 5½ mi. S.W. Indianola	Complete Access	640 acres
Washington	Lake Darling	3 mi. W. Brighton on Iowa 78	Complete Access	1017 acres
Wayne	Allerton	1 mi. W. Allerton	Complete Access	258 acres
Webster	Deception Hollow	2 mi. S.E. Lehigh	Des Moines River	40.20 acres
Webster	Dolliver	Iowa 50 and 121, 4 mi. N. Lehigh	Adjacent to Des Moines River	572 acres
Webster	Lizard Creek Area	2 mi. N., 1 mi. E. Moorland	46 acres ponds and S. Lizard Cr.	50 acres
Webster	Woodman Hollow	3 mi. N. Lehigh	Adjoins Des Moines River	62 acres
Winnebago	Rice Lake Area	1 mi. S., 1½ mi. E. Lake Mills	Entire shore	337 acres
Winneshiek	Bear Creek Access	3 mi. E. Highlandville	North Bear Creek	229 acres
Winneshiek	Bluffton Area	Bluffton—8 mi. N.W. Decorah	Upper Iowa River	95.50
Winneshiek	Canoe Creek Access	8 mi. N.E. Decorah	Trout Stream	224.16 acres
Winneshiek	Cardinal Marsh	1 mi. E. and 4 mi. S. Cresco	100 ac. marsh and Turkey River	270 acres
Winneshiek	Cold Water Spring Acc.	3 mi. E. Kendallville	Trout Stream	61.36 acres
Winneshiek	Decorah Fish Hatchery	1 mi. E. Decorah	Trout Stream (Siewer Springs)	21.2 acres
Winneshiek	Malanaphy Springs	4 mi. N.W. Decorah	Upper Iowa River	50.78 acres

Winneshiek	Twin Spring Hatchery	1 mi. W. Decorah	Trout Stream (City Park)	6.28 acres
Woodbury	Brown's Lake Area	2 mi. W. Salix	South Side	100 acres
Woodbury	Brown's Lake	4 mi. W. Salix	Partial Access	16 acres
Woodbury	Stone Park	N.W. Section Sioux City	Adjoins Little Sioux River	865 acres
Wright	Big Wall Lake	10 mi. N. Blairsburg	Access to E. Side of Lake	32.49
Wright	Elm Lake	2 mi. N. and 2 mi. E. Clarion	Access to E. Side of Lake	2.99
Wright	Morse Lake Access	4 mi. W. Belmond	East and South shore	67 acres

* Does not include water acreage

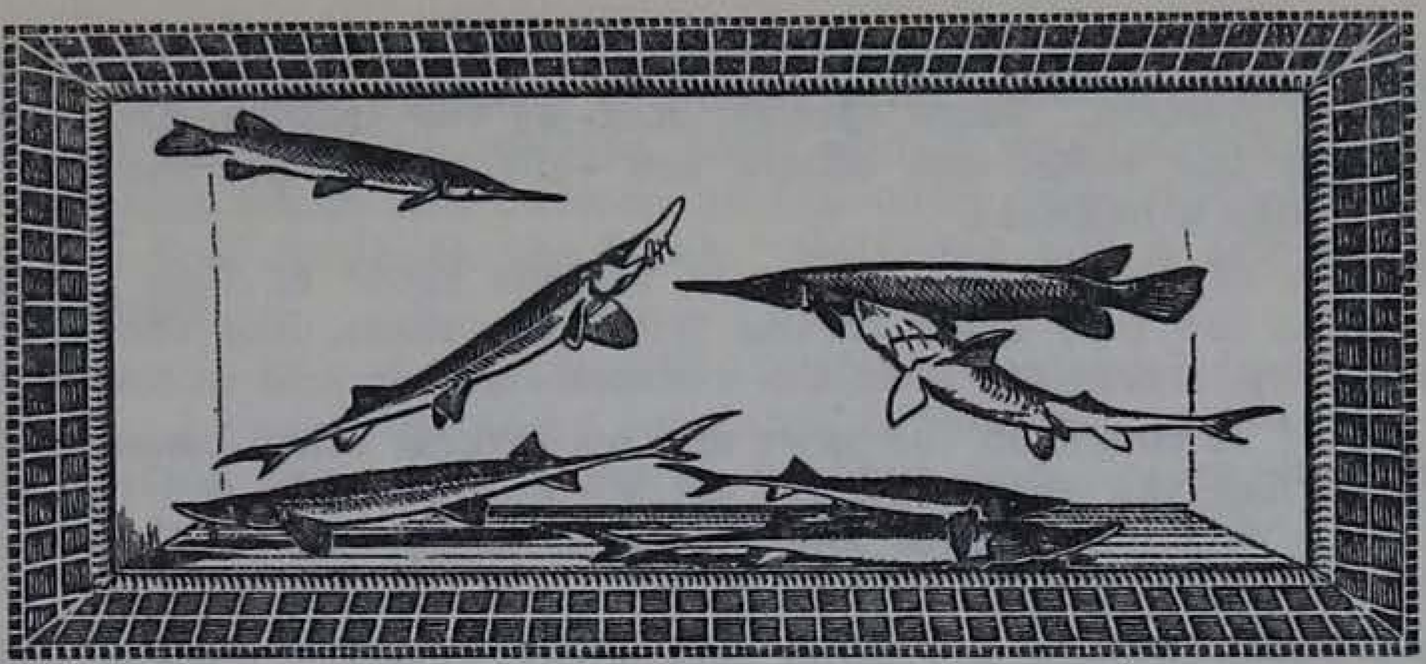
PLATE 4

BROWN TROUT *Salmo trutta* Linnaeus

RAINBOW TROUT *Salmo gairdneri* Richardson

BROOK TROUT *Salvelinus fontinalis* (Mitchill)


Maynard Reece



Chapter II

INTRODUCTION TO THE FISHES

Fossil remains of fishes millions of years old are found in the Silurian rocks that once formed the floor of gigantic seas. These early jawless forms were primitive and had little likeness to present day fishes except lampreys and hagfishes, which survive them. Through evolutionary changes the ancient armored forms developed into simple bony fishes, and later into sharklike animals. For a long period of time sharks dominated the entire fish population, and modern relics of their kind are still abundant in the sea. Meanwhile the early bony fishes evolved, producing in one line the ancestors of all land-living vertebrates and in another the vast group of modern bony fishes. Most of these have changed from their ancestors by the development of highly specialized habits and structures.

Since the earliest civilizations fishes have played an important role in the economy of man. The Egyptians and Chinese prominently displayed fish in their ancient art work, and developed specialized ponds for culturing their favorite table delicacies. Several of the Apostles, notably Peter, were fishermen by profession, and the sign of the fish became the symbol of Christianity in the days of ancient Rome. Today fish is still one of the most important items in the diet of man, and millions of pounds are consumed annually. In the United States alone over two and a quarter million tons are brought into the markets each year by commercial fishermen, and an unknown quantity is harvested by anglers in sport fishing. In addition to the monetary or food value placed on fish, the art of angling provides intangible pleasures in relaxation of jittery minds and tired bodies in a peaceful atmosphere away from the hustle and bustle of our overcrowded environs.

One of the pleasures of angling is to be able to identify properly the fishes we catch. Some of the more serious anglers would even like to know more about the minnows they use for bait and the tiny fishes discarded from the bait bucket as neither food nor bait. An attempt will be made in this book in the descriptions that follow, the color plates, the photographs, and the keys to the identification of fish to enable the angler to do this. The keys should be used whenever positive identification is in doubt.

Before we attempt to identify our fish we should know something about their structure. Fish are animals with backbones, and they breathe with gills. These two characteristics will separate fish from most other animals. Another characteristic must be added to divide them from some of the salamanders, however. Fish never have fingers or toes. When we look at a fish, certain features are immediately apparent. It has a head, a trunk, and a tail. Fish do not have necks, since the shoulder girdle is attached to the head. Most fish are more or less spindle-shaped and streamlined to move rapidly through the water with a minimum of friction. Some species, such as the crappie, are compressed or flattened from the sides, and others are said to be depressed, or flattened, from the top, like a bullhead.

The position of the mouth differs in various kinds of fish. In many it is terminal, or at the very front of the fish. In others, like the bottom-feeding suckers and carp, the mouth is on the underside and is said to be inferior.

Teeth are to be found on the jaws and on several other bones in the mouths of some fish like the pike, walleye, catfish and sunfish, but the suckers and minnows have soft mouthparts and the teeth are found only on the fifth gill arch in the throat just ahead of the gullet.

The two nasal cavities are blind pits which function only as sense organs since they are not connected to the mouth or breathing apparatus of the fish. Each nasal cavity is divided by a membrane so that there are two openings. The eye is movable, but has no lid. It does, however, have a lens, cornea, and retina similar to those of other animals. The ear of a fish is internal, imbedded in the skull, and is used as a balancing organ and to detect vibrations. A bony plate, called the opercle, sometimes scaled and sometimes naked, covers the gills. Bony rays support an expansible membrance that covers the underpart of the gill cover. Water taken into the mouth is discharged through this cover after oxygen has been received by the gill filaments.

Most fish have four pair of gills. The fine red filaments are attached to a bone called the gill arch. These filaments contain numerous blood cells which absorb dissolved oxygen from the water and give off carbon dioxide. In other words, the gills act as lungs. In the summer months there is usually enough oxygen in the water to support fish life. In winter the oxygen supply is greatly diminished, especially in shallow lakes and ponds that are covered with ice and snow for extended periods of time. Occasionally there is not enough oxygen to sustain fish life, and the fish die of suffocation. The oxygen requirements of fish are comparatively low in winter, but sometimes the oxygen concentrations are too low (Greenbank, 1945). Deep water in the summer may also have too little oxygen for fish, thereby limiting the fish to the water near the surface.

The fins are used by the fish in swimming and in maintaining their balance. Some of the fins of fish are paired and some are not. In the study of fish it is well to memorize the names of the most common fins. They include the dorsal, pectoral, pelvic, anal, caudal, and in some instances the adipose. If we think of a fish as an animal, the names of the fins become more understandable. Some of the fins are simply modified legs and arms, hence the pectoral fins might be likened to arms and the pelvic fins to legs. The position of these fins varies with different species of fish. Usually the pectoral fins are located on the sides of the fish just back of the head. The pelvic fins are situated on the belly ahead of the vent. The anal fin is on the belly, usually commencing immediately behind the vent and resembling the rudder of a boat. The fin on the top or back of the fish is called the dorsal. Minnows, for example, have only one dorsal fin and the rays or supporting structure in the membrane of the fin are not stiff. Perch, bass, sunfish and many other kinds have one or two dorsal fins that are either wholly or partially divided, and the rays in the anterior or front portion are stiff and spine-like. A few fish, notably the trout and catfish, have a small fleshy fin located on the back near the tail. This is called the adipose fin. The fin on the tail is called the caudal fin. When the two lobes of the caudal fin are equal, or nearly so, the tail is described as homocercal. In primitive fishes like the paddlefish and sturgeon the upper lobe is considerably longer than the lower one. These are typical examples of a heterocercal tail. Where this feature is less pronounced, as in the dogfish and gar, the tail is said to be abbreviate-heterocercal.

The body of the fish is covered with scales, skin or armor-like plates. Most Iowa fishes have one of three types of scales. The more primitive fishes like the gar and dogfish are covered with diamond-shaped, enamel-like plates called ganoid scales. The trout, minnows, and many other soft-rayed fish have cycloid or smooth-edged scales. Pike, walleye, bass, sunfish and other spiny-rayed fish have ctenoid scales which are covered at the outer edge with tiny spine-like projections that feel rough to the touch. Catfishes and a few other species have scaleless bodies.

Scales are formed of bone-like material and are contained in pockets in the skin of the fish. A protective slimy substance is produced by the skin. Among other functions this slime helps prevent bacteria and disease from attacking the fish. The age of fish can be determined (Carlander, 1948a) by counting the annuli or winter rings. There is a distinct line that runs laterally along the side of the trunk of many fishes. The scales in this line have pores which contain nerve endings. Its purpose (Eddy and Surber, 1947) is said to be concerned with the perception of vibrations and water currents.

The internal structure of a fish is quite similar to other animals in many respects. With the exception of some of the primitive examples, the fish has a bony skeleton made up of a flexible backbone and ribs. There is a gullet, stomach, intestine, liver, spleen, and kidney. Fish may have several appendixes, or pyloric caecae, attached to the stomach. The two-chambered heart contains only venous blood, which is pumped to the gills to pick up oxygen before going to other parts of the body. Fish also have a brain protected by a skull, and a spinal cord extending from the brain through the backbone and protected by the arches attached to the vertebrae. Nerves extend to the internal organs and muscles. A short distance below the backbone is an air bladder which is used in maintaining the buoyancy of the fish. In some species it contains several chambers. In a few fish it is connected with the throat and may be used as a lung.

Reproductive processes of fishes vary considerably, but in Iowa none of the fishes are live-bearers. The eggs are fertilized by the male after or at the time they are deposited by the female. They vary in number from a few dozen to over a million, depending upon the species. The size and period of incubation is also variable. Some fishes construct saucer-shaped depressions in which they deposit their eggs and guard their young, while others spawn at random and leave the fate of their brood to nature. For this reason fertility of the eggs is low in some species. At best a relatively small percentage of the eggs develop into mature fish.

Were it not for the fact that fish are largely dependent upon natural controls, our waters would be overcrowded with fish to a point where none could survive. Moyle (1950) found several kinds of natural fish population balances in Minnesota warm-water lakes, and attempts to change these balances by stocking more fish or removing a part of those already present usually failed to alter conditions appreciably. Johnson (1949) states, "The vast majority of natural lakes over 300 acres in size and still untouched by commercial fishing or by civilization's waste products remain unchanged by human efforts to alter the population structure into a more desirable composition." His reference to Minnesota lakes shows the importance of natural environmental controls in the production or lack of good fishing.

In most cases fish can be identified by their external appearance. In a few cases, especially with minnows, examination of the teeth or internal organs is necessary to cinch the identification. Color is widely used in identifying fishes, yet it is not always a good criterion since this will vary widely in different parts of the country or even within the same lake or streams. Many fishes actually change color in different environments, and much of the color is lost when the fish dies. The best characteristics, therefore, are the things which do not change, like the number of scales in the length of the body, numbers of spines or rays in the various fins, formation of the teeth, size and shape of certain fins, and measurement of the head in relation to the length of the body. Only a few simple tools are needed in most cases. With the aid of a good hand lens, ruler, pair of calipers, dissecting knife, fine-pointed forceps and needle one can make the necessary examinations. One of the most difficult groups of Iowa fishes to identify is the minnows, the juveniles of which are especially troublesome. If you can positively identify half of the fishes in the state you can feel justly proud of yourself.

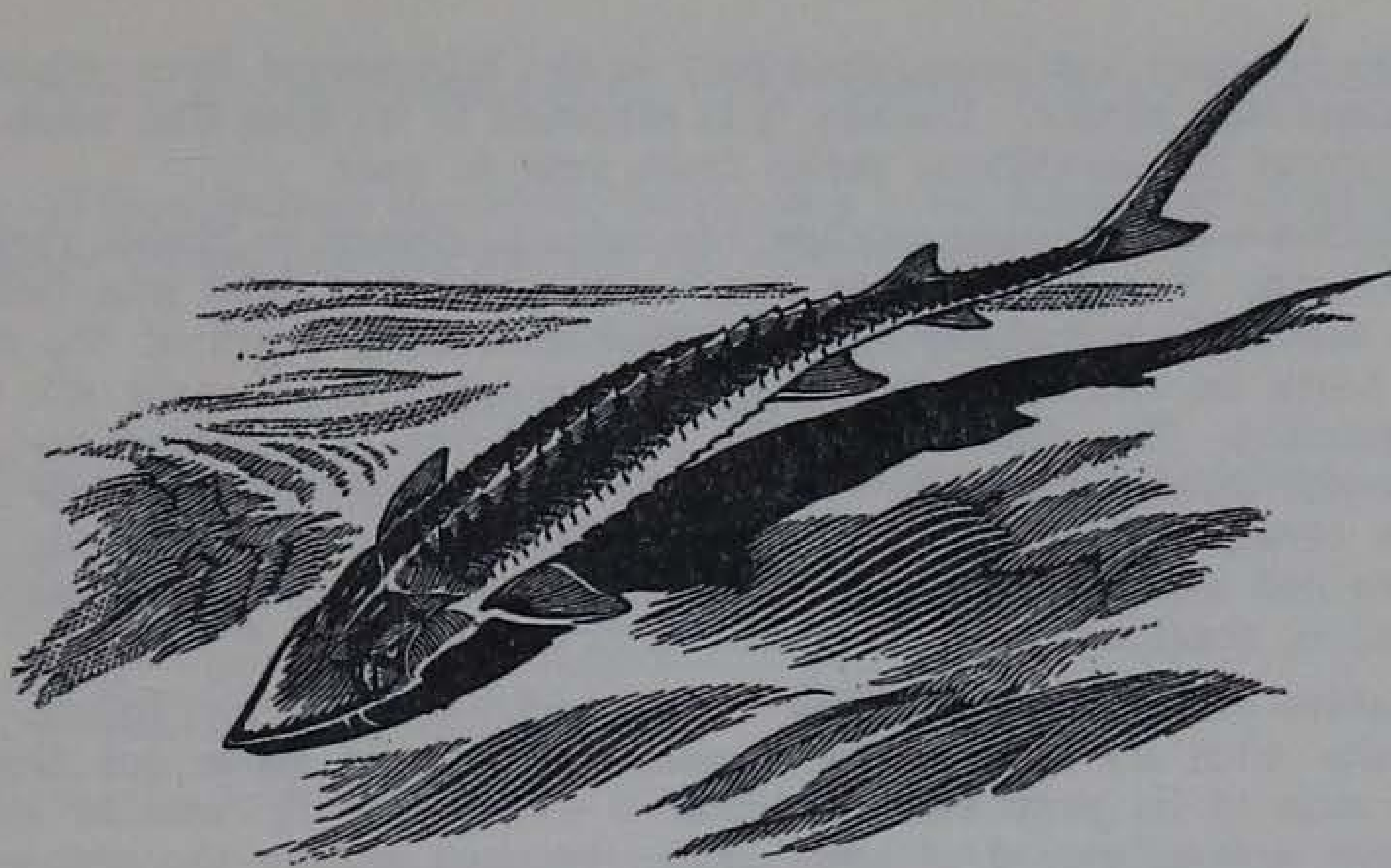
There are so many kinds of fishes it is necessary to group them into many divisions and subdivisions in order to identify them properly. Although this system of classification seems complicated, it is really quite simple when understood. Fishes that look alike or have similar characteristics are grouped together. Thus we find, for example, the channel catfish and black bullhead in the same family because they have many similarities. Each is in a separate genus, however, because they have certain differences. The black, brown, and yellow bullhead are more closely related than the channel catfish and the black bullhead. For that reason bullheads are not only in the same family, but also in the same genus. Due to slight differences, however, the bullheads are separated still further into individual kinds or species. Species are sometimes divided into subspecies to emphasize geographic differences within a single kind. For example, silvery minnows from the Missouri River basin have smaller eyes and smaller scales on the belly than do those from the Mississippi River drainage.

At the present time 140 kinds of fishes are known from Iowa. We are often asked how we know there are that many. Most species have been taken from our extensive survey operations throughout the state. It should be pointed out, however, that this list is not altogether of recent origin, but has been steadily constructed over a long period of years. Jordan and Meek (1885) published the earliest list of fishes from Iowa in the Proceedings of the U. S. National Museum. Several other lists have been published since that time, and in 1927 Potter and Jones published a compilation of all records for the state in the proceedings of the Iowa Academy of Science. Aitken (1936) published a bulletin entitled "Some Common Iowa Fishes" in which he listed the fishes of Iowa, and this list was revised in 1940 in the proceedings of the Iowa Academy of Science. At that time he listed 135 known fishes from Iowa. In the newly revised check list, Bailey accepts 133 species and 136 total kinds, including subspecies, of native fishes. To this may be added four introduced fishes. Despite active study in recent years, few unlisted species have been discovered, and it is doubtful if the number will be greatly expanded, although a few species may be added at the completion of the present surveys. Some of the fishes on the list have not been collected for over half a century and may be considered extinct or vanishing. Others which were once common are now rare. Some fish are currently more common than in former years.

The fishes listed in this book represent a compilation of those reported by former authors and taken from the extensive fish collections made by early and contemporary workers. It might be considered an annotated list of our known fishes with expanded observations on some of the species considered important to the angler. The currently accepted common and scientific names have been used throughout.

Chapter XIX contains a set of maps representing fish collections made by biologists of the State Conservation Commission and other workers. All species taken more than 10 times are listed on the maps. Fishes taken less than 10 times are listed on the following pages under each individual species.

In order that we may follow the keys more closely, we shall commence with the most primitive group of living fishes.



Chapter III

PRIMITIVE FISHES

Lamprey Family

Petromyzontidae

The lampreys are very primitive eel-like animals which differ from our true fishes in the absence of jaws and paired fins and the presence of gill pockets in place of regular gills found in the more familiar fishes. The lampreys, together with the marine hagfishes, are frequently called cyclostomes, meaning animals with round mouths. Most of the lampreys are parasitic, attaching themselves to fishes and other aquatic animals. They also feed, to a certain extent, upon dead organic material. They range in size from the little brook lamprey, which rarely exceeds 6 to 7 inches, to the giant sea lamprey which attains a length of nearly three feet. The sea lamprey has not been reported from Iowa, but it is abundant in the Great Lakes.

Three lampreys, the silver, chestnut, and brook, are native to our streams, but none is known from the natural lakes. The silver and chestnut lampreys, both parasitic, are found in the Mississippi River. Commercial fishermen frequently find them attached to fish, and as many as three or four have been observed on a single host. The brook lamprey, a non-parasitic form, is most common in the smaller streams of eastern Iowa. It seems to prefer rocky riffles, and is seldom observed by anglers. Lampreys attach themselves to rocks by means of their sucker mouths, but are difficult to capture since they can detach themselves quickly and dart down stream to safety.

Lampreys ascend the small clear-water tributaries of the large rivers to spawn in the spring of the year. They construct small depressions in the sand among the rocks in swift water to deposit their eggs. The young larvae are called ammocoetes, and the various species are difficult to tell apart. The larvae feed on microscopic organisms and on organic debris.

Silver Lamprey

Ichthyomyzon unicuspis Hubbs and Trautman

Other Names—Lamprey eel, blue lamprey, lamper, hitch-hiker, bloodsucker.

Iowa Distribution

Mississippi R.: Allamakee Co., vic. Lansing, Ia and DeSoto, Wis. (UMRCC, 1953).
Mississippi R.: Clayton Co., vic. Millville (UMRCC, 1953).
Mississippi R.: Lee Co., vic. Keokuk (Coker, 1930).

The silver lamprey has been found only in the Mississippi Rver, where it is, at present, taken only rarely. Usually it is attached to its host fish when captured. The incidence of its parasitism varies from year to year.

Description—As its name implies, the color is silvery or bluish above, fading to light beneath. The dorsal fin is continuous and not divided into two separate fins. The mouth is a sucking disc and the firm sharp teeth of the circumoral row (the teeth in circular row around the mouth) are nearly all unicuspid, or single pointed. The diameter of the buccal funnel, or sucking disc, is wider than the body when expanded. Typical of all lampreys, there are seven gill pores in a straight line behind the eye. The clearly defined body segments between the last gill slit and the anus number 49 to 52. The animal is slender and eel-shaped, reaching a length of about 12 inches.

Food Habits—The silver lamprey is parasitic upon other fishes, attaching itself thereto with its suction-cup mouth. The sharp teeth cut through the scales and skin of its prey and the blood is extracted. It remains attached to its host over a long period of time unless brushed off by the distressed fish. Fishes almost colorless from the loss of blood have been observed when several lampreys were found attached to them.

Life History—The life history of lampreys is exceedingly interesting. They ascend the streams in the spring to spawn among the rocks in the riffles. The larvae, or ammocoetes, resemble their parents except that they are blind and the mouth is hooded, toothless, and provided with a fine-mesh sieve. When the young leave the nest they drift downstream with the current, and usually lodge in the bottom ooze of quiet pools, where they live in little burrows for several years. At this stage they feed largely on algae and microscopic animals, and are not parasitic. The metamorphosis, or stage of maturing, occurs in the fall and by the following spring they emerge from their burrows as small but transformed lampreys. After one year as parasites the lampreys spawn and then die. There is still much to be learned about these very interesting animals.

Angling—Because of their feeding habits, these animals are of no importance to the angler. Various reports on their edibility have been received. Occasionally they are used for bait, and presumably are effective at times for such species as bass and catfish.

Chestnut Lamprey

Ichthyomyzon castaneus Girard

Other Names—Lamprey eel, lamprey, brown lamprey, lamper.

Iowa Distribution

Mississippi R.: Allamakee Co., vic. DeSoto, Wis. (UMRCC, 1953).
Mississippi R.: Allamakee Co., vic. Lansing (Bailey, ISC).

The chestnut lamprey is even more rarely taken than the preceding one. It has been taken in the Mississippi River in Allamakee County only.

Description—The chestnut lamprey is similar in appearance to the silver lamprey. The dorsal fin is continuous and not divided. The mouth is a sucking disc like the silver lamprey. The circumoral teeth (formed in a circular row in the mouth) are nearly all bicuspid, or two pointed, rather than single pointed as in the silver lamprey. There are 51 to 54, usually more than 52, myomeres or segments in the body between the last gill slit and the anus. This lamprey attains a length of from 8 to 13 inches.

Food Habits—The chestnut lamprey is parasitic, and lives largely by attaching itself to fishes. The digestive tract is well developed in this animal.

Life History—The life history of the chestnut lamprey is very similar to that of the silver lamprey. It usually ascends small streams to spawn in the spring of the year. The larva requires several years to reach adult stage, at which time it returns to the larger streams and remains there until the spawning period the following spring. The parasitic stage continues for one year.

Angling—These animals are never taken on a hook, hence are of no importance to the anglers except possibly as bait for other fishes.

American Brook Lamprey

Lampetra lamottei (LeSueur)

Other Names—Brook lamprey, lamprey eel, lamprey, rock-sucker.

Iowa Distribution

Lamont Cr.: Delaware Co., Backbone Park.
Mink Cr.: Fayette Co., vic, Wadena.
Volga River: Fayette Co., vic. Randalia.
Bear Cr.: Buchanan and Benton Cos., vic, Brandon.
Lime Cr.: Buchanan Co., vic. Brandon.
Prairie Cr.: Linn Co., vic. Cedar Rapids.
Des Moines R.: Polk Co., vic. Des Moines (Meek, 1892).

In all modern collections but one, this interesting species was taken during its spawning season in April. The single specimen taken in the Volga River was taken by the electric shocker in late November. The secretive nature of its habits makes knowledge of its distribution rather vague. It is usually taken in small creeks.

Description—The color of the American brook lamprey is olive-green to brown above, fading to light below. The dorsal fin is completely divided into two distinct fins. The mouth is a sucking disc, but is scarcely wider than the body. The teeth are weak, and are not formed in circular rows, but rather in several groups or clusters. There are from 65 to 70 myomeres, or body segments, between the last gill slit and the anus. A length of about 5 to 8 inches is attained. (See Plate 16.)

Food Habits—The food habits of the American brook lamprey are indeed very interesting. In its larval stage it feeds largely upon minute plants, animals and bits of organic matter. After the animal reaches maturity (in the fall), the digestive system is non-functional, indicating that little or no food is consumed from fall until the next spring (Brasch, 1950), at which time the lamprey reproduces and dies.

Life History—Spawning occurs in the spring, in small depressions in the sand, usually in the swift current. The larvae live in burrows for several years and the adults live from the fall of metamorphosis to the following spring.

Angling—Like the other lampreys of Iowa, these animals have no economic importance to anglers except possibly a very limited use as bait.

Paddlefish Family

Polyodontidae

The paddlefish is in many respects one of the most primitive of modern fishes, but is highly specialized in others. It is a remnant of ancient life, differing from other fishes by its elongated paddlelike snout, long gill covers and sharklike form. It was formerly abundant in the Mississippi Valley, but over-exploitation or change in environmental conditions, or both, have reduced its numbers to a point where it is no longer common except in certain places along the river. The Iowa State Conservation Commission imposed a continuous closed season for several years on this fish in an effort to aid in the recovery of the population. In former years it was an important item in the commercial fish landings on the Mississippi River, but recently the catch has dwindled to a point where it is no longer of much economic importance in the harvest.

Its large size and bizarre shape have made it particularly interesting to the layman and scientist alike. Specimens over six feet long have been taken from the state, placing it at or near the top of the list for "big fish" honors.

Specimens exhibited at the State Fair never fail to attract the attention of the spectators. Many anglers have never seen a live paddlefish, for it is scarce in all waters and seldom takes a hook.

Although considerable research has been done on the paddlefish there is still much to be learned about this interesting fish. Little is known of the spawning habits or early life of the paddlefish, and until recent years (Thompson, 1933) very few specimens were reported under five or six inches in length.

Paddlefish

Polyodon spathula (Walbaum)

Other Names—Spoonbill cat, boneless cat, shovel-nose cat, flatbill, and incorrectly, spoonbill sturgeon.

Iowa Distribution—With four exceptions all collections of this species are in the Mississippi or Missouri Rivers. The paddlefish, much reduced in the last two decades, is reported increasing in some river localities. It was formerly rather common but is now absent in Okoboji and Spirit Lakes. It is taken occasionally during spring floods in the lower reaches of the Cedar and Des Moines rivers. (See map 2.)

Description—The color of the paddlefish is slate-gray to gray-blue above, fading to somewhat lighter beneath. They can be distinguished from all other Iowa fishes by the immensely elongated snout, extremely long gill covers and sharklike mouth. The skeleton is largely cartilaginous. The jaws and palate of young specimens are covered with numerous fine teeth, but the jaws become large, feeble and toothless as the fish reaches maturity. The body is naked, or scaleless. There are 50 to 65 rays in the dorsal fin and about 60 in the anal. It commonly attains a weight of from 40 to 60 pounds, and a specimen weighing over 200 pounds was taken from the Okoboji lakes many years ago. (See plate 10.)

Food Habits—Little is known of the food habits of extremely young paddlefishes, but it is presumed to be largely tiny plants and animals. Contrary to popular belief, the adults feed only sparingly on fishes and mollusks. There is a very elaborate filtering system on the gill arches which enables the fish to "sift out," so to speak, the unwanted foods and retain the minute plankton or small plant and animal life upon which it largely depends for food. Because of the weakness of the jaws and lack of teeth, the fish is probably unable to feed upon very large or hard substances. Just what the long spatula-like snout is used for is not definitely known. It may possibly be used in feeding, but more probably used to direct the movements of the fish.

Life History—As stated earlier the breeding habits of the paddlefish are not clearly known. Some observers think the fish spawn in the deeper channels of the rivers, while others contend they reproduce on bars or in the backwaters. The literature is also lacking on the number of eggs produced and the exact spawning season. Adams (1942), in his determination of the age of fishes, found the average length of one-year-old paddlefish to be about 250 mm (about 10 inches) in standard length, which does not include the tail, and the weight 0.17 pounds. By the second year they reach nearly three pounds, and in their seventh year of life about 12 pounds.

Angling—The paddlefish is not considered an important fish from an angling standpoint in Iowa. An occasional specimen is taken, but the majority of these are illegally hooked by snagging, largely below dams or obstructions on the Mississippi River.

Sturgeon Family

Acipenseridae

Three members of the sturgeon family are said to occur in Iowa waters. The sturgeons are primitive in character, and include many of the largest fresh-water fishes in the world. Some species formerly abounded in coastal waters and entered rivers to spawn. Sturgeon are easily distinguished from all other fishes by the rows of armorlike bony plates, or scales, which partially cover the body. Four fleshy barbels are located on the long, pointed snout that projects far beyond the inferior mouth. The tail fin is typically heterocercal (meaning that the vertebral column turns upward into the upper lobe). The upper lobe, consequently, is longer and better developed than the lower one.

The largest of the Iowa sturgeons is called the lake, or rock sturgeon. It is quite rare in our waters. These fish live to be very old, and specimens approaching 50 years (Cuerrier, 1949; Speaker, 1946) have been reported.

The most common sturgeon in Iowa is called the shovelnose or hackleback. It is common in the Mississippi and Missouri rivers, but less abundant than in former years. It is still commercially important in the river landings, and is taken principally in drift or floating trammel nets.

In the early days of commercial fishing on the Mississippi River, sturgeon were harvested principally for the roe, or eggs, which were prepared into caviar. The carcasses were said to have been discarded. At the present time, however, the flesh is highly prized, and smoked sturgeon always demands a high market price.

Lake Sturgeon

Acipenser fulvescens Rafinesque

Other Names—Rock sturgeon, rock fish, rubber-nose and black sturgeon.

Iowa Distribution

Mississippi R.: Allamakee Co., vic. DeSoto, Wis. (UMRCC, 1953).
Mississippi R,: Allamakee Co., vic. Lansing.
Mississippi R.: Clayton Co., vic. Marquette. (UMRCC, 1953).
Mississippi R.: Muscatine Co., vic. Muscatine (Meek,1892).
Mississippi R.: Lee Co., vic. Keokuk (Coker, 1930).
Mississippi R.: Lee Co., Ft. Madison.

The lake sturgeon is confined to the Mississippi River, where it is taken only rarely in commercial operations.

Description—Young lake sturgeon are tan, or buff-colored, sometimes contrastingly blotched with dark, becoming more uniformly dark as they grow older. Adults are slate-gray to black above and light beneath. The body is partially covered with five longitudinal rows of heavy, bony plates, or scales. The head is roundly conical in shape, and not flattened. Spiracles, or openings from the throat cavity to the outside above and behind the eyes, are present. The mouth is inferior, and suckerlike, capable of being protracted for ease in sucking foods off the bottom. The fish feeds entirely by taste, and has four fleshy barbels on the underside of the snout which act as sense organs and gauge the distance from the mouth to the bottom. (See plate 10.)

Food Habits—The lake sturgeon is primarily a bottom feeder. The food consists largely of insect larvae, snails, bits of aquatic plants and other litter on the floor of the lake or stream. Hatchery men often keep several specimens in their ponds to keep down the growth of objectionable algae and to clean up a part of the partially digested excrement of the fish.

Life History—The lake sturgeon spawns in late spring or early summer, usually in streams, but also reportedly in the shallow areas of some of the lakes in states where it is native to lakes. This fish is not native to Iowa lakes, and little is known of its spawning habits in our rivers. It reaches a weight of several hundred pounds in some waters, but the largest reported from this state is about 100 pounds. Sturgeon grow slowly in their first years of life. Harkness (1923) found that four or five years is required for the fish to weigh one pound in Ontario.

Angling—The lake sturgeon is rarely, if ever, caught on hook and line in our waters. Considered a commercial species, it is taken in limited numbers by nets and seines when the season is open.

Shovelnose Sturgeon

Scaphirhynchus platorynchus (Rafinesque)

Other Names—Sand Sturgeon, hackleback, switchtail, flat-head sturgeon.

Iowa Distribution—This species is rather widely distributed in the Mississippi and Missouri rivers. It is occasionally taken inland during spring highwater periods in the Cedar and Des Moines rivers. Nowhere is it abundant. (See Map 3.)

Description—The color of the hackleback is buff or olive-drab above and light beneath. The body is completely armored with heavy plates. The snout is markedly flattened or shovel-shaped. There are no spiracles. There is a very long, threadlike filament attached to the top lobe of the tail fin, from whence the fish gets one of its common names "switchtail." This filament, however, is very fragile and is often missing, especially in older individuals. This species attains a weight of 6 to 8 pounds, although specimens over 4 or 5 pounds are unusual. (See Plate 10.)

Food Habits—The food habits of the hackleback are similar to those of the lake sturgeon. Primarily a bottom feeder, it lives principally upon insect larvae, small mollusks and other bottom organisms. Algae and bits of higher aquatic plants are also consumed.

Life History—The spawning season of the hackleback extends from April through June (Forbes & Richardson, 1909; Eddy & Surber, 1947), but very little is known about the life history and spawning habits of this fish.

Angling—An occasional hackleback is taken on hook and line, especially in the Missouri River. Usually no special attempt is made to catch them, and they are taken incidentally with other fishes. Most often they are caught in the deep waters around snags on worms and other live baits. The flesh is delicious and is prepared by deep-fat frying, broiling or smoking.

Pallid Sturgeon

Scaphirhynchus album (Forbes and Richardson)

Other Names—White sturgeon, hackleback.

Iowa Distribution—The inclusion of the pallid sturgeon is based on a single immature specimen examined by Coker (1930) on the Mississippi River in the vicinity of Keokuk. Bailey and Cross (1954) list this observation as a dubious record. The potential of this fish being in Iowa waters prior to the construction of the Keokuk locks is, however, not without credence. Despite the absence of records it probably occurs in the Missouri River.

Description—The pallid sturgeon is similar to the shovelnose sturgeon but is much lighter in color, has a smaller eye, and a longer and sharper snout. The inner barbels on the lower surface of the snout are only about half as long (instead of about four-fifths as long) as the outer barbels. The belly is naked, in contrast to the shovelnose sturgeon in which it is covered with small platelike scales.

Gar Family

Lepisosteidae

The gars are relics of a large group of primitive fishes, and are often referred to as living fossils. They can be distinguished from other fishes by the tough, interlocking rhombic, or diamond-shaped scales that cover the body. Two species, the longnose and shortnose gars, are found in Iowa waters.

Possibly the spotted gar is also to be found. Years ago the gigantic alligator gar ascended the Mississippi River at least to Quincy, Illinois, and it may well have entered Iowa. It is doubtful if the species ranges so far north today. These fierce predators are among our most vicious fishes, and will attack nearly any fish in their path. They are long, slender, graceful fishes that bask in the sun near the surface of the water where, motionless, they await their prey.

The snout of the gar is a long, extended, beaklike structure, closely rimmed with sharply-pointed teeth. The beak of the longnose gar is considerably longer and more slender than that of the other species. The beak is exceedingly tough and bony, which enables the fish to steal the bait from anglers' lines consistently, rarely becoming hooked.

Whether or not the gars are subject to cyclic variations is not known, but their population densities seem to rise and fall in both lakes and streams of this state. They are considered nuisance fish, especially in the lakes, and efforts are constantly expended to keep them under control. They afford but little pleasure to anglers because it is almost impossible to catch them, and they have little or no commercial value. They do, however, serve as an excellent predator in keeping in check some of the forage fishes that would otherwise become over-abundant in the river. Provided their reproductive activities are successful, they are almost certain to survive, since their tough bony structure and tenacious tendencies make them immune to most forms of predation.

Shortnose Gar

Lepisosteus platostomus Rafinesque

Other Names—Short bill, stub-nose gar, billy gar.

Iowa Distribution—The "Billy gar" is taken commonly in the Mississippi River and rarely in the lower reaches of the larger tributaries to the Mississippi. It is also found occasionally in the oxbow lakes and tributaries of the Missouri River. Despite efforts at reduction, this species is taken occasionally in the Dickinson County Lakes. (See Map 4.)

Description—The color of the shortnose gar is olive green above and silvery to white beneath. There are usually no dark spots on the head or snout, but where encountered in clear water dark spots are evident. The beak is much broader and shorter than that of the longnose gar. The scales number from 60 to 64 in the lateral line. (See Plate 11.)

Food Habits—Like other gars, this species feeds largely upon fishes, taking some insect larvae and crayfish in its diet.

Life History—The shortnose gar spawns in the spring in shallow bays. The coloration of the young is usually much darker than the other species, and the black side stripe is considerably broader. It attains a length of about 5 to 6 inches at the end of the first growing season, and reaches a length of 20 to 30 inches at maturity.

Angling—The shortnose gar furnishes little or no angling.

Longnose Gar

Lepisosteus osseus (Linnaeus)

Other Names—Billy gar, billfish.

Iowa Distribution—The distribution of the longnose gar is quite similar to that of the preceding species, if anything, it is more widely distributed. With the exception of the state's boundary waters it is rare in numbers; a single specimen often making up an inland collection. (See Map 5.)

Description—The color of the longnose gar is olive to dark green above and white or silvery below. There are large round black spots on the dorsal, anal, and caudal or tail fins. The entire body is covered with thick rhombic scales, and the snout is extended into a long slender beak. The length of this beak is from 15 to 20 times its least width. There are usually 8 rays in the dorsal fin and 8 or 9 in the anal fin. There are 60 to 63 diamond-shaped scales in the lateral line. (See Plate 11.)

Food Habits—The chief diet of the gar is fish. Lagler and Hubbs (1940) found the longnose gar feeding almost exclusively on fishes. A small part of their diet is made up of crayfish and insects. They are considered to be wholly carnivorous in their feeding habits.

Life History—The gar spawns in the spring, depositing its eggs in shallow, weedy bays, usually on submerged vegetation or aquatic plant roots. The eggs are dark in color and small in size; since they are poisonous they should not be used for human consumption or made available to domestic animals. A young gar grows rapidly for the first few months of its life, and attains a length of 6 to 8 inches at the end of the first growing season. It reaches a maximum length of 4 or 5 feet, and 3-foot specimens are not at all uncommon.

Angling—Gar are not commonly taken by anglers in Iowa by standard fishing methods, but once hooked this fish puts up a real fight. The few that are caught are usually hooked accidentally while fishing for other kinds. They will strike spinners, flies, plugs and all sorts of artificial lures, but prefer live baits such as minnows and crayfish.

Bowfin Family

Amiidae

The bowfin is a primitive type fish and the sole representative of an ancient family. Although the body feels smooth and leathery, it is actually covered with rounded (cycloid) scales, which are smooth and have no ctenii or rough prickles like some of the other fishes.

Fossil remains of the ancestors of this fish are found in the rocks of Europe and the United States. The present day form is a voracious, hardy individual with a determination to live under any circumstances it may encounter. It prefers large quiet waters and is abundant in the boundary streams and their overflow ponds. In the fish rescue work along the Mississippi River it is not uncommon to find only a few adult bowfin in ponds of considerable size, grim evidence that they have devoured all of the other inhabitants in their struggle for life.

Bowfin

Amia calva Linnaeus

Other Names—Dogfish, grindle, spot-tail, and mudfish.

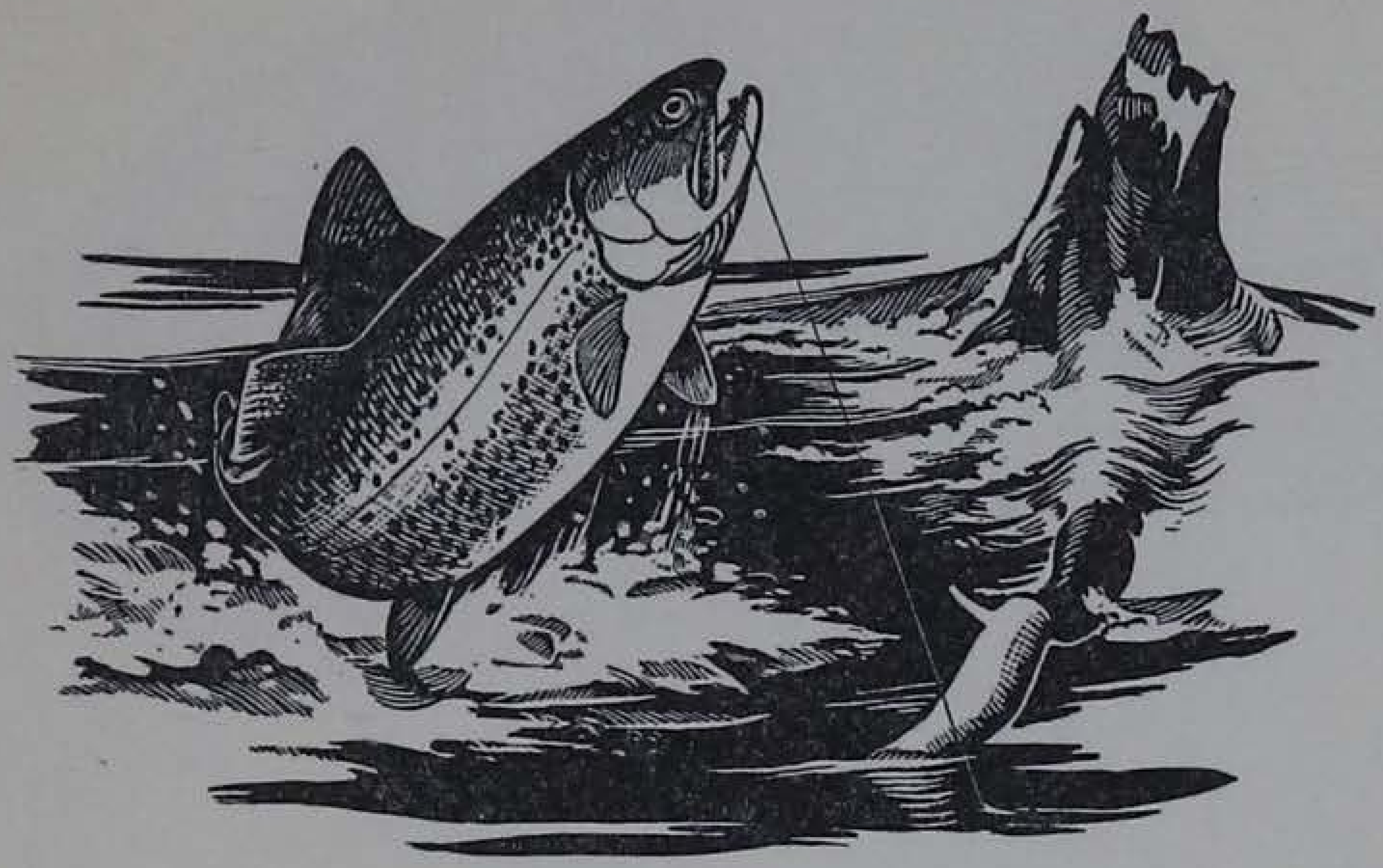
Iowa Distribution—With the exception of a rare specimen collected in Spirit and Okoboji Lakes, the bowfin is confined to the sloughs and ponds of the Mississippi River. It was taken by Meek (1892) in the lower reaches of the Cedar-Iowa drainage and is probably present in the lower reaches of all the major tributaries to the Mississippi River. This fish is not common in any of the inland waters of the state. (See Map 6.)

Description—The color of the bowfin is dark olive above with lighter sides and cream-colored belly. The long dorsal fin is dark green with a narrow longitudinal olive-colored band near the top margin and another near the base. The males have a dark spot on the caudal fin, bordered with yellow or orange. The lower fins are green, vivid as fresh paint, during the breeding season. The body is covered with heavy, rounded cycloid scales, and there are 66 to 68 in the lateral line. There are 47 to 51 rays in the dorsal fin and 9 or 10 in the anal fin. The head is more or less flattened on top and the mouth is large. The teeth are sharp and strongly set in the jaws. A weight of 6 to 8 pounds or more is attained. (See Plate 11.)

Food Habits—The dogfish is primarily carnivorous, feeding largely on fishes of all kinds (Lagler and Applegate, 1942), frogs, crayfish, large insects and their larvae, leeches, and other aquatic life.

Life History—The bowfin spawns in the spring, usually in May, in shallow quiet bays or backwaters of the river. It is a nest-builder and deposits the eggs in a saucer-like depression on the bottom or over sticks and vegetation. The eggs are guarded by the male until they hatch, and the young are herded about in schools until they are able to shift for themselves. Bowfin attain a length of 6 to 8 inches at the end of the first growing season, and often reach 2 feet or more at maturity.

Angling—Few Iowans intentionally fish for bowfin, but quite a number are caught. They are gamy fighters, and will strike viciously at all manner of live baits. Frequently they are caught on worms, nightcrawlers, minnows, chubs, frogs and crayfish. The flesh is not especially palatable, and the tough bone-like scales make it difficult to clean. Baked with highly seasoned dressing or marinated in spices and vinegar before cooking, it makes a passable dish. Some anglers and commercial fishermen smoke the bowfin. It is a little dry, but quite tasty.



Chapter IV

TROUT FAMILY

Salmonidae

Three species of trout, one native (Aitken, 1940) and two introduced, are known from Iowa. The brook trout, as far as we have been able to ascertain, has always lived in a few of our streams, but the brown trout was introduced from Europe and the rainbow from the Pacific Coast. Both of the introduced trouts have been stocked by state and federal agencies for more than seventy years, hence have been included in the present list of Iowa fishes.

All of the trout streams are located in the northeast section of the state, roughly east of the Cedar River and north of the cities of Cedar Rapids and Maquoketa. In the early days there were many more streams in the unglaciated area capable of supporting trout than there are at present. The original range of the native brook trout was probably confined to the drainage of the Upper Iowa River.

As farming became more extensive and forests gave way to cultivated fields, the lack of shade, rapid water run-off, siltation, and other factors caused conditions to change to such an extent that many of the streams could no longer support trout. Trout require water that does not become warmer than 70° to 75° Fahrenheit. At the present time only portions of some 40 streams can be considered trout water, and the supply of fish in these streams must be maintained by stocking with hatchery trout. Food conditions and water temperature of these streams are such that a fair population of trout can be supplied to anglers. Natural reproduction, however, is so limited that it is scarcely considered in our present day trout-management practices in Iowa. Probably the major reasons for the scanty natural reproduction are the shortage of good spawning grounds and the instability of the streams.

Experimental stream improvement similar to the work conducted in Michigan (Hubbs, Greeley and Tarzwell, 1932; Shetter, Clark and Hazzard, 1949; Tarzwell, 1937) was attempted in Iowa. Some benefits were temporarily derived, but most of the structures have since disappeared because of lack of maintenance.

From 150,000 to 200,000 trout, principally rainbow and brown, are stocked each year from the state fish hatcheries at Decorah and Strawberry Point. Trout are also stocked in a few streams from the federal fish hatchery located at Manchester. These fish are held in the hatcheries until they are at

PLATE 5

BLUEGILL *Lepomis macrochirus* Rafinesque

NORTHERN ROCK BASS *Ambloplites rupestris rupestris* (Rafinesque)

WARMOUTH *Chaenobryttus gulosus* (Cuvier)


Maynard Reece

least seven inches in length before they are released. Some anglers would like to have the trout released at 12 to 15 inches, but obviously this is out of the question with the present facilities and funds allocated for this purpose. To double the size of the trout would more than triple the cost of production if all streams were to receive their proportionate share of fish on the current numerical basis.

Trout have always been favorite fishes with anglers, and perhaps on the national level more money has been expended on their propagation than on any other fish. As early as 1873 the anglers of Iowa felt the need for a fish hatchery. This hatchery was located on the banks of the Wapsipinicon River north of Anamosa in Jones County. Its primary function was to produce trout, which have been propagated and stocked in Iowa streams since that time. For many years they were stocked as "fry," or newly-born fishes. Later they were reared to "fingerling" size and stocked when they had reached a length of about 2 to 4 inches. Since about 1933 most trout have been stocked at "legal" size, and the bulk range from 7 to 10 inches in length. Iowa was one of the first states to turn to stocking the entire output from the hatcheries at catchable size.

Several unsuccessful attempts have been made to introduce lake trout into Iowa waters. Because of the depth (132 feet) and low temperature of West Okoboji Lake, it was felt it would support these fish. There were two causes for failure of these plantings. None of the principal foods of the lake trout were present and, even more important, the lake is so rich that by summer the water that is cold enough for trout does not contain enough dissolved oxygen for them to breathe. Lakes suitable for trout are invariably rather poor in organic matter and will not produce as many fish as West Okoboji.

There have been experimental plantings with other species of trout in the streams, but it is believed that rainbow, brown, and brook trout are best suited to Iowa conditions. The brown trout appears to be able to withstand the flooding, turbid waters and high temperatures that invariably occur at certain seasons. Many anglers feel that the rainbow is more easily caught than the brown. A combination of these species, therefore, is thought to produce optimum returns to the anglers.

Trout belong to the salmon family. They are slender, often brilliantly-colored fishes, with very fine scales, naked heads, and a small fleshy fin called the adipose fin on top of the body near the tail.

Trout, especially the rainbow and brown, have been reported to weigh nearly 40 pounds (Caine, 1949), although specimens over 12 to 15 pounds are rare. In Iowa, several fish weighing as much as 7 to 9 pounds are taken each year. These large fish are rare in our little streams because of the limited space and tremendous angling pressure which greatly reduce the total population. The exact number of Iowa anglers that fish trout is unknown, but it is estimated that upwards of 10,000 avail themselves of the sport of trout fishing during the long open season. As many as 500 anglers have actually been counted on less than three miles of stream on the opening day. Although this is unusual, it does show the terrific pressure exerted upon the streams, especially in the early season.

Iowa trout fishing is largely man-made. While it might be considered a "put and take" proposition, the beautiful landscape is far from artificial. The countryside is most unusual, with a mingling of little farmsteads and lovely hardwood forests on the steep hillsides and narrow valleys cut through limestone rock. On the opening day of the season, and for a few Sundays thereafter, the fastidious fly-fisherman stands elbow to elbow with the old lady in the sun bonnet who is using sliced liver or ground beefsteak for bait. From midsummer until late fall, however, the picture is quite different, and trout fishing becomes a sport rather than a carnival. From a financial point of view the trout program does not pay its way, but it might well be likened to a special item on the grocer's shelf that is sold slightly below cost. It is a "leader" that is offered to the enthusiastic angler who has spent the long winter months getting his equipment ready for the coming season. It is an early form of fishing that pays dividends for those eager anglers who enjoy a little something special in advance of fishes that take the brunt of the pressure later in the season.

Brown Trout

Salmo trutta Linnaeus

Other Names—German brown, brownie, spotted trout, loch leven, Von Behr trout.

Iowa Distribution—The brown trout is common in all Iowa trout waters. Constant stocking keeps the species in fishable numbers; however, it has been known to reproduce successfully in favorable years in French Creek, South Bear, Cedar Creek, and Elk Creek. This fish is native to Europe and was introduced to this country in the late 1800's. (See Map 7.)

Description—As its name implies, the color of this trout is olive to greenish-brown. The large black and reddish-orange spots on the sides of the fish have a pale border. A yellowish margin is frequently present on the front of the pelvic and anal fin. The lower portions of young fish are yellow, fading to gray or white beneath. This yellow coloring may be found in mature specimens, especially the males in the breeding season. The brown trout closely resembles the brook trout except that it does not have the mottled coloration on the back and dorsal fin; the spots on the sides of the brown trout are larger and usually black, where those on the brook trout are light. The edge of the fins are yellow or the same color as the rest of the fish on the brown trout but white on the brook trout. The vomer, a bony structure in the roof of the mouth, has sharp teeth in an alternating or zig-zag row. There are from 115 to 150 scales in the lateral line along the body. Brown trout have been known to reach a weight of over 30 pounds. Individuals up to 8 pounds are reported from Iowa each year, although fish of this size are exceedingly rare in our waters. (See Plate 4.)

Food Habits—The brown trout is often rather inactive during midday, and spends its time in deep pools or under protective cover. It feeds more actively in early morning and evening. It consumes a large number of Mayflies (Needham, 1938). Other food items include both terrestrial and aquatic insects, insect larvae, worms, mollusks, small crayfish, and fish. Large brown trout will take chubs and even trout 7 inches or more in length.

Life History—The brown trout reproduces from October through December. It ascends the streams and deposits its eggs in saucer-shaped nests or redds which it scours in the sand or gravel. The average number of eggs deposited by the females varies considerably, depending upon the size of the fish. Needham (1938) found the production of eggs to range from 200 to 6,000 per female. The eggs are small, ranging from 240 to 300 or more per fluid ounce. The eye in the embryo of the egg appears in about 14 days, and the fish hatch in from 48 to 52 days in our hatcheries in a constant water temperature of 51° F. The fish attain a length of from 7 to 10 inches in 16 months in the hatcheries.

Angling Methods—Brown trout are taken on both natural and artificial baits. Dry flies are productive, especially in early morning, late afternoon, and evening. Wet flies and nymphs, creepers, and sundry imitations of larval aquatic insects are used extensively. Small spinners ahead of wet flies and small metal spoons are often used, especially in the early spring or when the water is somewhat turbid. In midsummer and fall, when the water is low and clear, small flies attached to long tapered leaders are very effective.

When live baits are used, a small split shot is often attached to the leader about 10 to 12 inches above the hook to keep the bait close to the bottom.

Worms, nightcrawlers, and salmon eggs, as well as a wide variety of insects and their larvae, are used as bait. Most often live baits are fished downstream with the current and drifted over riffles into pools, under cut banks and snags, and around large rocks in the stream bed.

Rainbow Trout

Salmo gairdneri Richardson

Other Names—Coast rainbow trout, coaster, Pacific trout, steelhead, and red-sided trout.

Iowa Distribution—This fish, like the brown trout, is stocked annually in all Iowa waters capable of sustaining trout. It is not a native Iowa fish, being introduced from West Coast stocks. Natural reproduction is known only in Elk Creek. (See Map 8.)

Description—The rainbow trout is olive to greenish-blue above and silvery below, with a prominent horizontal red band on the side. The sides, back, dorsal, and caudal fins are profusely spotted with small black spots. The rainbow trout, like the brook and brown, has a small fleshy adipose fin on the back just ahead of the caudal or tail fin. On the larger trout the males can be distinguished from the females by the hard, cartilaginous structure called the "button" on the tip of the lower jaw. Like the brown trout, there are sharp teeth on the vomer in the roof of the mouth. There are from 135 to 155 scales in the lateral line along the body of the fish. The rainbow has been known to reach a weight of nearly 40 pounds. In Iowa an occasional fish weighing up to 8 pounds is reported, but fish of this size are most unusual. (See Plate 4.)

Food Habits—A wide variety of food is consumed by rainbow trout (Leonard and Leonard, 1949). A large part consists of Mayflies, caddisflies, stone-flies and their larvae, small mollusks, and fishes. Terrestrial insects also constitute an appreciable percentage of the diet during the summer months.

Life History—The rainbow trout ascends the smaller streams to spawn from late February to early April. In the hatcheries where the water temperature remains fairly constant it reproduces from December through January, and occasionally into February in our state. Small females produce from 400 to 700 eggs, while larger ones may have 3,000 or more. In the hatcheries about 50 days are required to complete incubation of the eggs. Hatchery trout range from 6 to 12 inches in length in 16 months. Greeley (1933) found the rainbow trout in Michigan waters to average 3.3 inches the first year, 7.8 inches the second, 17.3 inches the third, 21.9 inches the fourth, 25.1 inches the fifth, and 27.7 inches the sixth year. In Minnesota (Smith and Moe, 1944) rainbow trout were reported to have grown to a length of 4.9 inches the first year, 9.1 inches the second, and 20.5 inches at the end of the fifth year of life.

Angling—Together with the brown trout, the rainbow supplies most of the trout fishing in Iowa waters.

A large majority of Iowa anglers use live baits in fishing for trout. Nightcrawlers lead the list, followed by angleworms, salmon eggs, small pieces of fresh meat, minnows, grubs, grasshoppers, crickets and the like. Most anglers use fly rods and reels and float the bait downstream through riffles into pools, brush piles, submerged logs, under cut banks, and around boulders. If any weight at all is used on the 6- to 10-foot leaders, it is usually a small split shot. Small hooks, from No. 8 to No. 10 or even smaller, are most often used.

When using wet flies most anglers prefer to fish down and across stream, retrieving their flies in short jerky movements to simulate the swimming action of immature nymphs of aquatic insects. Dry fly fishermen, on the other hand, nearly all fish upstream, permitting their flies to float down with the current. Slack must be taken up at all times to permit the angler to strike fast.

Brook Trout

Salvelinus fontinalis (Mitchill)

Other Names—Speckled trout, native trout, brookies and char.

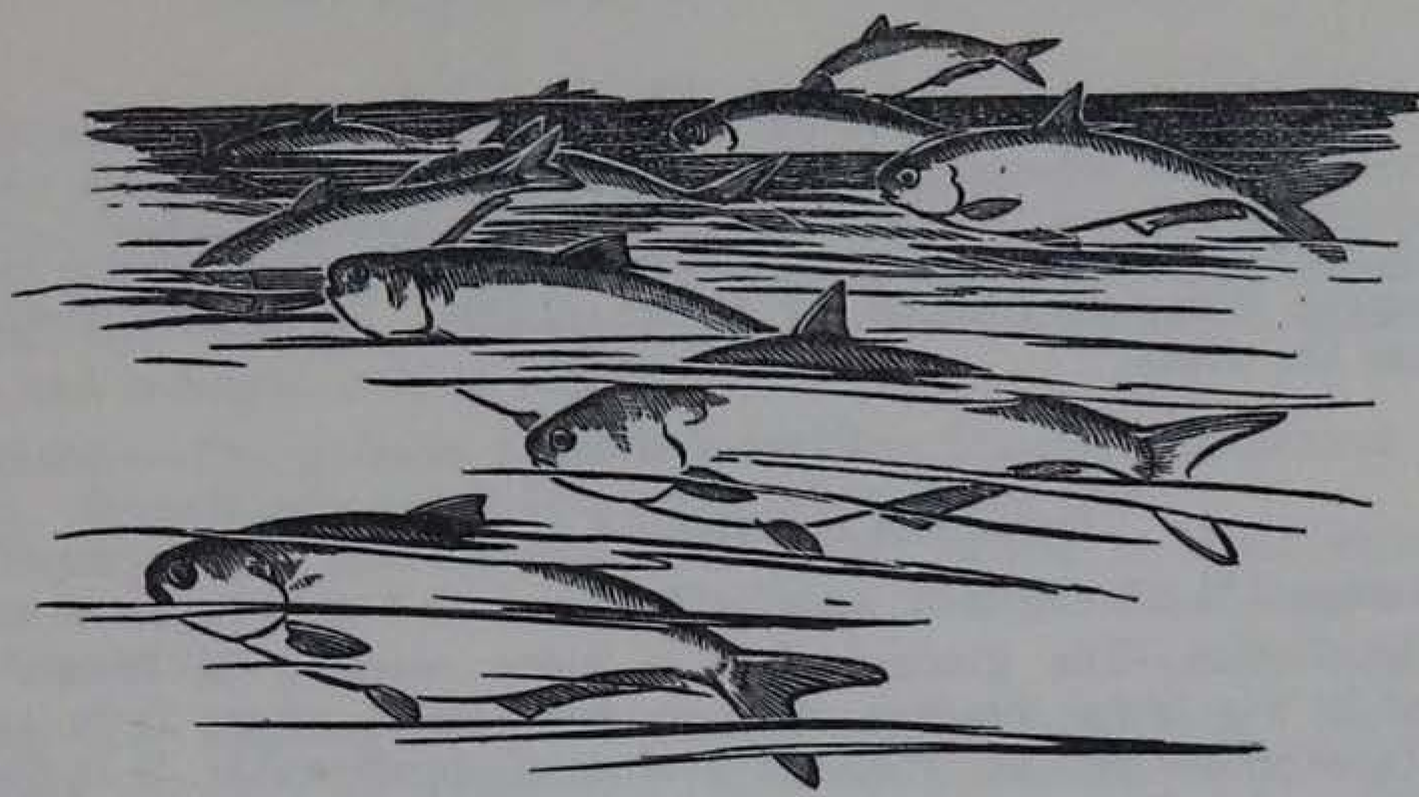
Iowa Distribution—Unlike the previous two members of the trout and salmon family, the brook trout is a native Iowa fish. The original native locale of this species, which was probably confined to the Upper Iowa River drainage, has been confused by artificial plants. Natural reproduction of this species occurs in some small streams in Howard, Winneshiek, Allamakee, and Fayette counties. (See Map 9.)

Description—One of the outstanding characteristics which distinguishes the brook trout from other members of the family is the vivid white markings on the front edges of the lower fins. The dark gray over-markings on the olive-green background form a mottled effect on the back of the fish and dorsal fin. The lower parts of the body fade into a lighter color, and a red or orange line extends laterally along the body. There are numerous red and pale yellow spots on the sides, each spot faintly surrounded with a blue circle. The dorsal fin is strongly mottled but does not have any colored spots. The vomer in the roof of the mouth is trough-shaped; the teeth are confined to the head of the bone, and the shaft itself is toothless. There are 200 or more scales in the lateral line along the side of the body. (See Plate 4.)

Food Habits—The food of the brook trout consists largely of caddisflies, two-winged flies, Mayflies, scuds, mollusks, fishes, and small crayfish. Of the food items (Lord, 1933), insects make up the bulk of the diet.

Life History—Brook trout spawn from September through November (Hazzard, 1932) under natural conditions, and usually the redds or nests are constructed by the females in the spring headwaters of small streams. Young females lay in the neighborhood of 200 to 500 eggs and larger fish may produce as many as 2,500 or more. About 50 days are required for the incubation of brook trout eggs at our hatchery where the water temperature is about 51° F. Under normal conditions brook trout reach a length of from 3 to 5 inches at the first year, 6 to 8 inches the second, and 9 to 11 the third year of life. In the fish hatcheries where the brook trout is hand-fed, however, it is reared to about 7 to 10 inches in 16 months. A specimen weighing two or three pounds is occasionally reported, but fish over a pound and a half are unusual in our small streams.

Angling Methods—The same methods are employed in catching brook trout as for the other trout in Iowa. Most fish are taken on live baits; however, brook trout rise beautifully to a fly and it seems a shame to take them by other methods. The brookie is fond of shelter and is often taken through open areas in beds of watercress or near brush piles and submerged logs.



Chapter V

MOONEYES AND HERRINGS

Herring Family

Clupeidae

The herrings are flat, elongated fishes, represented in Iowa by the skipjack, Ohio shad, and gizzard shad. Of these three species, only the gizzard shad is now common to abundant in our waters. The skipjack is occasionally found in the Mississippi River, but the Ohio shad seems to have disappeared.

Skipjack Herring

Alosa chrysochloris (Rafinesque)

Other Names—Shad, river shad, river herring.

Iowa Distribution

Mississippi R.: Grant Co., Wis., vic. Wyalusing (Greene, 1935).
Mississippi R.: Scott Co., Davenport (Meek, 1892).
Mississippi R.: Muscatine Co., Muscatine (Meek, 1892).
Mississippi R.: Lee Co., Keokuk (Coker, 1930).
Des Moines R.: Lee Co., vic. Keokuk (Coker, 1930).
Cedar R.: Linn Co., vic. Cedar Rapids (Meek, 1892).

The skipjack herring was never widely distributed in Iowa. Early records place it generally in the eastern rivers of the state, primarily in the Mississippi. The fish has not been taken in the last twenty years and is now thought to be rare or absent.

Description—The skipjack and the Ohio shad both have a terminal mouth, which distinguishes them from the common gizzard shad, which has an inferior mouth. In other words the snout does not project beyond the mouth. The last ray of the dorsal fin is not longer than the other rays. There are teeth in the jaws, but they are considered weak.

Food Habits—The skipjack feeds principally upon minute plants, animals, and small fishes.

Life History—This fish spawns early in the spring, and the young are 3 to 4 inches in length at the end of the first growing season. They reach a length of about 10 to 12 inches at maturity.

Angling—The skipjack is not taken in Iowa at the present time by angling methods.

Ohio Shad

Alosa ohiensis Evermann

This fish is included as an Iowa species on the basis of those collected in the Mississippi River at Keokuk by Coker (1930). It is now thought to be absent from the state.

Gizzard Shad

Dorosoma cepedianum (LeSueur)

Other Names—Shad, skipjack, and flatfish.

Iowa Distribution—The gizzard shad is quite common in Iowa's boundary waters and in the lower reaches of their tributaries, where it is common to abundant in overflow ponds. While it prefers sluggish water, it is occasionally found in the main channels. It is quite common to abundant in some natural lakes where it is fast becoming a problem species. (See Map 10.)

Description—The gizzard shad is a flat, compressed, silvery fish that strongly resembles the other members of the shad family. The mouth is inferior, or located on the lower side of the head. The last (posterior) ray of the dorsal fin is considerably longer than the others.

Food Habits—The gizzard shad feeds largely on microscopic plants and animals, particularly diatoms and other algae, and small crustaceans.

Life History—It spawns in late April or early May, and the young grow from 2 to 4 inches by fall. The fish mature in its second or third year of life, and reaches a length of 10 to 12 inches.

Angling—Occasional specimens are taken on artificial baits and small minnows, but it is not considered of any angling or commercial value.

Mooneye Family

Hiodontidae

The mooneyes resemble the herrings, but can be distinguished from them by the absence of the scutes, or sharp sawlike ridge of scales, on the belly. Two species of this primitive-type fish, the mooneye and goldeye, are native to Iowa waters. They are rather widely distributed in the state but have a strong tendency to inhabit the larger rivers. At the present time they appear to be increasing in some of the inland streams, particularly in the Des Moines River drainage.

Both the mooneye and goldeye will occasionally rise to a fly or take live baits. They are quite gamy and reach a length of 12 to 14 inches. The flesh is edible but not considered of top quality. There is little or no market for them, hence they are not taken in any quantity from the boundary streams by commercial fishermen.

Together with the herrings, the mooneye and goldeye constitute an important part of the food of many of the game fishes in the Mississippi and Missouri rivers.

Goldeye

Hiodon alosoides (Rafinesque)

Other names—No other common names known.

Iowa Distribution—The goldeye is quite common in the Missouri River, occasional in some of its tributaries, and is taken rarely in its oxbow lakes. It is occasional in the Mississippi and seems to be confined to the lower section of the river. It has been taken on two occasions in the Des Moines River below the city of Des Moines. (See Map 11.)

Description—The goldeye is somewhat difficult to distinguish from the mooneye. Both are flat or compressed fishes, bluish above with silvery sides and belly. The fleshy mid-ventral keel extends forward as well as backward from the pelvic base in the goldeye and the dorsal fin originates behind the origin of the anal fin. The eye, although large, is somewhat smaller than that of the mooneye and is bright gold in color.

Food Habits—The goldeye feeds largely upon insects, crustaceans and minute plant life. Occasionally small fishes are taken in the diet.

Life History—This fish spawns early in the spring in shoal waters and the young reach about 3 to 5 inches in the fall. They attain a length of 10 to 14 inches at maturity.

Angling—The angling values are almost negligible, although the goldeye will occasionally rise to a fly or strike a small minnow. The flesh, while palatable, is not considered exceptional.

Mooneye

Hiodon tergisus LeSueur

Other Names—Toothed herring, big-eyed shad.

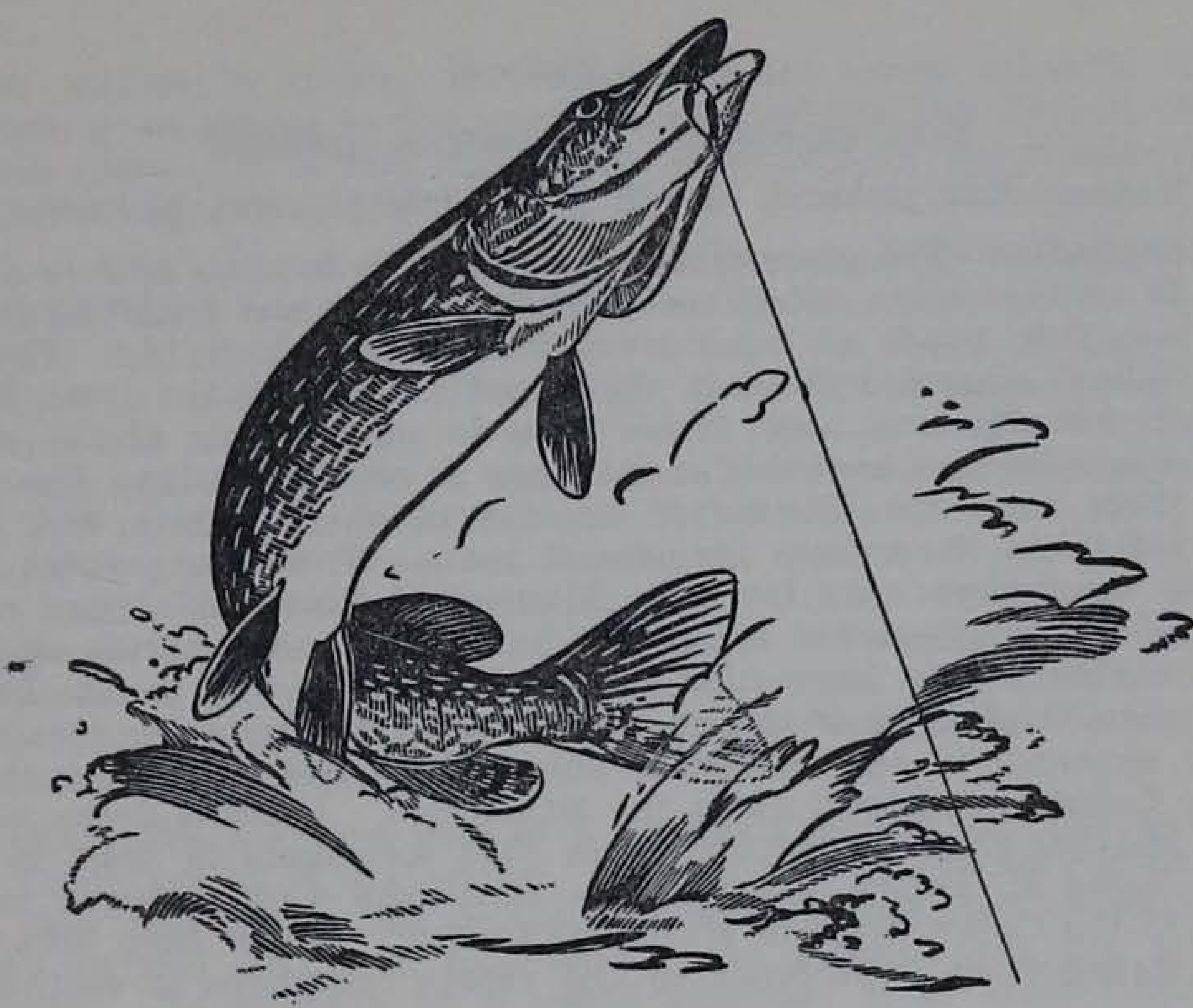
Iowa Distribution—All collections are confined to the Mississippi and its tributaries where it is occasional to abundant. (See Map 12.)

Description—The color of the mooneye is blue above, fading to bright silver on the sides and belly, which sometimes have a golden cast and pink color toward the tail fin. The body is rather deep and much compressed, and is covered with very thin cycloid or rounded smooth scales. There are slender, closely set teeth on the tongue whence one of the common names, toothed herring, originates. The fleshy mid-ventral keel does not extend forward beyond the pelvic base. The scales in the lateral line number from 56 to 58. The dorsal fin originates before the origin of the anal fin. There are 9 rays in the dorsal fin and 31 in the long anal fin. It attains the length of 12 to 14 inches. (See Plate 3.)

Food Habits—The food of the mooneye is largely plankton, or small, free floating plant and animal life. Insects and their larvae are also included in the diet.

Life History—The mooneye has no oviducts or passage for the eggs from the ovary, and the eggs fall into the abdominal cavity before exclusion. It spawns in the spring of the year in shallow areas. The young reach a length of 4 to 6 inches during the first growing season.

Angling—Mooneyes are frequently taken by fly-fishermen and anglers using minnows and spinner rigs, but usually incidentally to other fishes, since no special effort is made to catch them.



Chapter VI

PIKE FAMILY

Esocidae

Members of the pike family are found in the fresh waters of Europe, Asia and North America. Some of these voracious fishes grow to considerable size and have always been held in high esteem by the angling fraternity. They can be cultured in fish hatcheries, and in recent years large sums of money have been spent, especially by several of the northern states, in the propagation of the muskellunge and northern pike.

In Iowa the pike family is now represented by two species, the common or northern pike and the grass pickerel. A few specimens of the muskellunge have been reported, but it is doubtful if they were ever more than extremely rare fishes in our waters. The grass pickerel is confined almost entirely to a small area in the southeast section of the state, so for all practical purposes only the northern pike is of any consequence to our anglers.

Several successful attempts have been made to rear northern pike in our fish hatcheries, and large numbers have been widely distributed throughout the state from the fish rescue operations along the Mississippi River. While often found in the most unusual situations, the pike is largely confined to the larger natural lakes, upper reaches of the major inland streams, and the boundary waters. Because of their carnivorous habits, the pike is widely used by this and other states in an attempt to control the numbers of the more prolific fishes.

Populations seem to rise and fall periodically depending upon the reproductive success and the environmental factors which affect their mode of living. They are rarely abundant, but are common in some waters, especially in weedy lakes and in streams with numerous overflow waters that afford suitable spawning grounds.

Grass Pickerel

Esox americanus vermiculatus LeSueur

Other Names—Mud pickerel, slough pike, little pickerel, pickerel.

Iowa Distribution—The grass pickerel, as its name implies, prefers a vegetated habitat. In all the recent collections (Speaker, Bailey and UMRCC) it has been found in overflow ponds or small river lakes. (See Map 14.) The late Dr. Bohumil Shimek observed them in the upper reaches of the Iowa River, and other early investigators have found them in other areas of the state. No authentic specimens are available at this time to our knowledge. Greene (1935) reported them from the Mississippi River between Wisconsin and Iowa, but we have not taken them there for several years. From our present investigations, they are known only from the Mississippi River and lower reaches of its tributaries in southeastern Iowa. We have examined hundreds of specimens of young northern pike from other areas of the state, but so far have failed to find a single specimen of the grass pickerel from any other locality. These fish have appeared in our collections only rarely, and usually in those from Muscatine County southward along the Mississippi. About a dozen were taken by E. B. Speaker from Louisa County in 1940, and again in 1943, in company with Dr. Reeve M. Bailey, several more specimens were collected in a small tributary to the Cedar River in Muscatine County. A few have been taken by the Fish Management Department in fish rescue operations in southeast Iowa.

Description—The color of the grass pickerel is green to olive-brown above, with dark colored over-markings or bars on the sides, and light beneath. Like from 6 to 12 inches in length in 16 months. Greeley (1933) found the rainbow all of the other pikes, its snout resembles a duck bill when viewed from the top. The body is long and slender, like the northern pike and muskellunge. Both the cheeks and the opercles on the head are fully covered with scales. The branchiostegal rays, the slender bones lying in a membrane just below the gill cover, number 11 to 13 and there are only 4 mandibular pores, or small holes along the lower side of each of the lower jaw bones. There are about 105 scales along the lateral line and 12 rays in the dorsal fin. It is a small fish, rarely exceeding 12 inches in length, and usually from 7 to 10 inches at maturity.

Food Habits—The little grass pickerel prefers weedy areas, where it feeds extensively upon insects and their larvae and, especially, small fishes. It is a voracious little fish and, like the larger members of the family, is hungry most of the time.

Life History—The grass pickerel spawns in the early spring in very shallow waters. It leaves its eggs unattended. The fish reaches a length of about 3 or 4 inches the first year, but seldom exceeds 10 inches when full grown. It appears to have a strong preference for shallow, quiet or slow-moving water, and is often found in overflow ponds of the larger streams.

Angling—The grass pickerel is so rare and so small in size it is rarely, if ever, taken by anglers in this state. It may well be taken by children and fishermen who fish for crappies, sunfish, and other pan fishes in the overflow ponds along the streams in southeast Iowa, but is presumably mistaken for small northern pike and returned to the water.

Northern Pike

Esox lucius Linnaeus

Other Names—Common pike, great northern pike, jack fish, snake and pickerel.

Iowa Distribution—The northern pike is generally distributed over the upper two-thirds of the state. It varies from occasional to common in natural lakes, rare to absent in artificial lakes, and occasional to common, depending on reproductive success, in rivers. It prefers sluggish water areas in the latter and is especially numerous in the upper reaches of the Des Moines, Iowa, and Wapsipinicon rivers. It is also taken quite commonly in the Mississippi River above Dubuque. (See Map 15.)

Description—The color of the northern pike is extremely variable, depending upon the waters from which it is taken. Usually it is bluish-green to gray on the back, and the markings on the sides are in the form of irregular rows of light yellow or gold spots. These little markings distinguish it from the grass pickerel and muskellunge, both of which have dark bars or bands. The snout is broad and shaped like a duck bill. The cheeks are fully scaled, but the lower half of the opercle is scaleless. There are from 14 to 16 branchiostegal rays, or elongate bones, contained in a membrane just below the gill cover, and usually 5 pores on the under side of each lower jaw. There are 14 to 16 rays in the dorsal fin. There are about 125 scales in the lateral line. This fish attains a length of 3 to 4 feet and a weight of over 30 pounds. Individuals weighing 15 pounds or more are fairly common in the larger lakes and larger rivers. (See Plate 3.)

Food Habits—The northern pike is a voracious feeder, and one of the most predatory fishes known in our waters. The food of the young consists largely of insects and their larvae, but as the fish mature they feed extensively upon fish, frogs, crayfish, and even occasionally take young ducks and other birds on the water. The stomach of a single specimen from West Okoboji Lake examined by E. B. Speaker contained 27 young-of-the-year yellow perch. In our lakes perch, shiners, and young pan fishes appear to make up a considerable portion of the diet of large northern pike.

Life History—The reproductive period of the northern pike begins in March, immediately after the ice disappears from the lakes. In fact, the prespawning movements into the shallow waters is underway before the ice is out. A large female, usually accompanied by several males much smaller in size, finds her way up a small inlet stream of lakes to marshes and very shallow water to spawn. Pike are random spawners, and the adhesive eggs are carelessly deposited over the bottom or on submerged vegetation. Vessel and Eddy (1941) in their preliminary study of the egg production of certain Minnesota fishes, found 13- to 15-inch female northern pike produce an average of 7,500 eggs and 25- to 28-inch fish produce 63,000, and Carbine (1944) found females to average 32,200 in a study in Michigan. Twenty-five-to 30-pound females have been known to produce from a quarter to a half million eggs. The eggs are left unattended and hatch in about 12 to 14 days. The young stay on or close to the bottom for several days after birth. They grow rapidly, however, and are soon able to feed upon tiny animals in the water. The young remain in the shallow water for several weeks, then return to the lakes. By fall they reach a length of 6 to 8 inches or more, and at the end of their third year of life from about 17 to 23 inches. Twelve-year-old pike have been known to reach a length of about 46 inches (Van Engle, 1940). Under normal conditions, the northern pike reaches sexual maturity in its third year of life.

Angling Methods—Bait casting is the method most often used in angling for pike. Usually a 4½- to 5-foot rod of medium to stiff action is used, a line of 18- to 25-pound test, and a level-winding reel. Frequently wire leaders are used ahead of the plugs or baits, since the sharp teeth of the fish will cut the line. All types of surface and underwater lures are used. Large bucktail or feather-covered treble hooks are used in combination with spoons or large spinners, underwater and surface plugs, popping baits, jointed and plain wobbling baits, large metal spoons or flashing baits. Live baits, including chubs, shiners and frogs are good. The old adage: "big bait, big fish," applies in this case.

When anglers specifically try to catch northern pike, they usually work the edges of weed beds, lily pads or rushes in comparatively shallow water. Most fish are taken in daylight hours. Occasionally pike will strike at night, but dawn-to-dusk fishing is most productive. In Iowa many northern pike are taken incidentally by fishermen in quest of other fishes. The pike is not at all fussy about what he eats, and is just as apt to take the small boy's crappie minnow near the dock as a well-presented two-dollar plug in an open spot in the rushes.

Bait casting is not the only method of fishing for pike. Quite a number are taken by trolling. When trolling, most anglers row close to the edge of rushes or weed beds, using a fairly long line and very little weight so the bait will be rather close to the surface. Spoon hooks with feather or large bucktail flies, shallow-running plugs, spinner-minnow combinations, and surface baits are a good choice.

Live bait fishermen usually prefer to fish from a boat, quietly approaching openings in weed beds, lily pads, or rushes and fishing the "holes" with frogs or large shiners. When this type of fishing is done, nothing beats a cane pole for convenience of placing the bait quietly and accurately.

Standard largemouth bass equipment is productive when used properly and pike have even been taken on light fly rod tackle. They are powerful fighters, however, and only the most experienced anglers should risk extremely light-weight tackle in fishing for large pike. Spinning outfits are suitable if the heavy monofilament lines are used, although considerable time and care is needed to land a good-sized fish. For all-around pike fishing, we recommend a good, powerful bait casting rod, reel with an arbor large enough to accommodate 50 yards of 15- to 18-pound test line, heavy gut or light wire leader, and your choice of medium to large shallow-running baits.

Muskellunge

Esox masquinongy Mitchill

Other Names—Musky, muskellunge, Wisconsin musky.

Iowa Distribution

Mississippi R.: Allamakee Co., vic. Lansing (Greene, 1935).
Mississippi R.: Allamakee Co., vic. Harpers Ferry (Greene, 1935).
Mississippi R.: Muscatine Co., vic. Muscatine (Meek, 1892).
Clear Lake: Cerro Gordo Co. (Bailey & Harrison, 1945).
Skunk R.: Story Co., vic. Ames (Meek, 1892).

To our knowledge only two or three muskellunge have been officially reported from Iowa. Meek (1892) reported one from the Skunk River near Ames, and another was taken from Clear Lake in rough-fish-netting operations on several occasions. The fish was marked the first time it was returned to the water. It later died (Bailey and Harrison, 1945), and Mr. Ray Butler, then in charge of the State Fish Hatchery at Clear Lake, had the specimen mounted. The fish was identified by several authorities, including Dr. Reeve M. Bailey (1945) Museum of Zoology, University of Michigan, Ann Harbor, Michigan. The last we knew, the fish was in the possession of the Clear Lake Chamber of Commerce. Just how the fish got into Clear Lake still remains a mystery, but it is thought it may have been taken in fish rescue operations in the Mississippi River and transported to Clear Lake in a load of northern pike. While the muskellunge is not native to the Mississippi River, a few are occasionally reported which undoubtedly come in from Wisconsin or possibly Minnesota waters. Aside from these rather unusual records, we know of no other authentic reports from Iowa.

Description—The color of the muskellunge varies considerably. It is usually olive to dark gray with dark over-markings on the sides. These over-markings are in the form of horizontal, sometimes vertical bars, spots or blotches. The upper half of the cheeks and opercles are lightly scaled, and the lower portion of these parts are scaleless. There are 17 to 19 branchiostegal rays, and 6 to 8 pores on the underside of the lower jaw. There are usually 17 rays in the dorsal fin, and about 150 scales in the lateral line along the body. The world's record muskellunge (Caine, 1949) weighed 67½ pounds and was taken from Couderay Lake, Wisconsin. Fish weighing as much as 30 to 40 pounds are not unusual. Krumholtz (1949) found muskellunge in Lake St. Clair to average about 6½ pounds at 30 inches in length, 14 to 15 pounds at 40 inches and 33 pounds at 50 inches. The Iowa muskellunge from Clear Lake weighed 30¾ pounds and was 54 inches long.

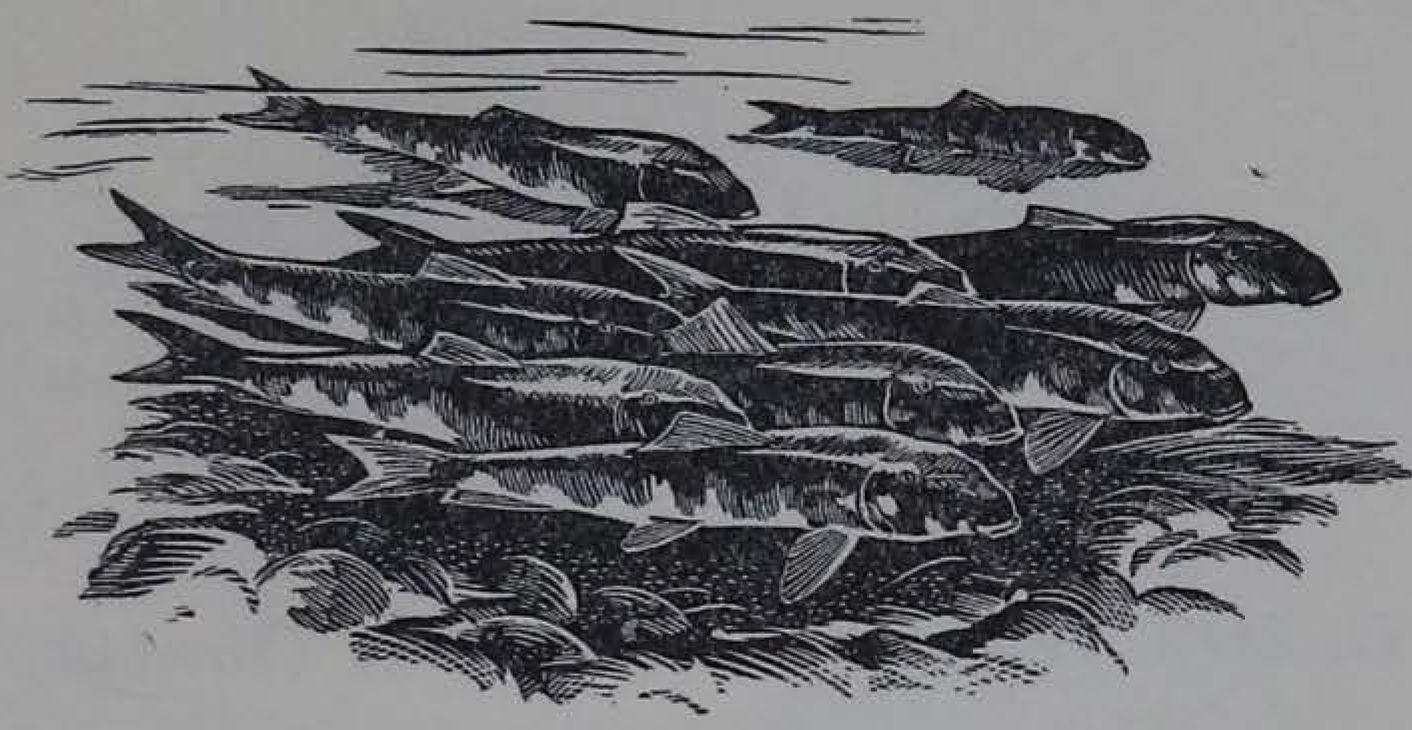
Food Habits—A predatory fish, the muskellunge consumes a wide variety of fishes in its diet, particularly perch, suckers, and shiners. It also feeds extensively upon frogs, crayfish, and large water insects and has been known to devour ducklings, shore birds, and even young muskrats.

Life History—Like the other pike, muskellunge spawn in shallow water early in the spring. They are non-nest builders, and deposit their eggs over the bottom or on submerged vegetation, logs and other detritus. The eggs are small, averaging about 75,000 to the quart. Incubation is completed in 12 to 15 days in water from 50° to 55° F. At the end of the first growing season, young muskies reach a length of from 5 to 10 inches, 17 to 26 inches the second year; about 30 to 34 the fifth year; and one specimen reported by Dr. Juday (1938) of Wisconsin reached the length of 54 inches at 12 years. The number of eggs produced by the females is dependent largely upon the size of the fish. The average range is from about 20,000 to 165,000, although female fish weighing 40 pounds (Nevin, 1901) have been known to produce as many as 225,000 eggs, and Hasler (1940) reported fish from 36 to 46 inches in length producing about 22,000 to 164,000 eggs. These fish are usually not long-lived, contrary to popular belief, and even the large muskellunge rarely lives to be more than 10 to 12 years, and usually dies before it reaches that age. In states where muskellunge fishing is important, like Wisconsin, Minnesota, Michigan and New York, artificial propagation of muskellunge has been carried on for many years with varying degrees of success. It is not particularly difficult to strip the eggs from the females and milt from the males, nor to incubate the eggs artificially until they hatch. The principal difficulty lies in rearing them from the newly-born, or fry stage, to a size suitable for stocking purposes. Some of the states have made considerable progress in this direction and produce them on a large scale at this time.

Angling—Perhaps no fish in the northern inland waters is more vigorously pursued by anglers than the mighty muskellunge. Because of its wariness, large size and fighting qualities, it is one of the most cherished prizes of all. Good anglers have been known to fish a life-time without landing a single trophy specimen, while others catch several in a single season.

When this fish is feeding it will strike all manners of lures, but at other times it lurks in the dark shadows and will not be tempted by anything. Almost invariably heavy casting tackle is used because of the power of the fish. Large wooden plugs, spoons, combination spoon and feather or huge bucktail baits, surface lures, and even the larger conventional bass plugs are used with success. While muskies are occasionally taken in deep water, they are more frequently caught in shallow weedy areas by casting or shallow trolling.

Once this tiger of the cold waters is hooked, the fight is on, and the thrill of a lifetime awaits the man fortunate enough to hook one, whether the fish is finally brought to gaff or not!



Chapter VII

SUCKER FAMILY

Catostomidae

The sucker family is represented in Iowa by 8 genera and 17 species. The largest in the group, the bigmouth buffalo, has been known to attain a weight of over 80 pounds, and individuals of 20 pounds or more are common. The buffalo, quillback and white sucker constitute a considerable proportion of the total fish poundage in Iowa waters. Buffalo are particularly abundant in certain lakes and the larger rivers, particularly in the backwaters of dams, and the quillback and suckers are numerous in the moderate size and smaller streams. Quillback and river carpsuckers are abundant in most streams.

Suckers, as their name implies, are largely bottom-feeding fishes. Their movements, habitat and items of food are for the most part similar, and most species prefer quiet waters over sand and gravel bottom. Suckers, especially during their first year of life, serve as an important item of food for many of the game fishes.

The food of these fishes is largely aquatic insects and their larvae, small mollusks, algae and higher aquatic plants. Their sucking, protractile mouths enable them to garner their food from the bottom ooze, off rocks, plants, submerged logs and roots. While these fishes seem to be somewhat selective in their feeding habits, their ability to find food by touch and taste makes it possible for them to survive where fishes that feed by sight could not exist.

Buffalo rarely take a hook, hence they are of little or no value to the angler. They are very prolific and often dominate the lakes at the expense of the game fishes. Nearly a half million pounds are removed from the inland waters of the state with nets and seines each year by the State Conservation Commission to make room for the more desirable fishes. A slightly larger number are taken from the Mississippi River annually by commercial fishermen. As many as 600 pounds per surface acre of water have been removed in a single year from some of our lakes. When the population reaches this peak, all kinds of fishes, including the buffalo themselves, become emaciated from overcrowding and starvation.

The quillback and carpsucker, or white carp as they are often collectively called, abound in most of the larger streams and in the Mississippi and Missouri rivers. According to Forbes and Richardson (1909) the name of white carp was applied to this group of fishes by the early settlers of Virginia, since it was believed that they strongly resembled the European carp. Though true members of the sucker family, the name carpsucker seems more applicable, and has found quite general use in many regions of the United States. The carpsucker can be easily distinguished from the European carp by the lack of bar-

PLATE 6

YELLOW PERCH ***Perca flavescens*** **(Mitchill)**

SAUGER ***Stizostedion canadense*** **(Smith)**

WALLEYE ***Stizostedion vitreum vitreum*** **(Mitchill)**


Maynard Reece

bels on the upper jaw. These fish are gregarious, traveling and feeding in schools. They are particularly abundant in the backwaters above dams in the rivers, but are usually well distributed throughout the course of the stream. They are native to a few of the natural lakes, but here are usually much less abundant than in the streams.

The group of fishes called the slender suckers include the white sucker, spotted sucker, hog sucker, and mullets or redhorses. The white sucker is perhaps the most important from the angler's point of view. It attains a weight of several pounds, although most individuals are less than 14 inches in length. It inhabits most lakes and is common to abundant in all streams. Important as a forage fish for the game fishes, it is also used extensively by anglers for bait.

Of the several species of redhorse or mullets, perhaps the northern redhorse is best known to most anglers by its large, bright silvery scales and blood-red tail and fins. Some of these fishes are widely distributed throughout the state, while others are largely confined to the largest of our rivers or to the eastern edge of Iowa.

The suckers are similar, in many respects, to the minnows and are often confused with them. There are no spines in the fins, hence they are called soft-rayed fishes. The teeth are located in the throat, and there are no teeth in the jaws. Hubbs and Lagler (1949) give us a good formula for distinguishing the suckers from the minnows: "The two groups may be readily separated by stepping the distance from the front of the anal fin to the base of the tail fin into the distance from the front of the anal fin to the tip of the snout. If the measurement from the anal to the tail fin is contained more than two and one-half times in the distance from anal to snout, the fish is a sucker. If it is less than two and one-half times, the fish is a minnow." The carp and the goldfish are the only exceptions to the rule. Although they fall into the sucker group by this formula, they are true minnows and can be distinguished from both the suckers and the other minnows by the stiff, sharply-serrated spine in the dorsal fin and in the anal fin.

With the exception of the buffaloes, most of the suckers are extremely bony, and although the meat is sweet and delicately flavored, they are little sought by anglers. There is some angling for them early in the spring when the water is cold, and in the trout streams throughout the summer. All of the suckers are edible and although the flesh is considered somewhat inferior to that of many fishes, it is quite palatable when properly prepared. A bulletin entitled "Eat Iowa Fish" (Olsen, 1944; Olsen and Hendrickson, 1945), published by Iowa State College, has done much to stimulate the use of many of the non-game food fishes in this region by listing excellent recipes for table preparation. Tons of high protein food is wasted annually by our failure to crop the existing surpluses of these fishes. In addition to the food value, there is considerable sport in angling for some of the suckers, especially when light tackle is used.

Blue Sucker

Cycleptus elongatus LeSueur

Other Names—Missouri sucker, razor-back, slenderheaded sucker.

Iowa Distribution—This sucker is an inhabitant of the channel of large rivers. It is taken on rare occasions in the Mississippi River and makes a concentrated spring run up the Cedar River where it is checked by the dam at Palisades State Park. It is more commonly taken in the Missouri River but nowhere is it abundant. (See Map 16.)

Description—The color of the blue sucker is dark gray or slate blue above and light beneath. The body is long and slightly compressed. The head is small and abruptly more slender than the body, and the eye is small and located back of the center of the head. The tail or caudal fin is deeply forked, and the lobes are of about equal length. There are 55 to 58 scales in the lateral line of the body, and from 31 to 32 soft rays in the long dorsal fin. It commonly attains a weight of from 4 to 6 pounds at maturity.

Food Habits—The food of the blue sucker consists largely of insects and their larvae, crustaceans and plant materials.

Life History—Little is known of the breeding habits of the blue sucker in Iowa. It ascends the lower reaches of a few of the larger rivers in late April or early May, presumably to spawn. The females are ripe at this time of the year, but young specimens are rarely taken in the collections of the continuing fishery inventories in the rivers. The young fish reach a length of about 5 to 7 inches at the end of the first year of life, and mature at the second or third year.

Angling—The blue sucker is uncommon to rare, even in the boundary waters of Iowa, hence it is seldom taken by anglers. No specific effort is made to catch them, and the occasional fish taken is usually caught on worms or other live baits while angling for other fishes.

Bigmouth Buffalo

Ictiobus cyprinellus (Valenciennes)

Other Names—Common buffalo, lake buffalo, blue buffalo.

Iowa Distribution—The bigmouth buffalo is widely distributed in Iowa and is especially abundant in some of the larger rivers and several natural lakes. Is is rare to absent in the lower reaches of some of the smaller tributary streams. It reaches a peak in numbers in the boundary waters and makes up a major portion of the commercial catch on the Mississippi River. A catch of 600 pounds per surface acre is not uncommon in some areas. (See Map 17.)

Description—The bigmouth buffalo is a bluish-green color, often with a coppery tint above the lateral line, fading to light cream to white beneath. In turbid waters they are frequently light bluish-gray in color. The mouth is large and oblique. The body is robust and slightly compressed. The head is large and heavy, but the lips are thinner than the other species of the buffalo. The scales are large and uniform in size, numbering about 38 to 40 in the lateral line. There are 24 to 28 rays in the dorsal fin. (See Plate 12.)

Food Habits—The food of the bigmouth buffalo consists largely of scuds and other small relatives of the crayfish, insect larvae, algae and other vegetation. Occasionally other items of food are found in their stomachs, including small fish and fish eggs, seeds from both acquatic and terrestrial plants, and small aquatic animals. Stomachs are packed with the "cotton" from the cottonwood trees in the spring. Whether items of this nature are taken for the vegetable value or are mistaken for insects falling on the water is not definitely known.

Life History—There is an old adage that the bigmouth buffalo spawn in the spring when the plums are in blossom. This is not far off, since it reproduces during the latter part of April and the early part of May in Iowa waters. They are random spawners, depositing their eggs over mud bottoms or on bits of submerged vegetation. The eggs are left unattended until they hatch. They spawn in water from 60 to 65 degrees F., and from 8 to 14 days are required for incubation, depending upon the temperature of the water. As many as 400,000 eggs have been taken from a 10-pound female, and larger fishes have been known to produce even more.

They reach a length of from 5 to 7 inches at the end of the first growing season and are sexually mature in their third year of life. Seven-year-old fish have reached a length of over 26 inches (Eddy and Carlander, 1942) and nearly 30 inches at 12 years. A buffalo weighing over 80 pounds was taken from Spirit Lake, and specimens up to 30 pounds are quite common in a few of the larger lakes and the Mississippi River.

Angling—Buffaloes rarely take a hook, hence they are only taken on occasion while angling for other fishes. A few are taken on worms or doughballs.

Black Buffalo

Ictiobus niger (Rafinesque)

Other Names—Mongrel buffalo, round buffalo, current buffalo.

Iowa Distribution—A rather uncommon species in state waters, the black buffalo has been taken inland in Storm Lake, and in the Des Moines and Little Sioux rivers. It is primarily confined to the boundary rivers and their overflow ponds or lakes. (See Map 18.)

Description—This fish is usually darker than the bigmouth buffalo in color, tending toward a deep olive-green or slate-gray to nearly black with dark fins. The mouth is less oblique and smaller than in the bigmouth buffalo. The lips are thicker and the upper jaw is distinctly shorter than the snout. The scales are large, running from 35 to 40 in the lateral line. The body is robust and well-rounded in front of the dorsal fin. There are usually 30 rays in the dorsal fin.

Food Habits—The food of the black buffalo consists largely of plankton, insect larvae and vegetation. Where vegetation is scarce or absent, it seems to survive entirely on animal matter. Snails and other small mollusks are taken in considerable quantities at all times by this and other buffaloes.

Angling—Little or no angling is afforded, since this fish rarely takes natural or artificial lures. Because of the scarcity of the fish, it is not very important in the commercial harvest, although a few individuals are occasionally found in the landings on the boundary rivers.

Smallmouth Buffalo

Ictiobus bubalus (Rafinesque)

Other Names—Roach-back, razor-back-buffalo fish, and thick-lipped buffalo.

Iowa Distribution—This species is even less common than the preceding. It formerly was commonly found in certain stretches of the Mississippi River, but now is taken only occasionally and then in small numbers. It is also found in small numbers in Spirit and Okoboji lakes, and rarely in the oxbows of the Missouri River. (See Map 19.)

Description—The coloration is similar to the bigmouth buffalo, except usually much lighter. The back is highly elevated and much sharper than either of the other two buffaloes. The head is small and compressed. The mouth is small and the lips thick. Scales are large and number about 38 in the lateral line. There are 27 to 30 rays in the dorsal fin.

Food Habits—The food consists largely of crustaceans, insect larvae, small mollusks and plant material.

Life History—Spawning occurs in May, and the eggs are deposited at random over the bottom or in vegetation. Incubation is completed in about 10 days. The fish mature in three years and reach a maximum size of 40 pounds, although individuals over 15 to 20 pounds are uncommon. A smallmouth buffalo from Reelfoot Lake, Tennessee, was nearly 33 inches long and weighed 25½ pounds (Schoffman, 1944). The fish was 12 years old. Ordinarily this fish does not attain the weight of the bigmouth buffalo in Iowa waters.

Angling—These fish are rarely, if ever, taken by anglers. They do bring a premium on the market, however, when brought in by commercial fishermen. The flesh is said to be somewhat superior to other buffaloes, and because of the smaller body cavity there is less waste in cleaning.

Plains Carpsucker

Carpiodes forbesi Hubbs

Other Names—White carp, white sucker, quillback and carpsucker.

Iowa Distribution—A difficult fish to identify, the plains carpsucker has a rather spotty distribution in the state. It is more common in the Missouri and Big Sioux rivers; however, it is taken occasionally in the major tributaries of the Mississippi River. It is not found in the natural or artificial lakes. (See Map 20.)

Description—The scales of the plains sucker are smaller than the two species described above numbering from about 37 to 39 along the lateral line. The snout is more pronounced. The back is highly arched, but the anterior or front rays of the dorsal fin are not longer than half the length of the dorsal fin. There are from 25 to 28 rays in the dorsal fin. The mouth is oblique, not in a direct or straightforward position, and the lips are thin. The halves of the lower lips meet at a wide range. There is no nipplelike tip on the lower jaw.

Food Habits—The food of the plains sucker consists largely of plant debris and small aquatic insects and their larvae.

Life History—From the few positive specimens we have examined, it appears that this fish spawns in early May. Like the other carpsuckers, the young reach a length of about 4 inches by fall and are mature in their third year of life. They are said to attain a weight of 4 to 6 pounds, although 3-pound specimens are regarded as unusual.

Angling—Occasionally these fish are taken by the angling methods described under the river carpsucker. They are not important in the catch of Iowa anglers.

Quillback Carpsucker

Carpiodes cyprinus (LeSueur)

Other Names—White carp, carpsucker, silver carp and white sucker.

Iowa Distribution—The quillback is most cosmopolitan in its living requirements. It is equally at home in lakes, creeks, and rivers. Together with the river carpsucker, it makes up a major portion of stream fish population both by weight and numbers. This species has a more apparent preference for clear water than any other in the genus, and, as such, is closely associated with the smallmouth bass in habitat preference. (See Map 21.)

Description—Externally, the quillback more nearly resembles the highfin sucker, in that the first rays of the dorsal fin are long and often reach to the base of the dorsal fin. They may be distinguished from the highfin, however, by the number of scales in the lateral line of the body. The quillback has from 37 to 41 scales in the lateral line in comparison to the 34 to 37 scales of the highfin. The snout is more pronounced like the plains sucker, but the halves of the lower lip meet in an acute, rather than a wide, angle. The tip of the lower lip is rounded, without a nipplelike projection. (See Plate 12.)

Food Habits—Our stomach analyses show little difference in the food habits of this and other fishes of the genus. They are scavengers and feed freely on debris in the bottom ooze, plant materials and insect larvae. Taken in the same areas with small channel catfish, they have been found to feed upon almost exactly the same materials.

Life History—The quillback migrate to the spawning areas in late April and through May to deposit their eggs in quiet waters of the streams. They are random spawners, depositing their eggs over sand or mud bottoms in the stream itself or in the overflow bayous. The young reach a length of about 4 inches the first fall and have been known to attain a weight of about 4 to 6 pounds at maturity, although fish of more than 3 pounds are the exception to the rule.

Angling—Quillback are not of any particular importance to the angler. More quillback are taken by anglers than any other carpsucker, but only a negligible proportion are harvested from the streams. Virtually none are taken from the lakes, except in the river impoundments above dams. Doughballs, bread, small worms, and grubs are generally used by the few fishermen who attempt to catch them, and because of their abundance in most streams, considerable numbers are taken incidental to other catches. Many illegal snagging devices are used to capture quillback, especially in the fast water below the dams. This method is wasteful, however, since not only the quillback, but other species as well, are injured in the unsuccessful attempts when the hook pulls out of the flesh.

River Carpsucker

Carpiodes carpio carpio (Rafinesque)

Other Names—Carpsucker, white carp, quillback and silver carp.

Iowa Distribution—This member of the quillback group is widely distributed over the state. It has a definite preference for large or moderate sized streams and is rarely taken in lakes or small creeks. It appears in great numbers behind dams and also in the tail races of the same obtsructions. (See Map 22.)

Description—Four kinds of carpsuckers or white carp are now recognized from Iowa. They can usually be divided into two groups by the number of scales in the lateral line of the body. The river carpsucker and highfin sucker have from 33 to 37 scales, and the plains sucker and quillback have from 37 to 41 scales. Both the river carpsucker and the highfin sucker have a small nipplelike projection at the tip of the lower jaw. This structure is not present in the quillback and plains sucker. The river carpsucker can be distinguished from the highfin by the length of the anterior or first rays in the dorsal fin. In the river carpsucker, the first rays extend little, if any, beyond the middle of the dorsal fin. The body is more slender, and its depth is about one-third the length from the tip of the snout to the base of the tail fin. Like all the carpsuckers, the color is bright silver above and white beneath.

Food Habits—From the limited studies of the carpsuckers, we have found the food to consist principally of unidentifiable material gleaned from the bottom ooze, plant material and insects and their larvae. About 100 specimens from the Des Moines River were examined by Harry M. Harrison (unpublished data) and the stomachs were found to contain 86 per cent unidentifiable material, 12 per cent plant material and 2 per cent insects and larvae. The insects were largely blood worms and larval cases of caddisfly. There was little difference in feeding habits of any of the carpsuckers.

Life History—The river carpsucker spawns in late April or early May, depositing its eggs at random and leaving them unattended until they hatch. Incubation takes place in from 8 to 12 days, and the young reach a length of from 3 to 5 inches the first year. They sometimes attain a weight of 10 pounds (Eddy and Surber, 1947) at maturity, although specimens over 4 pounds are uncommon in Iowa. From studies here (Carlander, 1949) fish of 12 to 13 inches usually weigh about a pound, and 18-inch fish reach about 2 pounds.

Angling—Angling pressure is generally light on all of the carpsuckers in this state. The meat is white and sweet, but the numerous bones preclude its wide use as a table delicacy. A few people are adept at catching them and find considerable pleasure in the sport. Usually very small hooks, No. 8 to No. 10, are baited with tiny doughballs or small pieces of moistened bread rolled into balls the size of a pea. The favorite fishing place is around large drift or brush piles in the stream or immediately below dams.

Highfin Carpsucker

Carpiodes velifer (Rafinesque)

Other Names—Highfin, longquill, white carp, quillback.

Iowa Distribution—The highfin carpsucker is found primarily in the large inland rivers where it is occasional to common in some locations. It was rarely taken in the Mississippi River and has not been taken in the last ten years in the Missouri River. It is not normally found in lakes or ponds. (See Map 23.)

Description—The highfin can be readily recognized from the northern carpsucker by the length of the anterior, or first rays, in the dorsal fin. These rays are greatly elevated and when depressed reach to the tip of the dorsal fin or beyond. There are from 25 to 27 rays in the dorsal fin. The body is deep, and its height is more than one-third the length from the tip of the snout to the base of the tail fin. The eye is somewhat larger than that of the northern carpsucker.

Food Habits—From our studies we find the highfin sucker lives on bottom ooze, plant material, and insects and their larvae. Like other carpsuckers it might be considered a scavenger, and it competes largely with the small channel catfish for food and with all fish for space in the rivers.

Life History—Breeding takes place in the early spring, usually in May, at which time these fishes migrate in large numbers to shallow areas and overflow ponds of the streams. The young reach a length of about 4 inches in November of the first year, and sexual maturity at the third year of life. A few specimens have been known to reach a weight of two or three pounds, but fish over 14 inches in length are uncommon.

Angling—They are not important to anglers, and the few taken are caught incidentally with other fishes, or by the methods described under the river carpsucker.

Black Redhorse

Moxostoma duquesnei (LeSueur)

Other Names—Black mullet and blackhorse.

Iowa Distribution

Volga R.: Fayette Co., vic. Fayette (Salyer, UMMZ).
Little Turkey R.: Chickasaw Co., vic. Little Turkey (Salyer, UMMZ).
Turkey R.: Howard Co., Cresco (Salyer, UMMZ).
Crane Cr.: Fayette Co., vic. Hawkeye.

This extremely rare sucker is confined to the upper reaches of the Turkey River watershed. A single specimen, constituting the only recent record, was taken over a pea-gravel bar bordering a large cutbank pool.

Description—The color is dark olive-green with brassy sides and white belly. The fins, especially the dorsal and tail, are dark. Like the other redhorses or mullets, the mouth is inferior and the lips are rather thick. The scales are small, usually about 45 in the lateral line. There are 12 or 13 rays in the dorsal fin. The caudal peruncle, that slender portion of the body between the anal and tail fin which supports the tail of the fish, is slender, and its depth is less than two-thirds its length from the end to the base of the anal fin.

Food Habits—The food of the black redhorse consists largely of insect larvae and small mollusks.

Life History—It ascends the smaller streams, preferably those with limestone rubble bottoms, to deposit its eggs at random in the spring, usually in early May. No specimens over a foot long have been observed in Iowa by the writers. In fact, they are so rare at this time, only an occasional fish is found in the test netting operations of the State Conservation Commission.

Angling—These fish are too rare to be of any importance to the angler at this time.

Golden Redhorse

Moxostoma erythrurum (Rafinesque)

Other Names—Golden mullet, golden sucker, and white sucker.

Iowa Distribution—Both the golden and silver redhorse are current-prefer-is primarily an inhabitant of large or moderate sized streams where it is ring species and are not normally found in lakes or ponds. The golden redhorse common to abundant. The redhorse group makes up over 15 per cent, by weight, of the fish crop in the eastern Iowa river test-netting catch. It has not been taken from the Missouri River nor in the lower reaches of the Mississippi River. (See Map 24.)

Description—The color of the golden redhorse, as its name implies, is light yellow to deep gold. Like the silver redhorse, the caudal peduncle is short and stout and its width is more than two-thirds its length. It can be easily distinguished from the silver redhorse, however, because the ridges of the lips are not broken by transverse creases into small papillae. There are 11 to 15 rays in the dorsal fin, usually 13, and 38 to 44 scales in the lateral line, most often 40 to 42. The tail fin is sometimes slate-colored in life, but may be golden yellow. (See Plate 19.)

Food Habits—The golden redhorse lives almost exclusively upon insect larvae and small mollusks.

Life History—Like the other redhorses, this fish spawns in the early spring and does not care for it eggs. It reaches a length of 18 to 20 inches, but most adults are from 14 to 16 inches.

Angling—This fish is not especially important to anglers, but a few are taken occasionally from streams on worms and other live baits. The flesh is sweet, but there are many bones to contend with.

Silver Redhorse

Moxostoma anisurum (Rafinesque)

Other Names—Silver mullet, silver sucker, and white sucker.

Iowa Distribution—This species, like the preceding, is generally distributed in the inland rivers of the Mississippi drainage, where it is occasional to common. It is also found in the smaller tributaries of these rivers. This species has apparently more stringent habitat requirements than the golden redhorse. It is taken only rarely in the southern half of the state. (See Map 25.)

Description—The fish has pale, silvery sides, somewhat darker above and bright silver below, with fins often lightly tinted with gold or pink. The caudal peduncle, or that part of the body upon which the tail is fastened, is shorter and stouter than that of the black redhorse, and its narrowest part is much more than two-thirds of its length. The large dorsal fin has 14 to 17 rays, and there are from 42 to 45 scales in the lateral line of the body. The folded skin of the lips is broken by transverse creases into minute papillae. The tail fin is slate-colored in life. (See Plate 19.)

Food Habits—The food of the silver redhorse is insect larvae, snails and other small mollusks.

Life History—The fish ascends the smaller streams to spawn in April and May, and the young may remain in these streams throughout their first year of life. Older fish have a preference for larger rivers. Large specimens reach a length of 20 inches or more at maturity, but fish of 12 to 16 inches are much more common.

Angling—The silver redhorse is taken by anglers on worms, grubs and occasionally on dough bait, but usually no special effort is made to catch it. It usually constitutes an extremely small part of the "mill run" catch of stream bait fisherman and is usually not distinguished from other suckers or redhorses by the anglers.

Northern Redhorse

Moxostoma aureolum aureolum (LeSueur)

Other Names—Redfin, redfin sucker, redhorse, and bigscale sucker.

Iowa Distribution—This species is most catholic in habitat requirements and is occasional to common in all rivers and streams in the state as well as in many natural lakes. It has not, however, been taken from the Iowa portion of the Missouri River although it is present in some of its tributaries, and is probably present in the Missouri proper. It is the most common sucker found in the Mississippi River. (See Map 26.)

Description—The color is bright silvery on the sides with somewhat darker back, and the fins, especially the tail fin, are bright orange or sometimes blood red. The upper lobe of the tail is distinctly narrower than the lower lobe. The mouth is small and inferior, or suckerlike. There are 41 to 48 scales along the lateral line of the body and usually 13 rays in the dorsal fin. (See Plate 13.)

Food Habits—The food is largely insect larvae and small mollusks.

Life History—The redhorse spawns in April or early May and ascends the small streams for that purpose. It attains a length of about 4 inches the first year and may reach a length of nearly 2 feet at maturity. It prefers rather swift, clear water of the smaller to moderate-sized streams.

Angling—There is some fishing pressure for this fish, especially in the early spring during and immediately after the breeding season. They are most often caught on worms, grubs, hoppers, crickets, or small pieces of meat. Occasionally they are taken by anglers when fishing for channel catfish in the thread of the current.

River Redhorse

Moxostoma carinatum (Cope)

Other Names—Greater redhorse, redfin redhorse.

Iowa Distribution

Raccoon R.: Dallas Co., Adel and Perry (Meek, 1892).
Floyd R.: Woodbury Co., Sioux City (re-identified from Meek's 1892-93 collections by R. M. Bailey).
Floyd R.: Plymouth Co., LeMars (Meek, 1894).

This species has not been taken in Iowa since the turn of the century and is now presumed to be extinct in Iowa waters.

Description—The mouth of this fish is somewhat oblique, and the lips are large and thick. The head is somewhat flattened on top. The pharyngeal or throat teeth are heavy, the most distinctive character. The tail fin is red, a character shared with only one other Iowa species, the northern redhorse. The lower fins are often tipped with red, especially the males in the breeding season.

Food Habits—Food items of this fish include insect larvae, plant material and small mollusks.

Angling—Because of its scarcity in the state, it is of little or no value to the anglers. Possibly a few individuals are taken by fishermen in quest of other fishes, when live baits such as worms, grubs and other small baits are used.

Northern Hog Sucker

Hypentelium nigricans (LeSueur)

Other Names—Black sucker, spotted sucker, riffle sucker, bigheaded sucker, and stone roller.

Iowa Distribution—The hog sucker is found primarily in the upper Des Moines River watershed and the upper reaches of the rivers in northeast Iowa. It is taken only in a rare instance in Clear Lake and in the Mississippi River at Lansing. While found in the major rivers, it reaches its peak abundance in the small, rocky, feeder streams. (See Map 27.)

Description—The head of the hog sucker is usually wider than the body, and the space between the eyes is broad and concave. The mouth is inferior, with large protractile lips. There are from 46 to 51 scales in the length of the body. The color is olive to black on the back, with mottled sides and light belly. The body, and especially the tail, is very slender. There are usually 11 rays in the dorsal fin, which is rather short and low. The large pectoral fins are frequently yellowish in color, with dusky shadings or mottlings. (See Plate 13.)

Food Habits—The hog sucker feeds extensively in the swift, rocky riffles of the streams. It moves rapidly about over the bottom, nudging stones to the side with its head, and sucks up small aquatic animals, bits of vegetation, and even sand and small rocks (which it quickly ejects) in a scouring movement. It feeds ravenously and is not easily disturbed by intruders. The organic materials, bits of aquatic plants, algae, and insect larvae lodged among or on the rocks constitute its chief diet.

Life History—It ascends the smaller streams in April to spawn. Little is known of its actual spawning habits. Young specimens less than 2 inches in length have been collected in July and August. This fish reaches a length of about 14 inches or more (Raney and Lachner, 1946), but specimens over a foot long are rare in most of our waters.

Angling—The hog sucker is rarely taken on a hook by anglers. Occasionally they are taken on worms, and have even been known to strike a wet fly but this is indeed uncommon. The flesh is coarse and not very desirable.

White Sucker

Catostomus commersoni (Lacépède)

Other Names—Sucker, black sucker, common sucker, slender sucker, mullet, and whitehorse.

Iowa Distribution—This species is most abundant in the smaller streams of the state, but is rare to occasional in numbers in the larger rivers when compared to the various species of redhorse. It is found quite commonly in both the natural and artificial lakes, but is rare to absent in the Missouri River and only occasional in the Mississippi River. It has the most general distribution pattern of any of the suckers, indicating a wide habitat tolerance. (See Map 28.)

Description—The white sucker can be distinguished from most of the other slender suckers by the large number of scales in the lateral line of the body. There are from 60 to 70 or more scales in the complete lateral line. It is brassy to dusky above, with brassy sides fading to white beneath. The scales are very much crowded toward the head. The snout is blunt and rather square at the tip, and the mouth is inferior, or located on the underside of the snout. There are usually 11 or 12 rays in the dorsal fin, and the first rays rarely exceed the length of the dorsal fin when depressed. (See Plate 13.)

Food Habits—The common or white sucker feeds largely upon insect larvae, small mollusks and plant material, although fish, fish eggs and other materials have been observed in their stomachs.

Life History—The common sucker spawns in April through May, usually over gravel bottom. It is a random spawner, depositing eggs in a careless manner in the swift, rocky riffles of the smaller streams, or in shallow bays of lakes, and leaving them unattended until they hatch. The young attain a length of about 4 to 5 inches the first year. Females 14 to 16 inches in length produce about 67,000 eggs (Vessel and Eddy, 1941) and over 100,000 at 20 inches. They have been known to reach a length of 25 inches or more (Webster, 1942), but individuals over 15 to 16 inches or more are quite rare except in a few of the larger natural lakes.

Angling—More anglers fish for the white, or common, sucker than for any other member of this family. Usually considered primarily as a small boy's fish because of its abundance in the creeks and smaller streams, it is important to anglers especially in the early spring months and in the trout streams of northeast Iowa. Large numbers often inhabit the lakes, but there is little angling for suckers anywhere except in the streams. All manner of tackle is used, but the most common gear consists of a pole, line, light leader, split shot sinker, and a single hook. Fly rods are often rigged in this manner, especially on the streams of northeast Iowa. Worms, grubs, bits of nightcrawlers, grasshoppers, and other live bait are most popular. The bait is fished in the deep holes, around brush piles, or even in the thread of the stream and immediately below riffles.

Spotted Sucker

Minytrema melanops (Rafinesque)

Other Names—Spotted redhorse, corn-cob sucker, and speckled sucker.

Iowa Distribution

Mississippi R.: Allamakee Co., DeSoto, Lansing, and Harpers Ferry (UMRCC, 1953).
Mississippi R.: Dubuque Co., vic. Dubuque (Barnickol & Starrett, 1951).
Mississippi R.: Muscatine Co., Muscatine (Meek, 1892).
Mississippi R.: Louisa Co., Timber Slough, vic. Grandview.
Mississippi R.: Louisa Co., vic. New Boston, Ill. (Barnickol & Starrett, 1951).
Mississippi R.: Lee Co., Keokuk (Coker, 1930).
Iowa R.: Iowa Co., vic. Amana (Meek, 1892).
Squaw Cr.: Story Co., vic. Ames (Meek, 1892).

While found by Meek in some inland streams, it is doubtful whether the spotted sucker now exists anywhere but in the Mississippi River and in its oxbows and overflow ponds. There are hearsay reports of this species being taken during spring high water below the Palisades dam on the Cedar River, but these reports have not been validated.

Description—One of the common names most aptly describes the spotted sucker. Commonly called the corn-cob sucker, it has a black or dark blotch at the base of each scale. The color is gray to dusky copper above, fading to cream or white below. Its mouth is typically inferior, or located on the underside of the snout. There are 11 or 12 rays in the dorsal fin. The scales are large, numbering from 42 to 46 along the length of the body. The lateral line of the body is incomplete, especially in the young.

Food Habits—An insufficient number of spotted sucker stomachs have been examined to determine the principal foods, but from the incomplete data it is assumed that they feed largely on mollusks and insect larvae.

Life History—No observations have been made during the actual spawning season, but gravid females have been taken in the seining operations in May, and it is presumed the fish reproduces in that month in Iowa.

Angling—No special effort is made by anglers to take this fish. An occasional specimen is taken on worms or grubs by fishermen angling for chubs and other suckers.

Lake Chubsucker

Erimyzon sucetta (Lacépède)

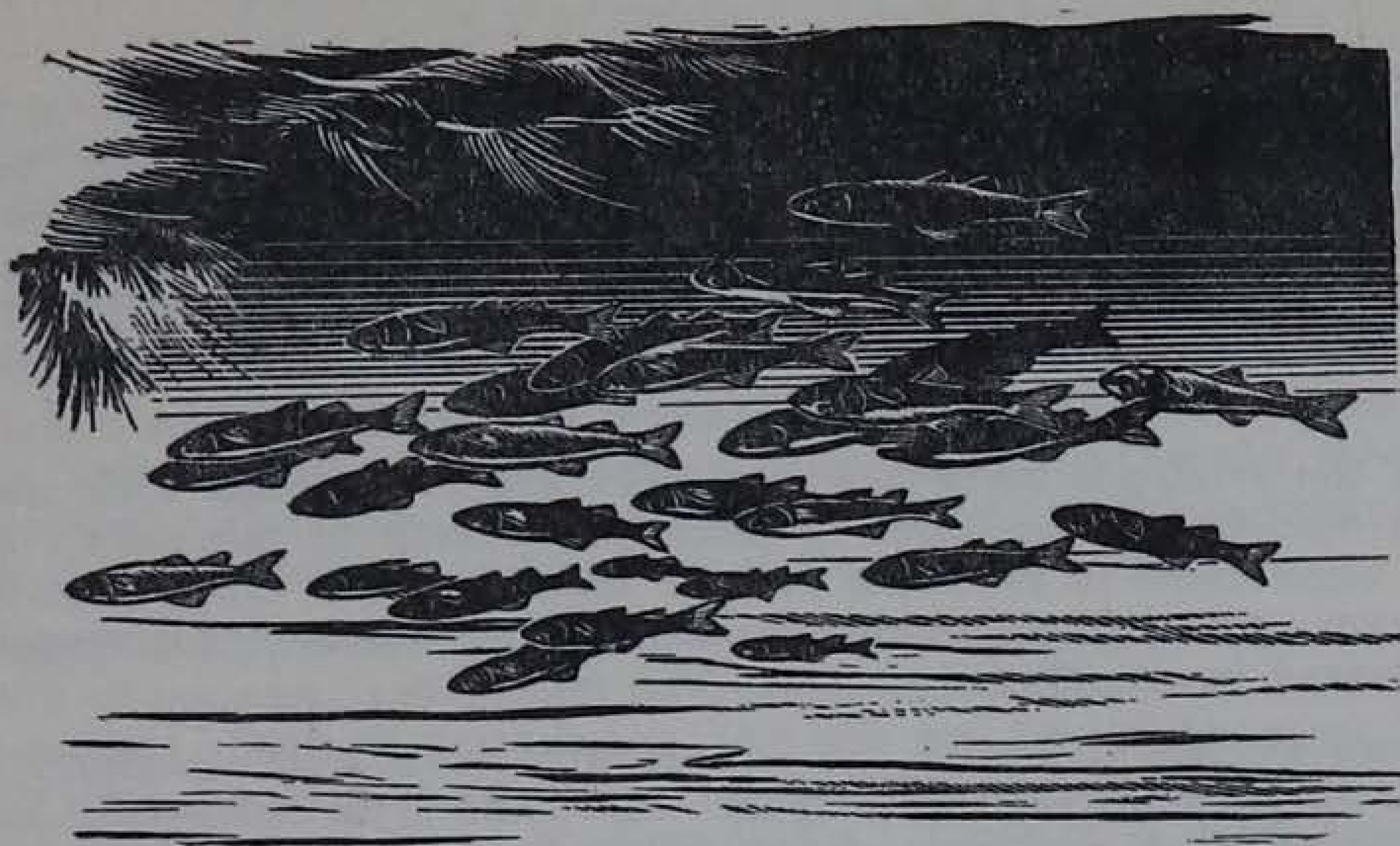
Other Names—Chubsucker and pin sucker.

Iowa Distribution—The inclusion of this species in the listing of the Iowa fish is based on a single collection made by Meek (1892) in the Cedar River, Cedar County, in the vicinity of West Liberty. It is doubtful whether this fish exists in Iowa at the present time.

Description—The color pattern of this fish consists of a broad lateral dark streak in the juvenile, and this streak is broken to form a series of vertical bars or blotches in the adults. The true lateral line along the body is wholly lacking at all ages. There are 10 or 11 rays in the dorsal fin and 36 to 40 scales in the length of the body.

Life History—The chubsucker spawns in the early spring and attains a length of 8 to 12 inches at maturity.

Angling—Because of its scarcity in Iowa waters, it is of little or no importance to the angler. It is occasionally taken by chub fishermen on worms, grubs, and other small live baits.



Chapter VIII

MINNOW FAMILY

Cyprinidae

The myriads of small fishes found in our lakes and streams are often referred to collectively as minnows. This is perhaps the most simple way to dispose of the largest and most complex group of our fishes. It should be remembered, however, that minnows are not merely the young of larger fishes, but a family that has been classified together because they look or act alike in many respects.

These little fishes have many characteristics in common. For example, all have fins without spines, with the exception of the European carp, the largest Iowa representative of the minnow family, and the goldfish. They have a scaleless head, a toothless mouth, a short dorsal fin with less than 10 rays (with the exception of the two exotic species, the carp and the goldfish), a stomach which is merely an enlargement of the intestine with no appendages, no adipose fin, and a more or less compressed body.

Over 300 species of minnows (Jordan, Evermann and Clark, 1930) are known from North and Central America, and of this number 42 are native to Iowa. They range in size from diminutive little fishes of less than two inches in length to the carp, which attains a length of over three feet and a weight of more than 50 pounds.

Many of the minnows prefer clear-water streams, and for that reason a larger number are known from northeast Iowa than from any other part of the state. Some kinds are very abundant in the lakes and streams, while others are so rare they are seldom found, even in the extensive fish inventories of the State Conservation Commission. They feed largely upon minute plant and animal life.

The role of the minnow in the scheme of aquatic life is manifold. They are competitive with larger fishes in that they occupy the same space and feed upon the same foods eaten by the young of all the important game and food fishes. On the other hand, they serve as a substantial part of the diet of most game fishes. Fish-eating birds like the herons, gulls, terns, kingfishers, cormorants, and many others depend largely upon the minnows for their existence. Some of the minnows feed extensively on algae and undesirable aquatic plants as well as the larvae of mosquitoes and other pests, hence they serve a very useful purpose in keeping these obnoxious organisms under control. Perhaps of most immediate interest to the angler is their availability for bait.

In many sections of the country there is a shortage of minnows in the public waters. Because the situation has become acute, fish managers have closed many areas to minnow removal. This situation has developed in certain Iowa lakes, and they will be closed until the population is sufficient to warrant additional harvest. Most of our streams still have a high population of minnows, and overexploitation is not serious except in a few areas near resort centers where the demand for bait is heavy.

Many of the artificial lakes and reservoirs are overstocked with crappie, and where this condition exists there is usually a dearth of minnows. Relaxation of fishing regulations to permit a greater harvest of the crappie, stocking predacious fishes to keep them in check, and stocking minnows for crappie food is being attempted in an effort to correct this situation.

Since Iowa anglers fish with live or prepared bait, it is necessary to supply the demand for minnows for this purpose. More and more commercial bait dealers are constructing ponds and propagating bait minnows. Where good management techniques are applied, as many as 300 pounds or more of minnows can be produced per surface acre of water. Commercial enterprises of this nature are to be commended, for they certainly are a step in the right direction toward the conservation of an important natural resource. The need for an additional supply of bait minnows has long since been felt in the northern lakes states, and Minnesota (Surber, 1940) published a bulletin on the propagation and care of the bait minnow. More recently the U. S. Fish and Wildlife Service made available the findings of the Tri-State Fishery Conference data (Dobie, Meehean and Washburn, 1948) in an excellent publication entitled *Propagation of Minnows and Other Bait Species.* Although the situation is not as acute in Iowa as it appears to be in some states, the reduction of minnows through overexploitation, pollution, drought, and other factors warrants special attention to see that the population is maintained at a reasonably high level.

Because of their small size and slight differences in external characters, minnows are among the most difficult of our native fishes to identify properly. It is not the intent of this book to give a comprehensive description of all of the minnows, but rather to list a few of the distinguishing characteristics and to give their general distribution as we know it in Iowa. The study of minnows is indeed complex, and anyone desirous of learning more about them should become familiar with the available literature. (Hubbs and Lagler, 1949; Dobie, Meehean and Washburn, 1948; Dobie, 1948; Washburn, 1947; Eddy and Surber, 1947; Surber, 1940; Markus, 1939; Langlois, 1937; Viosca, 1937; Hubbs and Cooper, 1936.)

Minnows usually require close scrutiny for positive identification, hence it is often necessary for the untrained observer to kill the fish in order to examine all of the minute characteristics. They are usually preserved in a solution of about 10 per cent formaldehyde and 90 per cent water. The preservatives cause the color to fade rapidly, hence color characteristics alone are usually not to be relied upon exclusively. External qualities such as the position and size of the various fins, number of rays in the fins, number of scales in the lateral line along the body, position and shape of the mouth, location of the barbels, relative size of the eye, formation of the pharyngeal or throat teeth, and many others are used extensively in minnow identification. It is almost necessary, therefore, for the observer to familiarize himself with the parts of the fish and certain technical terms, since it would be impractical to explain these items in each account of the identification of the individual fishes. Drawings in the fish keys showing the principal features and photographs of many of the typical forms are included as helpful aids. Every effort has been made to keep the language in simple, understandable terms, and a glossary is provided in the text for further use.

Since fin-ray counts are used extensively in identifying minnows, a word of explanation is in order at this time. Fins include the dorsal or top fin; caudal or tail fin; anal fin, which is located immediately behind the anus; pelvic fins, located ahead of the anal fin on the belly; and pectoral fins, which are located immediately behind the head. The only minnows that have a spine in the dorsal or top fin are the carp and the goldfish. The minnows belong to the so-called soft-rayed fishes, hence the stiffening structures in the fins will be referred to as "soft rays" or merely "rays" in this chapter.

Scale counts are made along the lateral line of the body of the fish, where the line exists, and in a like position which would normally be the lateral line in case it is absent. The lateral line of minnows and other fishes extends from the head back through the body to the base of the tail.

Pharyngeal or throat teeth are frequently used in minnow identification. The throat teeth of minnows are located on the two bones which are actually modified fifth gill-arches. Both of these bones, the left and the right, must be removed to identify fish by this character. This can be accomplished with a crochet hook, head of a large pin, or similar device. Usually a good hand lens will suffice to show their number and position unless very small specimens are being examined. Each of the bones have either one or two rows of teeth. Starting with the left bone first, the teeth are counted right to left. Thus the formula "teeth 2, 4-4, 2" means there are two teeth on the right hand, or inner row of the left bone, and four teeth on the outer part of the bone. In the right hand bone, starting from right to left, there are four teeth in the outer, or right hand row, and two teeth in the inner row. The formula "teeth 4-4" means there is a single row with four teeth on each bone.

The maxillary barbels are fleshy, whiskerlike processes, most notable on the carp. In some minnows the barbels are flaplike or small, conical, fleshy projections that are difficult to see without the aid of a strong magnifying glass.

The mouth parts are also used in minnow identification. Where the mouth is said to be inferior, it means it is on the lower side of the head, similar to the suckers. An oblique mouth is turned up, and not direct or straightforward, as is the horizontal mouth.

Except in special instances, only a very broad, general mention will be made of the distribution of the minnows. Most of this information has been secured from the survey or continuing fishery inventories of the State Conservation Commission's biology department. Starrett (1950) Harrison and Speaker (1950), Harrison (1949), and other contemporary workers have done considerable work on the ecological study and distribution of minnows in Iowa.

To keep the identification of minnows as simple as possible, they have been divided into two major groups: (1) The carp, chubs, dace and all other minnows except (2) the shiners. There are 27 fishes in the first group and 22 in the second.

Carp

Cyprinus carpio Linnaeus

The carp is the most widely distributed Iowa fish save a few species of small minnows. It is common to abundant in all major rivers, lakes and overflow ponds. It is the major commercial species by poundage in our boundary waters. Even creeks and small streams which have large, deep pools usually have resident carp popuations. (See Map 29.)

The carp was introduced into Iowa waters from Europe between 1870 and 1880. The fish is actually a native of Asia and was brought into Germany and other European countries from the Orient many centuries ago. In Germany and parts of the continent the carp is much valued as a food fish and is the object of important pond culture for the market. The carp have become so abundant in this section of the country that midwestern states spend large sums of money in an effort to clear them from the lakes to make room for the more desirable game fishes.

PLATE 7

CHANNEL CATFISH *Ictalurus punctatus* **Rafinesque**

BLACK BULLHEAD *Ictalurus melas* **(Rafinesque)**

FLATHEAD CATFISH *Pylodictis olivaris* **(Rafinesque)**


Maynard Reece

Records from the first fish hatchery in Iowa, located on the Wapsipinicon River a short distance above Anamosa in Jones County, reveal that a considerable effort was expended in culturing carp, and the distribution from that station from about 1880 until it was moved to Spirit Lake included all of the principal waters in the state. At first the carp were largely consigned to farm ponds or pools constructed especially for the purpose, but later they were introduced into numerous lakes and streams. In 1909 the carp were so plentiful in certain of the lakes as to cause concern, and that year the first effort to control them was inaugurated in Lost Island Lake. At the present time the Conservation Commission removes over a half million pounds of carp annually, principally from the natural lakes, and commercial fishermen operating in the Mississippi and Missouri rivers harvest nearly a million pounds annually.

The carp is so abundant in the Midwest that nearly everyone is able to recognize it without difficulty. The color is olivaceous to brassy, with lower parts and belly often bright yellow. There is a heavy, serrated spine in the dorsal and in the anal fin which serves to distinguish it from all of the other minnows. There are from 17 to 21 rays in the dorsal fin, and 5 or 6 in the anal. The lateral line is complete and contains from 35 to 37 scales. There are two fleshy barbels on each side of the upper jaw. The teeth are broad, with molar surfaces, and are located in the throat. (See Plate 12.)

Carp prefer moderately warm water and attain their greatest size in lakes. Records have been made of carp weighing nearly 50 pounds, and weights of 25 to 30 pounds are common. Carp are considered omnivorous feeders, taking both vegetable and animal matter freely in their diet. They are particularly fond of tender roots and shoots of young aquatic plants, and root up large quantities of vegetation in their feeding habits. They also consume a considerable amount of insects and their larvae, crustaceans, and small mollusks. Fish comprise only a small part of their diet, but fish eggs are often found in the stomach analysis. Whether they are taken purposely or accidentally in their bottom feeding is not known.

There is considerable angling pressure for carp, especially in the larger streams in and near urban centers. Fishermen line the bridges from spring to fall in the larger cities in quest of carp from the channel of the stream. They also fish immediately below dams, where the fish are concentrated in the turbulent waters. Others prefer to fish around snags and brush piles. Principal baits include doughballs, worms, large kernel sweet corn, and moistened bread rolled into small balls.

Goldfish

Carassius auratus (Linnaeus)

Iowa Distribution

Shellrock R.: Floyd Co., vic. Nora Springs.
Cedar R.: Black Hawk Co., Waterloo.
McKinley Lake: Union Co., vic. Creston.
South Twin Lake: Calhoun Co., vic. Rockwell City.
Gravel Pit: Woodbury Co., vic. Moville.
Spring Branch: Delaware Co., vic. Manchester.

The goldfish was originally imported from Eurasia as an ornamental aquarium fish. There are scarcely enough in the public waters of the state to list them among the fishes of Iowa, yet they are present in several city park lakes and many farm ponds. Their semi-wild existence is understandable, since they were undoubtedly stocked by well-meaning persons who tired of their care. This practice, however, could be dangerous to the native fishes, since they are very prolific and could cause the same nuisance problem as their closely related cousin, the carp.

Even though the goldfish often loses its bright orange or variegated color in the wild, it can easily be distinguished from the carp by the lack of the fleshy barbels on the upper jaw and the single row of pharyngeal teeth. It has fewer than 30 scales in the lateral line. Complete description is rather difficult because of the tremendous variation in the hybrids now on the market. They range in color from solid gold, orange and red to black, with many variations and calico-like patterns. Some have tails that closely resemble the carp, while others are longer than the fish itself. The food of the goldfish is similar to that of the carp and consists of plant materials, insects and their larvae, small snails, and tiny zooplankton.

Golden Shiner

Notemigonus crysoleucas (Mitchill)

This species is common to abundant in some lakes and ponds, preferring the smaller mud-bottomed, vegetated, overflow ponds along inland rivers. It is occasionally taken in small numbers in flowing waters and is common to the lakes of the Mississippi River. (See Map 30.)

The color is dark green above with olive sides and brassy belly. The entire body has a rish golden sheen, particularly in the larger adults. The head is small and sub-conic, but the eyes are large. The dorsal fin is set distinctly behind the pelvic fins. There are from 45 to 52 scales in the laterall ine. The mouth is small, terminal, and rather oblique. The golden shiner breeds from May through July and is prolific. The young reach a length of about 2 to 3 inches at the end of the first year, and adults may attain a length of nearly 10 inches. (See Plate 14.)

These minnows are used extensively as food by most game fishes. Fish culturists rear them in ponds to feed bass and other hatchery fish. As many as 200,000 (Dobie, Meehean and Washburn, 1948) have been produced in an acre of water. While they eat a small amount of fish, they feed largely upon algae, plankton, amphipodes, and to a lesser degree on arachnids, bryozoans, rotifers, and crustaceans.

They afford excellent bait for game and pan fishes and are used extensively by anglers for this purpose. A small number of fly-fishermen catch the larger ones for food or sport, especially in the natural lakes, where they commonly attain a length of 7 or 8 inches. They will take tiny dry flies or nymphs, but are usually taken incidentally with other fishes.

Creek Chub

Semotilus atromaculatus (Mitchill)

The creek chub is common in most small streams while rare to occasional in the major-sized inland rivers. It is also present in minor numbers in some natural lakes. It is taken only rarely in the boundary rivers with the exception of the Big Sioux where it is occasional. It reaches its greatest numbers in the cool streams of northeast Iowa. (See Map 31.)

The color is dusky olive-blue above, with light purple reflections on the sides and silvery below. It is a large, handsome minnow with stout, robust body and large terminal and oblique mouth. There are from 55 to 69 scales in the lateral line. The adults have a dark spot near the front base of the dorsal fin. They breed in May when the water temperature reaches about 65° F., usually in rocky riffles near the headwaters of the streams. These fish are nest-builders, the male preparing the nest and guarding the eggs until incubation is complete. At the end of the first year the young reach a length of about 3 inches, and adults often attain a maximum length of 8 to 10 inches. (See Plate 15.)

The intestine is almost equal to the entire length of the fish, and stomach contents examined reveal a large variety of foods, both plant and animal. It feeds principally upon aquatic and terrestrial insects, insect larvae, crustaceans, mollusks, small fishes, and bits of algae and other plants.

Chubs are important to the anglers in that they furnish considerable fishing, especially in the early spring, and are an excellent bait minnow throughout the year. They are a favorite of the small boy and fly-fisherman alike, for they strike all manner of live baits and artificial flies with equal vigor. They are an excellent food fish, and are often likened to the smelt of the Great Lakes in quality. As a bait minnow for walleye, bass and channel catfish, it is unexcelled. It is tenacious of life and lives well in bait buckets and on the hook. Some anglers prefer to "sour" their chubs by placing them in a capped fruit jar in the sun for a few hours before using them.

Redside Dace

Gila elongata (Kirtland)

In all probability, this species is no longer present in Iowa waters. Its inclusion in the Iowa fish list is based on a collection made by Meek (1892) in the Yellow River, Allamakee County, in the vicinity of Postville. The lateral line of the redside dace is complete, with 65 to 70 scales. The peritoneum, or body cavity, is silvery, and the intestine is short. There is a single dusky band along the lateral line. The strongly oblique mouth is larger than in any other Iowa minnows.

Pugnose Minnow

Opsopoeodus emiliae Hay

Iowa Distribution

Mississippi R.: Allamakee Co., vic. New Albin (UMRCC, 1953).
Mississippi R.: Clayton Co., vic. Marquette (UMRCC, 1953).
Mississippi R.: Clayton Co., vic. Guttenberg (UMRCC, 1953).
Mississippi R.: Dubuque Co., vic. Millville (UMRCC, 1953).
Mississippi R.: Rock Co., Ill., vic. Rock Island (Forbes & Richardson, 1920).
Mississippi R.: Muscatine Co., vic. Muscatine (UMRCC, 1953).
Yellow R.: Allamakee Co., vic. Marquette.

With the exception of a single specimen taken in the Yellow River near its junction with the Mississippi, this species is confined to the Mississippi River proper. The minnow is nowhere common in collections, but is probably more evenly distributed down river than the records indicate. As its name implies, its mouth is very small and strongly oblique, or turned up, giving it the effect of a pug nose. The back is straw-colored, with silvery sides striped with dark lateral lines. There is a black spot at the base of the dorsal fin, and the lateral line is complete. The throat teeth number 5-5 or 4-5. There are 9 dorsal rays, more than in any other native minnow. It is a small minnow, reaching a length of about 3 inches. It has been reported from southern Minnesota (Eddy and Surber, 1947) and the lower Mississippi River in Wisconsin (Greene, 1935.)

Southern Redbelly Dace

Chrosomus erythrogaster (Rafinesque)

This colorful species is found primarily in the clear, cool headwaters of the small streams in eastern Iowa where it has a preference for areas with overhanging marginal vegetation. A single specimen taken in West Okoboji Lake keeps this species from being classified as a stream fish only. The redbelly dace is occasional to common locally. (See Map 32.) The mouth is little if any oblique; the length of the upper jaw is more than one-fourth the length of the head, and the distance from the tip of the snout to the back of the eye is longer than the rest of the head. It has two dark bands along the lateral line of the body, the lateral line itself is incomplete, and there are more than 70 scales in this line. (See plate 14.)

Hornyhead Chub

Hybopsis biguttata (Kirtland)

This species is a "clear water" representative of the genus and is confined primarily to the upper portions of the streams where it is rare to occasional in numbers. It occurs in several natural lakes but is not found in the artificial lakes, the Missouri or the Mississippi River. (See Map 37.)

The hornyhead or river chub is strikingly similar to the common creek chub. Its coloration is dusky to black above and silvery beneath, with large, oblique mouth, and a red spot behind the eye in the adult males. There is a round blackish spot at the base of the tail fin. It attains a length of nearly a foot, although specimens of over 8 inches are rather uncommon. There are less than 47 scales in the lateral line, and the throat teeth typically number 1, 4-4, 1.

The hornyhead chub is one of the most sought for baits for bass and catfish and is used extensively for walleye fishing.

Lake Chub

Hybopsis plumbea (Agassiz)

The presence of the lake chub in Iowa waters may be interpreted as a case of a glacial or cold water relict similar to the sculpin, *Cottus cognatus*. This is a new species for Iowa in that it was only recently taken in Twin Springs Creek, Dubuque County, northwest of the city of Dubuque by Robert K. Chipman, a student of Tulane University. The identification was verified by Dr. Reeve M. Bailey. It is a barbled minnow with a sub-terminal mouth and has the general appearance of the flathead chub except the fins are not so falcate.

Flathead Chub

Hybopsis gracilis

The flathead chub is restricted to the Missouri River drainage system. It is even rare to absent in the Big Sioux River drainage in Iowa. In the collections it was occasional to common in streams and occasional in the Missouri River oxbow lakes. (See Map 33.)

The plains flathead chub is a beautiful silvery minnow with large sickle-like fins. It ascends the smaller streams for some distance and is essentially a fish of the western Iowa rivers. The head is broad and strongly depressed, hence its name. There are usually from 48 to 57 scales in the lateral line. The premaxillae, or mouthparts, can be protruded, and the teeth are 2, 4-4, 2. There is a small barbel at each corner of the mouth. (See Plate 14.)

This is truly one of the most beautiful chubs native to Iowa. It attains a length of at least 10 inches and is used extensively as bait for blue catfish in the lower reaches of the Missouri River. In the river proper it is most abundant over sand bars in rather shallow water, where it occurs in fairly large numbers. Fishermen prefer it for bait because of its size and its ability to stay alive for considerable periods of time on trotline hooks. Its streamlined body and large falcate, or sickle-shaped, pectoral fins enable it to swim well in the swiftest currents.

Silver Chub

Hybopsis storeriana (Kirtland)

This chub is confined primarily to the semi-turbid waters and channels of the large inland rivers of the state where it is occasional to common in abundance. It is taken occasionally in the Mississippi River, rarely in the Missouri, and taken only once in the lake surveys at Black Hawk Lake in Sac County. (See Map 34.) (See Plate 19.) It is a large, slender fish with fairly large fins. The color is green above with purple scale reflections, a greenish lateral band, and bright silvery beneath. The eye and mouth are large, and the dorsal fin is located distinctly in front of the pelvic fins. There are from 37 to 40 scales in the lateral line. The silver chub attains a length of about 10 inches and breeds in late May or early June. Although comparatively rare, it is an excellent bait minnow when available. It does not live long either in the bait bucket or on the hook, but because of its size it is highly prized for large fish angling.

Sturgeon Chub

Hybopsis gelida (Girard)

Iowa Distribution

Missouri R.: Cass Co., Nebr., vic. Plattsmouth (Bailey, 1951).
Missouri R.: Mills Co., Iowa, vic. Pacific Junction (Bailey, 1951).

This species is confined to the Missouri River and is extremely rare. Specimen identified as *Hybopsis gelida* by Meek (1892) were found, upon examination by Dr. Raymond Johnson, to be referable to H. Meeki (Bailey, 1951.) The fins are not falcate or sickle-shaped like the plains flathead chub, but the head is depressed. The belly is scaleless, and there are 40 to 43 scales along the lateral line of the body.

Sicklefin Chub

Hybopsis meeki Jordan and Evermann

Iowa Distribution

Missouri. R.: Woodbury Co., vic. Sioux City—re-identified from Meek's 1889-91 collections by Johnson (Bailey, 1951).
Missouri R.: Cass Co., Nebr., vic. Plattsmouth (Bailey, 1951).
Missouri R.: Mills Co., Iowa, vic. Pacific Junction (Bailey, 1951).
Lake Manawa (Inlet): Pottawattamie Co. (Bailey, ISC).

The sicklefin chub is confined to the Missouri River drainage in Iowa. The eye is small, and the fleshy barbels are about the length of the eye. The body is not spotted and the sides are silvery. The fins are falcate, or sickle-shaped.

Speckled Chub

Hybopsis aestivalis (Girard)

This small chub is limited in distribution to the larger rivers and varies from year to year in abundance. It runs the gamut from rare to common to rare over a period of years; evidently it has stringent breeding requirements and when they are not met, the population falls off sharply. It reaches its greatest numbers in the Des Moines River where it is found in the swift, shallow water of the main channel. (See Map 35.) The body is conspicuously and irregularly spotted with small dark markings. There are about 37 scales in the lateral line. The throat teeth are typically 4-4. It breeds in May and prefers clear-water streams. It is a slender minnow, reaching a length of about 2½ inches at maturity.

Gravel Chub

Hybopsis sp.

This chub has very specific living requirements and as its name implies, is usually found in swift water over a pea-gravel bottom. Meek collected this species in only four locations. The author visited the exact site of one of his collections in the Wapsipinicon River in Buchanan County just 60 years later and took a fine series of this form. (See Map 36.)The color is light olive green above with silvery sides and blue lateral band, with X-shaped markings along the lateral line. There are from 39 to 43 scales in the lateral line and 7 rays in the anal fin. The teeth are 4-4. The peritoneum, or body cavity, is lined with black or is dark-mottled. This minnow reaches a length of about 3 inches at maturity. Little is known of the life habits of this fish in our waters. This species has not yet been given a trivial name.

Western Blacknose Dace

Rhinichthys atratulus meleagris (Agassiz)

A resident of small, clear-water creeks, this species reaches its greatest abundance in the trout streams of northeast Iowa. It is occasionally taken in the upper Des Moines River watershed and is extremely rare in the lakes, a single specimen coming from East Okoboji Lake. (See Map 38.)

The color is brownish to black above, the sides speckled with dark scales, and light beneath. During the breēding season the lateral line often turns pink or red in the males. The upper jaw is little, if any, longer than the lower one, and the mouth is somewhat oblique. The air bladder is fairly well developed. There are from 62 to 71 scales in the lateral line and 7 rays in the anal fin. The teeth are 2, 4-4, 2. The peritoneum, or lining of the body wall, is silvery in color. (See Plate 14.)

These fish breed in April or May (Dobie, Meehean and Washburn, 1948) and construct their nests of small stones in rocky streams. The eggs are from 1/16 to 1/8 inch in diameter. They reach from 1½ to 2 inches by the end of the first growing season and about 4 inches at maturity.

This fish lives well on a hook and, because of its abundance in smaller streams, is used extensively as bait by anglers. Its coloration is more dull than that of the shiners, and for that reason it is not considered the best bait for crappies and pan fishes, but is widely used in bass and catfish fishing in streams.

Longnose Dace

Rhinichthys cataractae (Valenciennes)

The longnose dace is confined almost entirely to the swift, cool streams of the extreme northeast corner of the state. They are bottom dwellers and vary in abundance from rare to common in the swift-water, rocky riffles of these streams. In our collections it is found together with the western blacknose dace, hence its habitat preference may be considered similar.

The color is olive-green to brown above, with dark blotches on the sides, an indistinct lateral band, and pale beneath. There are from 63 to 70 scales in the lateral line. The teeth are typically 2, 4-4, 2. The upper jaw extends considerably beyond the lower one. In this fish the air bladder is only rudimentary, or not fully developed. (See Plate 19.)

The longnose dace breeds in April and May over sand or gravel bottom in clean, swift streams, and reaches about 4 to 5 inches in length at maturity. Like the blacknose dace, it is widely used by anglers for bass and channel catfish bait.

Plains Suckermouth Minnow

Phenacobius mirabilis (Girard)

One of the most generally distributed minnows of the state, the suckermouth reaches its greatest abundance in the Des Moines River watershed. Despite its general distribution this species is only rare to occasional in numbers. In eastern Iowa one or two specimens are usually all that are taken in a single collection. It has been taken on single occasions from Clear and Lost Island Lakes. (See Map 40.) The back of the fish is olive green in color, and the sides dusky-silver. There is a distinct dark spot at the end of the lateral line at the base of the tail. There is a faint gold stripe above the greenish lateral line band. The scales in the lateral line number 43 to 51. The lower lips are thick, with a fleshy projection on each side separated from the mandible or lower jaw by a pronounced groove. (See Plate 14.)

This minnow attains a length of about 4 inches and is used extensively as bait by anglers, who usually refer to it as the suckermouth dace. It is a hardy fish and fairly good bait for both pan fish and the larger game fishes.

Minnows of the Genus Notropis

Shiners

The following group of fishes have been separated from all others because they belong to the genus *Notropis*, collectively called shiners. There are 20 species and four subspecies native to Iowa waters in this genus. In most streams they make up the majority of the minnow population, and some species are common to abundant in the lakes and reservoirs. Several kinds, on the other hand, are rare and appear to be vanishing from our state.

A few of the shiners are found only in the swift, clear-water streams, while others prefer the more turbid waters of the larger rivers. A third group is native only to the Mississippi River, and another to the Missouri and its tributaries. Some are most abundant in the weedy areas of the lakes where food is ample and protection is afforded against their predators. Several of the shiners are found in nearly every conceivable habitat and are well distributed throughout the state.

These little fishes serve many useful purposes, two of which should be apparent to the anglers. They provide a substantial part of the diet of the larger carnivorous fishes, including the dogfish, gar, pikes, bass, walleye, perch, crappie, and others. Without their presence in large numbers, the game and predatory fishes would be forced to survive upon their own young, hence it goes without saying a good population of forage fishes is a requisite to large numbers of the desirable game species. Secondly, of course, the shiners provide the anglers with excellent bait and are unsurpassed for this purpose for most pan and game fishes.

Most shiners are rather delicate and die quickly in the minnow bucket or holding tank unless an adequate supply of fresh, well-aerated water is furnished. In the past, literally millions of minnows are wasted annually by careless handling. While the situation has become much better in recent years, there is still room for improvement. Minnow loss by anglers largely can be avoided by frequent changes of water in the minnow bucket, and by affording some sort of shade when fishing in the direct sunlight on hot days. Several types of minnow pails have been especially designed to keep the bait alive and are well worthy of consideration if live bait is used.

Many of the shiners resemble each other so closely that they are very difficult to distinguish. This is particularly true of the juveniles. The general coloration is so similar in most shiners that only a few outstanding marks are used in the identification work. For the identification of this group of fishes most fishery men prefer the physical characteristics such as the pharyngeal or throat teeth, position of the fins, number of rays in the fins, location and shape of the mouth, completeness of the lateral line along the body, and shape of the body.

We have listed the general distribution and a few of the more prominent characteristics of the shiners, but for positive identification it will be necessary to use the keys. A few natural photographs have been included of some of the more common forms to assist our readers further in knowing the fishes of Iowa.

The food habits of many Iowa minnows were intensively studied by Starrett (1950) in the Des Moines River, and in the shiner group the sand shiners were found to be omnivorous in their feeding. Most of the others were semi-specialized, feeding upon specific items throughout the entire year. The general feeders apparently are capable of modifying their feeding habits, thus avoiding serious depletion from competition or reverses in the abundance of food items. The more specialized forms appear to be subjected to considerable variation in numbers, depending upon the availability of their food supply and the number of competitors in the stream.

Emerald Shiner

Notropis atherinoides Rafinesque

With the exception of the Des Moines River system, where it is common in most reaches, the emerald shiner is confined to the lower reaches of the streams tributary to the Mississippi and Missouri rivers. This is definitely a "big-water" species, inhabiting the swift-flowing channel runs in numbers which range from common to abundant locally. It has not been found in the northern natural lakes but occurs in some of the Missouri River oxbows and a few southern Iowa impoundments as are in abundance. (See Map 41.) The back of the fish is emerald green and the sides are silvery. The body is elliptical in shape, and the snout is moderately short and blunt. The throat teeth are 2, 4-4, 2 and there are usually 10 or 11 rays in the anal fin. The diameter of the eye is contained about three times in the length of the head. This shiner reaches a length of about 3 to 3½ inches at maturity and is an excellent forage and bait minnow. (See Plate 19.)

Plains Shiner

Notropis percobromus (Cope)

Iowa Distribution

Missouri R.: Mills Co., vic. Pacific Jct. (Bailey, 1951).

This species may be more widespread than the above record indicates since it is easily confused with *atherinoides*. The minnow apparently has the same ecological requirements as the preceding species. It is a slender fish about 2½ inches in length, with a short, blunt snout. The throat teeth are typically 2, 4-4 2 and there are 9 to 11 rays in the anal fin. The diameter of the eye is contained about 4 times in the length of the head. It bears a strong resemblance to the emerald shiner but has a smaller eye and a deeper body.

Rosyface Shiner

Notropis rubellus (Agassiz)

This streamlined shiner, seemingly takes over in the eastern Iowa streams where the emerald shiner drops out. It is primarily a small-stream species, preferring clear water and a gravel or rubble bottoms. It is common in these streams and ranges in abundances from occasional to rare as the streams become larger and more turbid. (See Map 42.) There is a rosy tinge on the head and dorsal fin, and this color is particularly pronounced in the spring of the year during the breeding season. It is a small, slender shiner, reaching a length of about 2½ to 3 inches. The snout is sharp and slightly projected and the eye is small. The lateral line, containing 33 to 39 scales, is complete. In areas where this fish is abundant it is commonly used as a bait minnow. (See Plate 20.)

Redfin Shiner

Notropis umbratilis (Girard)

The upstream regression of this species is very apparent from Map 43. This minnow is now confined to the small clear-water streams of northeast Iowa. The species has an affinity for stream vegetation, which probably limits its distribution because vegetation in Iowa streams is very rare. The species is rare to occasional in collections. This shiner is especially colorful during the breeding season, when the back becomes bright steel-blue, the fins redden, and sharp tubercles appear on the heads of the males. It is a rather deep-bodied fish, attaining a length of about 3 inches. The teeth are 2, 4-4, 2. The lateral line, containing nearly 50 scales, is complete. There is a prominent black spot at the base of the front part of the dorsal fin. This minnow is used rather extensively for bait.

Silverstripe Shiner

Notropis illecebrosus (Girard)

This record is based on a single specimen taken from the Missouri River, Woodbury County, in the vicinity of Sioux City by Seth Meek. It was found in the Chicago Natural History Museum by Raymond E. Johnson. Bailey (1951) was prompted to say: "This locality is not close to any other known station for the species and the possibility of an inaccurately labeled specimen must therefore be considered."

Northern Common Shiner

Notropis cornutus frontalis (Agassiz)

This shiner has an ecological preference for clear water, and reaches its greatest abundance in the upstream tributaries to the major inland rivers. As collections progress downstream in the more turbid waters, the common shiner becomes reduced in numbers. It is rare to absent in the Missouri River and its tributaries and confined to Allamakee County on the Mississippi River where it is rare. It is occasional to common in the northern natural lakes of the state. (See Map 44.) It is a large, handsome minnow with a moderately compressed, deep body. The scales and dark reflections often give the appearance some of the scales have been removed from the scale pockets. During the breeding season these fish, especially the males, are very colorful. The back is olive-green with bluish reflections, the sides silvery, often tinted with pink; dorsal and tail fins are dusky, sometimes tipped with pink or yellow, and some scales on the sides are dusky in color, giving the fish a mottled appearance in life. Most of the color fades after midsummer, and the coloration is dominantly silvery.

The teeth are 2, 4-4, 2. The origin of the dorsal fin is in advance or forward from the insertion of the pelvic fin. The lateral line is complete, and there are from 37 to 40 scales in this line. There are usually 9 rays in the anal fin, but occasionally 8 or 10. The scales in front of the dorsal fin are small and crowded.

Together with the creek chub and suckers, the common shiner furnishes considerable fishing in the streams. It attains a length of 8 to 10 inches and can be taken on flies or live baits. Smaller individuals are often used for bait. (See Plate 14.)

Ironcolor Shiner

Notropis chalybaeus (Cope)

This species has not been taken in the state in over 50 years of collecting and may be considered extinct in state waters. To quote from Bailey (1951): "The small species of *Notropis* with a dark lateral band were badly confused by Meek, as a re-examination of his material in the Chicago Natural History Museum indicates. Carl L. Hubbs recognized the confusion and discovered a single specimen of the ironcolor shiner (Number 946) from the Cedar River at West Liberty and three other Iowa specimens (either Number 945 or 976) with uncertain locality data."

Weed Shiner

Notropis roseus (Jordan)

Iowa Distribution

West Fork Cedar R.: Butler Co., vic. Dumont.
Cedar R.: Linn Co., vic. Cedar Rapids.
Cedar R.: Muscatine Co., vic. West Liberty.
[Upon re-examination of Meek's 1889-1891 collections, Carl L. Hubbs found the above specimens to be misidentified as **N. heterodon** (Cleary), 1953)]
Mississippi R.: Allamakee Co., vic Lonsing & New Albin (UMRCC, 1953).
Mississippi R.: Clayton Co., vic. Marquette & Millville (UMRCC, 1953).

As its name implies, this shiner prefers the weedy, river habitats now present in the Mississippi River only. This fish ranges from rare to occasional in collections and probably extends throughout the downstream slough areas of the Mississippi River. The teeth are typically 2, 4-4, 2. The mouth is subinferior and more or less horizontal. There are 7 rays in the anal fin. There is a black lateral stripe and the chin is black.

Blackchin Shiner

Notrōpis heterodon (Cope)

Iowa Distribution

Volga R.: Fayette Co., vic. Fayette (Meek, 1892).
Bear Cr.: Fayette Co., vic. Arlington (Meek, 1892).
Maquoketa R.: Delaware Co., vic. Manchester (Meek, 1892).
Cedar R.: Bremer Co., vic. Waverly (Meek, 1892).
Skunk R.: Story Co., vic. Ames (Meek, 1892).
Des Moines R.: Emmet Co., vic. Estherville (Meek, 1892).
Storm Lake, Buena Vista Co. (Meek, 1894).
Spirit Lake, Dickinson Co. (Salyer, UMMZ).
East and West Okoboji lakes, Dickinson Co. Salyer, UMMZ).

This little species may be extinct in state waters since it has not been collected in the last 25 years. Here again a species has, in all likelihood, been removed from the state fauna, at least in rivers, because of a radically changed habitat. This minnow had a definite preference for clear, vegetated water with a sandy bottom. As its name implies, the chin is black or dusky in color. There are 36 scales in the lateral line and the teeth are usually 1, 4-4, 1. It is a small, unimportant fish in our waters, attaining a length of 2 or 3 inches at maturity.

Spottail Shiner

Notropis hudsonius (Clinton)

Another of the "big-water" members of the genus, the spottail shiner reaches its greatest abundance in the natural lakes of northern Iowa. It is also found in the upper Mississippi River and lower reaches of the inland tributaries thereof. It ranges from occasional to abundant in the lakes, including Lake Manawa on the Missouri River, to rare to occasional in eastern Iowa locales. (See Map 45.) Once the most numerous minnow in the larger natural lakes of Iowa, its numbers seem to have suffered depletion from commercial overexploitation. It is the preferred bait of anglers who troll for walleyes, and as such has been subjected to extreme pressure. Since many of these lakes have been closed for minnow seining in recent years, the spottail appears to be increasing.

This shiner attains a length of from 3 to 4 inches, and the large, prominent spot at the base of the tail fin aids in distinguishing it from other large, pale, silvery shiners of this state. The color above is very pale olive, the sides silvery with a broad bluish-purple band, the belly silvery. The teeth are variable, usually 1, 4-4, 0 or 1, 4-4, 2. There are from 36 to 39 scales in the lateral line. (See Plate 20.)

River Shiner

Notropis blennius (Girard)

The river shiner is rather similar in distribution to *Hybognathus nuchalis* and *Hybopsis aestivalis*. It is rare to occasional in the turbid channels of the larger rivers. A single specimen taken from Spirit Lake constitutes the only known lake record of the species. (See Map 46.) It is a slender, silvery minnow. There are about 37 scales in the complete lateral line. The anal fin has only 7 rays and the predorsal scales are large and not crowded.

Bigmouth Shiner

Notropis dorsalis (Agassiz)

This streamlined species is probably the most widely distributed, abundant minnow in the state. It is common to abundant in most flowing waters, occasional in the southern Iowa impoundments and rare in the northern Iowa natural lakes. In streams it is one of the few species found over the seemingly sterile sand flats so common to the medium-sized and smaller creeks. (See Map 47.) The eye is of moderate size and slightly less than one-third the width of the head. The mouth is sub-inferior and nearly horizontal, and the lips are thick. The scales in front of the dorsal fin are small and number more than 16. There are about 35 scales in the lateral line, and the teeth are 1, 4-4, 1. This minnow is one of the most important forage fishes in our streams and is also a very important bait minnow. It is widely used for pan fishes, especially crappies and perch. It reaches a length of about 2 to 3 inches. (See Plate 15.)

Pallid Shiner

Notropis amnis Hubbs and Greene

Iowa Distribution

Mississippi R.: Allamakee Co., vic. DeSoto, Wis. (UMRCC, 1953).
Mississippi R.: Allamakee Co., vic. Lansing (UMRCC, 1953).
Mississippi R.: Clayton C., vic. Marquette (UMRCC, 1953).
Mississippi R.: Clayton Co., vic. Guttenberg (Greene, 1935).
Mississippi R.: Clayton Co., vic. Millville (UMRCC, 1953).

The pallid shiner is indigenous solely to the Mississippi River in Iowa. It is taken commonly and seems to be generally distributed throughout the flowing water over sand bars in the northern section of the river. This species is probably quite common to the entire stretch of the river in Iowa.

Spotfin Shiner

Notropis spilopterus (Cope)

The spotfin is probably the most common minnow in the large, clear-water sections of inland streams. It prefers the shallow, swift water over sand flats or bars. A most interesting feature of this species is the abrupt cessation of its presence below the sixth tier of counties. It is as if an artificial barrier were erected across the state. All collections from southern Iowa are from artificial lakes . (See Map 48.) It was formerly known as the steel-color minnow and received its name from the steel-blue color of the sides of the fish. The anal fins of the breeding males are often bright yellow, and the back is olive green, grading to purple and blue. There is a prominent black spot on the last rays of the dorsal fin. The body scales are large and number from 36 to 38 in the lateral line. The anal rays are typically 8, and rarely 7 or 9. The teeth number 1, 4-4, 1. This minnow is a good forage fish and is widely used for bait. (See Plate 20.)

Red Shiner

Notropis lutrensis Baird and Girard

In this species we have almost the complement of the above on a statewide distribution. Whatever the limiting factor to the extension of *spilopterus* to the west and south, it evidently is tolerated by *lutrensis*, for the latter takes over in streams where the former drops out. There is some overlapping and hybrids between the two species are not uncommon. The red shiner is common to abundant in streams and occasional to common in natural and artificial lakes. The presence of this species in Bremer County is undoubtedly a case of being stocked by way of an angler's minnow bucket. (Cleary, 1952.) (See Map 49.) It is a deep-bodied fish with dark back, silvery-blue sides, and red fins. The teeth are usually 4-4, but are variable and are sometimes 0, 4-4, 1 or 1, 4-4, 1. There are 34 or 35 scales in the lateral line and usually 9 rays in the anal fin. (See Plate 15.)

Sand Shiner

Notropis deliciosus (Girard)

Iowa is evidently in the transitional zone between the eastern *(deliciosus)* and the western *(missuriensis)* subspecies of the sand shiner. Map 50 indicates the presence of the species but makes no differentation between subspecies. Generally speaking, *(missuriensis)* has a primary range west of the Des Moines River and *(deliciosus)* east. There are intergrades between the two subspecies, making field identification most difficult. The little species is common to abundant locally in small streams and rivers. It is common in more than 50 per cent of the natural lakes and occasional in a few of the artificial lakes. In the last five years in eastern Iowa streams there has been a definite reduction in numbers of *deliciosus* and an upsurge in the *dorsalis* population. (See Map 50.)

The eastern sand shiner, *Notropis deliciosus deliciosus* (Girard), usually has only 23 or 24 scale rows around the body. (See Plate 20.) The plains sand shiner, *Notropis d. missuriensis* (Cope), the other subspecies, usually has 26 to 29 scale rows around the body. The lateral line scales are somewhat smaller, averaging 35 to 38 in the lateral line.

Topeka Shiner

Notropis topeka Gilbert

This species has an interesting distribution in that present-day collections show it to be almost solely confined to the upper half of the Des Moines River watershed. Nowhere is this species common in occurrence; in fact, one or two specimens often make up a single collection. The Topeka shiner is essentially a fish of wide expanses of sandy shoals. (See Map 51.) There are about 35 scales in the lateral line, and the lateral band ends in a black spot at the base of the tail fin. It reaches a length of about 3 inches at maturity.

Blacknose Shiner

Notropis heterolepis Eigenmann and Eigenmann

The first Iowa collection of the blacknose shiner made since Meek collected it in 1889-91, was made in the fall of 1955. This minnow, thought to be extinct in Iowa waters, was found during a routine fisheries survey of Trumbull Lake in Clay County. Meek showed it to be quite widespread in the rivers of Iowa; however, it prefers clear and vegetated waters, a combination which is now very rare in Iowa streams. This accounts for its absence in flowing-water collections. (See Map 52.) It has 8 rays in the anal fin, and the dorsal fin when compressed is contained about 1½ times in the distance from the occiput to the dorsal fin. The scales in front of the dorsal fin are irregular and number from 13 to 22. The pharyngeal teeth number 4-4. There is a dark lateral stripe which is marked by black crescents. The chin is white.

Northern Mimic Shiners

Notropis volucellus volucellus (Cope)

Iowa Distribution

Mississippi R.:Allamakee Co., vic. New Albin (UMRCC, 1953).
Mississippi R.: Allamakee Co., vic. Lansing (Hubbs, UMMZ).
Mississippi R.: Clayton Co., vic. Marquette (UMRCC, 1953).
Mississippi R.: Clayton Co., vic Millville (UMRCC, 1953).
Buffalo Cr.: Linn Co., vic. Coggon (Salyer, UMMZ).
Winnebago R.: Winnebago Co., vic. Leland.

The northern mimic shiner is rare in all the collections and especially rare in the inland collections where it is represented by a single specimen in each case. This species has an appearance similar to *N. deliciosus* and is normally found in the same inland habitat.

Channel Mimic Shiner

Notropis volucellus wickliffi Trautman

Iowa Distribution

Mississippi R.: Allamakee Co., vic. Lansing (UMRCC, 1953).
Mississippi R.: Allamakee Co., vic. Harpers Ferry (Greene, 1935).
Mississippi R.: Allamakee Co., vic. Lynxville, Wis. (Greene, 1935).
Mississippi R.: Clayton Co., vic. Marquette (UMRCC, 1953).
Mississippi R.: Clayton Co., vic. Guttenberg (Greene, 1953).
Mississippi R.: Clayton Co., vic. Millville (UMRCC, 1953).
Mississippi R.: Jackson Co., vic, Bellevue (Hubbs, UMMZ).

Records indicate this form and the preceding one were found to occur in similar habitats in the Mississippi River collections. They were both found over sand bars or spoil banks where the current was moderate to swift. This minnow is probably more generally distributed downstream than our records indicate.

Ghost Shiner

Notropis buchanani Meek

Iowa Distribution

Mississippi R.: Allamakee Co., vic. New Albin (UMRCC, 1953).
Mississippi R.: Allamakee Co., vic. Lansing (UMRCC, 1953).
Mississippi R.: Clayton Co., vic. Marquette (UMRCC, 1953).
Mississippi R.: Clayton Co., vic. Millville (UMRCC, 1953).

Although the ghost shiner is seemingly less abundant in numbers and less generally distributed than the latter two forms it is usually found in the company of one or the other. This species, which is also confined to the Mississippi River, may be more widespread downstream than our records indicate.

Ozark Minnow

Dionda nubila (Forbes)

This species is confined to small, lime-rock creeks or to the upper lime-rock reaches of major streams in northeast Iowa. Its concentration in one area despite similar habitat in other portions of the state may be indicative of a geological requirement met only in northeast Iowa. This minnow is rare to occasional locally in the streams in which it is found, and is usually found in areas having bank seeps. (See Map 53.) The color of the Ozark minnow is rather dusky above, with dull silvery sides and sometimes yellowish reflections in the belly scales. The body is moderately compressed, somewhat resembling the shiners. There is a dark band extending along the lateral line, ending in a very faint spot at the base of the tail fin. The peritoneum, or body cavity, is black. The intestine is long and coiled in the body cavity. There are from 36 to 38 scales in the lateral line, and the teeth are 4-4.

This little fish attains a length of about 2½ inches and serves as forage for the game species. It is doubtful if it is used very extensively by anglers because of its very limited distribution in our state.

Brassy Minnow

Hybognathus hankinsoni Hubbs

The brassy minnow is primarily a fish of moderate-sized streams or small rivers. It prefers a pool habitat and is also quite common in overflow ponds adjacent to these streams. With the fathead minnow it is the co-dominant species of these river overflow ponds. It is quite common locally and is found in both artificial and natural lakes, but is rare in the former. (See Map 54.) It closely resembles the silvery minnow, but can be differentiated from it by the brassy or gold color on the sides. The scales have many weak radii, or ridge-like structures which radiate outward from the center part of the scale, instead of a few strong ones, which is typical of the silvery minnow. (See Plate 15.)

It attains a length of 3 to 4 inches and serves as a good forage and bait minnow. It is used quite extensively, especially by anglers of eastern Iowa, as bait for crappies and other pan fishes in the inland streams and the Mississippi River proper.

Silvery Minnow

Hybognathus nuchalis nuchalis Agassiz

The silvery minnow, unlike the other Iowa representatives of the genus, prefers the channels of the larger, more turbid rivers, both inland and border. It has not been found in the natural or reservoir lakes but has been taken in the oxbow lakes along the Missouri River. (See Map 55.) It is a silvery minnow reaching a length of 4 inches or more. The mouth is small, terminal, and somewhat oblique. There are 37 to 39 scales in the lateral line, and the teeth are 4-4. Forbes and Richardson (1909) have this to say about its feeding habits: "According to our observations the intestine is always filled with fine mud, containing only filamentous algae, diatoms, and other vegetable forms likely to be found on the mud bottom.. It is frequently found in large schools of from fifty to one hundred in deep quiet water, always lying nearer the bottom than the top, or moving slowly along the bottom as it feeds. The chisel-shaped lower jaw tipped with cartilage is probably used for scraping up the mud and ooze." (See Plate 20.)

This fish spawns in late May or early June. It is good forage fish for the game species and sometimes used by anglers, although it does not live well in close confinement, hence is not too desirable as a bait minnow.

Bullhead Minnow

Pimephales vigilax perspicuus (Girard)

Essentially a minnow of the large streams, this channel-inhabiting species reaches its greatest abundance in the Des Moines River where it is common. It ranges in eastern Iowa from rare to common locally and is occasional in the Mississippi River. (See Map 56.) It is quite similar in appearance to the bluntnose minnow and is often mistaken for it. The color is dusky green above with silvery sides and dark lateral band ending in a tiny, sometimes very faint, dark spot at the base of the tail fin. There is a prominent dark blotch on the first four rays of the dorsal fin. During the breeding season, the head of this minnow, like that of the fathead, becomes dark gray to black, hence they are often called blackhead minnows by anglers. The lateral line is slightly curved, and there are from 39 to 44 scales in it. (See Plate 21.)

This minnow is an excellent forage fish and is used very extensively by anglers as bait for both pan fish and bass. It has an apparent preference for larger streams and is rare to absent in the lakes. It spawns early in the spring through midsummer and reaches a length of about 3 inches at maturity.

Bluntnose Minnow

Pimephales notatus (Rafinesque)

The bluntnose is one of the most abundant and widely distributed of the Iowa cyprinids. It is essentially a small-creek species, abundant in this habitat. It is common to the upper reaches of the major inland rivers and decreases in numbers downstream. It is rare to absent in the more turbid streams of western Iowa and common to occasional in the natural and artificial lakes of the state. (See Map 57.) The color is pale olive-green above, with silvery-bluish sides and silvery beneath. It can be distinguished from the other minnows by the dark stripe that extends across the opercle, or gill cover, through the eye and along the lateral line of the body, ending in a prominent black spot at the base of the tail. There are 41 to 44 scales in the lateral line. The teeth are 4-4, and the intestine is about twice the length of the body, indicating that the fish feeds extensively on vegetable matter.

This minnow furnishes excellent forage for larger fishes. It is used by fish culturists throughout the country in connection with smallmouth and largemouth bass propagation. It is somewhat less prolific than the fathead minnow, but easily cultured in ponds. Females average about 2,000 eggs (Dobie, Meehean and Washburn, 1948) and spawn when the water temperature reaches about 70° F. Their eggs are adhesive and are deposited in masses on the underside of floating logs, flat rocks or other objects which afford shelter for the males while attending the eggs during incubation. Eggs hatch in about 8 to 12 days. Adults reach a length of about 4 inches at maturity and feed largely upon algae, insect larvae, diatoms and entomostracans. Occasionally they will eat very small fish or fish eggs, but this does not make make up a very substantial part of their diet.

The bluntnose minnow is excellent bait for anglers and is used extensively in fishing for crappies, perch, white bass, and other pan fishes. (See Plate 15.)

Fathead Minnow

Pimephales promelas Rafinesque

This little minnow is perhaps the most tolerant of varying habitats of the entire group of cyprinids. It is found most abundantly in ponds or lakes, but is also found in flowing water, clear, turbid or otherwise. It does have an aversion for swift water an is rare to absent in the flowing waters of the Mississippi and Missouri rivers. (See Map 58.) Because of its wide distribution and abundance, it is perhaps the best known minnow. The males have dark gray to black heads during the spawning season, hence many anglers have come to know this little fish as the blackhead minnow.

The color is dark olive above, with a tinge of copper or brass behind the head and often along the sides, especially in the spring and most dominantly on the males. There is a dusky cross-bar in the middle of the dorsal fin, and a dark blotch near the base of the anterior or forward rays in the dorsal fin. The lateral line is incomplete and developed only toward the front of the body. The mouth is small, terminal and oblique. There are 42 to 48 scales in the lateral line. The teeth are 4-4, and the intestine is about twice the length of the body. (See Plate 15.)

During the breeding season, which extends from early May through August, the males develop three rows of breeding tubercles, or horn-like projections across their snouts. These are lacking on the females and disappear from the males after the breeding season. A single female lays from 200 to 500 eggs (Hubbs and Cooper, 1936), and the period of incubation is usually from about 5 to 6 days. Often several nests are made in such close proximity as to appear as one, and several thousand eggs are found in a single mass guarded by several zealous males. A single female (Dobie, Meehean and Washburn, 1948) has yielded 4,144 offspring in 11 weeks, and spawned 12 times.

The fathead minnow is perhaps the best fish in Iowa for pond propagation and is used almost exclusively by the State Conservation Commission as forage for bass and panfish in our hatcheries. Under ideal conditions nearly 300 pounds of fatheads can be produced in an acre of water. They are very easy to raise, since they require little care. Like the bluntnose, they spawn on the underside of flat objects, hence log rafts and hollow tile are supplied for breeding purposes. These little fish reach a length of about 3 inches as adults and feed largely on microscopic plants, small insects and their larvae. They seldom eat fish, hence are stocked in the bass ponds to furnish food. The water is fertilized with commercial fertilizers (organic fertilizer is suitable where the supply of water can be changed in case of overfertilization), and no further care is required.

Because of their wide distribution and abundance, the fathead minnow is one of the most extensively used bait minnows in Iowa. It is ideal in size for crappie, perch, and white and yellow bass, and the largest adults are suitable for walleye, bass and larger game fish. The fathead lives well in minnow buckets and stays alive on the hook better than most of the minnows.

Stoneroller

Campostoma anomalum Rafinesque

The stoneroller reaches its greatest abundance in the trout streams of eastern Iowa. Primarily a small-creek species, it is common to the clear-water streams and occasional to rare in those which are more sizeable and more turbid. It is rare to absent in the Missouri and Mississippi rivers, as well as the natural and artificial lakes. (See Map 59.) It can easily be distinguished from all other Iowa fishes by the long intestine, which is nearly always wound spirally around the swim bladder. The fish reaches a length of about 6 inches and is sexually mature (Hubbs and Cooper, 1936) in its second or third year of life. The color is a brownish-olive with a brassy lustre above, and silvery

PLATE 8

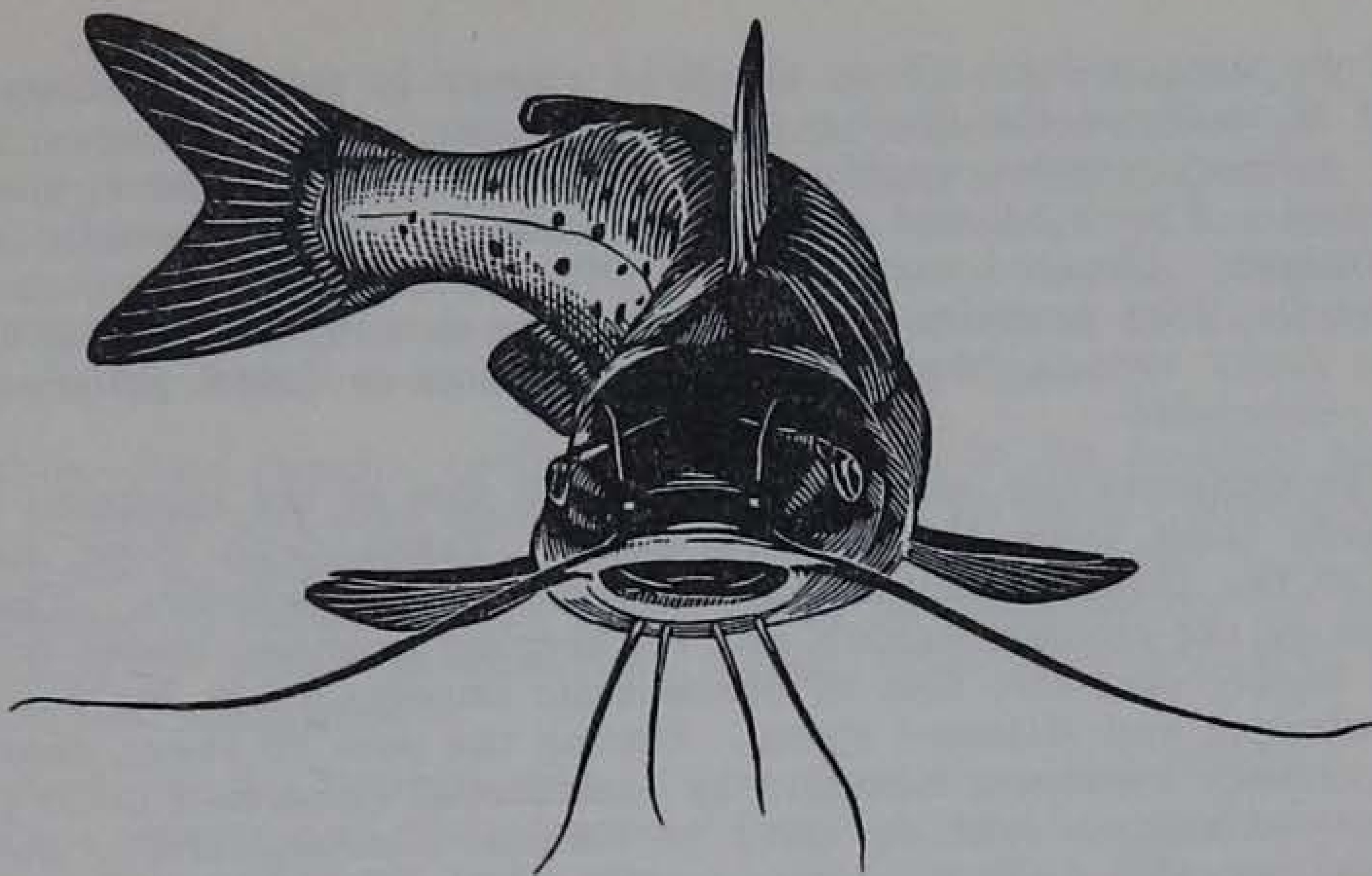
WHITE BASS ***Roccus chrysops*** **(Rafinesque)**

YELLOW BASS ***Roccus mississippiensis***
(Jordan and Eigenmann)


Maynard Reece

to white beneath. The sides of the body have irregular dark blotches. The males have a black crossbar of color through the middle of the dorsal fin. During the breeding season the head, and often the entire top of the back, of the male is covered with sharp spinelike breeding tubercles. These are used as defense against other fishes and to nudge the females onto the nest during spawning activities. There are from 49 to 55 scales in the lateral line. (See Plate 21.)

Stonerollers are often found in the catch, especially of small boys fishing in the smaller streams, and are used to some extent as bass and catfish bait.



Chapter IX

CATFISH FAMILY

Ictaluridae

Catfishes are unique among the fishes of Iowa and are easily distinguished from other kinds by their smooth scaleless bodies, the eight elongate fleshy barbels or "whiskers" on the head, and the strong sharp spines in each pectoral fin. Six of the nine species of catfishes found in the state are large enough to be of importance to the anglers and constitute a good share of the total catch.

Most anglers at some time or other have been stung or pricked by a catfish, bullhead, or one of the tiny madtoms. The sensation is comparable to a bee sting and is, temporarily, extremely painful. For many years scientists have known that madtoms were equipped with a poisonous gland beneath the skin near the pectoral fin, but thought the pain inflicted by a bullhead or catfish was caused by the mechanical injury of the spine. More recently (Reed, 1924) it has been recognized that all catfish are equipped with a poison gland and with a pore, which is open at least in the juvenile fishes. In addition to the pectoral glands, the tadpole madtoms possess a gland around the dorsal spine. The secretions from the pectoral gland stream from the pore and over the side of the body of the fish toward the tail, and the pectoral spine, when folded against the body, is in contact with the pore. Thus the spine is bathed with poison which enters the wound punctured by the spine. There is no hypodermic mechanism, however, such as occurs in rattlesnake bites

It should be clearly understood that although the catfishes are considered venomous fishes, these glands in no way affect the flesh of the fish, which can be eaten without hesitancy. The poison glands are always removed with the fins in cleaning. The sting, while temporarily very painful, is not considered dangerous. Obviously, it is well to handle all members of the catfish family with extreme care to avoid unpleasant experiences.

Most of the catfishes are nocturnal in habits and are often quite inactive in daylight hours. For this reason many seasoned fishermen frown on midday angling and reserve their efforts for the early morning, twilight, and after-dark hours. Catfish are omnivorous in their feeding habits and are taken on every conceivable type of bait.

The catfishes live contentedly in both clean and muddy waters and are able to withstand considerable pollution. They are very tenacious in habit and are found in most waters where the food supply is relatively abundant. The broad pad of teeth on the strong jaw, small eyes, wide esophagus, and highly developed sensory organs enable these fishes to thrive under most unusual circumstances. The blue and mud or shovelhead catfish usually prefer the largest streams. Channel catfish and bullheads are well distributed in most waters, and the little pygmies of the family, the slender madtoms and stonecats, prefer the rocky streams, but the tadpole madtom is found principally in the lakes and reservoirs.

All of the catfishes are edible, but the small size of the madtoms and stonecats preclude them from the angler's catch. Taken from clean cool waters, the flesh of the bullhead and catfish is considered a delicacy. The firmness of the flesh of the channel catfish and its keeping qualities under refrigeration make it a highly desirable fish of commercial importance in the Iowa portions of the Mississippi and Missouri rivers. During the past 10 years, nearly 270,000 pounds have been harvested annually by commercial fishermen from the Mississippi River. Although ranking third in volume (Carson, 1943), the catfishes are the most valuable fishery product in the entire Mississippi River.

In the inland streams of the state the channel catfish is highly important to anglers. It is believed that more people fish for channel catfish in our streams than for any other species. In lakes the ubiquitous bullhead leads all other fish in number and weight in the harvest. Although it is often referred to as the poor man's fish because of the simple tackle required to take it, the hordes of fishermen from all walks of life that pursue the sport of catching it attest to the importance of this fish in the recreational program.

In former years the bullhead was recommended for stocking in small stock-watering ponds in southern Iowa. In certain instances these prolific fishes dominated the population to a point where all were stunted and under-nourished for lack of food. Recently (Hull, Wilcox and Speaker, 1950), the State Conservation Commission has recommended a bass-bluegill combination in small ponds, since the management is more simple and the harvest more successful to the owner than stocking bullheads or other species.

Over twenty years ago a program was designed by the Commission to expand the recreational facilities for the children of Iowa. City park lakes, municipal reservoirs, and other urban water areas are stocked annually with adult bullheads in a cooperative plan with cities and clubs to provide additional youth recreation. The popularity of the "Kids' Fish Day" has taken the state by storm. Prizes are offered by merchants for the child catching the largest fish, showing the best sportsmanship, and other features, and the banks of the little "lakes" are lined with enthusiastic juvenile anglers of both sexes. These fishes are brought in from the shallow lakes which are overstocked with bullheads and from special rearing ponds. Usually a special day is set aside for the festive occasion, but the sport continues with somewhat less enthusiasm, throughout the summer.

Channel Catfish

Ictalurus punctatus Rafinesque

Other Names—Spotted cat, fiddler, channel cat and catfish.

Iowa Distribution—The most widely-distributed game fish in Iowa is the channel cat. Besides being common to abundant in most rivers and moderate sized streams, it is occasionally taken in many artificial and natural lakes. Commercially, it is the third most important form in the boundary waters. During spring floods the catfish also ascends small streams and is found in varying abundance in the larger pools of these streams. (See Map 63.)

Description—The color is silvery-gray, profusely marked with dark spots, which are usually more or less obscure in large adults. Young individuals under 2 or 3 inches in length also frequently lack the spots. There are from

24 to 29 rays in the anal fin, and this fin is about two-sevenths the standard length of the fish. The tail is deeply forked, which is unlike all the other catfishes except the blue cat. The eyes are large, but the head is small, slender, and subconic. The air bladder has two lobes which are paired so as to appear as one at first glance. The upper jaw is slightly longer than the lower jaw. The fish attains a maximum weight of about 25 pounds, although specimens over 12 to 15 pounds are quite rare. (See Plate 7.)

Food Habits—The channel catfish is omnivorous in its feeding, gorging on all manner of living and dead material. Because of its highly developed sensory system, it feeds by touch, taste and sight. For this reason it is frequently taken by anglers in turbid waters which would be unproductive for fishes that feed principally by sight. In extremely muddy water, however, they are prone to feed much less extensively.

A large part of the natural diet of the channel catfish (Bailey and Harrison, 1948) is insects and their larvae. Crayfish, snails, small clams, worms, and fish, both live and dead, make up a part of its diet. The catfish is not a selective feeder an d takes advantage of the food at hand. In the spring of the year its stomach is packed with elm seeds and cotton from cottonwood trees. Other natural foods include such items as wild grapes, weed seeds, red haw fruits, and other vegetable materials dropped into the stream from overhanging branches.

Life History—The channel catfish is quite selective in its breeding habits. It prefers obscure places to deposit its eggs. Overhanging rock ledges, deeply undercut banks, underwater muskrat runs, hollow logs and even large tin cans, tile, and other similar objects in the stream serve admirably for spawning purposes. Spawning activities take place after the water temperature reaches about 75° F. Eggs are deposited in a gelatinous mass, and the length of incubation depends upon the temperature of the water, but it is usually completed in 6 to 10 days. Although the number of eggs deposited per female may run to 20,000 or more, catfish averaging from 1 to 4 pounds (Canfield, 1947) produce from 3,000 to 8,000 eggs.

After the spawning takes place, the male drives the female from the nest and takes over the family duties until the young hatch. In artificial culture and perhaps in the wild as well, females and even the parent males will often devour the eggs from their own nests if disturbed too frequently.

Young catfish travel in schools for several days, or even weeks, after birth. Eventually the schools are dispersed and the young feed singly in the shallow waters over sand bars, around drift piles, and in rocky areas of quiet waters.

Female catfish reach sexual maturity at from 13 to 16 inches, and males somewhat earlier. In most of our streams they do not reach this size until the fourth summer of life.

Angling—In Iowa streams fishing for channel catfish is one of the most popular sports. Everything from the willow pole to the most expensive fly rod equipment is used, but it is not so much the tackle as the method used that spells the difference between success and failure.

Catfish feed largely in the channel during the twilight hours or in deep holes below riffles. As darkness sets in, however, they invade the shallow waters. Midday fishing is usually best under drift piles, overhanging banks and other protected areas. An increase in movement of the fish usually accompanies a rise in the stream, and following a light rain good catches are common. Fluctuations in the stream flow caused by manipulation of power dams also cause catfish to feed, and anglers have their best success shortly after the downstream rise occurs. The fish are in search of foods which wash into the stream, and the increased turbidity offers added protection to the fish by excluding the sunlight. Temperature, too, is an important factor to consider, since catfish are less apt to bite if the water is cold.

Probably the most popular type of gear used in catfish fishing in Iowa is a 5-foot casting rod rigged with a reel, 15- to 25-pound test line, sinker and single or treble hook. Calcutta bamboo rods of 7 to 8 feet in length are effective, especially when bait is drifted with the current in the thread of the stream. Bait fishermen prefer crayfish, shrimp tails, chicken entrails hog melts worms, nightcrawlers, live and dead chubs, coagulated blood, sour clams, frogs, prepared concoctions, and many other baits too numerous to mention. When using baits of this type, usually a single hook of No. 2 or No. 4 size is standard equipment. Bait fishermen using sundry cheese baits and "secret formula" prepared baits usually prefer small treble hooks ranging in size from No. 6 down to No. 10. While the majority of anglers prefer to fish off stream banks in deep holes, around snags and drift piles, at the foot of riffles, immediately below dams, or from highway bridges, others are more successful in "drifting" the bait from the center of the stream. In this latter type of fishing a longer rod is required to take advantage of the current. Bamboo, steel, glass, and Calcutta poles from 7 to 10 feet are most popular. They are equipped with reels and line, but little if any weight is used. Most anglers prefer the coagulated blood for this type of fishing, but other baits are employed.

In wading or drift fishing, it is best to wade the stretch of river prior to actual fishing. The purpose of this is to determine accurately the depth and feasibility of wading. After an interval of an hour or so you can resume fishing. Commencing at the upper reach of the stream, wade to the center of the channel and adjust a light float (barely large enough to float the bait properly) until the bait is off the bottom from 4 to 6 inches. If coagulated blood is used, care must be exercised in playing out the line, for this bait will come off the hook very easily. Ease the bait into the water and strip the line off the reel by hand, allowing the bait to travel with the current. By changing your position in the stream, it is possible to fish most of the good water provided a long rod is used. More often than not, retrieving the bait after the downstream float has been completed will dislodge the bait, and with each new "drift" through the hole a new bait must be used. If three or four drifts fail to produce a strike, move on to the next good stretch of river. Strikes are usually not felt at the butt of the rod, especially if a long line is out. It is necessary, therefore, to watch the float or bobber carefully and at its disappearance strike back immediately and take all of the slack out of the line. Because of the severe pressure on the rod, it is best to use a rather stiff action rod with plenty of backbone. This method of fishing is especially good in hot weather and will often produce fish when everything else fails.

Several excellent prepared catfish baits are now manufactured in Iowa and elsewhere. Many anglers prefer to use these baits because of the availability of the bait and their known ability to catch fish. Most of these baits are prepared in pound or pint jars or cans and can be easily carried in the tackle box or bait sack. They are sold under various trade names and are excellent baits for channel catfish.

In addition to the standard tackle, many new patent hook devices have recently appeared on the market. While we have not had the opportunity to use them extensively enough for comment, many appear to have considerable merit.

Blue Catfish

Ictalurus furcatus (LeSueur)

Other Names—Chucklehead cat, forktail cat, great blue cat.

Iowa Distribution

Mississippi R.: Allamakee Co., vic. Lansing (Greene, 1935).
Mississippi R.: Lee Co., vic. Keokuk (Coker, 1928).
Missouri R.: Mills Co., vic. Pacific Junction (Bailey ISC).
Lake Manawa: Pottawattamie Co. (Speaker, MS).

The blue cat, not to be confused with the "blue" color phase of the channel cat, is primarily a southern species and, is taken in rare instances in the lower reaches of the border streams. A "big river" species, it has never been taken in the inland streams. However, it could occur in the lower Des Moines River and in the lower reaches of the larger tributaries of the Missouri River.

Description—The color of the blue catfish, as its name implies, is blue or slate-gray above and light below. The upper jaw protrudes slightly beyond the lower one, and the head is prominently convex. The anal fin is very long, and its basal length is about one-third the standard length of the fish (the distance from the tip of the snout to the end of the vertebral column or base of the tail fin, not including the tail). The blue catfish can be distinguished from the channel catfish by the number of rays in the anal fin, the channel catfish having from 24 to 29 rays, the blue catfish from 30 to 35. The tail is deeply forked like that of the channel catfish, but the eyes are small. The air bladder consists of three lobes or parts, and anterior pair joined side by side, and the third lobe smaller and placed behind.

Food Habits—The range of the natural foods of the blue catfish is indeed very wide. They live principally upon insects and their larvae, crayfish, worms, frogs, small fresh-water mussels, fish, and a host of other living and dead material. They are omnivorous in their feeding and take everything available to them.

Life History—The blue catfish breed in June and early July when the water temperature reaches about 70° to 75° F. They construct nests similar to those of the channel catfish. The young attain a length of from 2½ to 4 inches at the end of the first growing season. The adults are among our largest fishes, and specimens weighing nearly 100 pounds have been taken from the lower reaches of the Missouri River. Several specimens weighing in excess of 50 pounds have been observed in the Missouri River by the writers. While fish of this size are rare, adults weighing up to 25 or 30 pounds are common.

Angling—The only place in Iowa where attempts are actually made to catch the blue catfish is in the lower part of the Missouri River. Most fish are taken there on heavy trot line tackle. Hooks of 2/0 to 4/0 are baited with large chubs, such as the plains flathead chub, or with several large nightcrawlers. Lines are sometimes set at right angles to the shore, but more often are fished off the lower side of islands in the river. In this type of fishing the lines are usually run only once each day. From 25 to 100 hooks are used on each line. More channel catfish are taken on these trot lines than blue catfish, but the fishermen who stick with it throughout the season usually catch several large fish in the course of the summer. Most blue cats run from about 5 to 15 pounds, but fish much larger are not uncommon.

Brown Bullhead

Ictalurus nebulosus (LeSueur)

Other Names—Bullhead, brown bullhead, horned pout, and speckled bullhead.

Iowa Distribution—While the brown bullhead is widely distributed over the state, nowhere is it abundant. Many inland collections are based on a single specimen only. The brown bullhead is taken most commonly in the upper Mississippi River where it inhabits the sloughs and river lakes. (See Map 61.)

Description—The color of the brown bullhead is olive to brown with dark mottlings on the sides, fading to white or cream beneath. The fleshy barbels, often called "chin whiskers", are dusky to black. It can be readily distinguished from the black bullhead by the lack of the light-colored bar at the base of the tail fin and the lack of black coloration in the membrane between the rays of these fins. There are strong barbs on the back side of the pectoral fin spine. There are from 20 to 24, usually 22 or 23, rays in the anal fin. The caudal or tail fin is slightly notched.

Food Habits—The brown bullhead lives largely upon insect larvae, crustaceans, snails, small crayfish, worms, and small fish. Like all of the other bullheads, however, it is tenacious of life and will feed eagerly on nearly anything available, either living or dead. The fish travel in schools and feed on or very near the bottom. A large part of their diet consists of midgefly larvae, called blood worms because of their red color, which they pick up from the soft bottom ooze. Considerable plant material is found in their stomachs, but we are not sure if this material is taken purposely or accidentally while feeding on insect larvae living in the plants. The teeth are in pads on both jaws and are used largely for tearing and pulling off pieces of their food. They have ravenous appetities and seem to be hungry at all times of the day and night.

Life History—The brown bullhead spawns rather early in the spring, usually in late April or May. It fans out a saucer-shaped nest in the mud and deposits its eggs therein. The number of eggs will range from 2,000 to 10,000 or more. The eggs are guarded by the parents during the incubation period, which is usually from 5 to 8 days. After the eggs hatch, they are herded about in schools for some weeks. At the end of their first year of life they reach a length of about 2½ to 4 inches and mature at three years. They grow to weigh about 2 pounds under ideal conditions, although most specimens will average from about 8 to 10 inches and weigh less than one pound.

Angling—Most anglers in this state use the same tackle and methods in fishing for all three species of bullheads. In former years the cane pole was the most popular equipment, but in recent times this outfit has been somewhat outmoded by the bait casting rod and reel. While all kinds of rods are used, the most popular seems to be either solid or tubular steel, about 4½ to 5 feet in length, with medium action. Since much fishing is done after dark, the level-wind reel is used almost exclusively. All types of lines are used, but a No. 15 or No. 18 appears to be most popular.

When fishing from shore, a lead weight enables the anglers to get proper distance and keep the bait on the bottom of the lake or stream. Some anglers use too much weight in their eagerness to get the line out a long distance from shore, and consequently often bury the bait in the soft bottom ooze. Occasionally corks are used, but anglers know the bullhead feeds on the bottom, so corks or floats are usually set so the hook is not more than a few inches off bottom. The float, however, is usually omitted, and the bait is fished directly on the bottom. All manner of bait is used, but worms and nightcrawlers lead the list and are generally most effective in catching bullheads. Once the line is cast out perpendicular to the shore in the proper place, the anglers rests the rod in a forked stick, tightens the line taut, applies the click to the reel, and awaits the strike. These fish are obliging in that they strike with considerable vigor and usually swallow the hook. Long shank hooks, usually from No. 6 to No. 2, are employed. A pair of pliers or a good hook disgorger is standard equipment in the bullhead fisherman's tackle kit, since it is nearly always necessary to remove the hook from the fish's throat or gullet. The more cautious anglers carries a leather glove, which he pulls on his left hand while holding the fish to keep from getting pricked with a sharp dorsal or pectoral spine.

Bullheads bite throughout the day and night, but most fishing is done in daylight hours, except in the early spring after the ice goes out of the lakes. At that time of the year the fish move into shore at night, and scores of tiny campfires along the shores mark the location of eager, yet usually cold, fishermen. Later in the spring most angling is done from early morning to dusk.

Many boat fishermen still prefer cane poles about 8 to 10 feet in length, with a line of equal length. When bullheads are biting fast and furious, they can be landed more quickly and the hook returned to the proper depth with less fuss. A few anglers even dispense with the pole entirely and use only the line, hook, short leader, and sinker. These are referred to as hand lines, boat or drop lines. While effective in perch fishing, most anglers agree a rod or pole is better for bullheads, since the bait is usually too close to the boat for feeding schools of bullheads.

Probably no other fish in Iowa provide as much recreation for the average anglers as the bullheads. The flesh is very tasty, especially when taken from clean water in the spring and fall.

Black Bullhead

Ictalurus melas (Rafinesque)

Other Names—Bullhead, common bullhead, yellow-belly bullhead, horned pout, brown catfish, catfish, stinger, and river snapper.

Iowa Distribution—This species is the most common and widely distributed of the three species of bullheads. It is abundant in most natural and some artificial lakes. It is a common farm-pond species and is taken less commonly in some overflow ponds of the major rivers. It is occasional to common behind dams in the larger rivers and is usually rare in flowing waters. It is quite common in the lakes and some sloughs of the Mississippi River, but its apparent aversion to flowing water limits its abundance in the Missouri River. (See Map 60.)

Description—The color of the black bullhead is usually dark olive to black, although in some waters it is light brown. Usually the belly is white, but here again the color is variable, and in certain lakes and larger rivers the belly is bright yellow, especially in the early spring and during the breeding season. The chin barbels are dusky or black. This fish can be distinguished from the other two bullheads of Iowa by the light color band at the base of the tail fin and the 17 to 20 rays in the anal fin. The tail fin is slightly notched, and the outer two-thirds of the fleshy membrane of the anal fin is uniformly black or dark-colored. This fish is rarely ever mottled in color. (See Plate 7.)

Food Habits—The black bullhead is strictly omnivorous, feeding upon nearly every conceivable thing in the water. Midge and Mayfly larvae make up a considerable part of its food. It also feeds extensively on other insects and their larvae, small crayfish, worms, small mollusks, crustaceans, and a host of other animals and plants. Bullheads have been known to eat the eggs of other fishes, as well as to feed quite extensively on minnows. The fathead minnow, an abundant form in most lakes and streams, is of particular importance in their diet.

Life History—The black bullhead spawns in May or early June, usually in weedy or muddy shallow areas. Saucer-shaped nests are constructed in the mud or sand in from 2 to 4 feet of water. These nests range from about 6 to 14 inches in diameter. The number of eggs depends on the age and size of the females, but will average from about 2,000 to 6,000 or more. Incubation is completed in a week or less under normal conditions. The young fry stay in tight black ball-like schools until they reach nearly two inches in length, at which time they leave their parents and shift for themselves. The black bullhead is usually considered the "runt" of the family, but in the larger lakes of northern Iowa many of them reach a weight of two pounds or more. In streams or lakes where food is scarce or the water overpopulated, they are much smaller and seldom exceed a length of 7 to 9 inches.

Angling—Angling methods and equipment are identical with those described under the heading of the brown bullhead and in the section on bullhead fishing elsewhere in this book. Bullheads move about in large schools, sometimes following the shore line and again moving out into deeper waters. Boat fishermen try to locate these schools of fish, but shore fishermen are content to throw their lines out from 50 to 100 feet perpendicular to the shore and wait for the fish to come to them.

If sharp hooks are used, the hungry bullhead will usually swallow the bait and insure the catch, hence it is not too important that the line be attended as closely as with most other species of fishes. This type of fishing permits a lazy cat nap in the sun, a leisurely day for visiting, or even a few hands of Canasta when the going is a little slow. When the gregarious bullheads start to bite, however, all hands must be on deck, for there is never a dull moment when the "school is in."

Yellow Bullhead

Ictalurus natalis (LeSueur)

Other Names—Brown bullhead, white-whiskered bullhead, Mississippi bullhead.

Iowa Distribution—Primarily a species of lakes and ponds, the yellow bullhead is nowhere abundant. It is taken occasionally in the flowing water of major inland rivers and the Mississippi River. It is quite commonly found in the southern artificial lakes of the state. (See Map 62.)

Description—The color of the yellow bullhead is light olive-brown to yellow on top, with white or cream belly. It can be immediately distinguished from the other two bullheads by the white or cream-colored barbels or whiskers on the chin. The tail fin is convexly rounded. There are 24 to 27, usually 25 or 26, rays in the anal fin. (See Plate 22.)

Food Habits—The yellow bullhead appears to be somewhat more selective in its feeding than the other two species, but the principal foods include insects and larvae, crutaceans, small mollusks, crayfish and small fishes.

Life History—Spawning takes place in May and early June in water from 18 inches to about 4 feet in depth. Nests are constructed and from 2,000 to 7,000 eggs are deposited. In from 5 to 10 days the eggs hatch, and the fry are guarded by the parent fish until late July or August. They reach a length of about 3 inches at the end of the first year and mature in the third year of life. Individuals weighing as much as 2 pounds are often taken from the Mississippi River, but fish weighing over a pound are not uncommon from Clear Lake and elsewhere.

Angling—The same methods and tackle are used in fishing for the yellow bullhead as are employed for the other two species. From our rather limited experience, it seems the yellow bullhead is more nocturnal in its feeding habits than the other two kinds. It is usually less abundant, hence makes up a much smaller proportion of the angler's catch. The flesh is firm and is usually preferred to the other bullheads.

Flathead Catfish

Pylodictis olivaris (Rafinesque)

Other Names—Shovelhead cat, mud cat, yellow cat, and Mississippi cat.

Iowa Distribution—The flathead is a big-water species, found quite commonly in the Mississippi and Missouri rivers. Inland it is found occasionally below dams on major rivers and in other well oxygenated areas. It is taken on rare occasions in some natural lakes. It is occasional to common in the border streams, where it is taken primarily in commercial gear. During the last five or so years, there has been a noteworthy increase in the flathead population, especially in the Iowa and Des Moines rivers. (See Map 67.)

Description—The color of the flathead cat is dark to olive-brown with dark brownish mottlings on the sides especially in the younger fishes. When taken over sand on light bottoms, the adults are often light tan or even yellowish in color. The anal fin is very short with only 15 to 17 rays. The head is broad and flat, and the tail is square or very slightly notched. The jaws are heavy, and the lower one is longer than the upper. (See Plate 7.)

Food Habits—Flathead catfish are found principally in muddy areas and prefer deep waters. They feed largely upon insect larvae, crayfish, mollusks, fishes, and worms and other terrestrial animals that wash into the streams. We have observed even small individuals, from 8 to 10 inches in length, feeding extensively on schools of young minnows in the shallow water along the riprap shores of the Mississippi River.

Life History—Spawning occurs in June and July in secluded hides and obscure places. These fish are nest builders, and parent fish guard the eggs and young. The young reach a length of from 2 to 6 inches the first year and are sexually mature in the third or fourth year of life. Adults grow to enormous size. We have exhibited fishes weighing up to 60 pounds at the State Fair, and specimens as large as 100 pounds have been reported by commercial fishermen operating in the boundary streams. Each year a few fish weighing 20 to 40 pounds are taken from the larger inland streams by anglers. Apparently they live for a considerable time, probably for at least 20 years and possibly more.

Angling—Occasionally flathead catfish are caught by anglers from many areas, but the largest catches are consistently made in the Des Moines, Raccoon, Skunk, Iowa, Cedar, and the boundary rivers. Most often they are taken on pole and line from the inland streams and on trot lines in the Mississippi and Missouri.

When deliberately fishing for flathead catfish, most anglers use heavy tackle. Lines of from 30- to 50-pound test are used on large bait casting or light surf reels. Large hooks are baited with 8 to 10 nightcrawlers or a chub about 6 to 8 inches in length. Chicken entrails are also effective bait.

Usually the bait is fished in the deep water of pools or in the tail waters below power dams. The bait is not moved often, but is permitted to remain on the bottom, sometimes for several hours at a time. In the evening these fish come into fairly shallow waters. At this time many anglers fish for them in pools below riffles or just where the quiet and swift waters meet at deep eddies.

Stone Cat

Noturus flavus Rafinesque

This species is principally a swift-water species, and is more commonly present in the inland streams than is shown on the distribution map. It is taken occasionally in some of the natural lakes and in the Mississippi River. (See Map 66.)

The stone cat, together with the two madtoms, represent the smallest fishes in the catfish family. These little fishes rarely exceed 7 or 8 inches in length and are more often only 3 or 4 inches long. They are known to most fishermen as distinct from the other catfishes, but some confuse them with the young of other species. They are found under rocks on riffles (Thompson and Hunt, 1930) of streams or weedy shore line of the lakes. Because of their small size and comparative scarceness, they are of little or no value to anglers. They are indeed interesting little fishes, however, and can easily be distinguished from the larger catfishes.

The color of the fish is yellowish-green to olive above and light below. The premaxillary band of teeth, a padlike band on the upper jaw, is U-shaped. The chin barbels are yellow. There are usually 16 rays in the anal fin. The fish has been known to reach a length of 12 inches, although it rarely exceeds 6 to 8 inches. (See Plate 21.)

Slender Madtom

Noturus exilis Nelson

This species reaches its greatest abundance in the Des Moines River drainage system, with a few scattered collections in eastern streams, and in Lake of

Three Fires in Taylor County. Nowhere is this species more rarely represented in the collections. (See Map 65.)

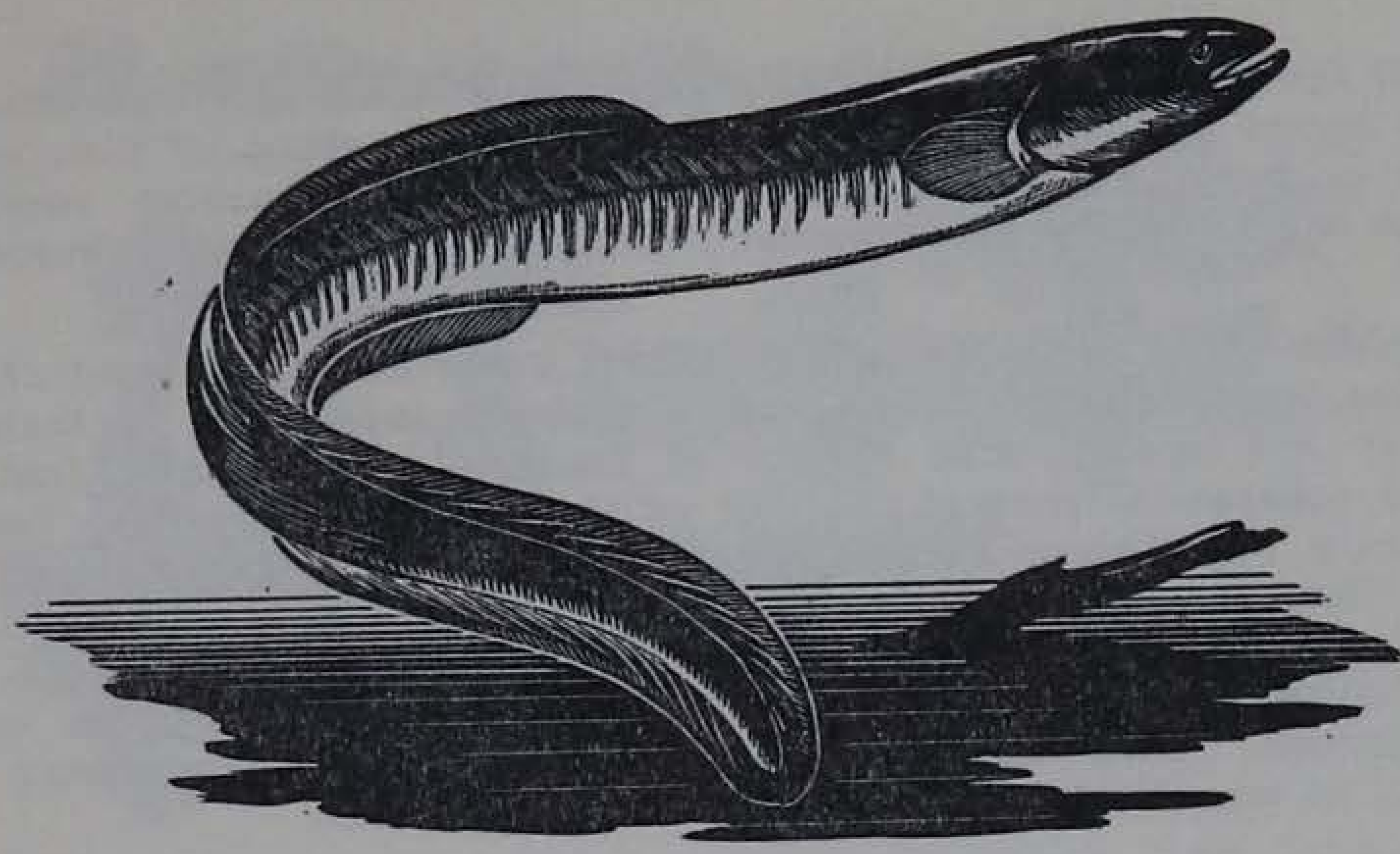
The color is yellowish on the sides and somewhat darker on the back. The belly is white to cream color. The premaxillary band, or tooth patch on the upper jaw, is bar-shaped. The head is small, narrow, and strongly depressed. There are from 14 to 17 rays in the anal fin. There is no lateral stripe along the side of the body. There is a light-colored bar-shaped marking on the back near the head and immediately preceding the dorsal fin. The upper jaw is somewhat longer than the lower one. It can also be distinguished from the other two tiny catfishes by the dark margin on the outer edges of the dorsal, anal and tail fins. It rarely exceeds 4 to 5 inches in length. (See Plate 21.)

Tadpole Madtom

Noturus gyrinus (Mitchill)

The tadpole madtom is more commonly found in natural and artificial lakes than either of the other two members of this genus in Iowa. Despite its presence in some of the larger inland rivers and in the upper section of the Mississippi, it reaches its greatest abundance in small, rocky, clear-water streams. Its presence in Missouri River oxbows indicates that it is also present in the Missouri River. (See Map 64.)

The color is dark olive or brown, sometimes dark gray and light beneath. The head is large and fleshy and not flattened. The body is short and stout. It more closely resembles the bullhead than does the stone cat or slender madtom. There are from 13 to 15, usually 14, rays in the anal fin. The premaxillary band, or teeth in the upper jaw, is bar-shaped. There is a conspicuous, very narrow dark line along the side of the body. The upper and lower jaws are of about equal length. This little fish rarely exceeds 3 or 4 inches in length. Young specimens have been taken in our collections in late fall measuring about an inch long. All of these little catfishes are equipped with a poison gland at the base of the pectoral fin. When stung or pricked by one of the spines, there is a burning sensation similar to a bee or wasp sting. (See Plate 21.)



Chapter X

THE EEL

Anguillidae

The true eel family is represented in Iowa by a single species, the American eel. They are long, slender, serpentlike fishes with paired pectoral fins and a true mouth with jaws, which distinguishes them from the very primitive lamprey ells. The scales are embedded and are so minute that the fish appears scaleless.

Eels are known from many parts of the world, but there are no fresh-water eels on the Pacific Coast of North America. Their origin is apparently unknown, and for many centuries nothing was known of their life habits or spawning grounds. In recent years it was learned that they spawn only in the sea and the young return to fresh water. Many species of eel are known, but most live only in salt water. Aside from the American and European eels, other forms like the morays, snake eels, and conger eels are all found in tropical seas.

American Eel

Anguilla rostrata (LeSueur)

Other Names—Common eel, Boston eel, Atlantic eel, fresh-water eel.

Iowa Distribution—The eel is found primarily in the large rivers of the state, and it reaches it greatest abundance in the Mississippi River. It was also found in Spirit Lake many years ago, where it probably was introduced by way of a stocking of Mississippi River fish. (See Map 68.)

Eel were stocked by the Iowa Fish Commission in the 1870's and 1880's. They could not be cultured here, but were transported from the east coast by the early commissioner. They were stocked quite freely in the state at that time.

Description—The color of eels varies considerably, usually from olive to brown on the back, fading to greenish yellow on the sides and gray or white beneath. The head is small and conical in shape and the mouth is wide with sharp and strong teeth on the jaws. The pectoral fins are paired and bluntly rounded. The dorsal, tail and anal fins are continuous with about 60 rays from the beginning of the dorsal fin to the tip of the tail. The tiny scales are oblong and slender, running about 150 per square inch, and are deeply embedded in the skin, giving the fish a slick velvety appearance. The scales are so fine, in fact, that the fish is very difficult to hold, and fishermen usually wet their hands and dip them in sand before attempting to pick up an eel. the body is long, slender and sub-cylindrical, more nearly resembling a snake than a fish. They are graceful fishes and strong, fast swimmers. (See Plate 16.)

Food Habits—Eels prefer deep mud-bottom water hence are most often found only in the larger rivers of this state. Chiefly scavengers in their feeding habits, they live upon a wide variety of foods both living and dead. Fishes make up a substantial part of the diet of the eels, but they have been known to eat nearly everything, including dead livestock that has washed into the streams. They are largely nocturnal feeders, but have been caught during daylight hours. Their snakelike movements permit them to move into extremely shallow waters and even overland for short distances in marshy or damp situations. They have been observed in damp lowlands near streams, presumably in search of frogs, crayfish, and other foods.

Life History—The American eel reproduces only in the tropical Atlantic Ocean. It is extremely prolific, and a single female (Forbes and Richardson, 1909) has been estimated to produce 10,700,000 eggs. Apparently there is a high rate of mortality in the young. Both the males and females die after spawning, hence the eel does not return to fresh water the second time. The young eels develop in about two years and ascend the fresh-water streams, where they spend their entire lives until they reach sexual maturity. Occasionally they become confined to lakes or impoundments and can not descend the stream to spawn in the sea. In this case they grow to considerable size, often reaching a length of nearly 6 feet and weighing over 10 pounds, reach their life span, and die. When they reach sexual maturity, the eels return to the sea. After several weeks of conditioning in salt water, their sex organs mature and reproduction takes place. The young are so different looking from the adults that they were not recognized as eels until the turn of the last century. There seems to be little change in the status of the eel in Iowa waters in recent years. It has not been abundant, at least for many years, and its numbers do not appear to be diminishing. It is one of the strange fishes that occur only occasionally, never becoming abundant nor vanishing completely from the fauna.

Angling—There is no specialized eel fishery, either sport or commercial, in this state. The few eel that are taken by anglers are caught while fishing for other kinds of fishes. They are most often taken on minnows, worms, or nightcrawlers either on or off the bottom. Most fishermen never catch an eel in a lifetime, but some have been known to catch several. The occasional specimens reported usually average from 2 to 3 feet in length. Commercial fishermen operating nets in the Mississippi and Missouri rivers frequently report eel attaining a length of 3 or 4 feet and weighing as much as 6 to 8 pounds. This fish, however, is not important to the commercial fishery because of the small numbers taken.

The flesh of the eel, while very rich, is delicious. It is sometimes prepared by usual pan-frying methods, but is most often either smoked or pickled in vinegar and spices. It is considered a delicacy and when available commands a high price on the markets. There is little demand for eels in this section of the country, however, since most housewives liken them to serpents and are hesitant to cook them. This is an erroneous conception, and those who properly prepare eels for the table are well rewarded for their efforts.

Chapter XI

BASS FAMILY

Serranidae

Only two of the sea bass family are native to Iowa waters. They are the white, or silver, and the yellow bass. Contrary to popular belief, the largemouth and smallmouth bass are not true bass at all but belong to the sunfish family. The original distribution of the bass in Iowa is not known, but there is reason to believe that they were largely confined to the Mississippi River and perhaps some of its principal tributaries. They have been widely stocked in the state for the past fifty years, but have become established in comparatively few areas. A planting of white bass was made in Spirit Lake as early as 1874 (State Fish Comm., 1880) and another planting of 100,000 fingerlings in the Okoboji chain of lakes in 1898. Whether they were native to those lakes before that time is not known.

Many attempts, a few successful but most of them unsuccessful, have been made to introduce the white and yellow bass into other waters of the state. Even in some of the areas where they have been established by stocking, food and proper environment have not been to their liking, and in most cases these plantings have failed, or a large stunted population of small unattractive fishes now exists.

Just how the bass fits into the biota of a lake is not clearly understood. In areas where plantings have been successful, phenomenal changes occur. Over a period of years their population may reach astronomical numbers, probably at the expense of other desirable fishes, then fall off sharply until only a few old individuals exist. Again an incredible hatch will occur when the population seems to have nearly vanished and their numbers will again soar upward. One- or two-year classes almost invariably dominate the entire population in the lakes, and there is not an even group of fishes of all ages as in the case of many other species. In a few areas, especially Spirit Lake, Clear Lake, Storm Lake, the Okoboji lakes, and the Mississippi River, goodly numbers of white bass seem to persist. Yellow bass are confined largely to Clear Lake, a few reservoirs, and the Mississippi River. Elsewhere the population of both species of bass is unpredictable.

Sigler (1949) made an extensive study of the white bass in Spirit Lake covering the period of 1941 to 1946. From his studies he concluded that since the white bass is a relatively fast-growing, short-lived fish, it should be harvested rapidly. Considering the fecundity of the white bass as more than half a

PLATE 9

SMALLMOUTH BASS *Micropterus dolomieui* Lacépède

NORTHERN LARGEMOUTH BASS *Micropterus salmoides salmoides* (Lacépède)


Maynard Reece

million eggs per female, he questioned if it is advisable to protect even weak or depleted year classes. His conclusion would seem to be correct, for even though the adult population was low in 1946, reproduction was good in the years following.

Yellow bass were rare in Clear Lake prior to 1930, but the white bass were numerous there. Within a short period of time, the population of yellow bass was superimposed over white bass, and they became much more numerous than the white bass. For a period of time it was felt the white bass would disappear entirely, but recently they have again appeared in large numbers. Fluctuations in the population of other fishes in common, but they do not appear as drastic or pronounced as in the case of the white and yellow bass.

Both white and yellow bass are common in the Mississippi River, but the white bass are much more abundant at this time. More and more anglers fish for them, and literally thousands are harvested each year. White bass are probably most abundant in the river north of Dubuque, but excellent fishing is to be found throughout the entire course of the river in Iowa. In former years practically all of the anglers used minnows and other live bait, but more recently fly rods, spinning rods, and very light bait casting outfits have come into use. These fish are fond of moving water and congregate in the mouths of small tributary streams or in the fast flowing water at the outlet pipes through the levees in the pumping districts in the lower reaches of the river. As the sport of white bass fishing increases, there is scarcely standing room in some of the more popular areas at the height of fishing activity.

White Bass

Roccus chrysops (Rafinesque)

Other Names—Silver bass, striped bass, silver fish, streaker.

Iowa Distribution—The white bass reaches its greatest abundance in the Mississippi River, where it is common to abundant. It also ranges from occasional to abundant in some natural and artificial lakes, and in oxbow lakes on the Missouri River. It is taken on rare occasions in the Cedar River drainage and occurs commonly in the lower reaches of the tributaries to the Mississippi, as well as in some eastern Iowa river impoundments. (See Map 73.)

Description—The color of this fish is dark gray to black on the back, with bright silvery sides and white belly. Several dusky stripes or lines run through the body laterally, of which about 5 are above the lateral line. There are 13 or 14 rays in the dorsal fin, and 11 to 13 in the anal fin. The first three spines in the dorsal fin are graduated in length, the first about half the length of the second, and the second distinctly shorter than the third. This character distinguishes it from its closely-related cousin, the yellow bass, in which the anal spines are not so graduated. There are small teeth on the tongue of the white bass which are not present in the yellow bass. The lower jaw of the white bass projects slightly beyond the upper jaw. The fish commonly attains a length of 12 inches, and sometimes reaches a length of 18 inches and a weight of over 3 pounds. (See Plate 8.)

Food Habits—The bulk of the food of the white bass (Ewers, 1929) consists of fish, insects and crutaceans. Young fish live primarily upon Entomostraca and small insects and their larvae. Fish make up the largest per cent of the diet of adult white bass. Sigler (1949) reported that white bass did not feed on carp in Spirit Lake, although carp were numerous there, but he did find them in the stomachs of the white bass (1949b) taken from Storm Lake. In both lakes they fed extensively on pan fishes, especially perch, bluegill and crappies. The young of game fishes other than the pan fish made up only a small part of the diet. Bailey and Harrison (1945) reported the white bass in Clear Lake feeding on small fishes, including the black bullhead. Small crayfish, when available in quantity, are taken to a considerable extent, and emerging Mayflies are eaten to the exclusion of most other foods when the hatch is heavy.

Life History—White bass reproduce in Iowa from late April to the first of June, with the greatest percentage of females spent by the third week in May. They spawn over rock reefs or gravel bottom. Sigler (1949) found that egg counts ranged from 650,000 to 970,000 in the large adult females examined from Spirit Lake. The eggs are small, averaging about .031 inch in diameter. The young attain a length of about 4 to 5 inches the first fall, and 11 to 13 inches at the end of the third year of life. Our fish appear to grow somewhat faster than those reported by Van Oosten (1942) from Lake Erie, but slower than in T.V.A. waters (Howell, 1945) of Tennessee.

Angling—White bass angling enjoys an enviable reputation among Iowa fishing enthusiasts in the larger lakes regions and in the urban centers along the Mississippi River. All manner of means are used in catching these fish. Limit catches are easily obtained when schools are found feeding, and the white bass provides a good substitute for the prized walleye when trolling efforts are slow to yield returns.

Feeding schools of white bass usually run uniform in size. The schools travel just beneath the surface from an hour before dusk until 9:00 or 10.00 p.m. and are frequently found on the quiet shores, although it is not unusual to find them feeding near the surface on the windward side of a lake. Their savage rushes send schools of minnows skipping across the surface of the water. When feeding near the surface the white bass will take almost any bait offered. A spinning rod, fly rod, or light bait casting outfit with spinner-fly, streamer, or large dry fly is very good tackle, and many of the small plugs like the Lazy Ike, Midge-Oreno, etc., are ideal under these conditions. The principal object is to keep the bait close to the surface.

During the daylight hours white bass prefer the deeper waters and are most commonly taken by trolling a minnow-spinner or spinner-fly combination 6 to 10 inches off the bottom. Favorite areas to troll include rock reefs, sand bars, or beds of submerged vegetation.

On the Mississippi River good catches are made in the fast water below the locks and dams, below the submerged rock jetties, and at the mouths of tributary streams or outlets from drainage districts. Live baits, principally minnows, are used more extensively on the river than any other type of bait, but flies and small plugs are effective there, too.

The white bass is not only fun to catch, but it is also a good fish to eat. The flesh is firm and white, and although not on a par with some of the other fishes, it is indeed palatable. The younger fishes are considered better to eat than the very old ones.

Yellow Bass

Roccus mississippiensis (Jordan and Eigenmann)

Other Names—Streaker, black-striped bass, gold bass.

Iowa Distribution—The yellow bass is the most abundant game fish in Clear Lake, and occurs in varying abundance in some natural lakes, oxbows and artificial lakes. It is occasional to common in the Mississipi River. In recent years it has apparently spread from Clear Lake into the upper Cedar River drainage system. It is also common in Hartwick Lake, an impoundment of the Maquoketa River. (See Map 74.)

Description—The color of the yellow bass is dark olive-green above, with silvery to bright golden-yellow sides, and white beneath. There are 6 or 7 dusky prominent longitudinal stripes on the sides of the fish, 3 of which are above the lateral line. The stripes below the lateral line are interrupted or broken toward the tail fin. Scales along the lateral line number from 51 to 55.

The anal fin spines are not evenly graduated as in the white bass. The first spine is scarcely one-third as long as the second, and the second and third are about equal in length. There are no small teeth on the base of the tongue, and the jaws are nearly equal in length. The yellow bass commonly attains a length of about 8 to 11 inches in our waters, which appears to be comparable to sizes recorded elsewhere (Straud, 1947) (Schoffman, 1940). (See Plate 8.)

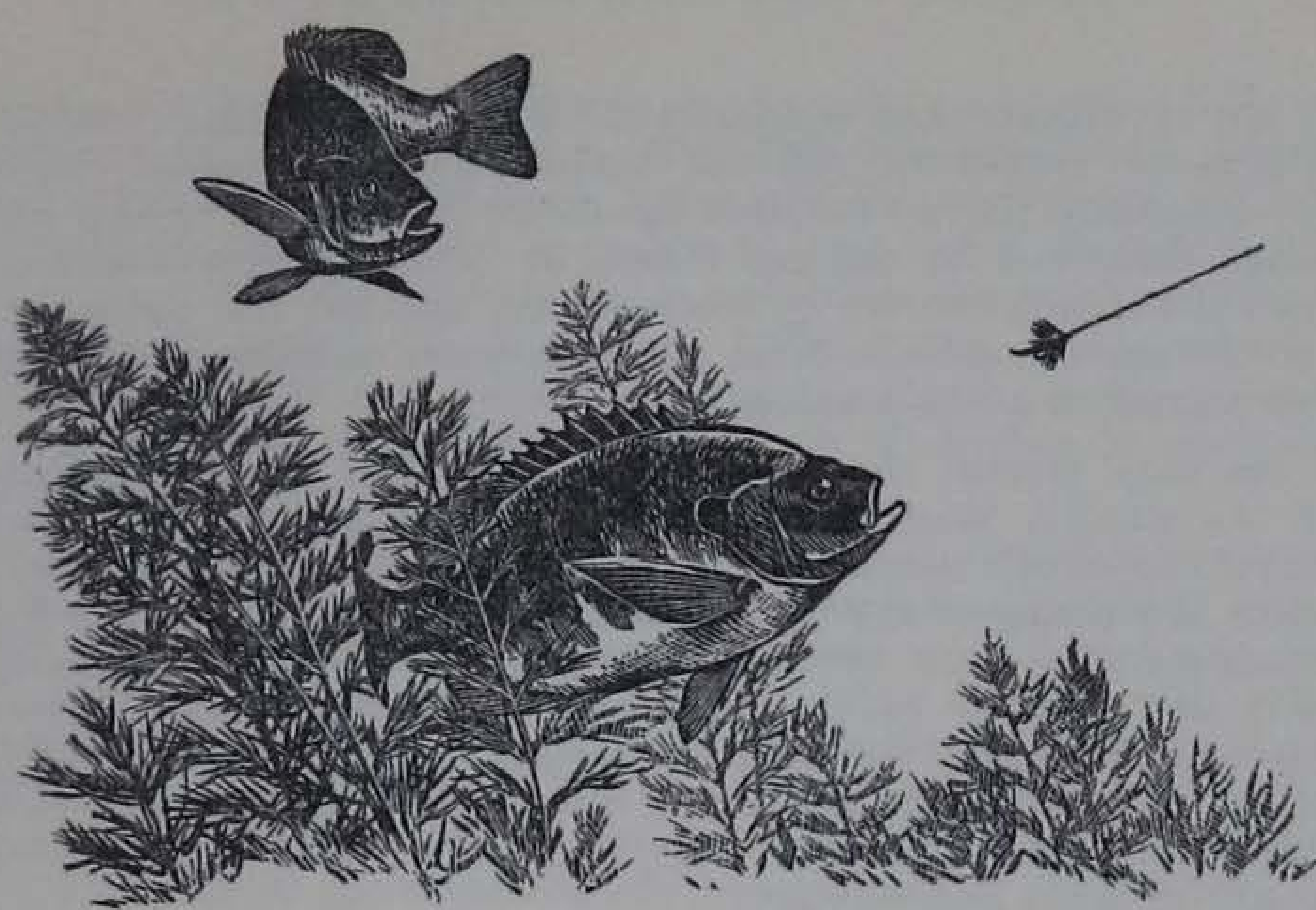
Food Habits—The primary food of the yellaw bass is crustaceans, insects and their larvae, and small fishes.

Life History—The yellow bass reproduce in shallow water in May, spawning over gravel bars and rock reefs. The eggs are extremely small, running from a million and a half to two million to the quart (Burnham, 1909). The fish reach an average length (Lewis and Carlander, 1949) of 4 inches the first year, 7 inches the second, 9 the third, and 10 at the end of the fifth year of life. They reach maturity in the third year, and a few individuals reproduce at two years of age.

Angling—In Iowa yellow bass are taken largely on live baits. Minnows and cut bait are most often used, although good catches are made with worms and nightcrawlers also. Fishermen usually troll slowly until a school is located, then drop anchor and still-fish for them. Some anglers use a spinner-minnow, small daredevil, or spinner-fly combination in trolling. Mid-afternoon or early evening usually nets the best results, although "rafts" of boats can be seen on the lakes at any time during the daylight hours when yellow bass fishing reaches its peak in the spring and early summer. Fishing slackens during hot weather but usually picks up again in September and early October.

An ever-increasing number of anglers are using fly rods, spinning rods, and lightweight tournament rods to catch yellow bass. These fish are small but quite gamy, and are real sport on light tackle. In the early spring and in the early evening during the summer, the fish come into shallow water to feed and can be taken with facility with streamer flies, small spoons, wet and dry flies, and a number of different lures. They nearly always travel in schools, and once a number of fish are located, several can be taken in no time at all. Occasionally the yellow bass feed near the surface, especially if a hatch of insects is on the water. At this time dry flies, popper bugs, and other surface lures are most effective. Usually, however, they feed considerably below the surface, hence deeper running baits give best results.

The flesh of the yellow bass is considered better than that of the white bass, more nearly resembling the yellow perch. It is a solid, firm little fish and the flesh is white and flaky. It is delicious either pan-fried or cooked in deep fat.



Chapter XII

SUNFISH FAMILY

Centrarchidae

The sunfish family is a group of spiny-rayed fishes native only to the North American continent. Of the 25 recognized species, 11 are native to Iowa waters. The sunfishes fall logically into three major groups, the black basses, the true sunfishes, and the crappies (including the rock bass). They are represented in our state by two black basses, six sunfishes, and three crappie-like forms. The only similar spiny-rayed fishes in this state are the members of the perch family, the bass family, and the fresh-water drum. In the sunfishes the front part of the dorsal fin contains the spines and is continuous with the posterior or rear portion of this fin. This characteristic distinguishes the sunfishes from the perch family, which have two distinct fins on the back, the spinous and soft dorsal fins. The sheepshead can be separated from the sunfishes by the continuation of the lateral line through the tail fin. From the white and yellow bass the sunfishes are most easily identified by the poor development of the false gill (pseudobrachium) on the inside of the gill cover.

All but one or two of the sunfishes are large enough to be of importance to the angler. The smallmouth and largemouth bass are highly prized, and the sunfishes, especially the bluegill, not only furnish sport for the fishermen, but a considerable amount of food for the game fishes.

All of the sunfishes, which reproduce in the spring or early summer months, are nest-builders. Some of them are colony builders, constructing their saucer-shaped nests in such close confinement that they almost meet, while others seek more secluded places. Some prefer cool running streams and others quiet, warm, mud-bottom ponds or lakes. Many are carnivorous and feed voraciously upon other fishes or even upon their own kind, and a few are content to retire to the dark recesses of weed beds and live placidly on insects. Because of this wide variety of habitat preference, some kinds of sunfishes are found in virtually all waters of the state. Collectively, they make up a substantial proportion of the game and pan fishes in most lakes and streams. By and large the smallmouth are most abundant in the streams, largemouth prefer the quiet waters of lakes and large rivers, crappies are found in both moderate to large streams and lakes, the white crappie being more tolerant to turbid waters than the black, green and orange-spotted sunfishes seem to be everywhere, but bluegills are most numerous in lakes, ponds, and the backwaters of the large rivers.

Most of the sunfishes are pugnacious, sometimes hiding behind rocks or submerged logs or suspended off the bottom in open water, but always on the alert for a passing fish or helpless insect on the surface of the water. They are not easily disturbed by falling leaves or other foreign materials, but let an insect or other choice morsel of food appear, and not one but usually several fish rush to the scene, and the first there devours it with a quick gulp while the others sulk back to await another chance.

Possibly the bass attract the most attention of the elite of the angling fraternity, but the smaller members of the sunfish family are pursued more diligently by the hordes of commoners. From early spring until the middle of June, the time the young-of-the-year fishes supply the bulk of the food needed, crappies dominate the catch of Iowa anglers. Everything in the book, from the cane pole and minnow to the most expensive imported trout rod, is used by enthusiastic and usually successful anglers. Bass are a special prize, and everyone loves to catch them, but when the smallmouth refuses to strike the most deftly-presented fly, the rock bass is an acceptable substitute in streams and the bluegill in lakes and ponds.

Smallmouth Bass

Micropterus dolomieui Lacépède

Other Names—Black bass, smallmouth, Oswego bass, bronzeback, redeyed bass.

Iowa Distribution—Aside from its presence in a few natural and artificial lakes, the smallmouth is confined primarily to the less turbid, flowing waters of central and eastern Iowa. The species varies in abundance according to habitat and time of year. It is common to abundant in some small spawning streams and rare to occasional in most major river collections. Its presence in southern Iowa waters is usually the result of intensive stocking. Since impoundment, it has been vastly reduced in the Mississippi River. (See Map 75.)

Smallmouth bass prefer the cool clear water of the better streams and deep lakes. Excessively muddy bottoms are unfavorable, since these fishes prefer gravel and rock areas to feed and reproduce. Lakes under 100 acres and less than 20 to 30 feet in depth are not considered ideal. The small tributary streams serve as natural hatcheries in Iowa, and spawning bass ascend these streams in April and early May to reproduce.

Description—The smallmouth is frequently confused with the largemouth as they are quite similar in appearance. The color is golden-green on the sides and back with faint wavy olive color blotches (especially pronounced on fish taken over light sandy bottoms or subjected to sudden temperature or oxygen change) fading to gray or bluish white on the belly. There are 5 olive-green bars radiating backward from the eye, and one forward to the end of the snout. There are from 14 to 18 small scales in a row across the cheek of the smallmouth and only 9 to 12 on the largemouth. The scales in the lateral line of the body number from 68 to 80. The mouth of the smallmouth is considerably smaller than that of the largemouth. In the smallmouth the maxillary or upper jaw extends about to the center of the pupil of the eye, but the maxillary of the largemouth extends beyond the eye. (See Plate 9.)

Food Habits—Staple foods of adult smallmouth bass include fish, crayfish, and the larger insects. In a study of the food of smallmouth in Iowa (Tate, 1949), fish were contained in about 40 per cent of the stomachs of the bass, crayfish in 30 per cent, and insects in 20 per cent. Newly-hatched fish (Wickliff, 1920) feed upon minute animals called copepods and cladocerans. As the bass increase in size, small insects are taken, gradually larger insects and small fishes are eaten. The food items that predominate in the successive growth of smallmouth bass (Hubbs and Bailey, 1938) are as follows: (1) copepods and cladocerans, (2) insects, (3) fish, (4) crayfish and (5) finally, fish again. Differences in the rate of growth of bass (Cooper, 1937) are correlated with differences in the volume of food consumed.

Life History—In most Iowa waters smallmouth bass reproduce during the first ten days to two weeks in May. The fish are inactive in winter, but in early spring often migrate up small tributary streams to spawn. Some fish spawn in the main streams, but probably the majority ascend the tributaries for this purpose. The actual spawning activities commence when the water temperature reaches about 60° to 65° F. The males construct the nests, or redds as they are sometimes called, on gravel, coarse sand, or rock bottom. They are saucer-shaped depressions from 14 to 30 inches in diameter, fanned out by vigorous movements of the tail fin.

When the nest is completed, the male selects a "ripe" female and drives her to the nest by nudging her with his snout or actually biting her about the head or body. The female often refuses to remain on the nest and swims away to deeper water. In this case the male pursues her and the pair return to the nest. After several unsuccessful attempts, reproduction takes place. To quote from the authoritative book *The Small-Mouthed Bass,* by Hubbs and Bailey (1938), "During the egg laying the fish lie side by side usually facing in the same direction with the head of the male slightly behind that of the female. He retains a normal upright position in the water while she drops to the bottom and assumes a semi-recumbent position. The female seems to become rigid just before the eggs are emitted, then rapidly vibrates her body and fins, especially the partly-depressed dorsal (fin), during the actual extrusion of the eggs."

Usually several attempts are made before the eggs are all deposited in the nest. As the eggs are emitted by the female, the milt is emitted from the male. The eggs deposited in the nest, the female retires to deep water. She may ripen again and mate with the same male or another. Likewise the male may again ripen in a day or two and remate with a female adding more eggs to his nest. In all cases females are driven away from the nest after spawning activities are complete, and the male assumes the duties of caring for the eggs and the young.

Respawning and renesting activities of the bass are of great advantage, since nests are often destroyed by sudden freshets or the eggs devoured by predators of various kinds. The number of eggs in each nest will vary greatly, depending upon many factors such as the size of the parent fish and the number of times the male reripens and spawns with other females. For this reason nests will contain as few as 200 eggs or as many as several thousand. New York investigators (Needham, 1920) found females to produce from 2,000 to 7,000 eggs per pound of fish, and other investigators (Surber, 1943) have found average nests to contain about 2,000 eggs. The eggs of the female do not all mature at the same time, hence are not all deposited at once but rather on a rise in water temperature at different intervals (Langlois, 1933).

The eggs hatch in from 3 to 5 days, and at first the young drop into the crevices in the rocks and can not be seen. From about 6 to 15 days after the eggs are deposited, the fry rise over the nest as a school. They are nearly black in color at this time. They move about rather slowly until the nourishment in the yolk sac is absorbed. At this time the young are about one-half inch long. They leave the area of the nest in about a week after they have hatched and feed upon tiny water animals called crustaceans.

By the first fall smallmouth bass fingerlings reach a length of from 3 to 4 inches. At the end of the second fall they average about 7 inches (Beckman, 1947) and in the third fall they reach 9 to 10 inches. Water temperature, abundance of food, turbidity, space, and many other factors will enter into the picture of growth, and fish from some waters will grow much faster than those from other waters.

Smallmouth bass mature in the second or third year of life normally. Eschmeyer (1940) found almost all two-year-old bass in T.V.A. waters of Tennessee to be mature. Bennett (1938) in a study of smallmouth bass from 17 Wisconsin lakes found them to reach a length of 10 inches in the third summer in only two lakes, 10 inches in the fourth summer from eight lakes, and that it required five summers to attain 10 inches in length in seven of the lakes studied. While fish in our more southern waters grow somewhat more rapidly, the Wisconsin data does show the variation of growth-rate in different waters in the same region.

Smallmouth bass have been known to attain a weight of about 5 or 6 pounds or more, but fish of over 3 to 4 pounds are rare in most waters.

Angling—Smallmouth bass are one of the most-prized game fishes in Iowa waters. Detailed information will be given in the chapter on angling, but we can not resist a few words concerning this king of all stream fishes. When bass are on a feeding spree they will frequently take almost anything presented to them, but there are also times when the most experienced angler returns home with an empty creel. Once the old bronze-back strikes, however, it seems as if a miniature atomic bomb had burst in midstream, and the savage rushes and aerial leaps that follow reward those who spend the many patient hours in pursuit of the prize. We shall never tire of the oft quoted statement from Dr. A. J. Henshall's *Book of the Black Bass*: "He is plucky, game, brave and, when hooked, unyielding to the last. He has the arrowy rush and vigor of a trout, the untiring strength and bold leap of a salmon, while he has a system of fighting tactics peculiarly his own. I consider him inch for inch and pound for pound, the gamest fish that swims."

Smallmouth bass are taken in our waters on both live and artificial baits. Live bait fishermen usually use a 4- to 5-foot bait casting rod, level-wind reel, 9- to 12-pound test line, gut leader, and hooks from No. 4 to No. 2 in size. Baits include nightcrawlers, frogs, chubs, minnows, hellgrammites, and even such items as field mice. A few anglers still-fish with live baits, but most of them either cast the bait into likely places and retrieve it or permit the bait to drift downstream under logs and brush piles, over rock riffles, etc.

Spinning outfits and extremely lightweight casting rods of tournament style are very popular with many anglers. With this type of equipment lightweight lures like the spinner-minnow and spinner-flies, rudder-headed flies and lures, quill-minnows, metal spoons, Lazy Ike and other small wooden and plastic plugs, and small surface baits can be used very effectively. In using this type of equipment the anglers can fish either up or down and across stream and are not bothered too much with overhanging brush or trees.

Fly casting is a time-honored method of bass fishing and perhaps has more devotees than any other method. Although every conceivable type of lure is used for smallmouth, most of them fit into a few categories including dry flies, wet flies, hair and feather streamers, spinner-fly combinations, spoons and small plugs, and one of the most effective, the various floating and popping bugs which include hair frogs, hoppers, cork and hair-bodied bugs, etc.

It is almost impossible to tell the angler what kind of bait to use. Experimentation on the stream will be your best guide. By and large the spinner-fly combinations are good early in the season, the surface lures and poppers in hot weather, dry flies when there is a hatch of natural insects upon the water, and the streamers and wet flies are good at all times of the year when the water is not too turbid. The novice had best go fishing with an experienced local angler first. He can later vary his technique and tackle to suit his fancy after some of the cardinal points have been learned.

The smallmouth will often hide on the downstream side of a large rock, log, or other obstruction. He is less apt to be disturbed if approached from the rear, hence we usually fish upstream. Cast your fly or lure so that it lands well above the point where you expect the fish to be, and maneuver it so it will drift close to the hide. Dry flies should be allowed to drift with the current, but keep the line taut so you can set the hook fast at the slightest indication of a strike. Wet and streamer flies represent the immature stages of insects, or minnows in the case of streamers, and should be retrieved with short jerky motion.

Fish are wary of movement, so wear drab-colored clothing and guard lest your shadow be cast across the stream ahead of you. They are also sensitive to shock and vibrations in the water and for this reason, in the stream or on the bank, one must walk with care to avoid unnecessary noises, crunching gravel, or stumbling over loose rocks.

In boat fishing for smallmouth in streams, it is necessary to fish downstream in most cases. Casting is usually done down and across stream. Don't pass up the holes immediately below rock riffles, snags in the stream, brush piles, or a rocky shore line.

Smallmouth feed at all times of the day and often at night, but the early morning, late afternoon, and twilight hours will do if you can't spend the entire day on the stream.

Northern Largemouth Bass

Micropterus salmoides salmoides (Lacépède)

Other Names—Largemouth, black bass, green bass, Oswego bass, slough bass, lake bass.

Iowa Distribution—The largemouth is primarily a fish of lakes and ponds where it varies in abundance from occasional to common. In the inland rivers it is taken occasionally in flowing waters, preferring the oxbows and overflow ponds. It is quite common in the river lakes, sloughs and ponds of the Mississippi River, and is one of the two species recommended for stocking in the thousands of Iowa farm ponds. It has not been taken in our collections from the Missouri River proper, although it is not uncommonly found in the oxbow lakes and sloughs adjoining the main river. (See Map 76.)

In combination with bluegills it is used extensively in stocking farm ponds (Hull, Wilcox and Speaker, 1950) in the central and southern part of Iowa. Investigators (Swingle, 1943, 1950; Bennett, 1943; Krumholz, 1950; Tulenko, 1944; Edminister, 1947; and others) have found the largemouth useful in stocking small lakes and ponds. Hubbs and Lagler (1941) list the original range of this fish from southern Canada (Manitoba to Quebec) throughout the entire Great Lakes system and Mississippi Valley to northeastern Mexico and Florida, and north along the Coastal Plain to North Carolina. It has been since introduced widely throughout the country, and to several regions abroad.

Description—Several characteristics are helpful in distinguishing the largemouth from the smallmouth bass. The color of the largemouth, although variable, is usually dark green on the back, becoming lighter on the sides and mottled with darker blotches. There is usually a dark band or streak along the side of the body, consisting of irregular patches. This line is less distinct in older fishes. The belly is greenish-white, sometimes tinted with yellow or pink. The dorsal fin is almost divided, and the soft portion of this fin contains from 12 to 13 rays. The upper jaw extends beyond the rear of the posterior margin of the eye when the mouth is closed. There are from 9 to 12 scales in rows across the cheek. There are from 58 to 68 scales in the lateral line along the body. The color of the eye is usually gold and lacks the red often found in the smallmouth. (See Plate 9.)

Food Habits—Primary foods of the largemouth include fish, crayfish, insects and frogs. When first hatched small bass feed largely upon tiny water animals called Cyclops, Daphnia, etc. As the bass increase in size they add insects to their diet and still later in life include small fishes. Fish are important in the diet of adult bass and often constitute as much as 60 per cent (Couey, 1935) or more of the total volume. Snails, water beetles, and other animals are taken regularly as items of food by the largemouth. Crayfish are extremely important foods and often make up a substantial part of the whole. A wide variety of foods (Webster, 1942) are taken by bass, and in some areas (Dendy, 1946) the gizzard shad is most important in the diet of the bass.

Fish culturists (Weibe, 1935; Swingle and Smith, 1942; Surber, 1948; Langlois, 1935; Meehean, 1936) have fertilized hatchery ponds to increase the production of tiny aquatic animals and have been successful in producing more bass of a larger size. This method of increasing the food supply is also used for species other than largemouth bass, and is common practice in Iowa fish hatcheries.

Life History—Reproduction of the largemouth is quite similar to that of the smallmouth, which is described in considerable detail elsewhere in this chapter. The largemouth spawn from early May into June. Usually they prefer to deposit their eggs on rootlets of submerged plants or grass, on aquatic vegetation, or often on mud bottom. Usually the nests are much less elaborate than those of the smallmouth, and often there is little actual effort to construct a nest at all. In lakes and ponds the fish move into shore and spawn in water from a few inches to 3 or 4 feet in depth. Occasionally nests have been observed in deeper water, but the average in our state would be between 18 inches and 3 feet.

A slightly higher water temperature is required for successful reproduction by the largemouth than for the smallmouth. Usually the water is between 63° and 68° F. when activities commence. The eggs, which may run from 2,000 to 26,000 (Eddy and Surber, 1947), hatch in from 3 to 6 days. The young fish reach a length of from 3 to 5 inches by the first winter. At the end of the second growing season they average about 7 to 10 inches in length. Three-year-old largemouth bass are frequently 12 inches or more in length. This is particularly true in Spirit, Clear and other rich Iowa lakes.

In the southern states, the largemouth bass has been known to attain a weight of over 22 pounds (Caine, 1949). In northern waters they are much smaller; however, from Iowa several specimens have been taken weighing between 9 and 10 pounds.

Angling—In Iowa, bait casting is probably the most popular method of fishing for largemouth bass, although fly rods, spinning rods, and even cane poles all have their advocates. Early June through October are considered the best months for bass fishing, even in areas where fishing is continuous throughout the year.

Prior to the advent of superior grade tubular steel and glass bait casting rods, the split bamboo was the favorite of all bait casters. Today there are strong arguments for various types of rods and reels used in this fine sport. While we do not wish to take part in these arguments, we do feel that whatever your choice of equipment may be, it should be of excellent quality, if you are to get the most fun out of fishing. One-piece rods are rather bunglesome to transport, but are mighty sweet to use.

As reels are made in virtually every price range, size, color, material and description, the angler may make his own choice. Some prefer the so-called tournament type reel with small line arbor and without the level-wind device; others prefer more complicated reels fully equipped with all the gadgets. For all-round fishing, the level-wind performs admirably, especially since the heavy spools have given way to those of lighter materials which enable much lighter baits to be cast over suitable distances. Since most bait casting is done within a radius of from 50 to 80 feet of the angler, accuracy is much more desirable than phenomenal distance.

The question of lines and leaders is almost as controversial as that of rods and reels. For most bass fishing in this part of the country, a good line of from 9- to 12-pound test will suffice unless you wish to "horse" the fish right in. In this case you should use 15- or even 25-pound test lines. Many anglers will differ with this opinion, but usually 10 to 14 inches of level gut, nylon, or synthetic leader will suffice in bait casting.

Because bass are fished in almost every conceivable type of water, at all times of the year and under every known condition, there are more baits and artificial lures manufactured for bass than for any other fish on the continent. Spinner-fly combinations of many styles are available, as are underwater wooden, metal, and plastic baits with wobbling and swimming action to simulate the movement of swimming fish or crayfish; surface lures representing crippled fish, frogs, large bugs, etc.; harnesses to preserve the physical character of various live baits; and automatic gadgets that eject hooks at the time of the strike. Few materials or colors are left that have not been incorporated into baits now available to the bass angler. While many of these baits are constructed to attract the angler, not the fish, most of them do have merit and have been known to catch fish. Many an angler takes pride in exhibiting huge bait boxes stuffed with every known lure. He feels he is prepared, no matter what the wary fish may desire on any particular day. This self-satisfaction should not be denied him. Actually if the fisherman is equipped with a few baits of the surface, underwater, and spinning variety, he is prepared to catch bass under most conditions. At times large baits may get results when small baits fail, but for the most part small baits weighing from ⅛ to ½ ounce are sufficient to take the largest bass in the lake.

Bass feed almost constantly and may strike at any time, even during the night or in the heat of the day, but early morning and evening hours are usually considered to offer the best opportunities for catching bass. The most consistent results are obtained from about two hours before sundown until two hours after dark. In cool, cloudy weather the time of the day does not seem of much importance, but on quiet, hot, sultry days large bass can be lured in mid-afternoon from their haunts among the water plants by surface lures of the popping, plunking, and splashing kind. Of course, final results depend primarily upon locating the feeding bass and presenting the bait correctly.

Some anglers prefer to fish from shore, casting laterally along the shore line in rocky or weedy areas or into open spaces in rush fringes. Others prefer to fish from a boat, in which case they fish toward shore from an easy casting distance of some 15 to 20 yards. In boat fishing, casts are also made parallel to weed beds, in open spaces in large beds of submerged and emergent plants, and around stumps, submerged logs, and brush piles. A little experimenting with "type" baits will usually tell the angler what bait to use. If bass are not striking underwater spinners or plugs, try a surface lure. Live baits, either fished still or cast like an artificial lure will sometimes produce results when everything else fails. Live baits commonly used include chubs, large minnows, frogs, crayfish, and worms.

Fly-fishermen are as versatile as bait casters when it comes to catching bass. They, too, have a wide variety of surface and underwater lures. Cork body "bugs," large hackle flies, feather and hair streamer flies are effective killers for bass. Like the bait caster, the fly-fisherman may fish from shore or from a boat. Usually when fishing from shore he wades out into the water to gain distance and to get away from shore obstructions in the back cast. Ordinarily it is not necessary to cast great distances, provided the angler approaches the likely spots carefully. Feeding bass usually work along the shores, especially in the evening, at distances not to exceed 50 to 100 feet from the bank. When using floating bugs and flies, the lure is allowed to rest a few seconds on the water before the retrieve is made. It is then recovered with short, twitching movements, allowing it to come to rest at intervals. Streamer flies are fished wet or under the surface either with or without a small weight, depending upon the depth at which the fish are feeding. The fly is permitted to sink and is then retrieved in short quick movements to simulate a swimming fish. Wet flies, which usually represent the immature stages of aquatic insects, are also fished under water and retrieved in short jerky movements to represent the rather feeble mobility of the larval forms they represent.

Spinning is gaining in popularity in this country because of the comparative ease with which the equipment can be employed, the wide variety of conditions to which this type of angling can be adapted, and the small size of the baits the equipment will handle over considerable distances. Depending somewhat upon the type of equipment used, baits of a fraction of an ounce can be cast by the amateur as far as baits of much larger size with the bait casting rod. A powerful rod of about 7 feet in length is ideal for spinning, and the European type reel is usually preferred because of its simplicity. Some reels of American manufacture, however, are popular, especially if regular casting rods are used.

Spinning, in the true sense, is not a common art in Iowa, and miniature models of regular bait casting lures are substituted for most old-world baits. Baits consisting of streamer flies constructed of feathers and hair attached to No. 2 or No. 3 willow-leaf spinners, midget models of popular bait casting plugs, the popular Lazy Ike, and special devices are widely used for bass. Harnesses for frogs and special double hooks constructed and attached to minnows to make them actually spin as they are retrieved are also commonly used with good success.

In spinning, anglers use about the same methods as those employed in regular bait casting. Because of the ease with which the lure can be cast, however, much greater distances can be achieved. Occasionally surface baits and poppers are used, but in the main anglers fish underwater lures when using spinning equipment.

Warmouth

Chaenobryttus gulosus (Cuvier)

Other Names—Warmouth bass, wood bass, mud bass, weed bass.

Iowa Distribution—This is essentially a lake or pond fish. The collections on the rivers, both inland and Mississippi, were made either in overflow ponds or river lakes. Nowhere in these locations is it found more than rarely. In some artificial lakes the warmouth appears occasional to common. (See Map 77.)

Description—The warmouth is a stocky, wide-mouthed, red-eyed sunfish strongly resembling the rock bass and often confused with it by many anglers. It can be easily distinguished from the rock bass by the 3 spines in the anal fin. The rock bass has 6 spines in this fin. The color of the warmouth is olivaceous to gray, with clouded or mottled markings on the sides and back. The sides have a golden color with emerald reflections, giving it a brownish appearance. There are from 39 to 43 scales in the lateral line of the body. The patch of small teeth on the tongue distinguishes it from the other sunfishes. (See Plate 5.)

Food Habits—Young warmouth bass feed on insects, and as they become larger add minnows and small fishes to their diet. They also feed quite extensively upon snails and small crustaceans they find on the heavily-vegetated areas the fish inhabit.

Life History—The warmouth is a nest-building fish, and its habits of reproduction are very similar to that of the bluegill and other sunfishes more fully described elsewhere in the text. The fish attains a length of about 1½ to 2 inches the first year and reaches a length of about 8 to 10 inches. They mature in the third year of life. More than any of the other sunfishes, the warmouth has a strong preference for weedy mud-bottom areas and is found largely in the quiet backwater lakes of the Mississippi River.

Angling—No special effort is extended to catch warmouth, since they are not abundant anywhere in our state. They are often taken by anglers fishing for bluegills and other sunfishes. They are most often taken on worms, flies, or small minnows, but they probably constitute less than one per cent of the sunfish catch in the overflow lakes in the Mississippi River flood plain. They are edible but are not considered as good as the rock bass or bluegill. Perhaps they could be likened more to the green sunfish in flavor.

Green Sunfish

Lepomis cyanellus Rafinesque

Other Names—Rubber tail, green perch, sunfish, sand bass.

Iowa Distribution—The green sunfish is the most universally distributed member of the sunfish family. It reaches its greatest abundance in both natural and artificial lakes, where it is common. It is occasionally found in the large and medium-sized streams, and rarely taken in the smaller creeks. Quiet or pooled waters are an ecological requirement for the species. (See Map 78.)

Description—This little sunfish is often mistaken for the bluegill, especially in the immature stages of life. Like the warmouth and rock bass, its body is rather short and stocky. The color is olive-green, with a yellowish-copper or brassy tint on the lower sides and belly. The scales are tipped with emerald, which gives the appearance of rather distinct rows. All of the fins, and especially the dorsal, anal, and caudal or tail fin, are dusky in color. The tail fin is often edged with an orange or yellow band. There are 45 to 49 scales in the lateral line along the body and 7 to 9 rows of scales on the cheek. (See Plate 1.)

Food Habits—The food of the green sunfish is largely insects, small crustaceans, and small fishes.

Life History—The green sunfish, like the bluegill, nests in colonies in shallow water near the shore. They breed over a long period from May through August, but the height of the spawning takes place in the first three weeks in June. Small saucer-shaped nests from 6 to 15 inches in diameter are constructed by the male fish. Small territories are set up by the males, but as many as 25 nests have been observed in an area of 50 square feet. There is considerable fighting among the males during the actual breeding season, but once the eggs have been deposited in the nests there is little disturbance except when one of the fish overshoots his mark and glides too close to his neighbor's doorstep. The fish attain a length of an inch to an inch and a half the first season, and most individuals mature at 2 years of age. They have been known to reach a length of about 10 inches although most fish in our waters seldom exceed 6 or 7 inches. They reproduce from 3 inches in length upward.

Angling—These little fish may well be considered the small boy's fish in our state. They seldom reach a size attractive to most adult anglers, although when as large as bluegills they are equally acceptable. Most of them are taken on worms, hoppers, or crickets or accidentally by anglers fishing bluegills with artificial flies.

Pumpkinseed

Lepomis gibbosus (Linnaeus)

Other Names—Common sunfish, round sunfish.

Iowa Distribution—This colorful species reaches its greatest abundance in the natural lakes where it is taken occasionally. It appears rarely to occasionally in some artificial lakes, and very rarely in the inland rivers. In the Mississippi River lakes and ponds it ranges from rare to occasional. (See Map 79.)

Description—The pumpkinseed resembles the bluegill in shape and size. It often hybridizes with the bluegill and occasionally with the green sunfish, thus making identification of these crosses difficult. The color is pale olive with purplish horizontal bars on the sides, and the scales have brown and emerald reflections. There is a bright red, semicircular spot on the margin of the operculum or gill cover. The belly is olive to orange-yellow, and there are 6 or more wavy bars of emerald or turquoise blue on the cheeks and gill covers, interspaced with gold or copper over the olive background. This is truly a beautiful, brilliantly-colored fish. The pectoral fins are long and pointed. There are from 36 to 40 scales in the lateral line of the body, and only about 4 rows of scales on the cheek. (See Plate 1.)

Food Habits—The food of the pumpkinseed is largely small mollusks, insects and occasionally fish.

Life History—The breeding season of the pumpkinseed is almost identical with that of the bluegill. The males construct saucer-shaped nests in colonies in shallow water, and reproduction takes place from May into July, with the height of activity in June. Several thousand eggs are deposited by one or more females in the nests, which are guarded by the males until incubation is complete. This requires from 5 to 10 days, depending upon the temperature of the water. The young reach a length of about 1½ to 2 inches the first year, and adults grow to about 8 to 10 inches. They mature in the second year of life. Three-year-old fish usually attain a length of from 6 to 8 inches.

Angling—The pumpkinseed is not too important to anglers in most areas because of its scarcity, but in Clear Lake, the Okoboji lakes, Arrowhead Lake, the Mississippi River, and elsewhere they are regarded as excellent pan fishes, even though they do make up only a relatively small percentage of the total sunfish harvest.

Most often these fish are taken together with bluegills, since they are found in a similar habitat. They prefer sand bottom or weedy areas where their food is abundant and they are protected from their natural enemies. Still-fishing with worms, grasshoppers, and other small live baits is productive, but it is much more fun to catch them on small dry flies, cork-bodied "bugs," or standard wet fly trout patterns. They are willing to strike any time of the day. Some of the best fishing is to be had in late afternoon in open holes of weed beds or in open water a short distance from shore. Along with the bluegills and crappies, they rise just before dark to the evening hatches of flies. At this time either a bi-visible dry fly or small foating bug on No. 8 to No. 10 hook is tops. In midday wet flies fished deep at the outer edge of weed beds are more productive. The flesh of this fish is excellent and is considered equal or superior to that of the bluegill.

Bluegill

Lepomis macrochirus Rafinesque

Other Names—Sunfish, sun perch, bream, pumpkinseed, blue sunfish.

Iowa Distribution—The bluegill is the most abundant member of the sunfish family. It is the most commonly stocked fish in the state's farm-pond program, and ranks as abundant in most of the natural and artificial lakes and reservoirs in the state. It is rare in western Iowa inland rivers and occasional in those of the east. In the Mississippi River it ranges from very abundant in the north to common or occasional in the southern reaches in Iowa. It also rates as common to abundant in the Missouri River. (See Map 80.)

Description—Probably none of the sunfishes varies so widely in color as does the bluegill. The over-all coloration is from pale blue to bright orange, depending largely upon the waters from which it is taken. In general the bluegill in most of our waters is light to dark olive, with a luster of lavender on the sides. The gill covers are sometimes bright blue, whence the fish gets its common name. There are 6 to 8 fairly distinct vertical darker bars on the sides of the fish. The throat is often bright orange or yellow, and this coloration frequently extends backward toward the tail. There are brown, copper, green, and turquoise reflections on the scales of the body, and the over-all appearance of the fish may be any one of these colors. There is a black flexible tip on the opercular or ear flap which has no margin of other colors. There is a dark blotch on the median portion of the last rays in the soft portion of the dorsal fin. The pectoral fins are long and pointed like the pumpkinseed. There are 38 to 45 scales in the lateral line along the sides of the body and 5 rows of scales on the cheeks. (See Plate 5.)

Food Habits—The food of the bluegill consists largely of insects and their larvae. Throughout their entire life they feed upon minute plant and animal life in the water, but as they increase in size these small animal forms become less important in their diet. Fresh-water shrimp, small crayfishes, snails and insects, principally Mayflies, damselflies, midge, etc., make up the bulk of their diet. They feed upon these aquatic invertebrates during most of the active growing season (Ball, 1948), but turn to plant food to supplement or replace the animal food during the midsummer season, when the supply of these animals reaches its lowest point of the year.

Life History—Bluegills reproduce over a considerable length of time, and spawning activities have been observed from June through July and even into early August. Under most conditions, however, the height of the spawning activity is in June. The nests are constructed by the males in water from 12 to 40 inches in depth, usually on sand beaches or gravel bars near shore. They are saucer-shaped depressions from 1 to 2 feet or more in diameter, usually constructed in close proximity to each other. It is not at all uncommon to find 40 to 50 nests in a radius of 60 to 70 feet of shore line. The nests resemble miniature volcanic craters that have been weathered away close to the ground. They are not deep, averaging perhaps 2 to 6 inches, but there is a rim around each nest where sand, silt and debris have been brushed out by the fanning action of the tail fin of the male fish. Every stone in the bottom of the nest is clean and free from all foreign material.

Once the nest is completed, a process that may take several busy days, the male finds the lady of his choice and nudges her over it and spawning takes place. Like the bass, all of the eggs are not emitted at one time. These little fishes are polygamous, and the eggs of several females may appear in a single nest. The male, however, rarely leaves the nest for more than a few seconds nor moves any distance from it for fear another fish will occupy it. Once the spawning is completed, the male fish stays home and tends to the family duties of keeping the eggs clean by gentle motion of the fins. If an intruder comes too close, he will rush at it and drive it to a safe distance away.

The fry are zealously guarded by the male. A 4-ounce bluegill at the Fairport station (Culler, 1938) produced 12,000 eggs, larger fish up to 27,320. Investigations in Michigan (Carbine, 1939) revealed the number of fry from a single nest varied from 4,670 to 61,815, with an average of about 18,000 individuals. Since nearly all carnivorous fishes prey upon the bluegills, the high productivity is probably nature's way of perpetuating the species.

Growth is rather slow, and by the end of the first season most bluegills in our state run from about an inch to 2½ inches in length. They are sexually mature in their second, rarely third, year of life, and attain a maximum length of about 12 inches and a weight of a little over a pound. Fish of this size, however, are unusual, and in most waters adults average from about 7 to 9 inches. Beckman (1941), in a study of over 4,000 bluegills, found the average fish reached 6 inches in length in their fourth year of life in the lakes of Michigan. From these studies it was learned a bluegill 6 inches in length weighed about 2½ ounces, an 8-inch fished weighed nearly 6 ounces, and a 10-inch fish weighed about 12½ ounces. In a later study (Beckman, 1949), he found there were slightly fewer males, 45 per cent, than females, and that the average fish grew from a length of 3.1 inches the first year to about 8 inches the tenth. These

PLATE 10

LAKE STURGEON ***Acipenser fulvescens*** **Rafinesque**

SHOVELNOSE STURGEON ***Scaphirhynchus platorynchus***
(Rafinesque)

PADDLEFISH ***Polyodon spathula*** **(Walbaum)**


Maynard Reece

studies were based on over 8,000 specimens taken from 153 lakes. In a study of 56 Indiana lakes, Ricker (1942) calculated the average length at 3 inches at the second annulus and 9.2 inches at the seventh.

Angling—The bluegill has not received the attention from the anglers in this state that it has elsewhere and that it justly deserves. It is usually considered a child's fish, and until fly rods became more popular only a relatively few people actually enjoyed the princely sport of catching it. It is one of the finest eating fishes that swims, and if it grew to a weight of 4 or 5 pounds deep sea fishing tackle would be required to land it! It does reach a length of from 7 to 10 inches in most of the larger lakes and in the Mississippi River, and there is no excuse for its low priority on the fish list.

Always hungry, the bluegill accommodates the anglers at any hour of the day. Tackle requirements are simple, and the willow pole and bent pin are sufficient, although standard trout equipment is much more fun, once the simple art of dry fly fishing is mastered. One can not appreciate our sentiments until he has encountered a school of feeding fish rising to tiny midgeflies on the surface of placid waters just at dusk, when every well-placed cast means a fighting, tugging, "sunny" at the end of the line!

To get back to bait fishing—worms, hoppers, crickets, grubs, corn borers, and other small terrestrial or aquatic baits are all acceptable to the bluegill. Small hooks should be used, since this fish has a small mouth. Trout hooks of size No. 8 down to No. 12 are suitable for this purpose. In live bait fishing anglers usually fish in or close to weed beds, around brush piles, along rocky shores, or in quiet bays. Live bait fishermen usually prefer a lightweight cane pole 8 to 10 feet in length, equipped with a line of about 9- to 12-pound test of equal length, a short gut leader, and split shot weight. Corks may be used or omitted, as the angler sees fit. The main object is to get the bait in the vicinity of the fish and hope the small ones will leave it alone until "grandpa" comes along. Bluegills feed from near the bottom to the surface, so it is not too important where you fish. The best way is to try different depths until the fish are located. Larger fish usually stay out some distance from the shore, in five feet or more of water. In fishing at this depth, it is well to lower the bait to a foot or two off bottom. Occasionally bluegills are found in deep waters, but primarily they live and feed in shallow waters rather close to the shore line unless, of course, the entire lake or stream is shallow enough to support a growth of aquatic plants.

Wet and dry flies are perfect for bluegill fishing. A few standard patterns of each are sufficient, although a wide variety is more desirable. Bluegills are not easily disturbed while feeding, hence long casts are not necessary. Well-placed casts of from 30 to 50 feet are adequate unless the fish are feeding on a hatch of insects some distance from shore, especially on large lakes. In this case, if the angler is wading, longer casts are to be desired.

During the day most catches are made in shallow waters in or near beds of aquatic plants, using either wet or dry flies. In the evening, just before dark, floating or small popping flies have been most successful for us. Standard pattern trout flies, including the fuzzy hackle, bi-visible, or regular flies are excellent; spent wing, cork-bodied bugs, and tiny poppers, and even very small wooden plugs that run very close to the surface are all good. Dusk fishing may be done from shore, but a boat is even better since it enables the angler to maneuver about more rapidly and follow the fish from shore to the deeper areas if necessary. Evening fishing will give you plenty of action, but it lasts for only a short time, since bluegills usually slack up on their feeding in total darkness. They have a tendency to suck in the surface insects, hence a large school of fish can be feeding without making much commotion. Watch for dimples on the surface of the water, and when you find considerable numbers of them start fishing. The interesting thing about dusk fishing in situations of this kind is that the angler never knows what he will catch. It may well be a bluegill, crappie, perch, or even a bass or walleye.

Once hooked, the bluegill is a good scrapper and great sport when taken on light tackle. It has been our experience that fish taken in the evening in deeper water run larger in size than those taken from the shallow shore line in midday. The firm white flesh places it at the top of the list for table use.

Orangespotted Sunfish

Lepomis humilis (Girard)

Other Names—Redspotted sunfish, pumpkinseed, dwarf sunfish, pigmy sunfish.

Iowa Distribution—This small species appears commonly in the southern Iowa impoundments, and abundantly in most natural lakes. It is common to abundant in most inland streams with a preference for the medium-sized and smaller streams and creeks. It is occasional to common in numbers in the Mississippi, Big Sioux, and Missouri Rivers. (See Map 81.)

Description—This little sunfish is easily recognized by the bright red or orange spots on the sides of the males and the more obscure brownish spots on the females. The color is light olive, and the sides are liberally sprinkled with fine dots of gold and emerald. During the breeding season the belly of the males is deep orange. The spinous dorsal, or spiny portion of the top fin, is edged with crimson, and the soft portion of this fin has a wide band of orange. The black tab on the gill cover is margined with white. The scales are rather large, and there are only 34 to 42 in the lateral line. The cheeks are covered with 5 or 6 rows of scales. (See Plate 1.)

Food Habits—Food of the orangespotted sunfish largely consists of insects, small crustaceans, and occasionally small fishes.

Life History—Like most of the sunfishes, the orangespotted sunfish nests in colonies, the male constructing small depressions in sand or gravel in water from a few inches to 3 feet in depth. During the breeding season the males are so brilliantly colored they appear to be more artificial than real. The majority spawn in late May or early June, although some reproduce into July or even August. This is the smallest member of the sunfish family in Iowa waters, and also one of the most highly-colored fish. It reaches a length of less than one inch the first year, and adults more than 4 inches are rare. We have observed 3-year-old females full of spawn that were less than 2½ inches in length.

Angling—Very few people actually fish for the orangespotted sunfish because of its small size. Many are taken, however, since they are everywhere in shallow water and have ravenous appetites. Occasionally they are used as aquarium fishes because of their brilliant coloration, and the appear to live well as long as they have sufficient daphnia and other live foods.

Northern Longear Sunfish

Lepomis megalotis peltastes Cope

Other Names—No other common name is known for this region.

Iowa Distribution

Cedar R.: Mitchell Co., vic. Otranto (Salyer, UMMZ).
Raccoon R.: Dallas Co., Coll. 1867—J. A. Allen (Bailey, UMMZ).

This species is either very rare or extinct in the state since it has not been collected since 1932. It may possibly still exist in the Cedar River near Otranto since this area is a vegetated stream relict—the only major one left in the state. The longear may also exist unnoticed in a group of orangespotted sunfish in some of the heavily vegetated portions of the natural lakes. Most, if not all, of Meek's (1892) records of *L. Megalotis* in Iowa were misidentifications of *L. humilis*, as determined by re-examination of material by R. M. Bailey.

Description—The longear sunfish is a highly colored, beautiful little sunfish. Its distinguishing characteristic is the extremely long tip on the opercular or ear flap. This flap is narrowly bordered with scarlet. The color of the fish is olive, and the sides are spotted with orange and emerald or turquoise blue. The cheeks are light olive to orange, with very prominent wavy streaks of emerald or blue. The soft dorsal and anal fins are pale orange to yellow. It can be distinguished from the orangespotted and pumpkinseed sunfishes by the short bluntish gill-rakers, or projections from the front face of the first gill arches. The pectoral fin is short and rounded.

Food Habits—Food of the longear sunfish is largely insects, crustaceans, and small fishes.

Life History—The longear sunfish is a nest-builder like other sunfishes. While precise data is not available from Iowa, Hubbs and Cooper (1935) report the spawning season in Michigan centers in July, but extends from the later part of June into early August. These investigations, together with similar studies carried on in Indiana by Hile (1931), indicate that it requires about 5 years for this fish to reach a length of about 4 inches. They reach sexual maturity in the third summer, at which time they are about 2½ to 3 inches long.

Angling—The longear sunfish attains a length of about 4 to 6 inches. In Iowa it is too scarce to be of importance and is only occasionally taken by fishermen in pursuit of other fishes. No special effort is made to catch this fish exclusively. When taken, it is usually less than 5 inches in length and commonly classified by anglers as merely "sunfish" in the catch.

Northern Rock Bass

Ambloplites rupestris rupestris (Rafinesque)

Other Names—Redeye, redeye bass, rock bass, goggleeye, rock sunfish.

Iowa Distribution—The incidence of this species is limited to the clearer, rocky portions of the inland streams of the state. It is evenly distributed over northeastern Iowa streams where it is occasional to common in abundance; in the upper Des Moines River it is rare, as it is in the upper Mississippi River. It is found rarely in the Okobojis, Clear and Spirit lakes. (See Map 82.)

Description—The rock bass is a robust fish, similar in appearance to the warmouth. It can be distinguished from other fishes of this family by the 6 spines in the anal fin and 11 spines in the first dorsal fin. The mouth is large and the eye red like the warmouth, but the warmouth has but 3 spines in the anal fin. The color is olive with dark mottlings and brassy reflections, giving the fish a brassy or sometimes brownish appearance. The brown or coppery color of some of the scales gives the appearance of dark longitudinal bars or stripes along the sides. The fins, except the pelvic, are dusky in color. There is a dark, sometimes indistinct, blotch at the tip of the gill cover, the lower portion of which is tipped with white or gold color. The pectoral fins are amber color, set low, and the tips are rounded. (See Plate 5.)

Food Habits—The food of the rock bass is largely insects, small crayfishes, and fish. It inhabits rocky areas of streams and lakes, usually in the same habitat with smallmouth bass, and its food does not differ greatly from the smallmouth.

Life History—Reproductive habits of the rock bass are similar to those of the other sunfishes. It spawns in May or early June over gravel or sand bottoms, where it constructs a nest to deposit the eggs. By the end of the first growing season the young reach a length of from 1½ to 2 inches, and adults will grow to a weight of a pound, although fish exceeding 8 to 10 inches are rather rare in our state. Other investigators (Beckman, 1943; Hile, 1941; and Wright, 1929) report similar growth.

Females lay an average of about 5,000 eggs (Eddy and Surber, 1947), and as many as 6,000 to 9,000 have been observed. Vessel and Eddy (1941) reported rock bass from Minnesota to average about 3,000 eggs from females weighing 4 to 8 ounces, 5,000 eggs from females averaging 8 to 12 ounces, and 8,500 eggs in females from 16 to 20 ounces. Three-year-old fish average from about 5 to 7 inches in length (Bailey ,1943), (Hile, 1941), (MacKenthun, 1947), (Carbine and Applegate, 1948) in most Midwestern waters. Our data (unpublished records) indicate this is the average growth-rate of Iowa rock bass.

Angling—Rock bass are most often taken by fly-fishermen in the smallmouth bass streams in northeastern Iowa, and by perch and walleye fishermen in Spirit and a few of the larger natural lakes. Sometimes they are expressly fished for, but usually they are taken accidentally with other species of fish. They will take a wet or dry fly in the same waters with smallmouth and are often caught on minnows by anglers still-fishing or trolling over rock reefs in the lakes. A few anglers locate schools of rock bass in the lakes by trolling, then anchor their boat and fish for them. Rock bass bite almost any time in daylight hours.

White Crappie

Pomoxis annularis Rafinesque

Other Names—Crappie, silver crappie, bachelor.

Iowa Distribution—The white crappie is seemingly more tolerant of turbid conditions than the black and as such is found in greater numbers in the turbid rivers and lakes of the state. The white crappie is abundant in most natural and artificial lakes. It is also abundant in the Mississippi River; occasional to common in the inland rivers and the Missouri and Big Sioux. (See Map 83.)

Description—The color of the fish is silvery-olive, shading to green or brown on the back. There are several, usually 7 to 9, vertical dark bars on the sides, and the belly is bright silver to white. The mouth is moderately oblique. There are usually 6 spines in the front portion of the dorsal fin, distinguishing it from the black crappie, which almost invariably has 7 or 8 spines. There are 43 to 48 scales in the lateral line of the body. (See Plate 2.)

Food Habits—The white crappie lives mainly on insects, crustaceans and fishes. It eats insects throughout its life, but minnows and small fishes make up a considerable part of its food after it reaches adulthood.

Life History—Crappies, like other sunfishes, are nest-building fishes. They usually build their nests, however, in deeper waters, ranging from 3 to 6 or 8 feet. Langlois (1935) reported 7½-inch females having 14,750 eggs, and other Ohio investigators (Huber and Binkley, 1935) found 42 females averaged 7,120 with a range of 2,900 to 14,750.

The fish attains an average length of about 2 to 3 inches the first year. Crappies from many sections of the country (Carlander, 1950) average about 5 to 8 inches at 2 years of age, 7 to 11 the third year, 10 to 14 at the fourth, and apparently grow very slowly thereafter. As a rule crappies are shortlived fishes, and most of them do not live more than 6 to 8 years. One exception to the rule was a 13-year-old fish taken from the Corydon reservoir several years ago by Mr. George Nickles. The fish weighed 3 pounds 9 ounces!

Angling—The white crappie, together with the black, affords a considerable amount of fishing for Iowa anglers. In the early spring it is one of the principal fishes taken in the natural lakes and furnishes a good share of the total fishing in the artificial lakes and reservoirs throughout the year. It is also harvested in considerable quantity from some of the major rivers, particularly in the backwaters and overflow lakes adjacent to the streams.

A good share of the anglers catch crappies with minnows and a few other live baits. They fish either from shore, off docks, along rocky points or near weed beds, or from boats in water from 5 to 15 feet deep. They are taken both by still-fishing and slow trolling. When trolling, the anglers usually row slowly until a feeding school is located, then anchor and still-fish with live minnows.

A large number of crappies are also harvested by fly-fishermen using spinner-fly, spinner-minnow, hair and feather streamer flies, dry flies, wet flies, and small floating cork-bodied bugs. Fly-fishermen are most successful in late afternoon or early evening, at which time the crappies come into the shallow waters near shore to feed upon minnows and small fishes or insects that appear upon the water. The period of greatest feeding activity is from an hour before sunset until dark.

Some anglers prefer to use light bait casting rods or spinning rods for crappies. This method of fishing enables the average angler to reach out into the water a greater distance. Similar tackle, with the exception of dry flies, etc., is used with these rods as is used with fly rods, except that they are weighted with a large split shot or two.

Black Crappie

Pomoxis nigromaculatus (LeSueur)

Other Names—Calico bass, crappie, speckled crappie.

Iowa Distribution—This species is most abundant in the clear lakes and streams of northern Iowa. It is common to abundant in the state-owned artificial lakes and in the upper Mississippi River. It is occasional to common in certain eastern Iowa rivers and rare to absent in the western streams. During the dry years of 1952-1954 there was a population eruption in the black crappie in the Cedar and Wapsipinicon rivers. Its general absence from the Missouri River drainage system is indicative of its preference for clear water. (See Map 84.)

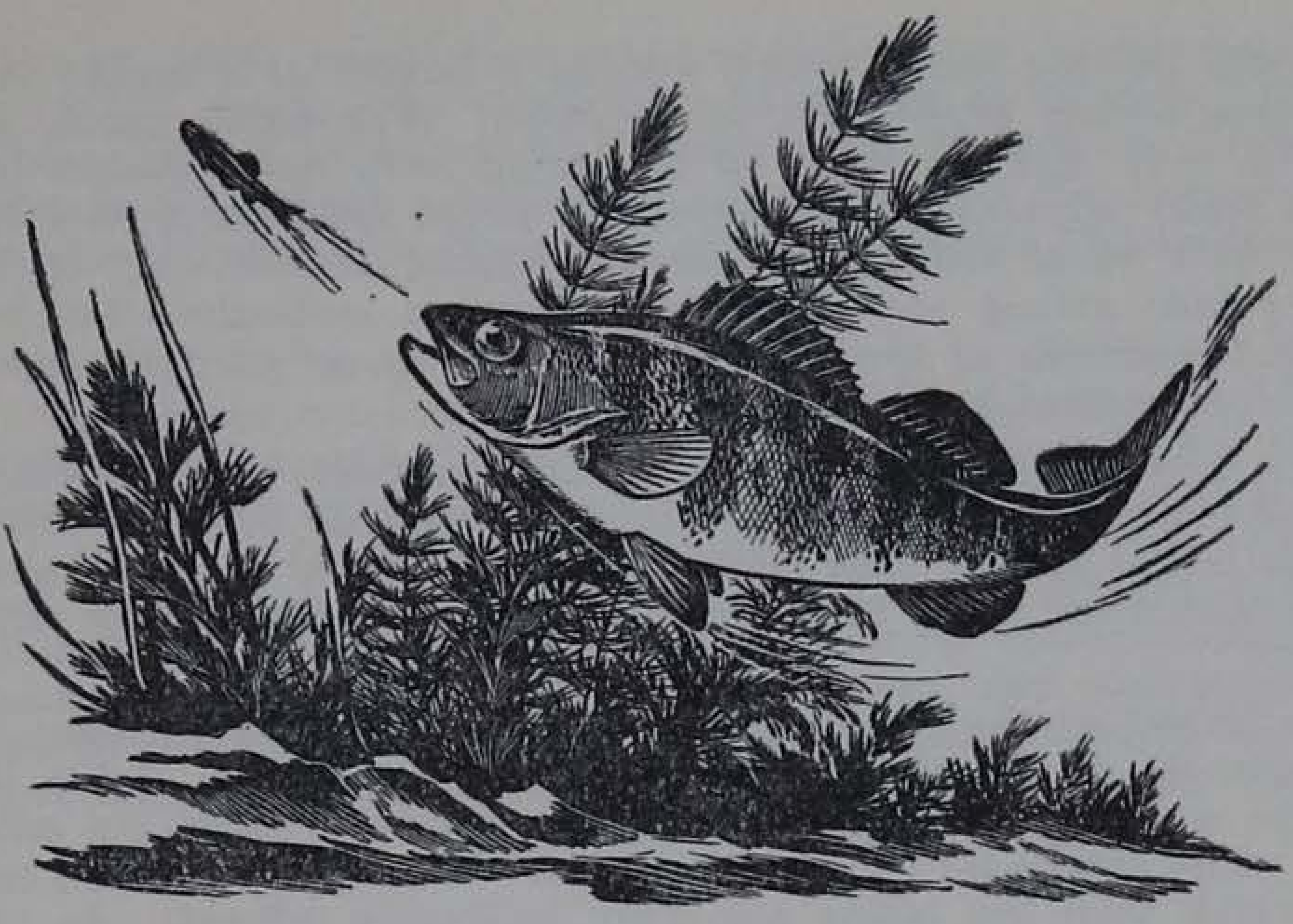
Description—The color of this fish is silvery-olive, with dark back and numerous green or blackish spots irregularly spaced over the sides. There are no distinct vertical bars as in the white crappie. The throat and fore part of the belly is often dusky or slate-gray in color. The mouth is more oblique than in the white crappie, and the body is somewhat deeper in proportion to the length. Both of the crappies are very thin-bodied fish. There are 7 or 8 spines in the front portion of the dorsal fin, which distinguishes it from the white crappie, which has only 6. (See Plate 2.)

Food Habits—The black crappie is strictly carnivorous, feeding almost exclusively upon insects, crustaceans, and fishes.

Life History—The colonies of nests, rather shallow in depth and saucer-shaped, are constructed by the males in water from 3 to 8 feet in depth. Females of a half pound in weight (Eddy and Surber, 1947) average from 20,000 to 60,000 eggs, and Culler (1938) reported over 158,000 eggs from one large female.

The young reach a length of about 2 or 3 inches in our waters and mature in the third year at about 7 to 8 inches. Occasionally very large specimens have been reported, the largest to our knowledge a fish weighing slightly over 4 pounds, from the reservoir at Corning. Quite often fish weighing over 2 pounds are taken from the Mississippi River and its overflow lakes, but fish from 8 to 12 inches are most common. Even in lakes with high populations of fishes, crappies appear to spawn successfully every year. This has also been reported (O'Donnell, 1943) by Wisconsin investigators.

Angling—The same tackle and methods are used for black crappies as for the closely-related white crappie. Methods for catching them appear elsewhere.



Chapter XIII

PERCH FAMILY

Percidae

Forbes and Richardson (1909) list about 25 genera and 125 species of perches from North America and Europe. Of this number 20 species and subspecies are native to Iowa waters. This large family includes three major groups, the walleye and sauger, the perch, and the darters. Members of this family have rather slender elongate bodies, and the large bone of the gill cover ends in a flat spine. They are all spiny-rayed fishes, and the spinous and soft parts of the dorsal fin are distinctly separated into two fins. Canine teeth are developed on the jaws, in the roof of the mouth and palate of the walleye and sauger, but are absent on the perch.

All of the perches are strictly carnivorous, from the tiny least darter, which is only slightly over an inch long, to the walleye, which has been known to attain a weight of more than 20 pounds. The wide range of food and habitat preference has distributed the family throughout the state, and some of the fishes are found in every stream and lake.

All members of the perch family are protected by the sharp spines in the dorsal fin and gill cover bones, their tough scales, and their ability to swim well. Some of the darters are capable of burying themselves in the sand with only their snout and eyes protruding, an added feature of protection in their hazardous environment. Even with these protective devices, however, they are not entirely immune to predation from other fishes, and yellow perch in particular serve as an important forage for such game species as the northern pike, black bass, white bass, and walleye. The darters are occasionally eaten by larger fishes, but for some reason comprise only an insignifcant part of the diet.

The larger fishes of this group, the walleye, sauger and yellow perch, are held in high esteem by anglers. They are unexcelled as food fish. In Iowa the walleye is considered a better fish than the sauger and attains considerably larger size. All of the darters are too small to be of importance to anglers and are not useful for bait. Their beautiful coloration and odd habits, however, excite the interest of all who observe them.

Aside from the log perch, which attains a length of 6 inches or more, the other darters seldom exceed 2½ or 3 inches. The name darter comes from the dartlike body and the habit of swimming with quick dashes in the swift current of rocky streams. They start with great speed as if shot from a bow, then stop with equal suddenness, often dropping immediately to the bottom, where they hide among the rocks. They remain motionless for long periods of time on the bottom of the streams, under rocks, or perched on a stone like a little bird, supported by their pectoral fins.

Although many darters are found in comparatively swift streams, several species are known to prefer the quiet weed beds of lakes or the open sand bars of the larger rivers. The entire group of darters is little known to most sportsmen, and when taken in minnow nets they are collectively referred to as "sand darts."

Little is known of the breeding habits of many of the darters. Some bury their eggs in the sand, others leave their eggs unattended, and a third group deposits the eggs in a nest guarded by the parents. Some lay comparatively few eggs, while others lay as many as 3,000. Most of them breed in April and May, at which time the males are most brilliantly colored. So vivid is the coloration in some of these little fishes that they look more artificial than real.

Darters are true fishes belonging to the perch family, and should not be confused with minnows and young of other fishes. Frequently they are transported by well-meaning fishermen from streams to lakes because they are thought to be young perch or walleyes. If the new environment suits their fancy they will thrive in competition with other fishes, but if not they will probably soon be erased from the picture by the stresses of nature.

Sauger

Stizostedion canadense (Smith)

Other Names—Sand pike, river pike, spotfin pike, jack fish, and jack salmon.

Iowa Distribution—With the exception of Spirit Lake and Lake Manawa, into which the species was probably introduced, the sauger is limited to the boundary rivers and the lower ends of their major tributaries. The sauger is common in the border rivers and abundant locally in the Mississippi and Missouri rivers. (See Map 86.)

Description—The color of the sauger is olive-gray, with brassy or yellowish-orange sides mottled with dark blotches. The body is long and rather cylindrical. There are 2 or 3 rows of black dots on the first dorsal fin, and a large black blotch at the base of the pectoral fin. There are 17 to 19 rays in the dorsal fin and 11 to 12 in the anal. There are from 85 to 91 scales along the lateral line of the body. The cheeks are fully scaled, and the scales are in about 15 rows. (See Plate 6.)

Food Habits—The adult saugers live largely upon fish, crayfish and other crustaceans, and insects. The young feed extensively on midgefly larvae and, as they become older, on immature and adult Mayflies.

Life History—The sauger has a strong preference for large rivers and spends most of its life there except during the breeding season, when it ascends the tributary streams or enters backwater lakes to spawn. Reproduction takes place in April through early May. The spawning habits are very similar to those of the walleye, which are more fully explained later in the text. The eggs are deposited at random and are left unattended until they hatch. Incubation is completed in from 12 to 18 days in water temperature of about 50° F. Young sauger reach a length of about 2½ to 4½ inches the first year and mature in their third or fourth year of life. They are a more slow-growing fish than the walleye and rarely exceed 2 to 4 pounds in our waters. Most fish are less than 15 inches in length. Researches conducted in Minnesota (Smith and Moe, 1944) and Ohio (Roach, 1949) reveal that saugers 8 inches in length weigh from 3 to 5 ounces, at 11.5 inches they weigh 6 to 10 ounces, at 14 inches they weigh 13 to 15 ounces, and at 18 inches they weigh about 30 ounces. Iowa fish approximate the length-weight relationship listed above. The sauger seems to be increasing in abundance in the upper stretches of the Mississippi River at this time.

Angling—Angling for sauger is largely confined to the Mississippi River and the extreme lower reaches of its major tributaries. Occasional fish are taken elsewhere but the majority are taken in or very close to the river. Usually anglers prefer to catch walleyes, since they are considerably larger in size, but the sauger is important in the harvest of river fishes. Saugers are taken on both artificial and live baits. Some of the more popular lures include the small bass plugs, spinner-minnow and spinner-fly combinations, streamer hair and feather wet flies, live minnows, small frogs, and nightcrawlers. The sauger is taken in similar places to the walleye, especially below dams, at the mouths of tributary streams, and below the rock wing-dams in the river.

Walleye

Stizostedion vitreum vitreum (Mitchill)

Other Names—Pike-perch, walleyed pike, pike, jack fish, jack salmon.

Iowa Distribution—The walleye ranges from occasional to common in the natural lakes of northern Iowa and is locally abundant. The same range of abundance is found in upper reaches of the major inland river drainages. The walleye is rare to absent in the Missouri River and its tributaries; however, it is common to abundant above Clinton in the Mississippi River. The population of this much-prized fish is never static and goes through "booms and depressions", especially in rivers. (See Map 85.)

Description—The color of the walleye is a brassy olive-buff, sometimes shading to yellowish sides and white beneath. There are no distinct dark bars or mottlings on the sides, but rather an over-all mottling of black or brown. Spots on the first dorsal fin are lacking, but there is a dark blotch at the back of the spinous dorsal fin, usually coloring the lower portion of the last 2 or 3 rays of the fin. There are 19 to 22 soft rays in the dorsal fin and 12 to 14 in the anal. There are from 80 to 89 scales along the lateral line of the body. The cheeks, as a rule, are sparsely scaled. (See Plate 6.)

Food Habits—Young walleyes feed extensively on cladocera and insects, and after they reach the length of about 2 inches they begin to add small fishes to their diet. Fishes most often found in the stomachs of young walleyes include the young of minnows, yellow perch, suckers, and bluegills. Adult walleyes consume large quantities of fish, sometimes feeding upon them almost wholly. Yellow perch make up a substantial part of the fish diet of the walleye in our lakes. Eschmeyer (1950) also found this to be true in his studies of certain lakes in northern Michigan. Midgefly larvae are taken in large quantities by both young and adult walleyes; and when hatches of Mayflies appear the walleyes feed upon them to the exclusion of all other foods. Crayfish, frogs, snails and other items are often taken but are of lesser importance to their diet.

Life History—Walleyes reproduce in both streams and lakes in Iowa. Shortly after the ice melts from the lakes and the water temperature reaches 45° to 50° F., walleyes move into the shallow waters to spawn. Actual reproduction takes place at night, usually in water from 1 to 5 feet deep, over rock reefs, sand bars, or gravel areas. Possibly some of the fishes spawn in daylight hours, but through many years of experience our hatcherymen have found the best catches in their nets are from sundown until about four o'clock in the morning. A few individuals come into the spawning areas prior to the larger numbers that follow several days later. Usually only a small percentage of the females are ready to spawn, but the males are apparently ripe at that time. The entire spawning activity takes place over a period of about 3 weeks, but in our lakes the bulk of the eggs are deposited in about a week or 10 days.

Generally a large female is accompanied by several males of smaller size. At this time they swim very close to the bottom and come into water a foot or less in depth. On very quiet nights fish can be heard splashing in the shallow water, but quite often the lakes are rough at that season of the year and the fish seem to stay in water from 2 to 4 feet deep to spawn. They are random spawners and scatter their eggs over the gravel, stones, and rubble of the lake bottom. After spawning the fishes return to deep water and do not attend the eggs nor young. In some instances spent fishes sometimes return to the spawning grounds. We have tagged walleye females and transported them by truck to the hatchery, where the eggs were stripped artificially. The fishes were released at the hatchery and were later retaken by the crew as they were operating nets several miles away at the site where these fish were originally taken.

In the collection of spawning walleyes for hatchery use, we have found about 51 per cent males and 49 per cent females at the Spirit Lake station, and from 60 to 72 per cent males at Clear Lake. This figure will vary somewhat from year to year but represents the average. In the operation of the Wolf River station in Wisconsin, Schneberger (1938 and 1940) found from 74 to 93 per cent of the walleyes were males. In observing over 4,000 spawning walleyes in Michigan, Eschmeyer (1950) found 89 per cent of the fish were males, and that the percentage of males present varied with the progress of the spawning season. This has been found true each year in Spirit, Clear, and the Okoboji lakes. The males are usually the first to appear, with larger numbers of females entering the catch toward the peak of the season. In an exhaustive study of Lake Erie pike (Deason, 1933), all males under 11 inches and all females less than 12 inches were found to be sexually immature.

The eggs of the walleye are small, running from about 140,000 to 180,000 per fluid quart. The number of eggs produced by individual females will vary considerably with the size and condition of the fish, but is usually within the range of 23,000 to 50,000 per pound of fish weight.

The incubation period is from 12 to 18 days, depending upon the water temperature. The newborn fish, called "fry," are about 3/16 inch long at birth. Immediately after the egg sac is absorbed, the fry commence to feed. At first only the tiniest organisms can be taken, but as the fish increases in size daphnia and immature insects are included in the diet. Small fry have been observed in schools at the spawning grounds, but they are soon dispersed, and because of their small size it is difficult to catch them until in July, when they will stay in the fine mesh seines used by our department to determine the reproductive success. At this time they are an inch or more in length.

Walleyes under normal conditions reach a length of from 3 to 6 inches by November of their first year of life. In special rearing ponds or in lakes with an exceptionally good food supply, some fishes have grown to 8 inches or more the first year. Cleary (1949) found walleyes in Clear Lake to attain an average of 5.9 inches at the end of their first year of life, 10.9 in the second year, 14.5 the third, 17.2 the fourth, 19.3 the fifth, and 27.7 in the tenth year. He also found that the males mature at 2 years of age at a length of about 12 inches, but the females do not mature until the third year, when they have reached a length of 13 to 14 inches. Carlander (1948) found the growth rate of walleyes in 6 Iowa lakes to be about the same or a little above average when compared with growth-rates throughout the country, except in T.V.A. waters, where Eschmeyer (1940) reported a growth of 16.3 inches in 2 years, and suggested the richness of the lake, population densities, and length of growing season are factors that modify the growth in different waters. In a fish population study of the walleyes of Spirit Lake (Rose, 1949), 550 adult pike were tagged and returned to the lake. These fish averaged from 1 to 3½ pounds in weight. Tagged fish caught by anglers one year later increased in weight from 0.2 pounds to 1¼ pounds. A total of 157 or 28.2 per cent of the fish were recaptured by anglers from this 6,000-acre lake.

Angling—The Biology Department of the Iowa Conservation Commission has carried on extensive creel census work for several years in the major walleye lakes. These data indicate that most of the fish are taken from May 15 to July 1 and later from September 15 to November 1, with May, June and October producing best results.

Walleyes apparently feed most of the time; however, they have periods of greater activity and change the location of their feeding grounds frequently. During the daylight hours they are most apt to be in deep water, and the time-honored method of trolling with minnow-spinner combinations or artificial lures is usually as productive as any. Frequently they can be located feeding on or near rock reefs, gravel bars, or on insect larvae over mud bottoms. Anglers troll slowly over these likely places, weighting their lines so they will fish from 6 inches to a foot off the bottom. When they get a strike they mark the spot by landmarks on shore or, better still, toss overboard a long cord with a heavy sinker attached to one end and a large white float to the other. Rather than to anchor and still-fish, as is done in perch fishing, most anglers prefer to troll back and forth over and around this area. Ordinarily several fish can be taken from one locality, since walleyes usually feed in schools and rarely as individuals.

In the twilight hours walleyes come into shallow water to gorge themselves on emerging May-, caddis- and stone flies or schools of minnows. At this time they are most vulnerable, and once they are located they can be taken with facility. This type of fishing requires the use of a fly rod, spinning rod or bait casting rod. All are effective if properly used. Rocky points running into the lake, shallow rock reefs, and inlets are ideal for this type of fishing. Most fishermen wade into 2 or 3 feet of water to shorten the length of the cast required to reach the fish. Occasionally however, fish will come almost in to shore, especially if the drop-off into deep water is abrupt. If fish are feeding close to the surface, as they often do, flies or shallow running lures will give best results. Streamer and hair flies should be retrieved in a short, slow, jerky motion. In our opinion the smaller baits are better than the larger ones. Some anglers prefer to use hair or feather streamer flies, other add a No. 2 or No. 3 spinner ahead of the fly. Small metal spoons of the Daredevil type, either plain or with a white bucktail fly replacing the treble hook, are an excellent choice if the fish are feeding in deeper water. Many small wooden and plastic plugs on the market are "killers" for night walleye fishing. They include the Lazy Ike, Midge-Oreno, Midget Didget and many others. Most of the time these baits should be retrieved rather slowly for optimum results.

There are times when walleyes are not "in" on the shores but are feeding after dark over reefs and rock piles farther out in the lake. Here it becomes necessary to fish from a boat, and because the fish are usually in deeper water, deep running lures are most productive.

Walleyes often stay in shore for only a short period of time but are almost invariably in from dusk until about ten o'clock at night. If you don't find them on the lee side of the lake, try the windward side, sheltered bays, and especially at inlets where there is water coming into the lake.

Telling one how to fish is difficult. The best bet is to go out with an experienced native who knows the lakes and the habits of its fishes.

Yellow Perch

Perca flavescens (Mitchill))

Other Names—Perch, ringed perch, ring-tail perch, lake perch.

Iowa Distribution—Essentially a lake species, the yellow perch reaches its greatest abundance in the natural and artificial lakes of the state. It is rarely found in flowing water collections with the exception of the Mississippi River, where it is common in some localities north of Dubuque. It is also common in the upper reaches of the East Des Moines River. (See Map 87.)

Description—The sides of the yellow perch are rich yellow to brassy green in color, with 7 dusky bars running perpendicularly. The belly is light, and the back is dark olive-green. There are no canine teeth on the jaws or roof of the mouth. There are 12 to 13 soft rays in the dorsal fin and 7 or 8 in the anal. Scales in the lateral line along the body run from 57 to 62 in number. The cheeks have about 8 to 10 rows of scales. (See Plate 6.)

Food Habits—Natural foods of the yellow perch consist of small fishes, insects, young crayfish, snails, and scuds. They feed throughout the daylight hours and often come into shallow water in the evening to feed upon schools of minnows. Midgefly larvae and both immature and adult stages of the Mayfly often make up a substantial part of their diet. During the daylight hours the perch feed in deeper waters, but about dusk they move shoreward and feed close to the surface.

Life History—The yellow perch reproduce in Iowa when the water temperture reaches 45° to 50° F. Spawning activities commence in April shortly after the ice leaves the lakes. Large schools of perch spawn in small areas, but apparently the fishes are paired. The eggs, which are contained in long, flat, ribbon-like masses, are deposited over sand bars, submerged vegetation, brush, and other extraneous material on the bottom of the lake. The eggs are about 1/13 inch in diameter and average from 25,000 to 35,000 to the quart. Females, depending upon thieir size, may produce from 10,000 to 40,000 eggs. The egg masses swell considerably after they are fertilized by the males. Under normal conditions from 12 to 21 days are required for incubation.

Perch are random spawners and do not construct nests or guard the eggs or young. The eggs are usually deposited in sheltered areas, but those that are not are often washed ashore by the waves.

Young perch travel in schools in or near weedy areas where food, including daphnia, insect larvae, and other minute animals, is abundant. They are rather slow swimmers when young, hence depend upon the aquatic plants for protection from their natural enemies. They are subjected to heavy predation from most fish-eating fishes and birds.

Parsons (1950 and 1951) found that yellow perch in Spirit Lake and East Okoboji grew faster and attained a larger size than those in Clear Lake and West Okoboji. A greater growth rate was maintained by the fish from East Okoboji and Spirit lakes through the first 4 or 5 years than any investigations listed by Carlander (1950) from other states. Normally the perch average from 2 to 4 inches in length at the end of the first growing season. Van Oosten (1948) found the perch of Saginaw Bay to average 3.0 inches the first year, 5.3 inches the second, 7.9 the third, 9.5 the fourth, 10.6 the fifth, 11.9 the sixth, and 12.8 the seventh year. To express the growth-rate in a different way, Hile and Jobes (1941 and 1942), in collective studies of the growth of perch in the Great Lakes, found them to average from 0.1 to 0.3 ounces the first year, 0.6 to 2.1 ounces the second, 1.4 to 4.4 the third, 2.5 to 6.7 the fourth, 4.2 to 8.7 the fifth, 6.3 to 10.7 the sixth, with some fish weighing a pound or more in their seventh year of life. In Spirit Lake perch reach a length of about 12 inches and weigh a pound or slightly more. In most of our waters, however, they are considerably smaller.

Angling—A wide variety of methods are used in perch fishing. While some fishing is done from docks or shore, the majority of anglers prefer to fish from boats, especially in the spring and summer. In the late fall, however, in shallow water excellent catches are taken from shore by fly-fishermen.

One can usually locate feeding schools of perch by the rafts of anchored boats. Anglers use medium-sized minnows for bait and troll slowly over submerged weed beds or gravel or rock reefs until the first fish is caught. Since perch are gregarious, the first fish taken usually indicates the presence of a school. When the fish are located, the anchor is dropped and still-fishing takes the place of trolling.

Perch bite throughout the daylight hours, but periods of greatest activity are from 10 a. m. until 2 p. m. and again from 4 p. m. to 6 p. m. in deep water. Perch often cease to bite after dark. In water from 8 to 20 feet deep they feed from 6 to 12 inches off the bottom. On quiet days anglers move the bait slowly up and down, varying the depth from 6 inches to a foot or two off the bottom. A few anglers use a float, but more often it is omitted, since a taut line is needed to feel the feeble strike.

All types of rods and poles are used in perch fishing with nearly equal success. When the fish are biting gingerly, some anglers use only a hand or drop line, dispensing with the pole and reel entirely. Lightweight lines, usually from 8- to 15-pound test, are used. Hook size is No. 4 or No. 6, and a small weight or split shot is used just large enough to hold the minnow down to the desired depth.

When live minnows are used they are hooked on the back, just behind and slightly below the dorsal fin. Dead minnows are just as effective if properly hooked. One of the best methods is to insert the point of the hook immediately to the left of the dorsal fin, run the point through the body and out through the right side of the bait so the point of the hook is exposed near the anal fin on the right side of the minnow. A bait so rigged will ride right side up at all times.

Toward evening in the fall of the year perch come in to shore to feed in shallow water. On windy days they prefer the lee side of bars, points, or protected bays. Some anglers use live baits, but fly fishing is more successful under these conditions. Small hair or feather streamer flies, fished wet, are most productive. They are fished deep, just off the bottom, and retrieved with a slow jerky motion. Best catches are made in late afternoon and at twilight.

In the winter months perch are taken through the ice. They often make up the bulk of the angler's winter catch. Holes from 14 to 18 inches in diameter are cut in the ice with a spud bar, and the fine shavings are removed with a small wire skimmer. Live minnows are the best bait; although some anglers use worms with good success. Hand lines, ice "tip-ups," short casting poles, and other devices are standard tackle. The main object is to dress warmly because it is plenty cold on a lake in sub-zero weather!

The Darters

The darters are the miniatures of the perch family, seldom exceeding 3 or 4 inches in length. They are confined to eastern North America, and 17 species and subspecies of the group have been reported from Iowa waters. Many of these little fishes are brilliantly colored, especially in the breeding season. Others are nearly sand-colored and are difficult to distinguish from the rocks on the stream bottom.

As a group, the darters are sometimes referred to as the hummingbirds of the fish family. Their small size, broad fins, pointed heads, and other physical characteristics enable them to maintain themselves in the swift shallow water they usually inhabit.

Apparently they constitute only a small part of the diet of larger fishes, since their small size and maneuverability enables them to hide under rocks and in crevices, thus avoiding the larger fishes of prey. They are largely carnivorous, feeding upon insect larvae and other small animals which abound in their environs.

The darters can be distinguished from the larger perches by the 6 branchiostegal rays, or elongate bones lying in a membrane just below the gill cover. The larger perches all have 7 rays. They are divided into two major groups. The first includes those which on the midline of the belly have a single median series of enlarged scales and have the pelvic fins separated by an interspace at least three-fourths as wide as the base of the fin. This group includes the gilt, blackside, slenderhead, river, crystal and western sand darters and the northern logperch. All other darters belong to the group having the belly between the pelvic fins and anus covered with normal scales and the pelvic fins usually separated by an interspace less than three-fourths as wide as the base of the fin.

Darters are found in southern Canada, in the United States east of the Rocky Mountains, and in northern Mexico. They are well distributed throughout Iowa and are generally found in four distinct habitats according to the specific desires of the individuals.

Blackside Darter

Percina maculata (Girard)

This darter sometimes reaches a length of 4 inches or over, but is usually less; greenish-yellow in color with about 7 oblong dark blotches more or less connected along the sides and irregularly mottled on the back; cheeks covered with small scales; dorsal rays 12; anal rays 9. It is common throughout the state, especially in the Mississippi River drainage. Aside from the central Johnny Darter, this species has the widest general distribution of any member of the darter group. However, its numbers in any given collection never amount to more than a few. As can be seen from the distribution map, this species is confined to streams or rivers of moderate to large size. Also comparing the literature with present-day locations in eastern Iowa, a definite upstream withdrawal is apparent. This is probably due to an ecological demand for pure waters and points up the senescence of eastern Iowa rivers. (See Map 88.) (See Plate 22.)

Gilt Darter

Percina evides (Jordan and Copeland)

Iowa Distribution

Cedar R.: Black Hawk Co., vic. Waterloo (Collected by Evermann—Meek, 1894).
Cedar R.: Linn Co., vic. Cedar Rapids (Meek, 1892).

Doubtless this colorful species is extinct in Iowa. The species formerly inhabited the rocky riffles below the above towns, and if nothing more, the increased pollution has caused them to abandon the areas. Certain species of darters and minnows have narrow tolerance limits in habitat requirements and the alteration of those requirements causes a severe retrenchment in the species.

This little darter attains a length of about 3 inches. It is gilt or orange in color with 7 or 8 broad transverse bars extending upward to the mid-dorsal line; the cheeks are naked; there are 11 rays in the dorsal and 8 rays in the anal fin; the anal and pelvic fins are blue-black. The fish is rare in Iowa waters.

Slenderhead Darter

Percina phoxocephala (Nelson)

The length of this fish is about 3 to 4 inches; color sand to yellowish-brown; orange band below the margin of the spinous dorsal fin; head very slender; breast with scales; dorsal rays 13; anal rays 9; small dark spot on each end of the lateral line. The slenderhead darter reaches its most general distribution on the Des Moines River watershed where it appears occasionally in collections. It is less abundant in eastern Iowa where it is rarely taken both in the Mississippi River and the inland streams. It has never been reported from natural or artificial lakes. (See Map 89.) (See Plate 18.)

River Darter

Percina shumardi Girard

Iowa Distribution

Mississippi R.: Allamakee Co., vic. New Albin (UMRCC, 1953).
Mississippi R.: Allamakee Co., vic. Lansing (UMRCC, 1953).
Mississippi R.: Allamakee Co., vic. Lynxville, Wis. (Greene, 1935).
Mississippi R.: Clayton Co., vic. Marquette (UMRCC, 1953).
Mississippi R.: Clayton Co., vic. Guttenberg (Greene, 1935).
Mississippi R.: Clayton Co., vic. Millville (UMRCC, 1953).
Mississippi R.: Muscatine Co., vic. Muscatine (Meek, 1892).
Wapsie R.: Scott Co., vic. Martins (Bailey ISC).
Des Moines R.: Boone Co., vic. Madrid.

This species is primarily confined to the Mississippi River where it is rare in numbers. Inland, the species abundance and distribution is rather vague since it is a channel-dwelling species and not easily taken in normal sampling procedure.

The river darter attains a length of about 3 inches; color olive with darker blotches and sides with 8 to 10 faint bars; dorsal rays 15; anal rays 11; anal fin in breeding males greatly enlarged and tuberculate; black spots between the first and second spines and the last spines in the first dorsal fin; about 56 scales in the lateral line.

Northern Logperch

Percina caprodes semifasciata (DeKay)

The length of the logperch is about 5 inches; color yellowish-green with about 15 dark crossbands; usually 15 dorsal rays and 9 anal rays; top of head strongly depressed between the eyes; anal spines stiff; from 80 to 90 scales in the lateral line; black spot at base of anal fin. Literature records of the 1890's show this species to have been quite generally distributed in the Mississippi River drainage. Present-day collections show it to be confined to some of the larger natural lakes of Dickinson County and extreme upper reaches of the Cedar River. Nowhere, including the Upper Mississippi River, is this species taken any more than rare to occasionally. (See Map 90.) (See Plate 18.)

Crystal Darter

Ammocrypta asprella (Jordan)

The crystal darter is usually less than 3 inches in length; color light yellow to translucent; dorsal spines about 14; upper part of the body largely scaled. The inclusion of the crystal darter in the Iowa fish list is based on a collection made by Greene (1935) over a gravel bar on the Mississippi River, Grant County, Wisc., in the vicinity of Cassville, which is opposite the outlet of the Turkey River. This collection also contributed the only known record in Wisconsin at the time of Greene's work.

Western Sand Darter

Ammocrypta clara Jordan and Meek

This fish is usually about 3 inches in length; color translucent and finely spotted above lateral line; dorsal rays 10; anal rays 8; about 75 scales in the lateral line; cheeks and opercles finely scaled. Indications are that this species is much reduced from former times in its Iowa distribution. It is primarily a fish of large rivers, with the Mississippi River affording a very compatible habitat. Nowhere does this species reach any measure of abundance. It is primarily a fish of the deep channel with a preference for coarse sand or fine gravel bottom. (See Map 91.)

Central Johnny Darter

Etheostoma nigrum nigrum Rafinesque

This darter may reach a length of 2½ inches; color olive with numerous W-shaped markings along the side; dorsal rays 12; anal rays 8; usually about

PLATE 11

SHORTNOSE GAR ***Lepisosteus platostomus*** **Rafinesque**

LONGNOSE GAR ***Lepisosteus osseus*** **(Linnaeus)**

BOWFIN ***Amia calva*** **Linnaeus**


Maynard Reece

50 scales in the lateral line; breast and cheeks without scales. The Johnny darter is the most abundant and most widely distributed member of the perch family. It reaches its greatest abundance in small creeks and streams. It is common in some natural lakes and rare in the artificial lakes. It is occasional to common locally in the major inland and border rivers with the exception of the Missouri River where records indicate it is rare to absent. It has an ecological preference for riffles and gravelly runs in streams. (See Map 92.) (See Plate 18.)

Scaly Johnny Darter

Etheostoma nigrum eulepis (Hubbs and Greene)

Iowa Distribution

Clear Lake: Cerro Gordo Co.
Spirit Lake: Dickinson Co.
West Okoboji Lake: Dickinson Co.

The scaly Johnny darter has been found in the above lakes only. In some localities one collects pure *nigrum* and in others *eulepis*. In other areas (see Greene, 1935) these subspecies form freely interbreeding populations termed intergrades. One such area extends in and adjacent to the Mississippi River from Minneapolis to St. Louis.

The length of this fish is about 2½ inches; color olive with dark W-shaped markings along the sides like the western Johnny darter, but differs from it in that the breast is completely scaled; cheeks usually moderately scaled and nape completely scaled.

Bluntnose Darter

Etheostoma chlorosomum Hay

The bluntnose darter reaches a length of 2½ inches; color olive; general characteristics similar to western Johnny darter except the lateral line is developed only on anterior half of the body, and the dorsal fins are widely separated. The only inland record of the bluntnose darter in the state was furnished by Bailey (1951). This specimen (UMMZ 146885) was collected in an overflow pool of the Cedar River, 5 miles south of Atalissa, Muscatine County. Four specimens taken in the Mississippi River between New Albin, Iowa and Minnesota Slough in 1944 constitute the only known record from the Iowa section of the Mississippi River. (UMRCC, 1953.)

Banded Darter

Etheostoma zonale (Cope)

The banded darter is about 2¼ inches long; color greenish with small crossbars; dorsal rays 12; anal rays 9; usually 45 to 48 scales in the lateral line, which is complete; cheeks scaled. This rather colorful species inhabits the rocky riffles of the upper reaches of major inland streams and attains its greatest abundance in the smaller streams and creeks. Nowhere is this species common and in most collections it is listed as rare. It has also been taken from the Mississippi River above Dubuque. (See Map 93.) (See Plate 18.)

Mud Darter

Etheostoma asprigene (Forbes)

Iowa Distribution

Mississippi R.: Allamakee Co., vic. New Albin (UMRCC, 1953).
Mississippi R.: Allamakee Co., vic. Lynxville, Wis. (Greene, 1935).
Mississippi R.: Allamakee Co., vic. Harpers Ferry (UMRCC, 1953).
Mississippi R.: Clayton Co., vic. Marquette (UMRCC, 1953).
Mississippi R.: Clayton Co., vic. Guttenberg (Greene, 1935).
Mississippi R.: Clayton Co., vic. Millville (UMRCC, 1953)

The mud darter has not been taken in any recent inland collections since Bailey and Speaker took five specimens in 1943 from the riffle-outlet of an overflow pool of the Cedar River in Muscatine County. Its presence in the

Mississippi River lakes and sloughs indicate that the species prefers the sluggish or overflow waters of the major rivers of eastern Iowa. Nowhere has this species been taken more than rarely.

The length of the mud darter is about 2½ inches; color brownish-olive with 8 or 9 greenish bars on sides; interspaces between bars red to orange; belly orange; cheeks olivaceous and without scales; dorsal rays 12; anal rays 9; scales in lateral line usually fewer than 50; lateral line incomplete.

Iowa Darter

Etheostoma exile (Girard)

The Iowa darter is about 2½ inches long; color bright green with dark brown blotches and small red spots on the sides; belly fading to yellow or gold and white; dorsal rays 9 to 11; 7 anal rays; about 60 scales in the lateral line, which is incomplete; cheeks, opercles and nape scaled; breast naked. In its namesake state, the Iowa darter reaches its greatest abundance in the natural lakes of northwest Iowa, where it appears in 20 per cent of the lakes sampled. It is taken occasionally in the overflow or impounded pools of the major inland rivers, and the oxbow lakes of the Missouri River. Although it has been taken in only one collection on the upper Mississippi, it is doubtless more widespread in the bottomland lakes and ponds. (See Map 95.) (See Plate 22.)

Rainbow Darter

Etheostoma caeruleum Storer

The rainbow darter seldom exceeds a length of 2 inches; color brownish-olive with 8 or 9 greenish-brown bars on sides, belly orange; cheeks bluish-brown, opercle iridescent golden-green; spinous dorsal fin edged with blue with row of reddish spots; sides with about a dozen bluish blotches; fins light orange; dorsal rays 12; anal rays 7; scales in lateral line 45 or more; one of the most brilliantly colored of all darters. The rainbow darter in recent years has been confined to the small to moderate-sized streams in northeast Iowa where it is very rare. In all cases it has been taken over a gravel or limerock rubble riffle where the current is quite swift. (See Map 94.) (See Plate 18.)

Northern Orangethroat Darter

Etheostoma spectabile spectabile (Agassiz)

The orangethroat darter grows to a length of about 2¼ inches; cheeks naked; lateral line nearly straight; color olive-green with bright orange throat; dorsal spines 8. This species has been taken only twice in state waters and then in two locations in one county. Bailey took specimens in swift water over rubble bottom in Big and Indian creeks in Linn County, in 1940 and 1942. Recent coverage in the same areas failed to uncover the species. Pollution from the city of Marion probably accounts for the extirpation in Indian Creek.

Striped Fantail Darter

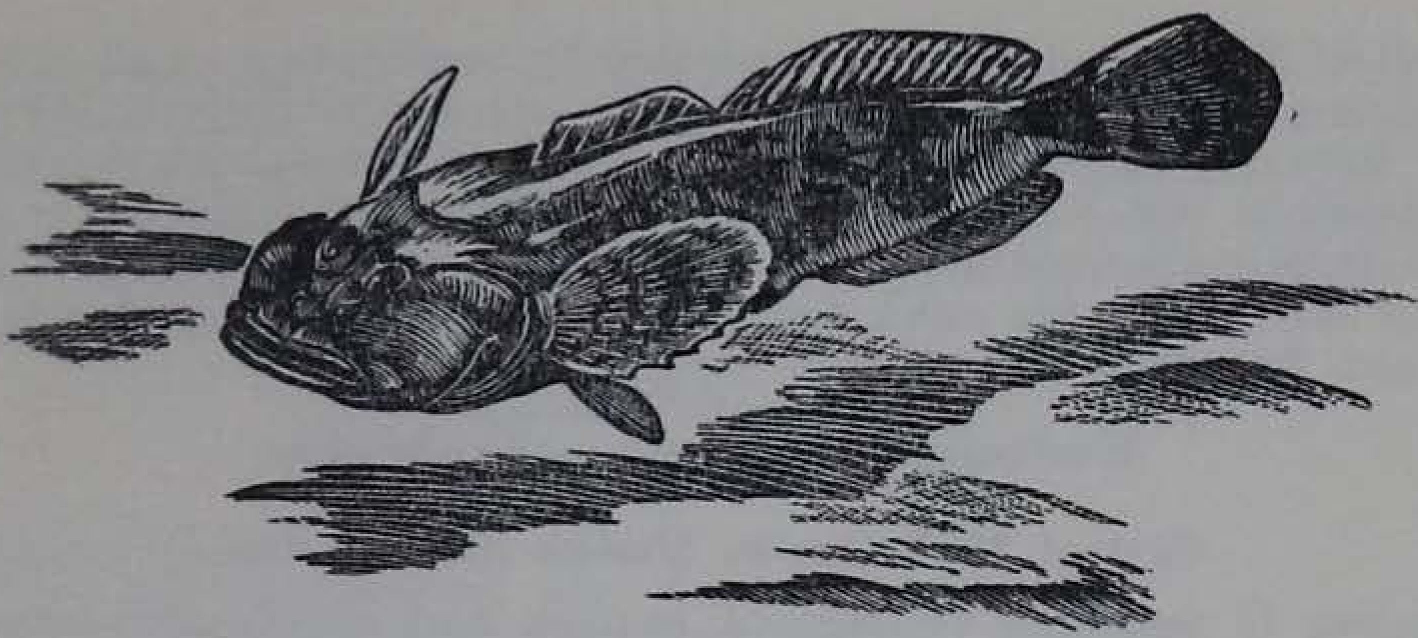
Etheostoma flabellare lineolatum (Agassiz)

About 2 inches is the usual length of the fantail darter. The spinous dorsal fin is low with tips on dorsal spines forming fleshy knobs in adult males; color sand to brown with small dark spot on each scale; dorsal rays 12 to 14; anal rays 7 to 9; scales in lateral line usually more than 50. Although this darter is quite generally distributed throughout the Mississippi River drainage in Iowa, it is taken only rarely in major inland river collections. The fantail is quite common in some of the spring branches and small creeks of the eastern portion of the state and is rare to occasional in the Mississippi River collections. It prefers a rock and sand bottom and is especially difficult to seine since it spends most of its time underneath these rocks. (See Map 96.) (See Plate 18.)

Least Darter

Etheostoma microperca Jordan and Gilbert

This tiny darter reaches a length of 1½ inches; color olive with brown flecks; dorsal rays 10; anal rays 6; scales in lateral line large and usually only 33 to 35, rarely 37; pelvic fins are pointed and reach the anus; head short; lateral line absent. The least darter has not been taken in Iowa since 1890. Meek (1892) lists three locations for the species, all in east central Iowa. In the Maquoketa River in Delaware County, he lists the species as rare at Manchester and common at Delhi; in the Cedar River in Cedar County he also lists the species as rare at West Liberty. The first two locations are over a shattered lime stone and bed rock bottom.



Chapter XIV

MISCELLANEOUS FISHES

The term "miscellaneous" is hardly appropriate for this group of nine fish families, yet most of them are represented by a single species and have been collectively listed in this chapter for the sake of convenience. Many of these fishes are highly specialized individuals, living in restricted habitat, while others are abundant in certain waters. Their correct classification will be found in the keys to the families in the appendixes of this book.

Eight of the families of this group have but a single species in Iowa. The killifishes, with four species, are the exception. With the exception of the sheepshead, most of the fishes listed in this chapter have little or no economic importance to the angler, since they are either too rare or too limited in distribution to be of value as food or bait. Many have highly specialized processes, and their life history is interesting to the layman and scientist. Some are undoubtedly relict or vanishing forms from periods of earlier abundance.

Physical characteristics of these fishes differ widely from the more common forms found in Iowa, and for this reason they are frequently sent to the Conservation Commission for identification by interested sportsmen who find them in their minnow nets. A few are so rare as never to be found by the average person. The pirate-perch is a good example. It has been taken only twice in the past 15 years in the extensive fish census operations by the department.

Most of these fishes are content with the environment in which they live, and their movements throughout life are restricted to comparatively short distances. The mudminnow prefers the sluggish, muddy backwaters of larger streams, but the sculpins, or muddlers, are found only in the cold spring waters inhabited by trout. The burbot, a fresh-water representative of the codfish family, is essentially a fish of northern waters, but is found in limited numbers in the Mississippi River.

One of the most interesting little fishes of this group is the brook stickleback. This fish constructs a barrel-shaped nest, somewhat resembling that of an oriole, from bits of vegetation and debris, and savagely guards the 75 or 100 tiny eggs until they hatch. Fusiform in shape, their scaleless bodies are surmounted by 5 stiff spines, which are widely separated in the dorsal fin.

One of the most unusual anatomical characteristics found in this group of fishes is the anterior position of the anus of the pirate-perch. Rather than in the usual position, the anus in the adults is situated in the region of the throat.

The trout-perch, as its name implies, resembles both an immature perch or walleye and trout. The shape is similar to a perch, with which it is often confused, yet it has the small fleshy adipose fin resembling that of a trout.

While all of these strange fishes undoubtedly constitute a small percentage of the diet of our larger carnivorous fishes, they are not extensively taken for food and have been able to maintain residual numbers throughout the centuries of their existence in our waters. Some are beneficial, particularly the killifishes, which live largely on mosquito larvae and other top-water insects, while others compete seriously with the more desirable forms since they feed extensively on the eggs and fry of these desiderate fishes.

Mudminnow Family—Umbridae

Central Mudminnow, *Umbra limi* (Kirtland)

This species is scattered throughout eastern and north-central Iowa. It is common in certain localities and is found in heavily vegetated, mud-bottomed river sloughs or ponds. It is probably more widely scattered than our records indicate. (See Map 13.)

This is the only representative of the family found in Iowa waters. Another species (Hubbs and Lagler, 1949) is known from the lowland fresh waters along the Atlantic Coast and one from southern Europe. The name mudminnow comes from the habitat this fish prefers. In this state it is found largely in overflow ponds adjacent to the larger rivers. It reaches a length of 6 or 7 inches, but specimens of 3 to 4 inches are most common. Everman and Clark (1920) report the average female lays from 425 to 450 eggs. The upper part of the body is an olive-brown in color, mottled with black, fading to light gray or white beneath. There are about 14 indistinct dark bars on the sides, and a prominent dark bar or blotch at the base of its rounded tail fin. There are 14 or 15 rays in the dorsal fin and 8 or 9 in the anal fin. Insofar as known this fish is not abundant anywhere in Iowa. It is largely confined to the eastern part of the state. It is used extensively as a bait minnow in Wisconsin and other states where it is plentiful since it is able to live for a long time in the bait bucket, as well as on the hook. It is not considered as good, however, as many other species of minnows. (See Plate 22.)

Killifish Family—Cyprinodontidae

This group of small fishes is represented in Iowa by a single genus containing only four species. With the exception of the blackstripe topminnow, these little fishes are quite rare in our waters and are largely confined to a relatively few lakes. The western banded killifish, for example, has only been collected from lakes in Dickinson and Cerro Gordo counties in recent years, and only a single specimen of the northern starhead topminnow, taken by Speaker and Rose near Muscatine, has appeared in the Conservation Commission's collections in the past 20 years. The plains topminnow is known only from Dickinson County in recent collections. The blackstripe topminnow, however, has been taken quite widely in the streams of eastern Iowa.

The scarcity of these fishes in Iowa waters is not too surprising. Greene (1935) observed only rather limited numbers of most of the topminnows in southeastern Wisconsin and found only two records in that state of the starhead topminnow. Eddy and Surber (1947) report the western banded killifish as common in some of the shallow Minnesota lakes, but state that the other species have been reported rarely or not at all from that state. It is apparent that some of these topminnows may be vanishing from this section of the country.

Banded Killifish

Fundulus diaphanus menona Jordan and Copeland

Recent collections indicate that this species is confined to the natural lakes of northern Iowa. It is occasional to common in the collections in which it occurred. In 1890 Meek also found it in the Iowa, Des Moines, and Missouri Rivers, where he listed it as being rare. (See Map 69.) It can be distinguished from other topminnows by the 11 to 14 rays in the dorsal fin; there are 38 to 49 scale rows on the body; the dorsal fin originates ahead of the anal fin, and there are dusky bars or bands on the sides. It attains a length of 2 to 3 inches. Its color is straw to olive on top with silvery sides. The males have some 16 vertical silvery bars or bands on the sides and these bands are dark on the females. (See Plate 17.)

Plains Topminnow

Fundulus sciadicus Cope

Iowa Distribution:

Little Sioux R.: Dickinson Co., vic. Milford (Speaker, MS).
East Okoboji Lake: Dickinson Co. (Meek, 1894).
Floyd R.: Woodbury Co., vic. Sioux City (Meek, 1894).
Rock R.: Lyon Co. (Aitken, UMMZ).

This species is apparently confined to the western portion of the state. In the above recent collections it appeared as a single specimen only. This species body be on its way to extinction in the state. It has 10 dorsal rays; 30 to 35 body scale rows; broad; conspicuous stripe lengthwise on side of the body; 12 rays in the anal fin (rarely 11 or 13); there are 8 pores along the preopercular canal; color olivaceous to brown with fins and sides scattered with small brown or black dots.

Blackstripe Topminnow

Fundulus notatus (Rafinesque)

This species is limited to stream habitats. The recent collections are confined to three adjoining counties where they were occasional to common in the portions of small streams draining sloughs and boggy lands. (See Map 70.) It has 7 to 10, usually 9, dorsal rays and 10 or 11 anal rays. Scale rows around the body number 25 to 28. The color is bluish-olive with prominent lateral dark stripe on the side of the body. (See Plate 17.)

Starhead Topminnow

Fundulus notti dispar (Agassiz)

Iowa Distribution:

Lost Island Lake: Palo Alto Co.
Pine Cr.: Muscatine Co., vic. Fairport (Speaker, MS).
Cedar R. oxbow: Cedar Co., vic. West Liberty (Meek, 1892).

While this species may be more generally distributed than our records indicate, nowhere does it occur more than rarely. In abundance, a single specimen constitutes three of the collections. It has a definite preference for weedy, quiet water of a minimum depth. It has from 7 to 10 dorsal rays and 10 to 11 (rarely 12) anal rays. Pores along preopercular canal 7. The male's coloration is bluish above with slender vertical bars, and the female's with 10 horizontal stripes. This fish attains a maximum length of about 2½ inches.

Cod Family—Gadidae

Burbot, *Lota lota* (Linnaeus)

Iowa Distribution

Mississippi R.: Allamakee Co., vic. Lansing.
Mississippi R.: Dubuque Co., above Dubuque.
Mississippi R.: Muscatine Co., vic. Muscatine (Meek, 1892).
French Cr.: Allamakee Co., vic. Lansing.
Wexford Cr.: Allamakee Co., vic. Wexford (Bailey, ISC).
Bloody Run Cr.: Clayton Co., vic. Marquette.
Little Sioux R.: Clay Co., vic. Spencer.
Missouri R.: Pottawattamie Co., vic. Council Bluffs.
Missouri R.: Harrison Co.

This is the only fresh-water representative of the cod family in Iowa waters. It is also known locally as the ling cod, lawyer, and fresh-water cod. It occurs in great abundance in many of the northern waters, especially in the Great Lakes and certain deep-water lakes of northern Minnesota and southern Canada.

The burbot is primarily a large-river or lake fish, and is more abundant in the major boundary rivers. It does ascend small coldwater tributaries to spawn, which accounts for its presence in three eastern Iowa trout streams. Evidently these trout streams are also the nursery streams for the young burbot as specimens of less than 10 inches are not uncommon. The species is uncommon in the Missouri River. Although it reaches a length of 30 inches and a weight of about 10 pounds (Eddy and Surber, 1947), most fishes taken from the Mississippi River run considerably smaller in size. They are eel-like in appearance, with rather small head and eyes. The single barbel attached to the lower jaw distinguishes this fish from all others in our state. The dorsal fin is divided, and there are 12 to 13 rays in the anterior portion and 70 to 75 rays in the posterior part of the fin. The color is olive to dark greenish-brown above with dark mottlings, fading to a dusky gray beneath. The flesh is edible, but strong. The large livers are sometimes extracted in commercial operations for medicinal purposes. Excellent recipes for preparing this fish for the table are contained in Economic Circular No. 25, issued (1917) by the Bureau of Fisheries (now U. S. Fish and Wildlife Service.) (See Plate 16.)

Trout-Perch Family—Percopsidae

Trout-perch, *Percopsis omiscomaycus* (Walbaum)

Of the two species in this family, only one is known from Iowa waters. These fishes strongly resemble the young of the walleye and other perches, hence their name. They attain a length of about 4 to 5 inches. They are straw color, nearly transparent, with numerous dark spots along the lateral line and on the top. The dorsal fin has 2 spines and 9 rays, the anal fin 1 spine and 7 rays. There is a small fleshy adipose fin about midway between the base of the caudal and dorsal fins.

In eastern Iowa, the trout perch is limited to the upper portion of the Mississippi River; in western Iowa, it is more generally distributed. It is taken occasionally in the Big Sioux and its tributaries; is occasional to common in the natural lakes of Dickinson County; and is rarely taken in certain tributaries to the Missouri River although not from the Missouri proper. (See Map 71.) (See Plate 17.)

Pirate-Perch Family—Aphredoderidae

Pirate-Perch, *Aphredoderus sayanus* (Gilliams)

Iowa Distribution:
Mississippi R.: Allamakee Co., vic. Lansing (Bailey, UMMZ).
Mississippi R.: Allamakee Co., vic. New Albin (UMRCC, 1953).
Mississippi R.: Lee Co., vic. Ft. Madison (Speaker, ISC).
Mississippi R.: Grant Co., Wisc., vic, Boscobel (Greene, 1935).

The pirate perch has been collected in three widely separated locations on the Mississippi River. Indications are that it is more widely distributed up and down the river than collections show. It is an inhabitant of small, weedy, overflow ponds in the river bottoms. They are small, dark-colored fishes, reaching a length of about 4 to 5 inches, and inhabiting sluggish backwaters of the river proper. The most peculiar feature of this fish is the position of the anus. In adults it is located in the region of the throat instead of just in front of the anal fin. The high dorsal fin has 3 spines and 6 rays. It is bass-like in appearance and feeds largely on aquatic insects. (See Plate 22.)

Silverside Family—Atherinidae

Brook Silverside, *Labidesthes sicculus* (Cope)

The silversides is also called the ghost minnow, transparent fish, and other names that describe its slender, silvery, and virtually transparent appearance. Correctly it is known as the northern brook silversides. It attains a length of about 3 inches, and the body is long and extremely slender. Its color is pale olive above, translucent, a very distinct silvery lateral strip along the side, and the dorsal fins of the males are tipped with black. The eye is large, occupying a considerable portion of the small, slender head. The jaws resemble a blunt beak, with the lower one projecting slightly beyond the upper. Two lake collections, Clear and Ahquabi lakes, keep this species from being entirely confined to rivers. It normally is found behind dams; however, it has occasionally been taken in flowing-water collections. The species reaches its greatest numbers in the lake and impoundment callections. (See Map 72.) (See Plate 17.)

Drum Family—Sciaenidae

Freshwater Drum, *Aplodinotus grunniens* Rafinesque

The freshwater drum has a large number of local names, many of which relate to the peculiar noises it makes. It is called sheepshead, white perch, croaker, grunter, grinder and, incorrectly, silver bass. There seems to be a difference of opinion as to the origin of the sound made by these fishes, but there is no doubt in anyone's mind that the noise is made once a boat is anchored over a school of them. Some contend it is the expulsion of air from one chamber of the air bladder to another, while others think it is the grinding of the large, well-developed throat teeth.

The family is represented by a single genus in Iowa. It strongly resembles the red-snapper, an important marine fish, except it is bright silvery in color. It feeds extensively over rock reefs and bars on small fresh-water mussels, crayfish, snails, and also upon minnows, small fishes, and other aquatic animals. It is essentially a carnivore.

This species reaches its greatest abundance in the Mississippi River, where it is a top-ranking commercial species. It is common to some of the larger natural lakes and to the Missouri River and its oxbow lakes. It is taken rarely in inland streams except that it may reach some magnitude in numbers in the lower reaches during its spring highwater migration. (See Map 97.) Specimens weighing over 50 pounds have been reported from Spirit Lake, and 20-pound individuals are not at all uncommon from Spirit and the Okoboji lakes. They grow to about 5 inches the first year (Butler and Smith, 1950) and nearly 2 feet at 10 years. They constitute an important part of the catch by commercial fishermen on the Mississippi River.

The color is bright silvery. The body is robust, but rather strongly compressed and strongly arched at the head. There are 8 or 9 spines in the dorsal fin, and 25 to 31 soft rays. There are 50 to 56 scales in the lateral line. The tail is rounded, or double-truncate. The throat or pharyngeal teeth are very large and millstone-like in structure, thus enabling this fish to crush heavy shells and bones.

The flesh is rather firm, and while not relished as much as some of the game fishes, it is very palatable. Anglers usually fish for drum from shore or from a boat anchored off rock reefs. The most common bait is crayfish, either a peeled tail or small whole softshell. Shrimp, worms, minnows and cut bait are also used. Baits are usually weighted and fished on the bottom. Occasionally these fish will strike spinner-minnows, wet flies, and small plugs and are not infrequently taken while trolling or casting for walleyes, white bass and other fishes. (See Plate 3.)

Sculpin Family—Cottidae

Slimy Sculpin, *Cottus cognatus* Richardson

Iowa Distribution

South Bear Cr.: Winneshiek Co., vic. Highlandville.
Trout R.; Winneshiek Co., vic. Decorah.
Coldwater Cr.: Winneshiek Co., vic. Kendallville.
Village Cr.: Allamakee Co., vic. Lansing.

French Cr.: Allamakee Co. vic. Lansing.
Livingood Springs: Allamakee Co., vic, Postville.
Hickory Cr.: Allamakee Co., vic. Postville (Meek, 1892).
Bloody Run Cr.: Clayton Co., vic. Marquette.
Buck Cr.; Clayton Co., vic. Garnavillo.
Richmond Springs: Delaware Co., vic. Strawberry Point.
Spring Branch: Delaware Co., vic. Manchester.
Little Mill Cr.: Jackson Co., vic. Bellevue (Bailey, ISC).

This rather bizarre looking species is probably found in all the spring runs in the northeast portion of the state. It reaches its greatest known abundance in Bloody Run Creek where it inhabits the limerock rubble and vegetated portions of the stream in great numbers. Its coloration so perfectly blends in with its surroundings that it is seldom, if ever, seen unless it moves. It is not found in the small spring branches in the other parts of the state.

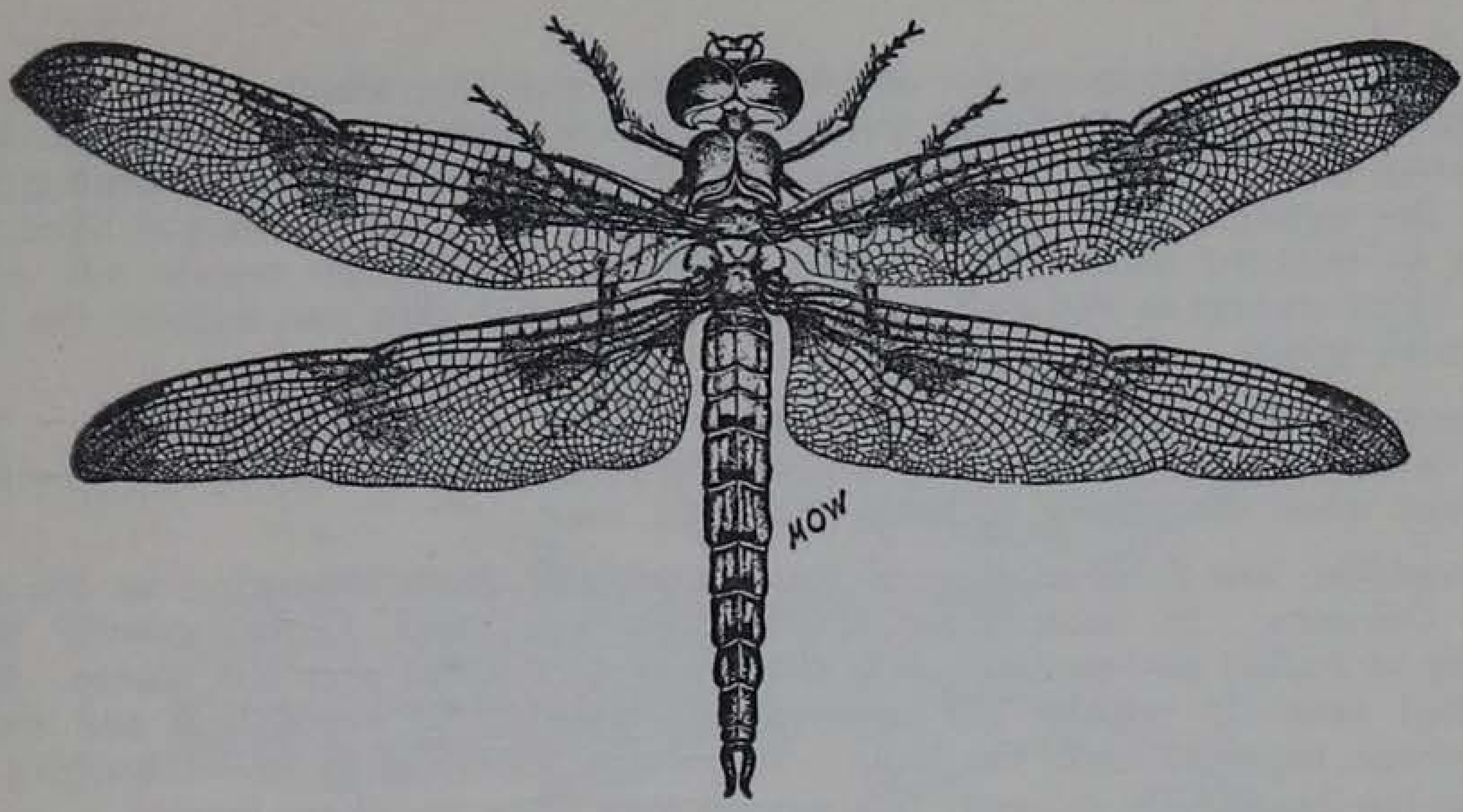
To our knowledge there is only one member of the sculpin family in Iowa waters. It is also called the miller's thumb because its broad, flat head resembles the flattened thumb of the unfortunate miller who had the misfortune of having his thumb crushed between the millstones. Other names include cottus, big fin and sculpin. This little fish rarely exceeds 4 inches in length. The body is robust, and the pectoral fins are very large and heavy. It is usually dark olive to brown in color, speckled with dark mottlings. The skin is smooth and velvetlike, without scales. There are one spine and 3 rays in the pelvic fin, 8 spines and 16 to 18 rays in the dorsal fin. It has little or no value as a bait minnow. (See Plate 17.)

Stickleback Family—Gasterosteidae

Brook Stickleback, *Eucalia inconstans* (Kirtland)

Hubbs and Lagler (1949) report about a dozen species of sticklebacks in northern seas and fresh waters. The brook stickleback is the only one reported from Iowa. It prefers clear, cool water and is found, sometimes abundantly, in some of the upper reaches of streams and in ponds. Streams frequented by the sticklebacks are usually rocky with low, grassy banks. They seem to prefer ponds with rank growths of aquatic vegetation.

This unique species has a rather wide distributional pattern over the state. While found in both natural lakes and streams, it is most common, locally, in the latter. It is also common to abundant in some overflow ponds adjacent to small drainage ditches or streams. It is not found in either the Mississippi or Missouri rivers but is taken occasionally in the Big Sioux River. (See Map 98.) Their nests are constructed from bits of aquatic vegetation and sticks, which they fasten together by silklike threads formed from a glandular secretion in the males, according to Forbes and Richardson (1909). Usually from 75 to 100 eggs are deposited in the nest and guarded by the male until incubation is completed. They reach a length of about 2 to 3 inches and are fusiform, or spindle-shaped. The color is olive to green above with about 10 dark crossbar-like bands, fading to silvery below. The 5 spines in the dorsal fin are widely separated and prominent. These are followed by 9 or 10 rays in the soft dorsal fin. The skin is smooth, velvety and scaleless. They have little economic value to anglers since they are not regarded as a very good bait minnow. These little fishes are pugnacious and frequently devour large numbers of game fish fry, especially in fish hatchery ponds. They feed largely upon insects and crustaceans. (See Plate 17.)



DRAGON-FLY

Chapter XV

SOME COMMON FISH FOODS

Harry H. Knight
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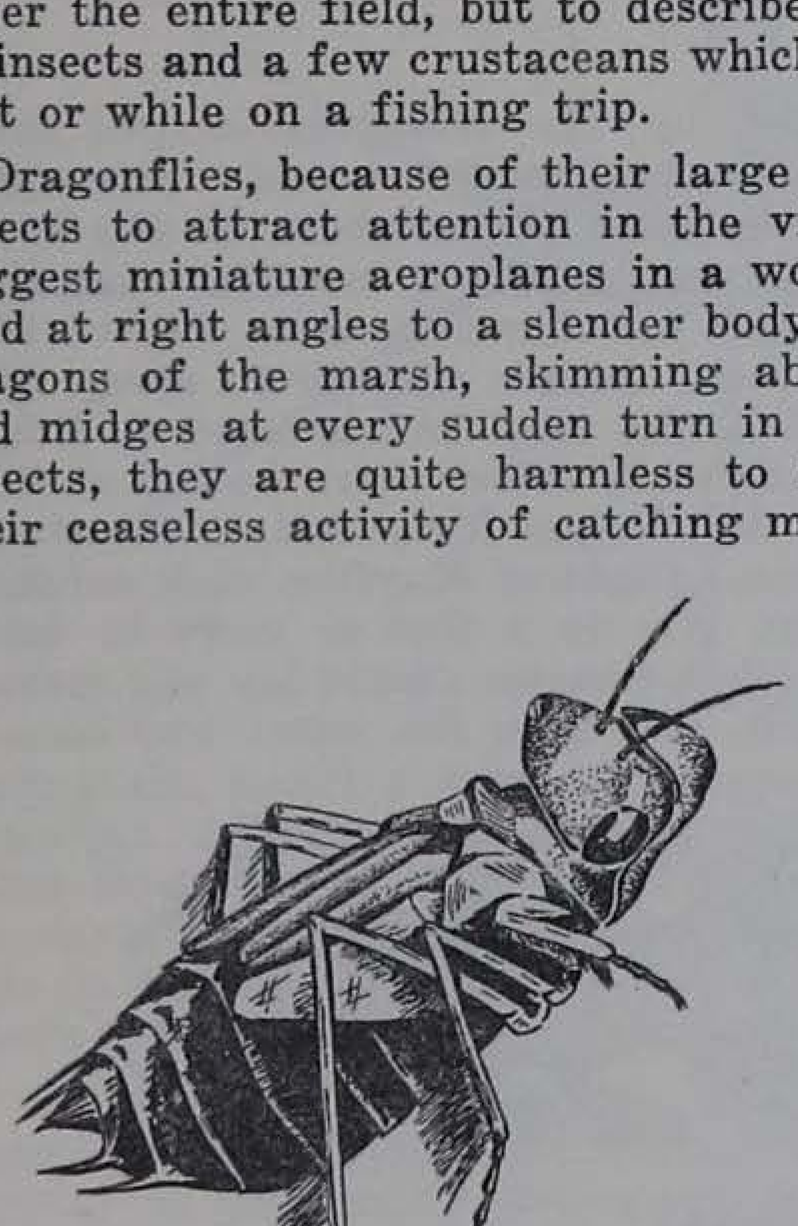
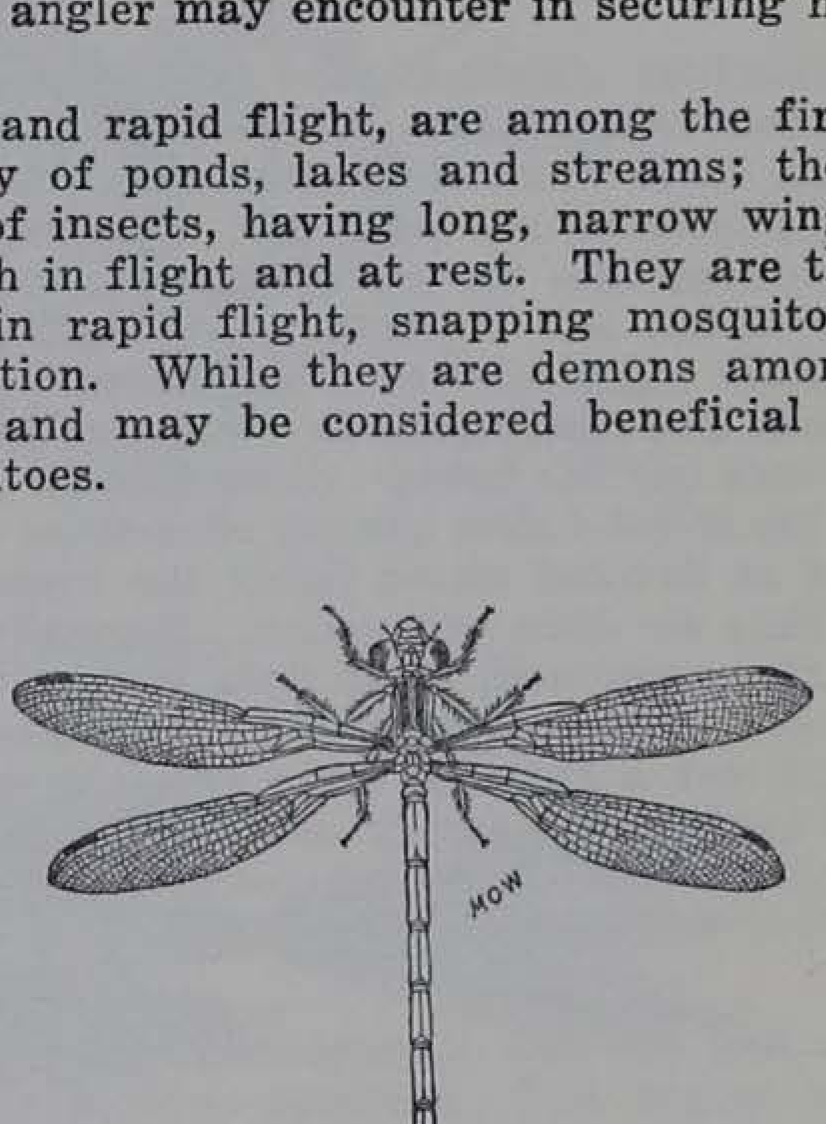
A list of foods consumed by our fish would number into the thousands. It includes, in addition to fish, such items as frogs, tadpoles, leeches, mollusks, salamanders, worms, a host of aquatic and terrestrial insects, and even such items as birds and small mammals. It is not the purpose of this chapter to cover the entire field, but to describe briefly some of the more common forms of insects and a few crustaceans which the angler may encounter in securing his bait or while on a fishing trip.

Dragonflies, because of their large size and rapid flight, are among the first insects to attract attention in the vicinity of ponds, lakes and streams; they suggest miniature aeroplanes in a world of insects, having long, narrow wings held at right angles to a slender body, both in flight and at rest. They are the dragons of the marsh, skimming about in rapid flight, snapping mosquitoes and midges at every sudden turn in direction. While they are demons among insects, they are quite harmless to man and may be considered beneficial in their ceaseless activity of catching mosquitoes.



DRAGON-FLY *(Nymph)*

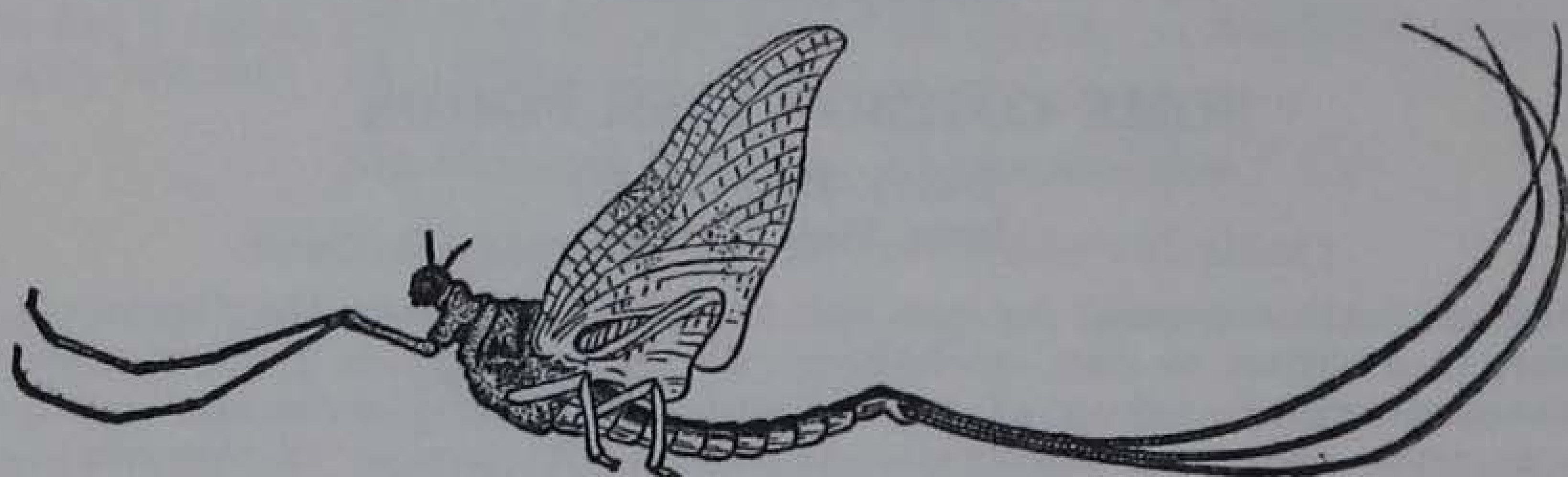


DAMSEL-FLY

The eggs are laid in water and hatch into nymphs, which spend from nine to twelve months feeding and growing. The nymph has a remarkable lower lip, being elongated and jointed, having claws at the tip for grasping prey. While the nymphs feed mostly on other aquatic insects, the larger forms are known to capture small fish. When fullgrown the nymph crawls out of the water upon emergent vegetation, sheds the nymphal skin and attains the adult form with wings.

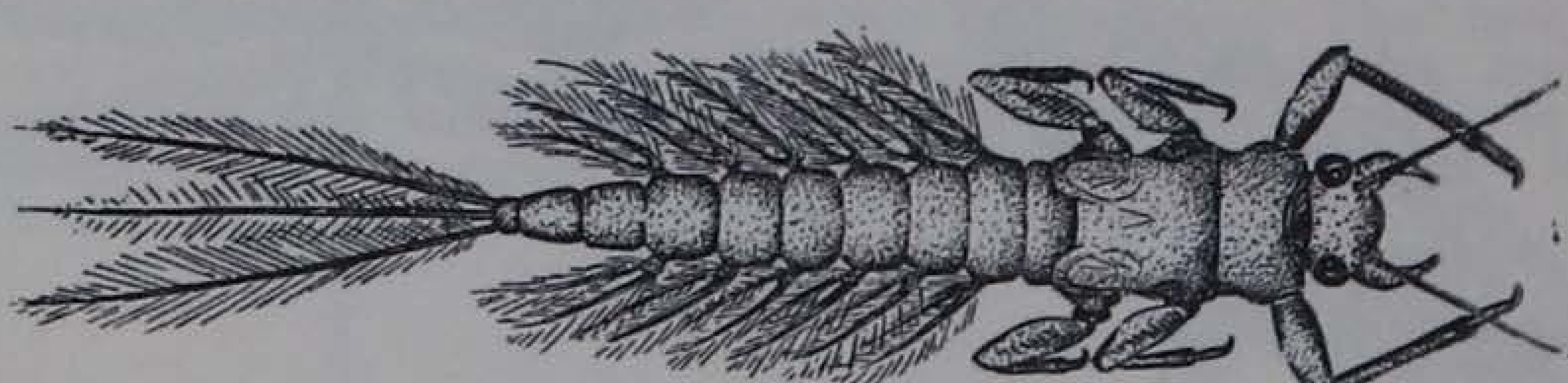
Collectors of insects find it real sport trying to catch dragonflies. Their flight is so swift they can easily dodge the strokes of an insect net, except on occasions when the stroke is made from the rear.

Damselflies are first cousins of the dragonflies, both belonging to the same order, *Odonata*. In comparison, damselflies are weak fliers, usually found clinging to rushes and grasses around the edges of water and wet places. When disturbed they fly readily but soon alight, clinging to vegetation and closing their wings together over the back. There are many kinds of damselflies and some of the beautifully colored. Fishermen may often see these insects, especially blue-colored ones, alighting on floating bits of wood on the water surface. The nymphs of damselflies live in the water, usually spending several months developing, then come forth as adults during the warm season.



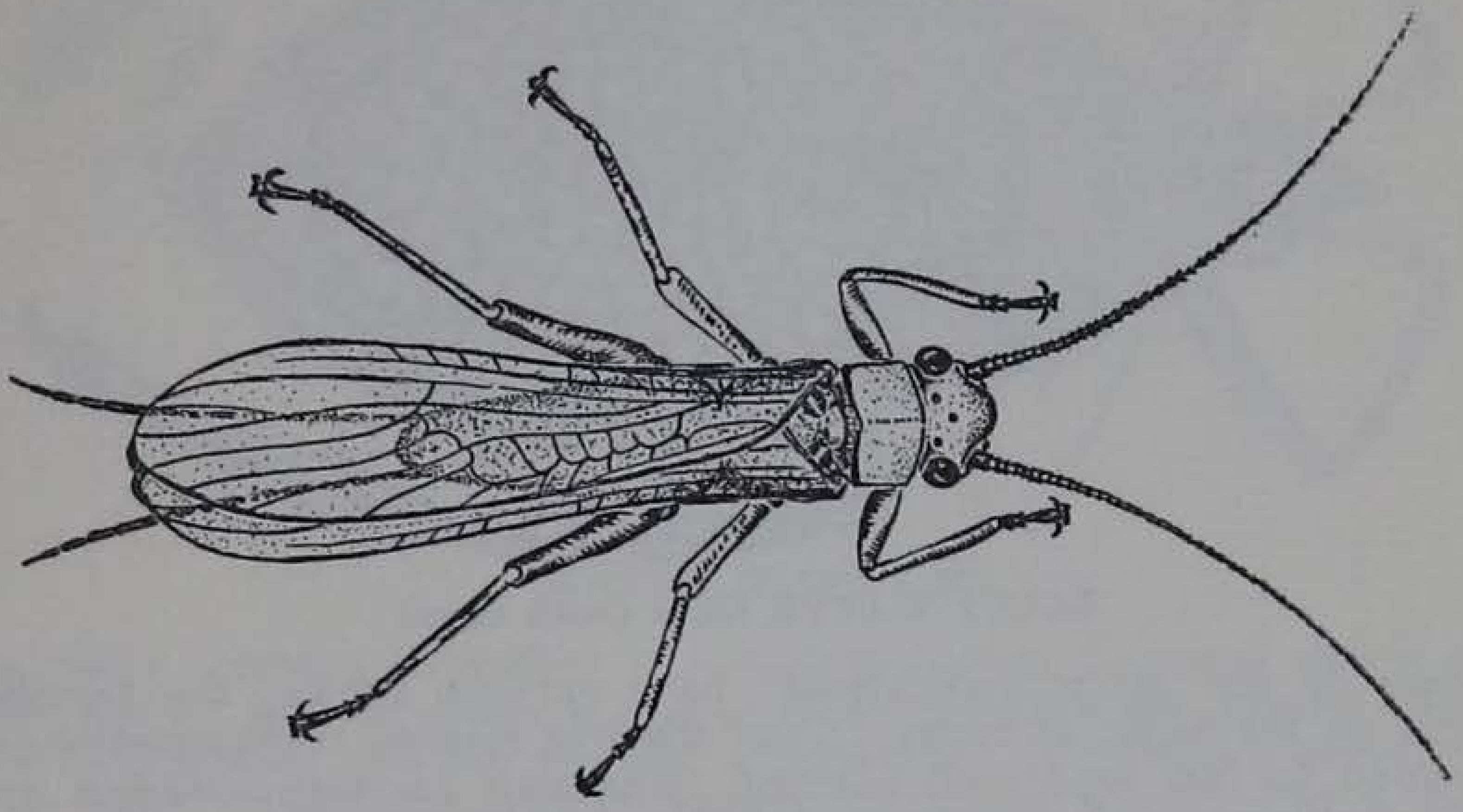
MAY-FLY

Mayflies *(Ephemerida)* are distinguished by the triangular-shaped membranous wings which are held upright over the back while at rest. The adults come forth from the water, and for a given kind all members of the brood come forth on the same day. Certain species may appear in countless numbers, swarming into the air about dusk, dancing up and down in their flight above the water, and if there is a gentle breeze, the swarm may drift along in a manner suggestive of a snowstorm. These adults may be attracted to bright lights and congregate in such numbers that people often retire behind screens or turn out the lights. Cities located on the Mississippi River and on the shores of the Great Lakes usually experience one great flight of Mayflies each summer, and at favored street lights the insects may pile up a foot or more in depth as they die from exhaustion. Normally the adult females should lay egg masses in the water and, after their energy is spent, fall upon the water and become



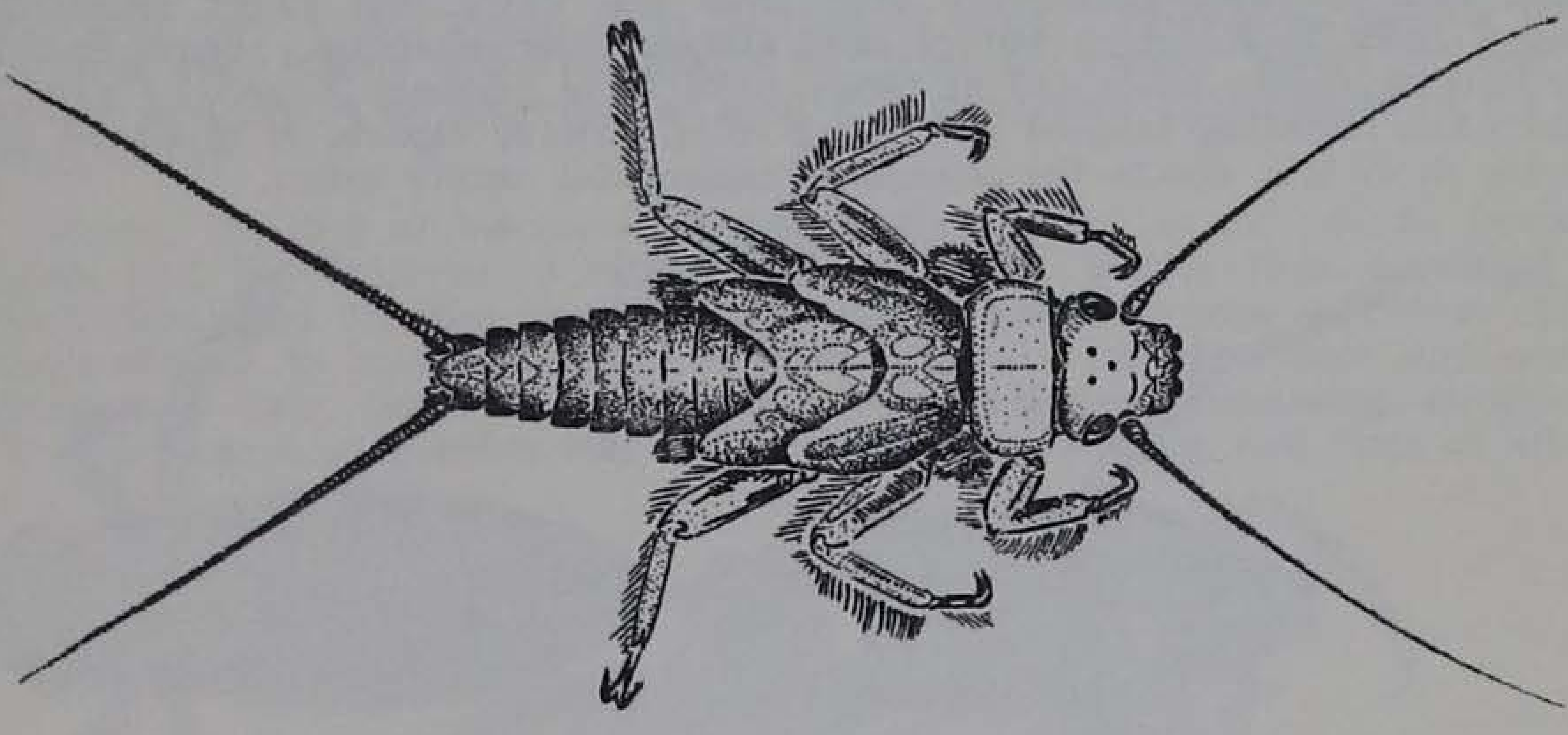
MAY-FLY *(Nymph)*

choice morsels in the food supply of fishes. While Mayfly adults live only a few hours, a day and a night, the nymphs spend a year of activity and growth in the water. These nymphs are much sought by many kinds of fish, and because of great numbers they are important in supporting the fish population. Artificial flies imitating both nymph and adult Mayflies are much used by the fly-fisherman.



STONE-FLY

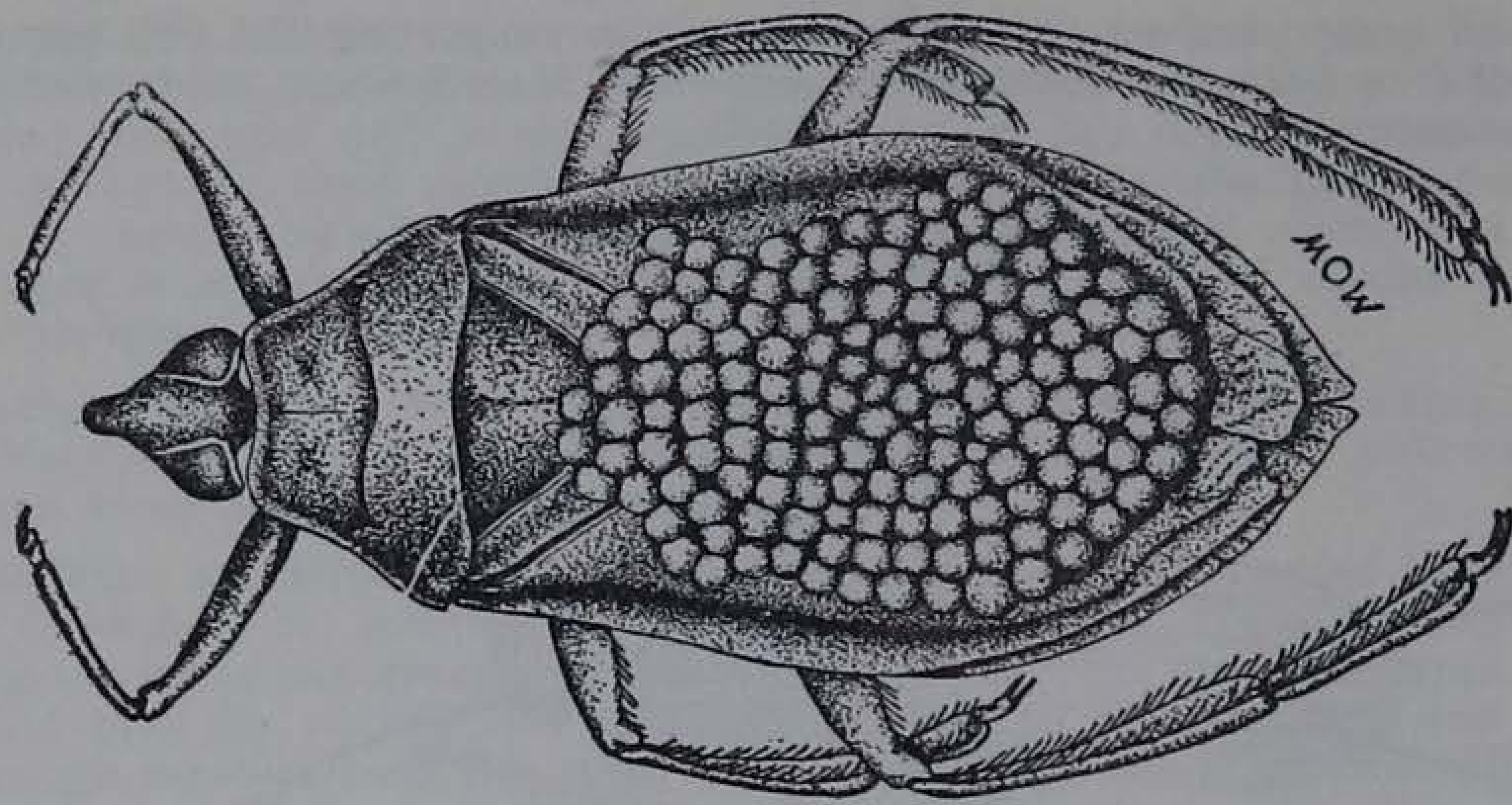
Stoneflies *(Plecoptera)* are retiring, obscure-looking insects which hide away during the daytime under leaves, loose bark, and such shelters along the banks of streams. When at rest the adults fold the wings tightly over the back,



STONE-FLY ***(Nymph)***

giving the insect a slender, wrapped appearance. The nymphs live in water, crawling under and clinging to stones for the most part, although a few kinds cling to chunks of wood debris on the stream bed. The nymphs are rather flat in appearance and cling to depressions on the under-surface of stones. Trout are particularly fond of stonefly nymphs, and some of the best wet flies imitate these insects.

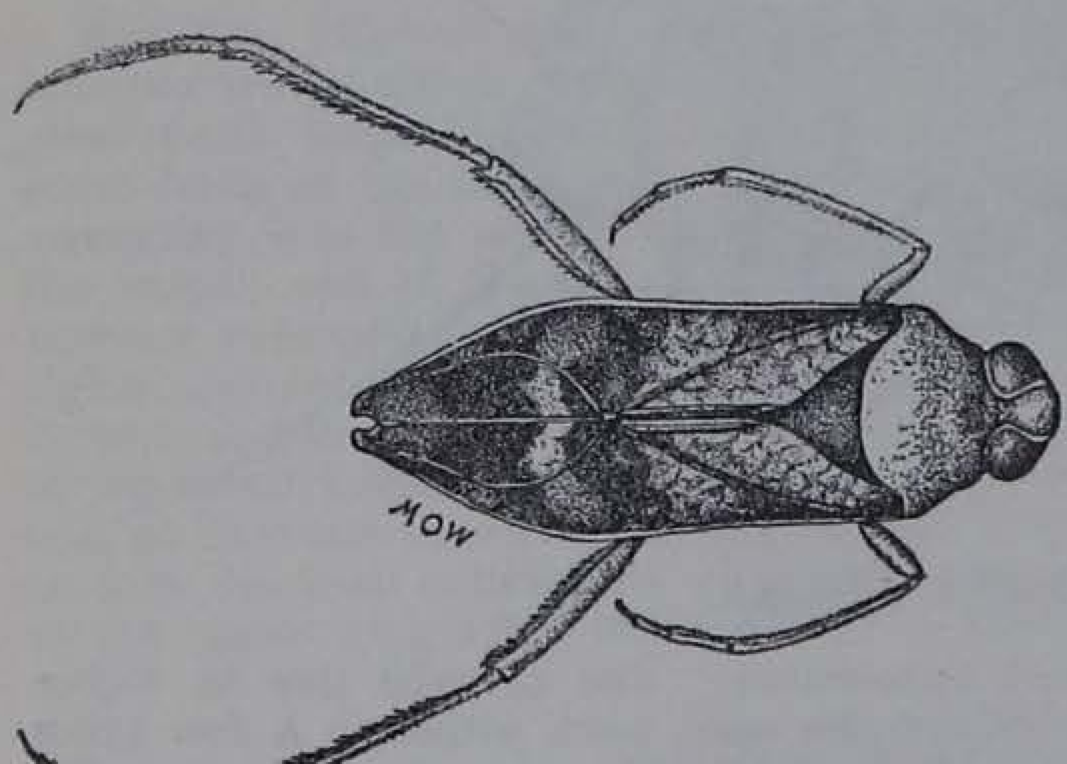
There are several families of aquatic bugs *(Hemiptera)*, but we will call attention only to the more common and conspicuous members. The largest bugs belong to the family *Belostomatidae*, giant water bugs; they are predaceous in habits and are built powerfully, suitable for their mode of life. The larger species prey on various aquatic insects and even small fish. When catching them one should handle with care as they puncture the skin on one's hand easily with their beaklike mouthparts.



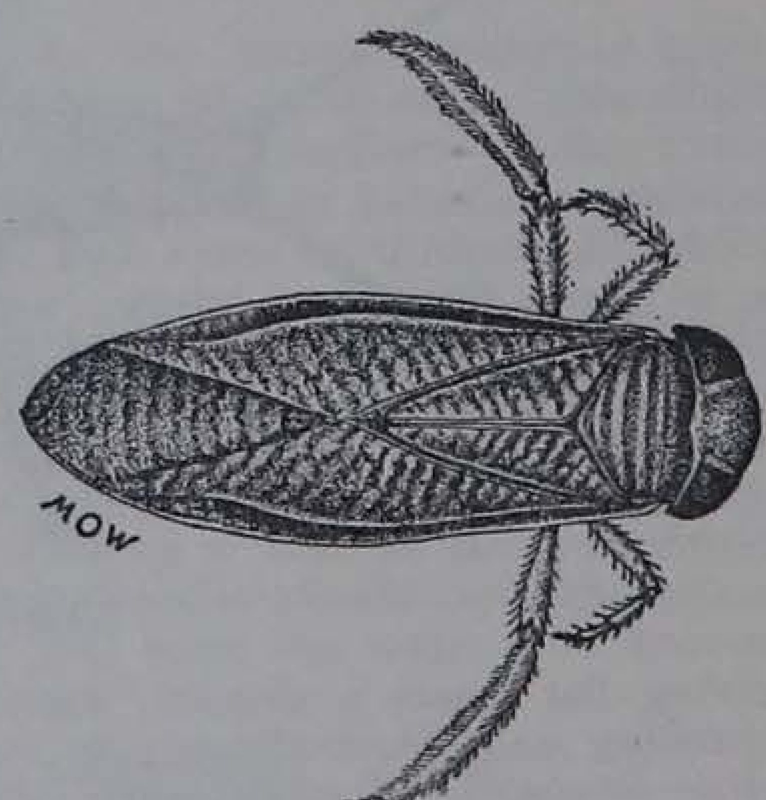
GIANT WATER BUG (with eggs)

Members of one genus *(Belostoma)* have curious habits; the females lay their eggs on the backs of males. Thus the bug insures transportation, safety and aeration for the eggs until hatched. The male in some instances appears to be an unwilling victim, but is overpowered in the clutches of the female.

The back swimmers *(Notonectidae)* have the curious habit of swimming on their backs, ventral surface up, as they feed on the surface film of the water. Their food consists for the most part of the dead remains of insects which fall upon the water. Members of this family are usually common in ponds and lakes, and on favored evenings leap from the water into flight eventually coming down in different waters that attract their attention. Some usually get into swimming pools and at times make their presence known by painful bites when becoming tangled in bathing suits. Fewer reports of this kind are coming in of late, due to the changing fashions for scanty attire.

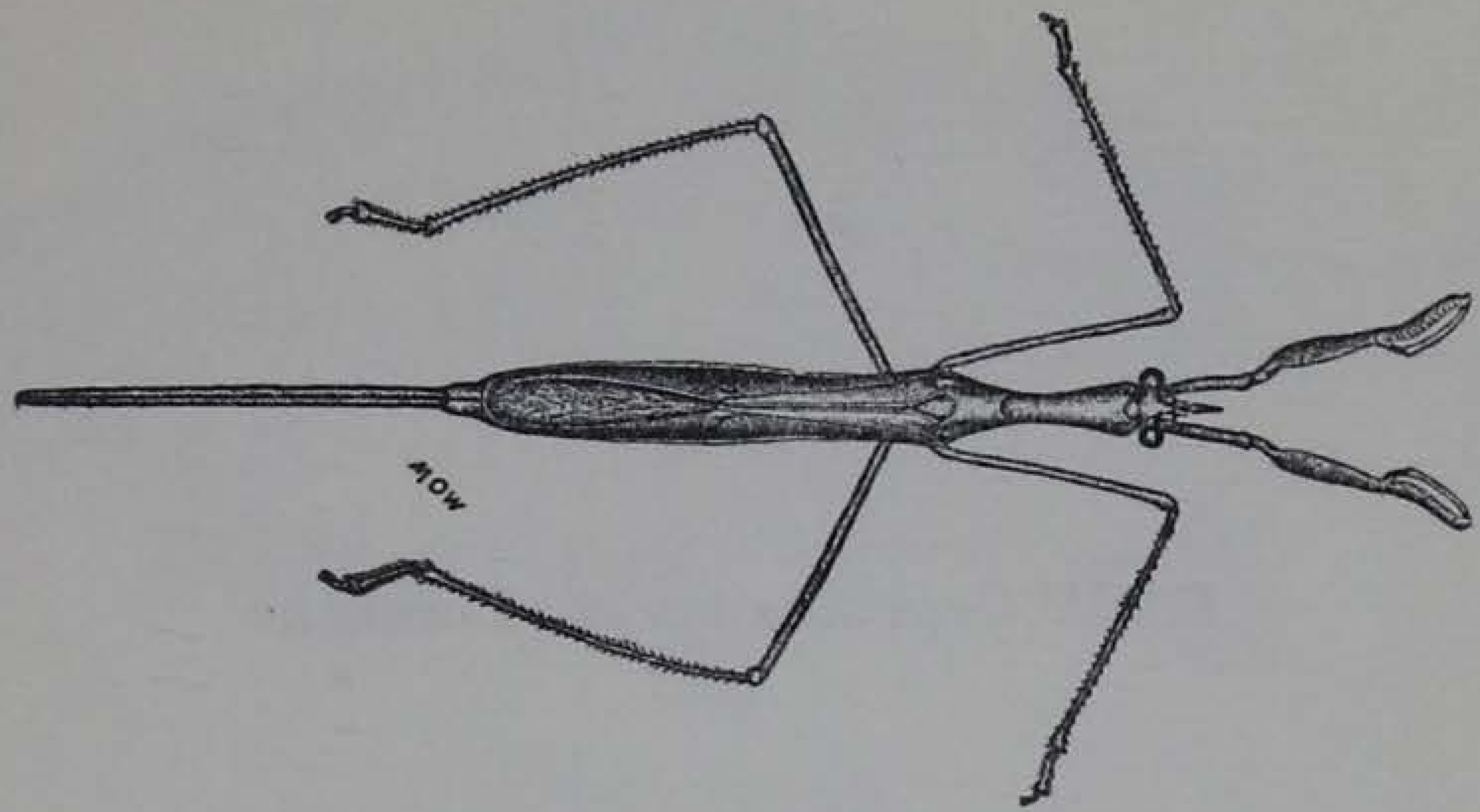


BACK SWIMMER



WATER BOATMAN

The water boatman *(Corixidae)* gets its name from the appearance it makes while swimming; the long hind legs reach out to make strokes suggestive of oars from a boat. Members of this family are very numerous in most bodies of water as their food, consisting of the smaller forms of plant life, is usually very abundant. These rather small insects do not bite when handled and may be easily collected by means of a fine mesh dip net. *Corixidae* serve a useful purpose in aquatic environment and because of their abundance supply much food for various fishes.

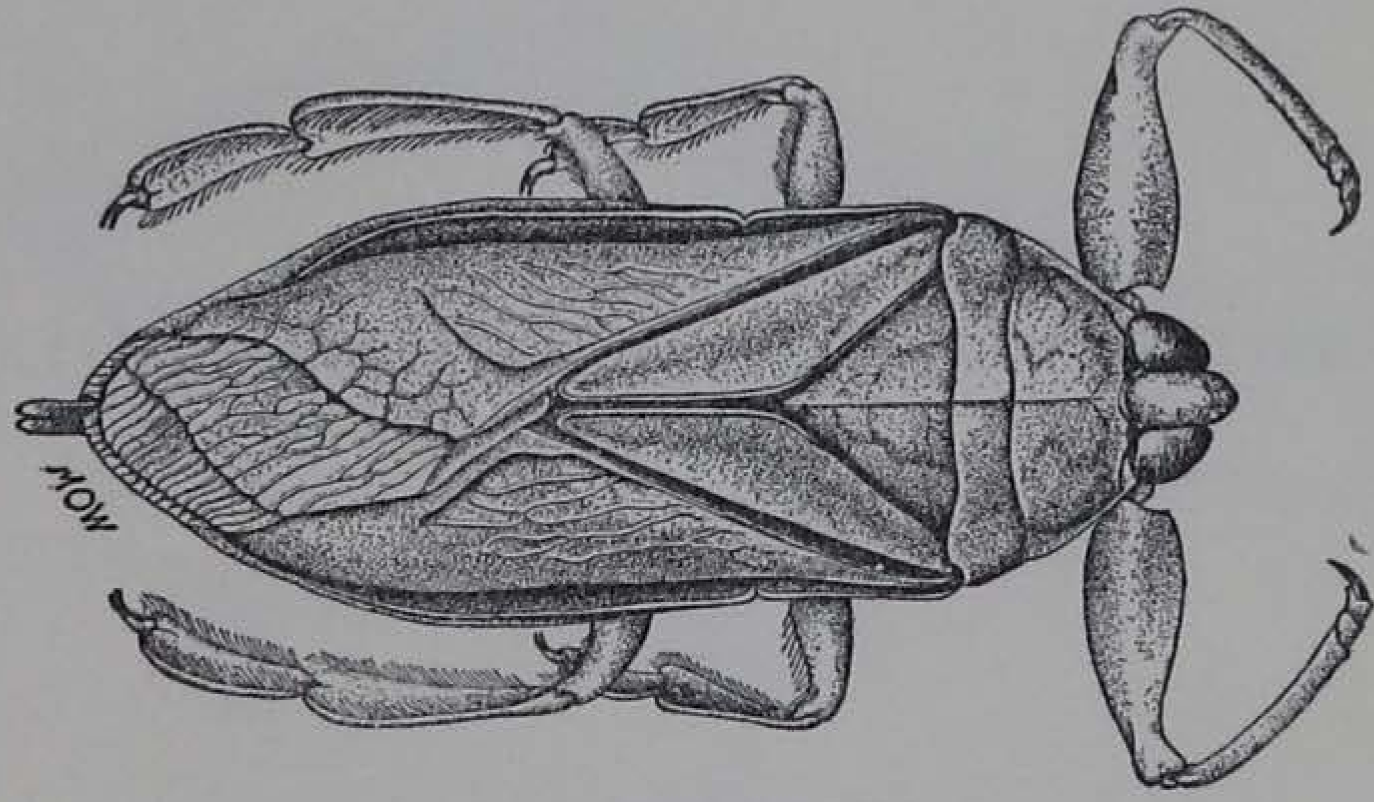


WATER SCORPION

The water scorpion *(Nepidae)* is a curious insect; it moves slowly about in shallow waters, and to obtain a supply of air projects the slender tube at the end of its abdomen into the air like a periscope. It feeds on various insects, dead or alive. The other aquatic insects mentioned above carry a supply of air with them in a cavity beneath the wings; periodically they must come to the surface to obtain a fresh supply.

Water striders *(Gerridae)* live on the surface bodies of water; their long, slender legs have nonwettable feet which rest on the surface film and give ample support to their weight. They appear to skate over the surface film, and with speed which makes them difficult to catch. Their food consists of all kinds of dead insects which happen to fall upon the water. Water striders are so fast and expert at dodging that most fish soon learn it is useless to try and catch them.

Several families of beetles *(Coleoptera)* have taken to an aquatic environment, and the evidence is rather conclusive that beetles first developed on land, then some families invaded the water. They have legs and other structures similar to land forms, but by flattening the leg structures and adding fringes of hair, they have come by rather efficient swimming structures. We have space to mention only two or three family types, and first of all we



GIANT WATER BUG

will notice the whirligig beetles *(Gyrinidae)*. These streamlined, flat-legged forms move rapidly over the surface film, usually whirling in never-ending circles as the name implies. They are black in color, oval-shaped, and have

PLATE 12

CARP ***Cyprinus carpio*** **Linnaeus**

BIGMOUTH BUFFALO ***Ictiobus cyprinellus*** **(Valenciennes)**

QUILLBACK CARPSUCKER ***Carpiodes cyprinus*** **(LeSueur)**

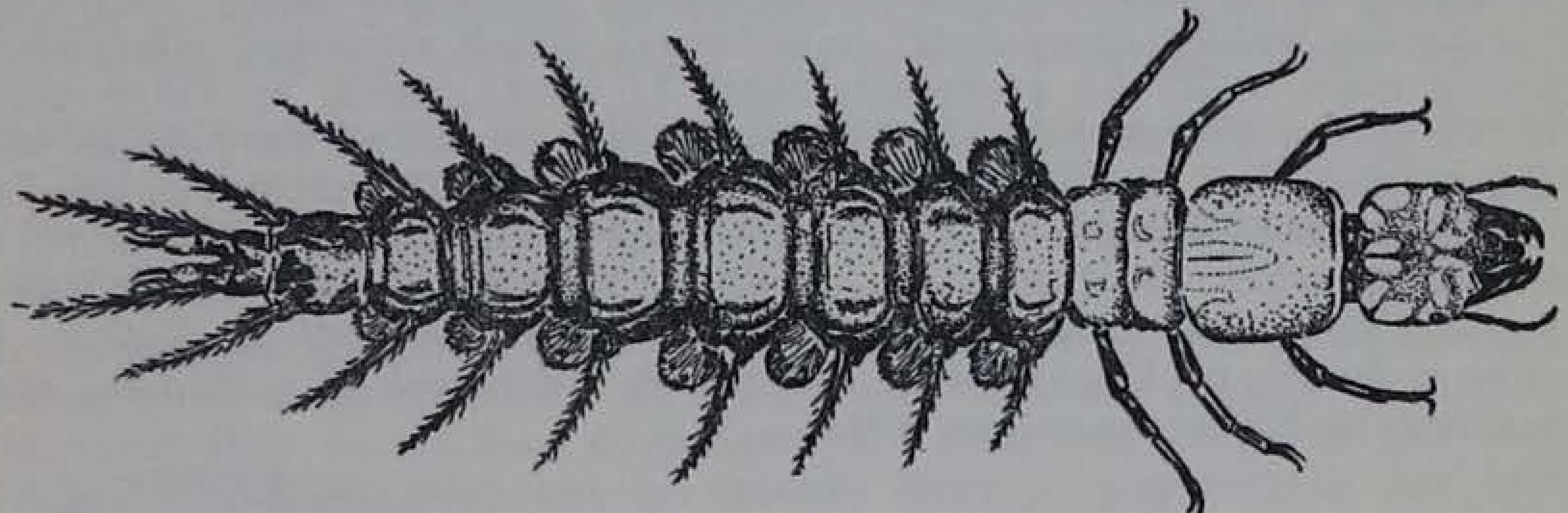

Maynard Reece

the compound eyes divided by a flange at the water line; half of each eye views the atmosphere above, while the lower half scans the marine depths below to watch for enemies such as fish.

Predacious diving beetles *(Dytiscidae)* are a large family of both large and small species. The larvae of these beetles live in the water and because of their bloodthirsty, voracious habits have been called water tigers. These grubs are elongated, spindle-shaped forms with prominent strong jaws. The beetles swim freely in the water but at rest hang beneath the surface film with the tips of their abdomens protruding into free air; when swimming a supply of air is carried beneath the thick wing covers.

Another family which includes large forms are known as water scavenger beetles *(Hydrophilidae)*. These beetles may be recognized by the sharp, spine-like keel which projects between and behind the bases of the hind legs. The air supply of these beetles is carried as a film on the lower side of the body, and in a jar or aquarium one may see this air space shining like liquid silver.

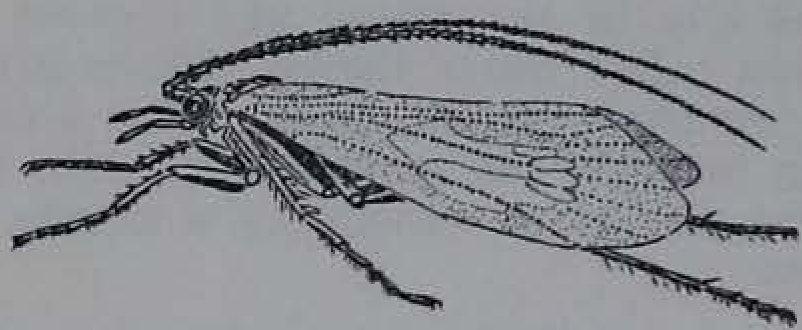
The larvae of the dobson, commonly called hellgrammite, shown in Fig. 14, is a member of the family *Sialidae*, order *Neuroptera*. The hellgrammite is one of the best live baits to use when fishing for smallmouth bass. The prothorax, or collar behind the head, offers a perfect structure for retaining the larva on a hook, and they are so durable a second bass may often be caught with one hellgrammite. These larvae are commonly found in streams where water one or two feet in depth flows over sizable rocks. To catch them one should hold a dip net or minnow seine just below rocks which can be turned on edge by hand; when disturbed the larvae usually detach and wash into the net.



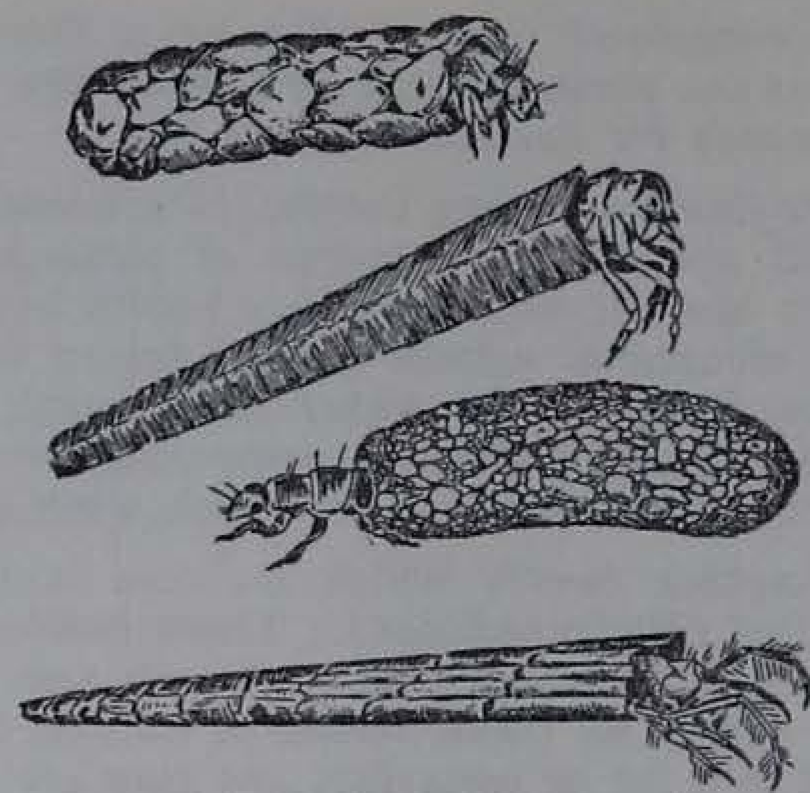
HELLGRAMMITE ***(larva of dobson fly)***

Hellgrammites are predaceous, feeding upon nymphs of stone flies and May-flies and other water insects. When about two years and eleven months old the hellgrammite crawls from the water and makes a cell under a rock or log on the edge of the stream. Here it spends about three weeks in the pupal stage before the adult emerges. The adult is a remarkable insect about three inches in length, gray in color, with jaws an inch long in the males and half as long in the females, but better fitted for pinching. Adults often fly to electric lights, where one may see how the four large wings have many veins and cross veins. The female deposits her eggs in blotchlike masses, chalky white in color, on leaning tree trunks or leaves of sycamore overhanging the water. Where modern highway bridges span favorable streams, the egg masses may be seen in quantity on the under structures. A single mass may contain one or two thousand eggs. Upon hatching, the larvae drop into the water and soon find the rocks where they will remain until full-grown.

The caddisflies, or *Trichoptera*, are mothlike insects in the adult stage but they are distinguished by having the wings and body covered with round hairs rather than flat scales. The larvae are aquatic, caterpillar-like in appearance, with most species living in specially constructed tubes which are characteristic of the genus or species. When you look closely for objects in clear water streams, you may notice a bundle of sticks or a single short length of stem



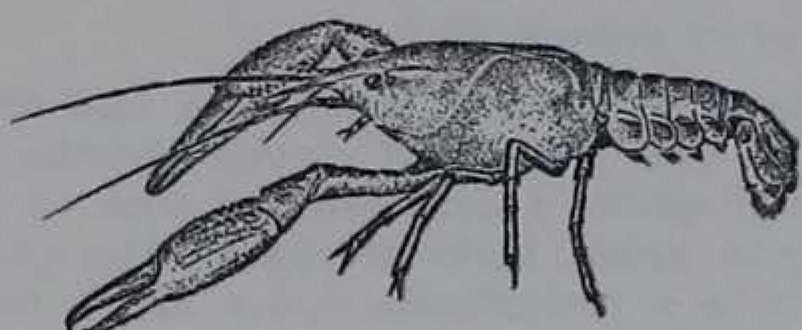
CADDICE FLY



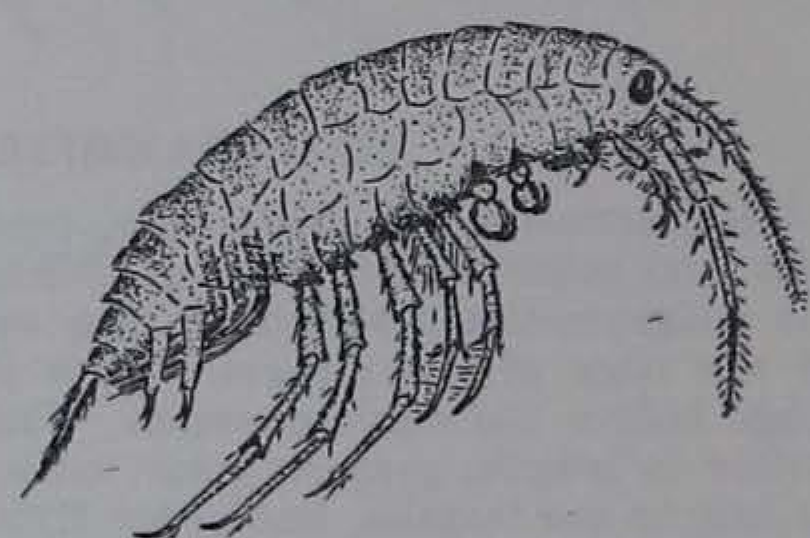
CADDICE FLY *(larva)*

move about, actually crawling over the bottom on rocks or vegetation. What you see are the cases of caddiceworms, which contain the larvae of caddisflies. Some species use grains of sand to make their cases, but a greater number of species build with bits of vegetation. The larva projects its head and thorax from one end of the tube so the legs may function for locomotion. The case probably gives protection from enemies through camouflage and perhaps in other ways—we can only guess. The larvae of many small species spin silken nets on stones or vegetation which serve to catch floating organisms used for food.

The life cycle of many species of caddisflies takes one year. Eggs are laid in or near the water; these hatch into larvae which resemble caterpillars, but the young soon build the protective cases of sticks, sand, or other materials. When full-grown the larva makes a cocoon at one end of its case in which it changes to the pupal stage. During this stage the adult structures are formed; later the pupa wiggles free of the cocoon, rises to the surface, crawls out of the water and attaches itself to stone or stick, after which the adult may burst the pupal skin, crawl free, expand its wings and take off in flight. Adults may live a month or longer; they are mostly nocturnal in activities, spending the daytime in hiding near the water.



CRAYFISH



GAMMARID or SCUD

Crustaceans are very important in the food supply of fishes. The largest and best known is the crayfish. There are several species, each adapted to a particular condition of water and bottom cover. In growing larger each crayfish must shed its exoskeleton once or twice each year. This molt is accomplished in a retreat under stones in shallow water, and the "soft-shell" requires a few days for the new exoskeleton to become hard. Now is the time to collect them for bait, and many will be found under flat stones in shallow water.

Some of the smaller crustaceans are very important in the "food chain" which supplies the food for fishes. A common example of this group is the gammarid, order *Amphiopoda*. Members of this group range in size up to one-half inch in length and are common in Iowa waters.

Chapter XVI

BAIT AND BAITING

For the bait fisherman, bait hunting can be as much fun as the fishing itself. It provides the same exercise, excitement and surprises for the angler and gives him an additional excuse to "live it up" outdoors. Bait hunting leads to an eye-opening introduction to the wonderful complexity of pond and stream life, and in addition, a working knowledge of where and how to secure natural baits will often put fish on a stringer that otherwise would remain empty.

This chapter is designed to help you secure and use the more popular natural baits. Included are worms and nightcrawlers, minnows and chubs, crayfish, frogs, salamanders, clams, grasshoppers, crickets, hellgrammites, leeches and the soft-bodied larvae of various "bugs".

For the beginning bait hunter, only one specialized piece of equipment is a "must"—a good minnow seine. It should not be more than 15 feet long. It may be from four to six feet deep from the cork line (top) to the lead line (bottom). The mesh must not be smaller than a quarter-inch bar measure, that is, a full quarter-inch between the knots that tie the twine into the net. It should have cork, wood, or light plastic floats at the top and small lead weights about two feet apart at the bottom. Additional clip-on weights may be added when needed.

The net should be tied and not woven. Woven nets are cheaper, but they have the miserable characteristic of slipping where the warp and woof intersect, leaving holes in the seine where bait will go through, resulting in the not uncommon "water haul". Investment of a few extra dollars is wise when buying a net.

A good net will last a long time if properly taken care of. After its use it should be washed by swishing back and forth in water until free of mud and debris, shaken briskly to free it of excess water, and all bait carefully removed. It should never be stored or left rolled on the brails while still damp, and should never be dried in direct sun. When not in use, it should be suspended from the rafters of a barn or garage with some circulation of air and out of reach of mice. Except for the guy on the other end, a bait hunter's best friend is his minnow net. Get a good one and give it good care.

Earthworms

Earthworms, angleworms, garden worms, nightcrawlers, dew-worms, or by whatever name known—this great and varied group has been recognized for hundreds of years as prime fish bait. More than 2,000 kinds are known in the world, some too small for bait and some too large, including a South American species six feet long and an inch in diameter. It is difficult for the bait hunter in mid-July to believe that the now scarce worms live in the soil in astronomical numbers—as many as two million in a single acre.

Earthworms thrive in almost any kind of soil, but those containing a great deal of organic matter carry the heaviest populations. Favorite worm-digging grounds include rich bottomlands not too frequently flooded, in and around decayed straw butts or manure piles, and in the vicinity of stockyard debris and dumping grounds where residue from feed and flour mills is found. Often in such choice locations the turn of a single spadeful of earth will reveal a hundred or more worms.

More often than not, worm-digging entails considerable work with a spade in a garden plot. Worms can be gathered by following the plow in the spring and held in storage until needed during the fishing season. In an emergency, even in the driest weather, a good supply of fishworms may be found by turning over rotting logs on the stream bottoms. In such locations the worms concentrate in the damp earth and decaying wood and may be easily scratched out with a stick or pocket knife.

Nightcrawlers or dew-worms are most popular with the fisherman, if not the fish, because of the ease of capture and their large, spectacular size. Nightcrawlers are not as hardy as most species of garden worms, are not as active on the hook, and in the opinion of many fishermen not as attractive for bait.

Nightcrawlers are hunted with a light on wet or rainy nights on the surface of the ground, when they come out to secure food and breed. They are most abundantly found in the spring, appearing shortly after the frost leaves the ground.

The method of capture is simplicity itself. The worm hunter, with the aid of a flat-focus flashlight or lantern, catches the glisten of the worm's slimy body in his light, determines the head end, and catches it gently but securely between his thumb and forefinger. The more of the worm emergent from the hole, the easier it is to disengage it from the burrow. Experienced worm hunters give the worm a quarter twist between the fingers, then pull it slowly but steadily from its doorway. Occasionally the worms are broken into two parts. Damaged worms should be discarded, for they will soon die and will foul the soil and container in which they are placed for storage.

There are a number of gimmicks used to secure limited numbers of nightcrawlers during dry weather, but the most common dry weather method is to sprinkle the lawn for a couple of hours before sundown. Give the crawlers an hour of darkness in which to start to prowl, and then go after them.

In recent years commercial earthworm raisers have become numerous. The procedure is not complicated nor expensive. The U. S. Fish and Wildlife Service, Washington, D. C., has prepared and published a leaflet on the subject that would be of interest to anyone wishing to raise his own worms. It may be secured without cost by writing to the above address for Leaflet FL23, "Earthworms for Bait".

The old axiom "There is a time to fish, and a time to cut bait," might be rewritten to read, "There is a time to fish, and a time to get worms." During wet periods worms are easily secured. During dry times they go deep into the ground and are almost impossible to secure in large numbers. Nevertheless, the worm fisherman may have ample midsummer bait supplies by storing the easily secured spring worms for use when bait is at a premium.

The best storage or holding pen for worms is a tight wooden box. It must be remembered that the seams of the box must be tight to prevent the worms' escaping. The box should then be filled about two-thirds full of good earthworm soil. The Fish and Wildlife Service recommends one part stable manure, one part screened topsoil, and one part peat moss well mixed. About one-half pound of cornmeal or mash is added for each cubic foot of filler material.

This mixture will maintain as many as 200 worms per cubic foot if the box is kept in a proper location and if moisture is maintained at the proper level.

It is to be remembered that too much heat or too much moisture is deadly to earthworms.

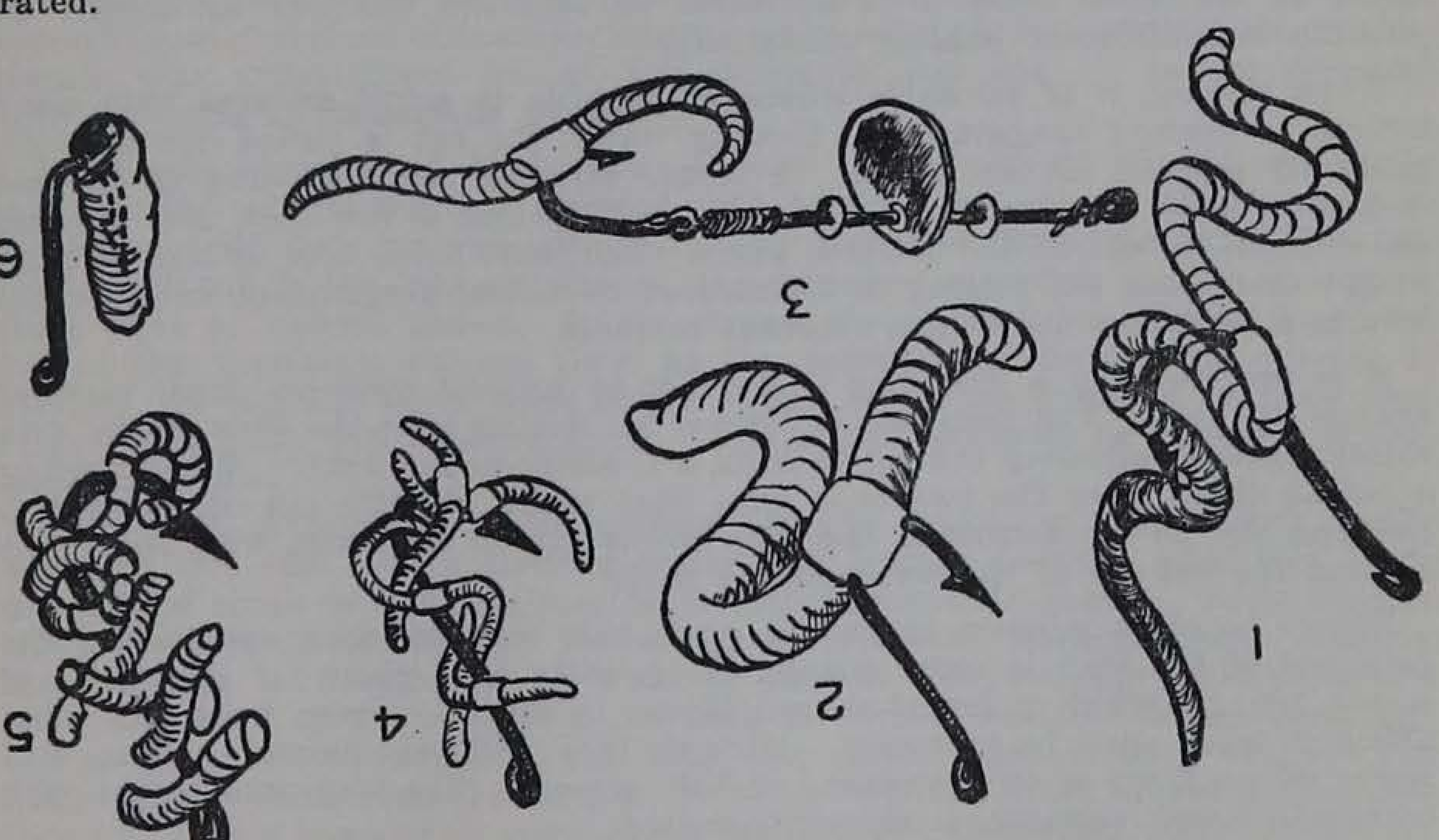
Worms in storage should be kept out of direct sunlight. They may be held satisfactorily in their containers in a basement, in an airy barn or garage, on the north side of buildings, or in any other location in the shade where there is air circulation.

The soil in worm boxes must be kept moist, but not wet. It should be kept out of direct rain, unless the storage box is large with proper drainage. This is especially true where the worms are held any length of time in metal containers. At the same time, if the soil becomes too dry, there will be a loss of worms.

Nightcrawlers are a little touchier to hold than are most other earthworms. One of the best ways to hold them is to fill a wooden box or properly ventilated metal container with several layers of bluegrass sod from which the bulk of the soil around the roots has been removed. The earthworms are dumped on the top and allowed to seek refuge in the sod roots and between the layers. Those that remain on top for 30 minutes should be discarded. When needed, they are easily removed by lifting the top layer or two from the container. In this way a full gallon of nightcrawlers can be held in a washtub.

For nightcrawlers, it is well to "harden" them before using—that is, let them dry out a bit. When first taken, they contain a great deal of body moisture and are not very active bait. If kept in sod that is fairly dry, they lose moisture and shrink in size, but become much more active. Do not, however, let the worm bedding get too dry, and keep it out of direct sunlight or excessive heat from any other source.

When transporting worms for considerable distance, the sod layers in a wooden ammunition box will transport them safely. Don't, however, carry them in the heat of a locked car trunk. When fishing with worms, keep them out of the heat of the sun so that they will remain lively and active when placed on the hook. There are several ways to hook worms. The most popular are illustrated.



Angle worms: 1. Single worm, double hooked, for all fish; 2. single worm, collar hooked, for all fish; 3. single worm, collar hooked, for trolling or casting; 4. multiple worms, double hooked, for most fish; 5. broken chunks of nightcrawlers, single hooked, for bullheads; 6. worm tip used chiefly for trout and panfish.

Minnows and Chubs

Universally minnows are one of the most important of all fish baits. In the vernacular of the angler, "minnow" means any small fish that can be used for bait and sometimes includes the young of pan fish, bullheads and others. Small fish make up the bulk of the food of most of our principal game fish. Minnows of one kind or another are found in all of our permanent streams, even the smallest, and in most of our other waters. They are readily available, easy to seine or trap, and with the exception of the shiners, most of them are easy to transport and hold if not overcrowded. They are easy to bait, stay well on the hook, and they appeal to hungry fish like Thanksgiving turkey does to a small boy. For pan fish the best baits are fathead minnow, sand shiner, bigmouth shiner, bluntnose minnow, and brassy minnow.

For catfish, large and smallmouth bass, northern pike, walleye and other large fishes, the best baits are creek chubs, stoneroller minnows, golden shiners, and the young of some of the sunfishes, bullheads, certain rough fish, and the common sucker.

Read the life histories of these minnows, beginning on page 83, to find out where they live. The angler should learn to recognize these species and not clutter up his bait bucket with poor bait kinds.

Most minnows are taken by seining, trapping, or drop-netting. No matter how collected, certain rules should be followed. FIRST, TAKE NO MORE THAN NEEDED OR THAN CAN BE SAFELY TRANSPORTED AND HELD UNTIL USED. Select sizes that can be used for the kind of fishing contemplated, and return to parent waters unharmed undersized or oversized bait. This is especially true of large-sized creek chubs. In many areas a shortage of breeders of this magnificent bait minnow has created a critical problem.

In seining, it is preferable to make short quick hauls to avoid overcrowding bait in the net and bruising it. Bruised bait will fungus rapidly in a holding tank and die. The seine ends should be pulled onto the shore, allowing the bag containing the bait to remain in shallow water. The bait is then hand-sorted and put into the minnow bucket or pails. If crawfish and minnows are taken at the same time, it is advisable to separate the two as quickly as possible into different holding containers.

When seining, it is advisable whenever possible to select an area with clean bottom to prevent snagging. In flowing water, the net is pulled downcurrent, generally parallel to the banks. In larger streams the outer end of the net is kept a little in advance of the shore end. After a few feet, the advance seiner pulls his end of the net into shore. The same holds true in lake seining, except that often the seining is commenced on shore, progressing out into the lake in a horseshoe shape, and returned to shore.

It is best to keep a deep bag in the net to prevent minnows from running around the ends. The deep bag is formed by seining with the ends of the nets closer together, allowing the net to form a U-shape in the water. When landing a net on shore after the two ends have been pulled slightly out of the water, the lead line on the bottom is carefully worked in on the shore with the floats holding the net out of the water at the back.

Screen or glass minnow traps will catch bait in a one-man operation. The principal of the trap is quite simple. It consists of a glass jar or a tube of screen wire in which a funnel-shaped throat is placed. These traps are most efficient when used in a stream, although they will take minnows from still water where there is an abundance of bait present. The traps are baited with cornmeal, bread, oatmeal, or cheese trimmings.

In streams the traps are placed in the current in shallow water above a fair-sized hole known to contain bait minnows. As the current carries particles of bait into the deep hole, the minnows strike the trail and follow the particles to their source in the trap. These traps must be run frequently, for after the bait is gone, the minnows quickly find the entrance to the funnel and escape.

In still water the use of drop-nets is more common than trapping. The drop-net is usually square in design and a minimum of three feet across. The net is supported by a framework and is lowered into the water either by hand or with a tripod arrangement. Bait is placed in the webbing, and when a good number of minnows are feeding, the net is lifted straight up. The webbing forms a pocket in which the fish are entrapped.

Occasionally in areas of heavy minnow concentration, such as below the aprons of river dams, a fine mesh dip-net is all that is needed to secure ample bait supplies.

It was said earlier that storage and transporting the preferred bait minnows is easy. The term "easy" is a comparative term and is correct only if certain iron-bound rules are followed, plus a great deal of common sense and care.

The rules are: Take your minnows without injury; don't at any time over-crowd them in the containers; and when in live-boxes, either in the stream or lake, do not allow them to be buffeted by waves or strong current. Feed bait very sparingly.

Immediately after the minnows are taken out of the net and placed in the minnow buckets, it is advisable to place the inner container of the bucket back in the stream, where a supply of fresh water is brought by the current. Many more minnows may be held in this way than can be held in a bucket where no fresh water is introduced.

When seining minnows, it is advisable to have storage tanks in your car. Five-gallon cream cans work well. Before your bait buckets become crowded, transfer the minnows to the storage tanks. Be sure that the temperature of the water in the storage tank and the collection bucket does not vary greatly. Cool water is best. The water in which the fish are transported may be slowly cooled down, either with addition of cooler water or by the introduction of small quantities of ice. A slick method of carrying a bucketful of minnows on a hot day is to place a fist-sized chunk of ice on the top of the minnow bucket lid, allowing the cold water to drop into the container as the ice melts. Another commonly used method of transporting minnows safely is by aerating, the professionals with motor-driven pumps, the angler by pumping air to the minnows with a bicycle or automobile pump.

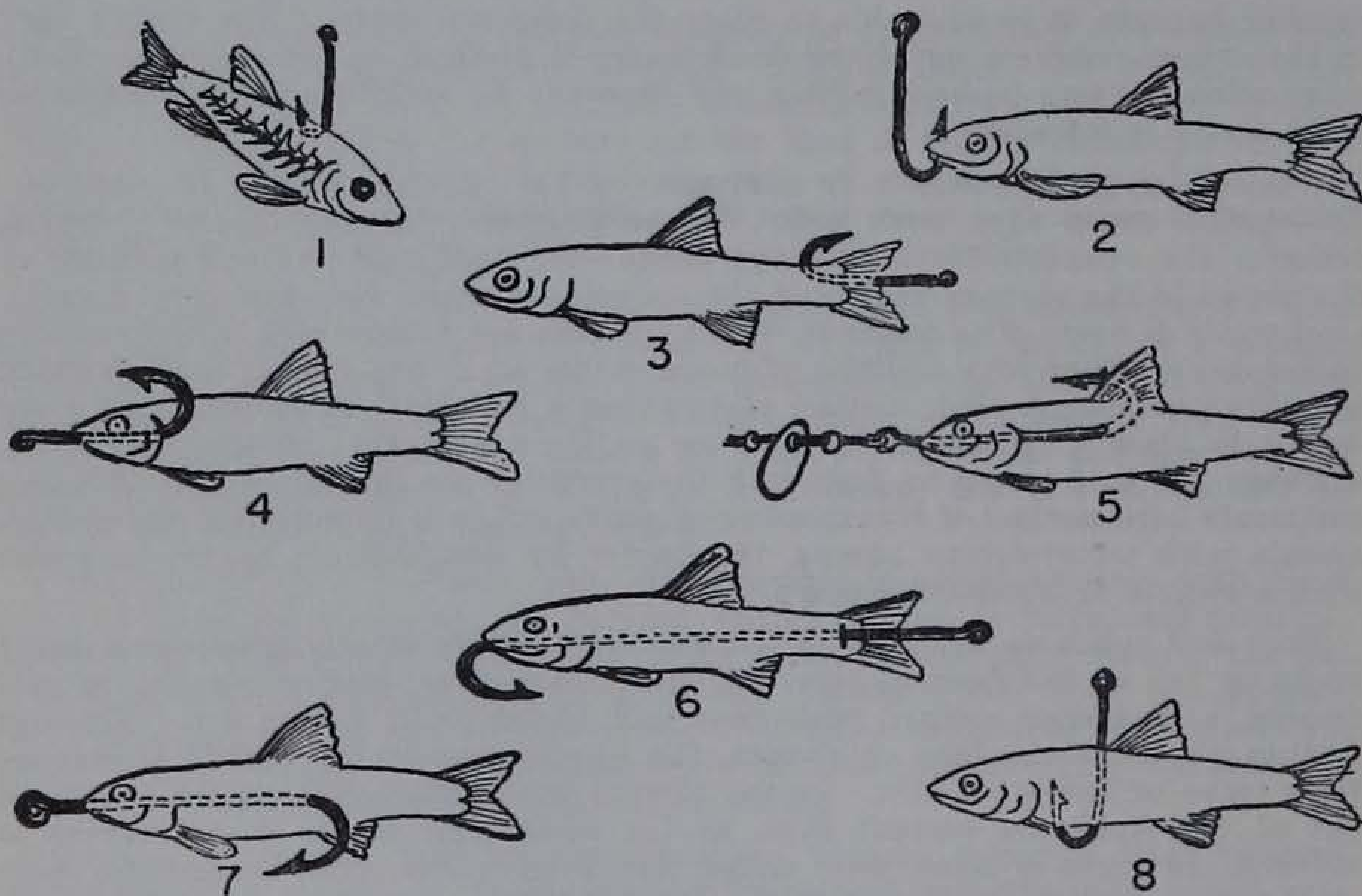
Most bait minnows are held in live-boxes. Live-boxes are simply and easily made on 2x2 or 2x4 framing, covered with screen wire, copper wire being preferable, a trap door secured with hasp and hinges built in the top. The box is then placed in the lake or stream, the minnows receiving plenty of oxygen from wave or current action. In the stream the minnow box should be placed out of the maximum current flow, at the same time where some current is moving. In boxes in lakes, wave action should be broken down by covering part of the wire mesh with wooden slats. Dead minnows should be removed at frequent intervals.

Some bait enthusiasts build minnow storage tanks or adapt stock water tanks to this use. With flowing water and proper feeding, relatively large numbers of chubs or minnows may be held throughout the season. Some anglers carry creek chubs throughout the winter in basement storage tanks. Holding tanks should be constructed of wood or smooth concrete, the insides painted with aluminum or asphalt paint. A tank 36 inches wide, 40 inches deep, and 6 feet long without aeration will hold four dozen medium-sized chubs. The same tank, with a constant supply of water entering from overhead pressure jets, will hold a hundred or more chubs comfortably, depending upon the amount of water introduced.

For long-time holding, the fish introduced to the tank should be in topnotch physical shape, carefully handled from the time of capture until introduced to their new home. Minnows in permanent storage tanks should be fed. They will eat a variety of foods, but the most practical are those that are convenient, such as cornmeal, oatmeal, or small bits of raw hamburger. Do not *overfeed*, or the tank will be contaminated by unused food. If fungus epidemics attack the fish, all dead fish should be removed at once, the remaining dipped in a solution one to 15,000 parts of Malachite green. They may be held in this solution for about 10 seconds. The tank should then be drained and sterilized with sodium chlorate, one part to 10,000.

Minnows are used dead or alive and hooked by many different methods, depending upon how the bait is fished and for what fish the baits are intended. Some minnows are hooked so that they will stay alive and active. Others are fished as dead bait. For catfish, the bulk of the baits are fished dead, and in the case of creek chubs often the chub is allowed to die and remain in water for an hour or two, until it turns white, but not long enough to allow it to become soft. Chubs used in this way after turning white should be removed from the water and packed in a jar in chipped ice to keep from further decomposition.

The accompanying illustrations show some of the most popular methods of hooking minnow baits.



Minnows. 1. Hooked alive lightly under the dorsal fin, avoid injury to the backbone; 2. hooked alive through lips, for casting and trolling; 3. live-hooked through body at tail; 4. live-hooked through mouth and out gill covers; 5. hooked through mouth out gill cover, through back below dorsal fin, for casting and trolling; 6. hooked through the center of the body beginning at the tail, out the mouth, for catfish; 7. through the mouth, out through the side of the body behind dorsal fin for catfish; 8. down through the back and up through the belly, for perch.

Crawfish

Crawfish or crayfish are one of our most important fish baits. A big, juicy soft-shell is second to no other bait when it comes to taking big channel catfish, large and smallmouth bass, and carp. There are many species of crawfish found in the state, and they are found in most of our waters.

The most popular sources for bait crawfish are in shallow ponds that freeze out periodically and destroy predaceous fish, in the sloughs along the river and stream bottoms, and in the main bodies of the smaller streams. In some ponds and bayous they live in astronomical numbers. Lucky is the angler who has a private crawfish pond.

A little of the natural history of crawfish will help the angler understand the potentials of this bait. Crawfish eat both animal and vegetable material. They eat both fresh and decomposing animal life. They are truly one of nature's most remarkable sanitary engineers. The young hatch from eggs in the spring and are attached to the undersides of their mothers' tails, where they are carried until they are crowded off by growth. They drop to the pond bottom and for the rest of their lives are on their own. They grow rapidly and periodically outgrow their hard covering shell, which is cast off. As soon as the old shell is cast, the animal, which is soft and jellylike and completely helpless, begins to redevelop its new armor. Within a very short time the new shell is complete and the crawfish again becomes an active, armored garbage eater.

It is immediately after shedding its armor that the helpless animal is known as a "soft-shell", and at this time it is at its best for bait. As the shell gradually hardens, the larger individuals lose much of their attractiveness as bait. The softer the shell, the better the bait.

With this last thought in mind, we'll go crawfish hunting. The same seine and the same methods of seining are used for crawfish as were mentioned in the minnow section. In ponds with muddy bottoms, a few extra clip-on lead weights are placed on the lead line, for we want to drag the bottom to pick up as many of the inactive soft-shells as we can. When the net is landed, generally pulled clear out on dry land, the active crawfish begin to move, the soft-shells lie still. The active crawfish will injure the soft-shells in the net, therefore the almost dormant soft-shells should be picked out immediately and placed in a bucket of water. Then the active crawfish are picked up and placed in a dry bucket.

Except for the soft-shells, which are prime bait regardless of size, the crawfish should be sorted, taking only those that are suitable bait size for the fish to be angled for. For instance, if the whole crawfish is to be used, the best size channel catfish baits are from an inch to an inch and three-quarters in length. If peeled tails are to be used, the large crawfish are selected.

When sorting crawfish from the net, many anglers select the largest craws that are parasitized with insect eggs and deeply discolored, for these are about ready to cast their old external skeleton and in a very short time become "super-duper" soft-shells. More about holding them for their shell change later.

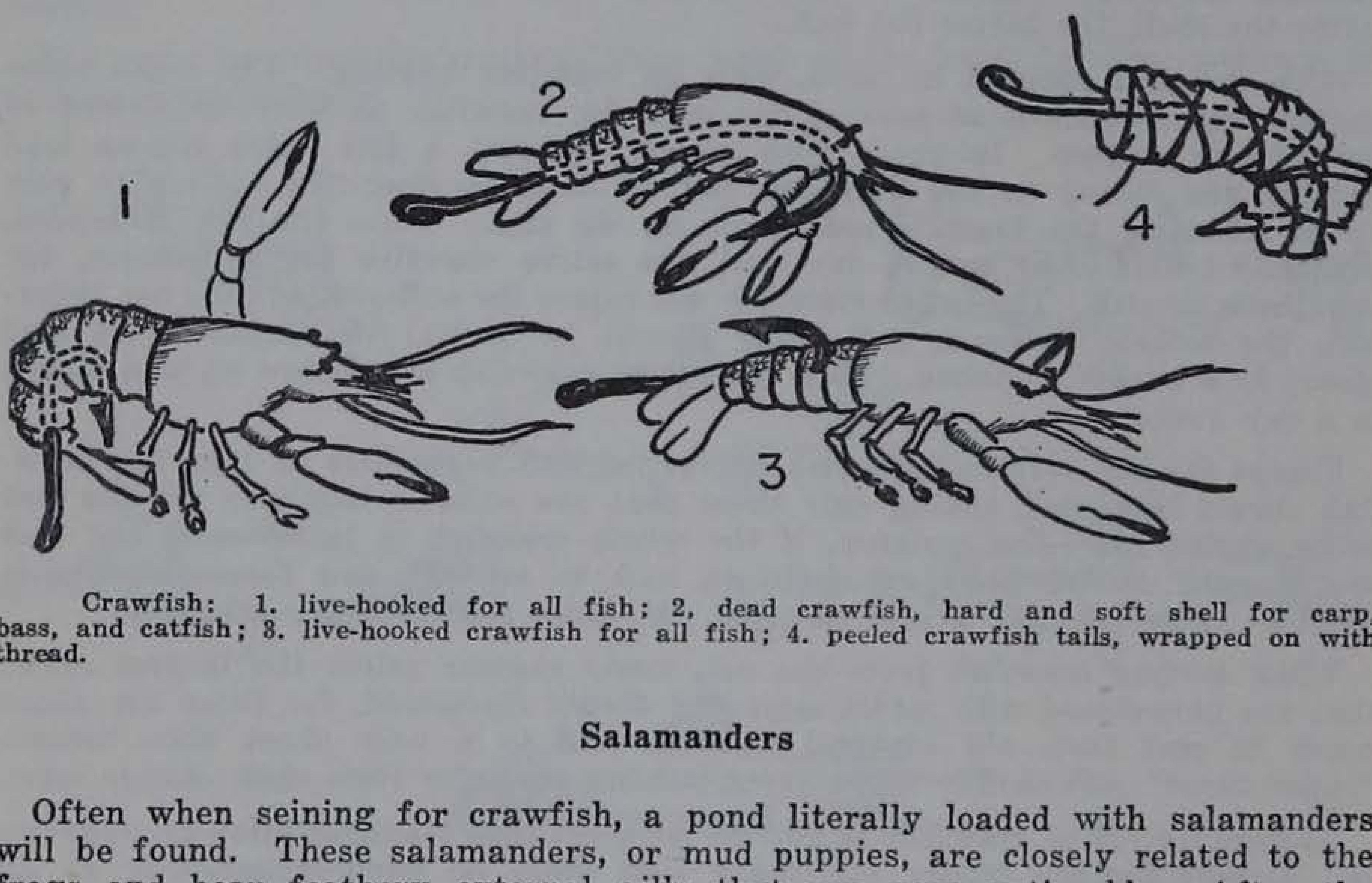
Transportation of crawfish is not the problem that transportation of minnows is. Except for the tender soft-shells that must be handled carefully at all times and carried in water, the crawfish is a tough hombre. He can be carried in a dry bucket safely for long distances, even on a hot day, or in a damp flour sack.

Storage of crawfish is yet another matter. Some species can be kept rather well for long periods, others are very difficult to keep. Commercial bait dealers keep crawfish either in live-boxes similar to the minnow live-box or in aerated storage tanks similar to the chub tank. Joe Mathers, in his excellent booklet "The Crawfish as Fish Bait", advises not to overcrowd storage containers, keep the water cool, feed lightly, and allow a little faucet drip. If this advice is followed, an ordinary washtub will carry 25 to 30 crawfish indefinitely.

Crawfish may be kept with very little water in a metal bait tank. A tank 2x4 feet with 12-inch sides, kept in a cool basement room, will handle crawfish wonderfully well. The tank is tipped by placing one end on bricks, allowing two or three inches of water in one end, dry in the other. A little damp florists' moss or leaves or other vegetation is placed in the tank. This is where the mangy-looking crawfish that we separated at the pond are allowed to cast their shells and become soft-shells. Our batch of crawfish about to shed are placed in the tank and watched carefully. They should be observed every eight hours, the soft-shells taken out and placed in glass jars as soon as the shell is cast. The glass jars, with five or six soft-shells in a jar, are then placed the formation of the new shell, and the soft-shell will remain superb bait for in the refrigerator at a temperature of about 45 degrees. The cold retards five or six days.

In water storage of crawfish, do not overcrowd, see that there is a continuous fresh water supply, and remove the dead crawfish frequently. In "dry" storage, keep the tank cool, the vegetation moist, and water free from fouling by removing dead crawfish promptly and changing the water occasionally.

There are numerous methods of hooking crawfish. The accompanying illustrations show the most popular ones used. When using crawfish tails, peel out the white meat of the tail. When fishing for catfish or carp, carry a spool of cotton thread in your bait bucket. Put three or four tails on the hook and wrap them on the hook with ten or a dozen loops of thread. Carp or catfish will have quite a time stealing crawtails when fastened in this manner.



Crawfish: 1. live-hooked for all fish; 2. dead crawfish, hard and soft shell for carp, bass, and catfish; 3. live-hooked crawfish for all fish; 4. peeled crawfish tails, wrapped on with thread.

Salamanders

Often when seining for crawfish, a pond literally loaded with salamanders will be found. These salamanders, or mud puppies, are closely related to the frogs and bear feathery external gills that are very noticeable. After the gills have been shed and the animals become air-breathers, they leave the pond and spend most of the rest of their lives burrowing in moist places.

The gill-bearing mud puppies are used quite extensively for catfish bait on trot-lines. They are a "slow" bait, for the most part, but are sometimes taken ravenously by large catfish.

They are easy to transport and hold, trot-liners generally staking them in the stream in a gunny sack. The salamander is hooked under the backbone immediately in front of the hind legs. This is the only hooking that is secure enough to hold this tender-bodied animal on the hook. Hooked through the lips or through the tail, it will be promptly torn off by a feeding fish.

Frogs

In many waters frogs are an important fish food, and because they are tough and often readily available, they make up one of the most important baits. The leopard frog is the most common and most desirable.

The leopard frog reaches its peak of perfection as bait in late July and August, when it is from two to three inches long. Larger-sized frogs are in most instances a "slow" bait.

Frogs, of course, are born in the water from eggs that develop into the well-known tadpole. The tadpole in midsummer changes into a frog that soon is securing most of its food in the territory surrounding its birthplace. It feeds principally at night on living prey, mostly insects. It returns to the pond at frequent intervals and spends most of the daylight hours in the water or in the immediate vicinity.

In some years and in some localities frogs become very abundant. They thrive best in waters where there are no predaceous fish, the frog's greatest enemy except for prolonged drought.

Frog migrations are familiar to most. The migrations are most spectacular in late fall in the northwestern part of the state, as they move from lush summer feeding grounds into the lakes proper, where they hibernate. At this time the smaller frogs are taken ravenously by walleyes, northern pike, largemouth and smallmouth bass, as well as some of the other game fish. A less spectacular migration occurs on the major rivers. The bulk of the young frogs are reared in bayous and overflow ponds along the river bottom. In dry years, as the ponds dry out in July and August, the young frogs move to the river. For the most part they remain well hidden in the daytime; however, at nighttime they may be seen with the aid of a flashlight, lining the riverbanks like spectators at some sports event. At this time they are food for the river walleyes, northerns, smallmouths, and channel catfish. Under such conditions, there is no bait for catfish that can compare to 1½-inch-long leopard frogs.

The easiest way to locate large numbers of bait frogs is to walk the pond margins at night, searching the mud flats between the water's edge and the grass line with a light. The easiest way to catch frogs for bait is to find them at night with the aid of a flashlight. A flashlight with a strongly concentrated beam is focused on the sitting frog. The frog hunter then merely walks up to the dazzled animal, catches it in one hand, and pops it into a damp flour or sugar sack, or sock carried for that purpose. In ideal locations a limit of frogs may be caught in a short time. A much less productive method is to catch them by hand in the daytime, and this is a task for a spry young boy.

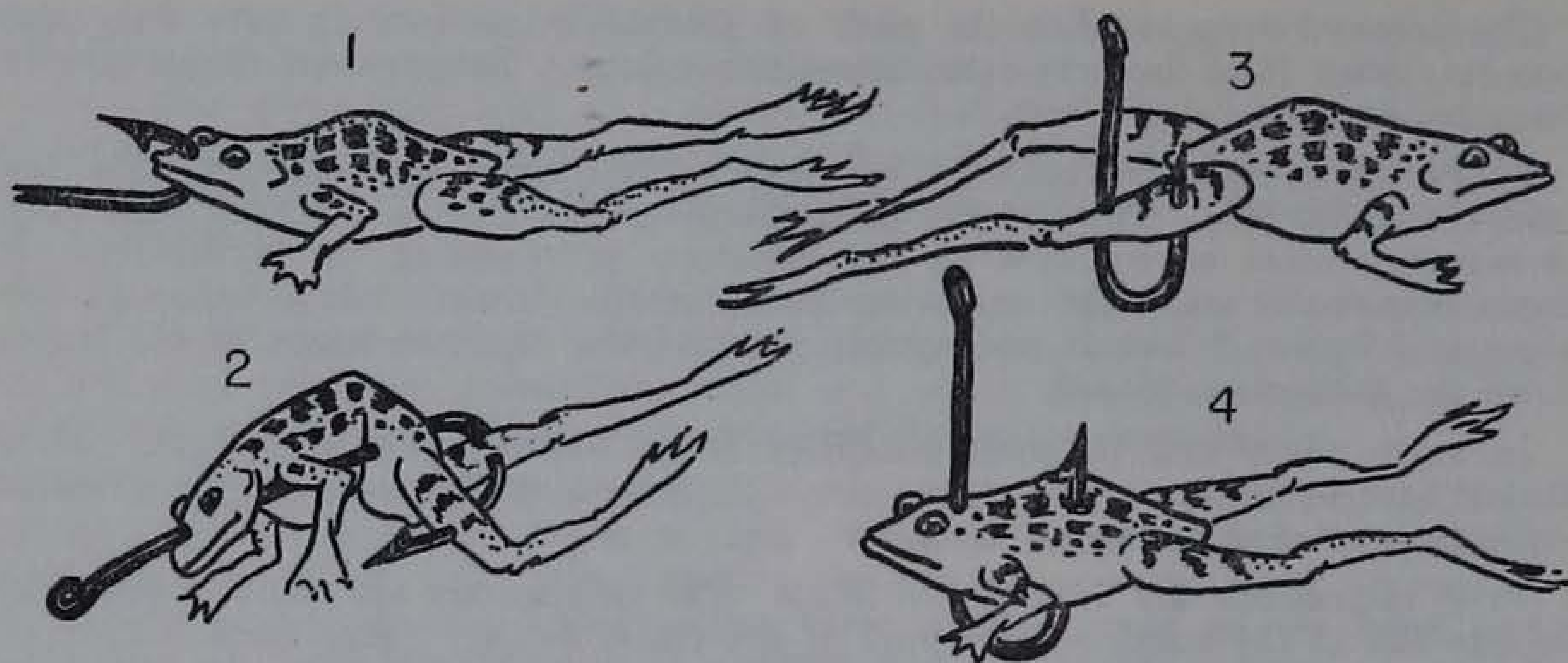
There are times when an abundance of frogs may be taken by minnow-netting. As the ponds start to dry and the area between the water's edge and the edge of the grass widens, frogs may often be flushed out of the grass into the pond and seined out with a minnow net. This works especially well with the very desirable small frogs.

Frogs are not a transportation or storage problem. They are generally carried in a damp sugar or flour sack, and they may be held without feeding for two weeks or longer in a cool basement storage tank. The tank should contain no more than a quarter of an inch of water.

Frogs are used as bait both alive and dead. They are cast, trolled, and still-fished. For some fish the frog is used alive, for others dead. Dead frogs, however, must be fished fresh, for any decomposition causes them to lose their bait values. It does not hurt the frog as bait for catfish if it is mangled and chewed up. Often if the bait is hooked securely several catfish may be caught on the same small frog.

Frogs larger than the two-inch size may be made more attractive by taking off the legs below the hip joint, leaving the skin of the legs attached to the rest of the frog to serve as trailers.

The accompanying drawings show some of the favorite methods of hooking frogs for bait. Remember in catfishing to hook the frog as securely as possible.



Frogs: 1. Hooked alive through lips for casting and trolling; 2. dead frog, triple hooked, a catfish killer; 3. live-hooked through thigh muscle used in casting for bass, walleyes, northerns and catfish; 4. double-hooked dead frog, used in still fishing and casting.

Clams

Clams are used as catfish baits and forty years ago were considered one of the very best for this fish. Because of pollution and siltation clams have almost disappeared from many streams They are abundant yet in some lakes and ponds and in northeast Iowa streams, and in parts of the lower reaches of the major streams in the Mississippi watershed.

In the clear water streams, clams may be seen. It is then a matter of wading out, picking them up, and dropping them into a gunny sack. In the sand streams of the central part of the state during clear water periods, clams may be found by following the trail they make in the sand as they move about. They may be found buried in the sand at one end or the other of the trail. Clam beds can sometimes be found by feeling with hands and feet in certain lakes and ponds and in the deep eddy water at the lower or downstream ends of sandbars. Clam meats may be purchased from the commercial clammers along the Mississippi River and those eastern Iowa streams open to commercial clamming.

Live clams may be transported without difficulty in a wet gunny sack. They can be kept alive in the sack in a cool basement for several days if a little water is allowed to drip on them. For longer storage alive, they should be put into a bait box in the direct current of a moving stream. The best method of holding clam bait fresh is to open the clams, pack the meat in quart or half-gallon fruit jars, and put in the freezing compartment of a refrigerator until ready to use.

Clams are fished both fresh and soured or "prepared". Fresh clams are effective bait in water where an abundance of clams live. In waters where clams are scarce, soured clam is a much preferred bait. In the old days souring clam was a great ritual. The baits were cut out of the shell and sliced into ¾- to 1-inch wide strips, with a chunk of the gristly foot making one end of the strip. They were then put into a glass jar with sugar, cornmeal, oatmeal, milk, sweet anise oil, or a host of other ingredients, and allowed to sour.

For the most part, modern clam fishermen find souring less exacting. The clams are cut in the same ¾- to 1-inch wide strips, sprinkled with cornmeal, and placed in a half-gallon fruit jar. The lid, with a few small holes punched in it to allow gas to escape, is then screwed on. The fruit jar is buried in the ground with the cap two or three inches below the surface and allowed to "work", the souring process taking from five to ten days, depending on the weather. Keep clam meats out of the reach of flies at all times.

When ready to fish, the juices are poured off the clam meats and the clam baited by running the hook through the fleshy foot, then returned through the body. One, two or three chunks of clam meat are used at each baiting.

Grasshoppers

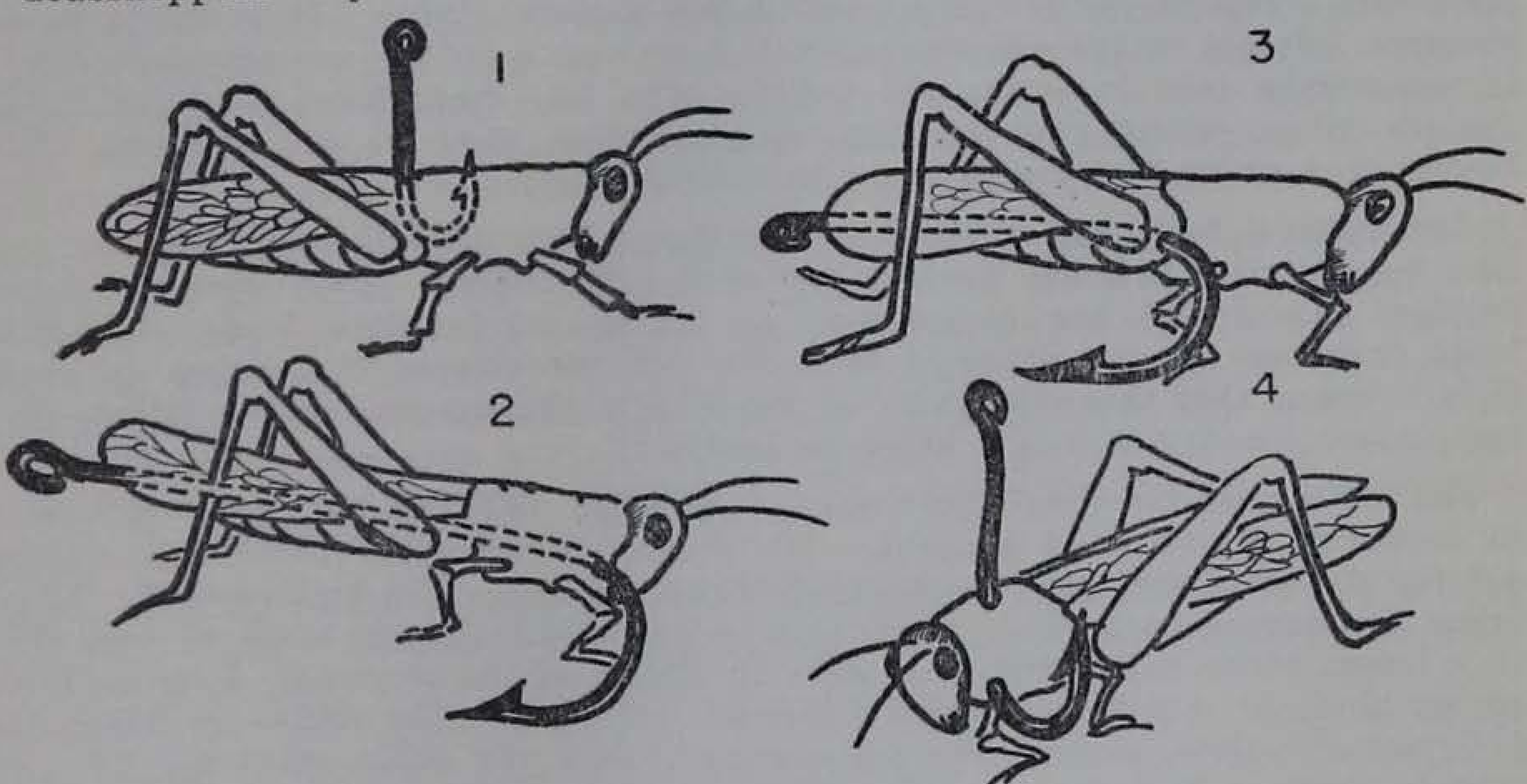
At times of grasshopper abundance they form an important part of the diet of many kinds of fishes. Oftentimes stomachs of fish are literally packed with them. They are good fish bait.

Catching grasshoppers is a problem for a boy. A combination of age and hot weather make it necessary for many of us to look for an easy way, and the easiest way is with the use of a minnow net. The secret, if there is a secret, is to select low-growing vegetation in which there is an abundance of grasshoppers. The net is then stretched tight and "seined" rapidly through the grass and weeds. The grasshoppers jump onto the webbing, and after a dozen or so are settled on the net, they are shaken into a pocket, then quickly grabbed by hand. In choice locations and with expert net manipulation, an abundant supply of grasshoppers can be caught in an amazingly short time.

A long-handled dip or butterfly net also will help the oldster in his pursuit of this bait, or he may go out on a cool night with a flashlight and pick up the night-chilled grasshoppers as they rest on weed stems.

Grasshoppers can be kept alive several days by placing them in glass jars with holes punched in the lid in the icebox at about 45 degrees.

Grasshoppers may be hooked several ways; the most common are illustrated.



Grasshoppers: 1. Lightly hooked through thorax for most fish; 2. hooked full length of the body, two or more hoppers fished dead. Especially good for catfish. 3. variation of two grasshoppers, hooked through thorax; 4. cricket baiting the same as grasshoppers.

Crickets

Crickets are a fine bait, especially for pan fish and smallmouth bass. They may be found under flat stones, bark, boards or any earth-hugging debris that allows them to get under to hide. It is difficult in most instances to find sufficient quantity of these little cousins of the grasshopper to make them a standard bait. They can, however, be raised very easily in large quantities.

The cricketry is usually a garbage can or a clean oil drum from which the end has been cut. Two or three inches of damp sand is placed in the bottom. The sand is kept moist for the crickets to lay eggs in. On top of the sand three or four inches of wood excelsior or florist moss is placed to provide hiding places. The crickets are fed dry oatmeal, poultry mash, or cornmeal. They must be provided with drinking water in a container from which they can escape if they fall in.

Circular No. 12 of the U. S. Fish and Wildlife Service, titled "Propagation of Minnows and Other Bait Species", advises stocking a garbage can with 30 adult crickets, half males and half females, the female being distinguished by the egg-laying tube projecting from the rear of the abdomen. Only the winged adults lay eggs. The can should be kept in a temperature of 80 to 90 degrees, the optimum for cricket growths. A light bulb suspended in the can is recommended fo crool weather. This arrangement will produce about 400 crickets in three months. All dead crickets should be removed from the can periodically, and the floor on which the can sets should be dusted with insect powder to keep out insects that may kill them. It is advisable to wax the inside of the can down about 12 inches to keep the crickets from crawling out, or to cover the can with a tight screen.

Whether the crickets are raised or caught in the wild, they should be handled very carefully, for they are one of the most tender baits and they should be presented to the fish in as lively condition as possible.

The best methods for hooking are the same as for grasshoppers.

Hellgrammites

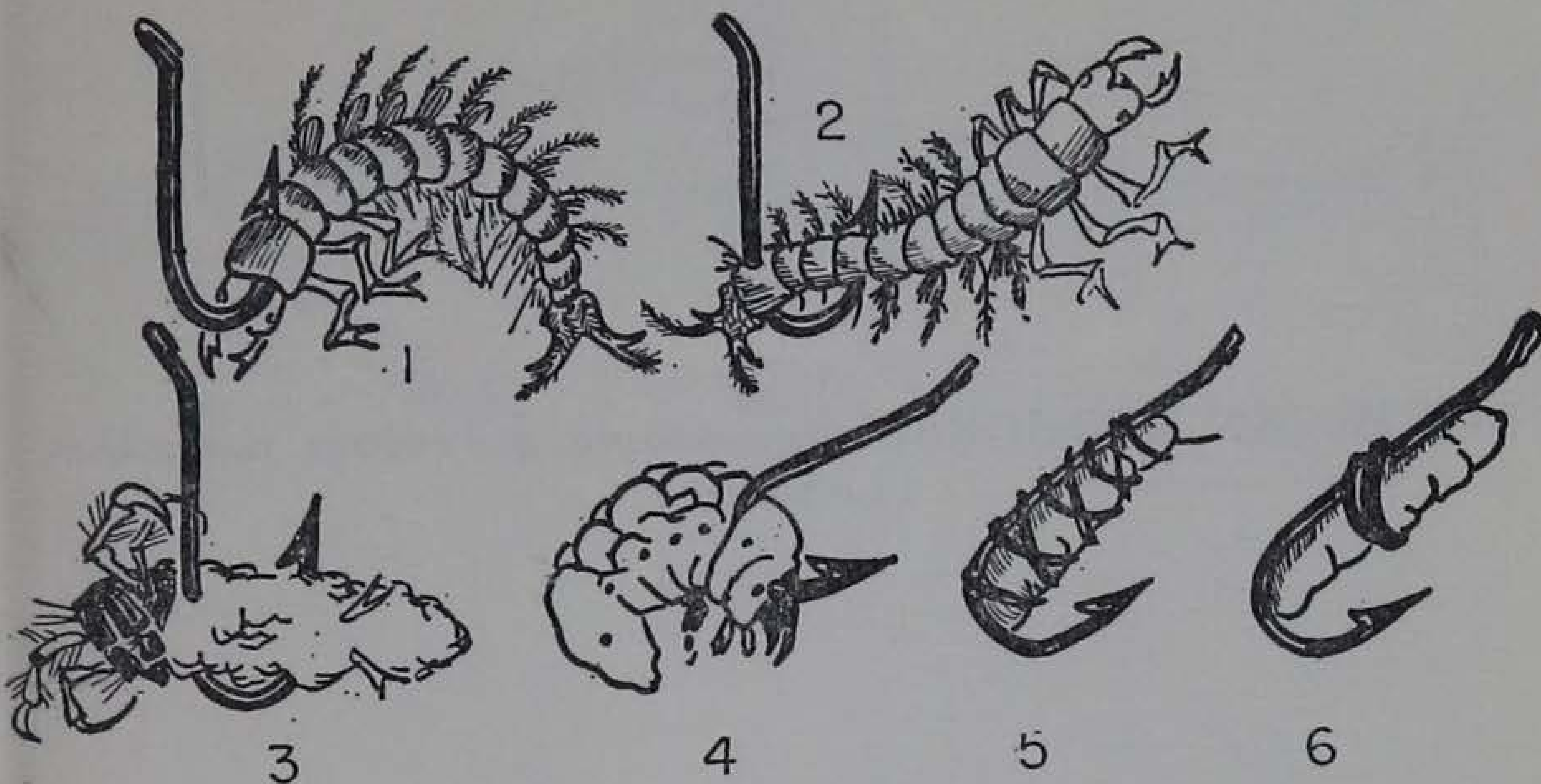
The hellgrammite is eulogized by many anglers as the supreme smallmouth bass bait. This is particularly true in the eastern states. It is found in our streams, but not in the abundance that it is known in the eastern streams. It is not widely used in Iowa, and anglers who buy them from commercial bait dealers often report poor angling success when used in our streams. This brings up a point that might be re-emphasized here.

Any natural bait that is found in abundance in a given locality will be good bait because the fish are feeding on what is available. They develop certain feeding habits and are accustomed to dining on familiar foods, disdaining baits that may be presented if they are not accustomed to feeding on them. It is believed that this selectivity of the fish is the reason for the failure of a bait in one locality that is a killer in another.

The hellgrammite (see illustrations on page 181) is not hard to secure in locations where it is present. We return to our old friend the minnow net for the most successful capture of these animals. The hellgrammite, which takes 35 months to develop from egg to adulthood, spends most of this time in a larval stage under the flat rocks in riffles in the streams. Here it feeds on all kinds of soft-bodied aquatic insects. We locate the riffles in which the hellgrammite lives, stretch the minnow net below the riffle, allowing the current to make a bag downstream. Three operators are necessary, one to hold each brail and one to turn over the rocks in the riffle, and stir up the gravel with his feet. The current washes the hellgrammites downstream, where they are caught in the bag of the net.

It is not difficult to keep hellgrammites alive in a minnow tank if they are not overcrowded and if water is aerated. They are a vicious animal and will become cannibalistic and injure one another if overcrowded. A few flat rocks under which they can hide should be placed in the tank. They may be refrigerated alive for a few days by placing them in a glass jar without water and kept in the refrigerator at 40- to 50-degree temperatures.

Hellgrammites may be hooked in the tail through the second segment up through the belly, with the barb emerging from the back. However, the preferred method is lightly through the collar, the first segment behind the head, and hooking only deep enough to securely attach the creature to the hook.



Larval baits: 1 and 2. Hellgrammites hooked alive. They are excellent baits for bass, catfish and other kinds; 3. Cadice fly, larvae and case are used principally for trout and small panfish; 4. Junebug grub, hooked for panfish; 5 and 6. Wasp larvae attached with thread and small rubber band.

Leeches

Leeches of many species are important fish foods. In recent years the very large, sometimes 10-inch-long horse leech has become a very popular channel catfish bait in the southern part of the state. This leech is not uncommon in the south central parts of Iowa, and may be found in other areas. In good leech hunting grounds a hundred or more may be caught in a half day's hunting.

The horse leech is hunted in late spring and during the summer months. It is found, for the most part, in stream backwaters or river bottom bayous. It is hunted where the water line has receded from the grass line. Here in the unvegetated mud may be seen molelike trails where the pressure of the leech's passing raises the soil, making the familiar leech paths. The leech hunter follows the path and with a small spade or other digging tool digs the leech up at the end of the burrow. The animals are found from slightly below the surface to six inches below.

They may be easily kept in wide-mouth gallon or half-gallon jars in a cool basement; the jar lid must be perforated to admit air. Periodically the watery body secretions that accumulate should be poured out. The leeches may be washed at this time by pouring a little water over them and swishing them around in the jar. The water is then poured down the drain.

Leeches may be hooked at the collar through the skin of the back, through the middle of the leech, or through the tail end. They are very hardy and will live on the hook for several hours, even when hooked directly through the body. When bottom fishing with leeches, it is advisable to retrieve the bait every few minutes, for they have a tendency to fasten themselves on the underside of rocks, or even to bury themselves hook and all in the mud, where they become inaccessible to the fish.

Soft-Bodied Bugs

The soft-bodied larval forms of many insects are used as bait, some for single species of fish, others for many kinds. They are especially good for pan fish. These soft-bodied bugs are so numerous that only a few of the most popular kinds will be mentioned. Possibly the best-known is the familiar grubworm, the larval form of the Junebug. This large white grub is found

PLATE 13

NORTHERN REDHORSE *Moxostoma aureolum aureolum* (LeSueur)

NORTHERN HOG SUCKER *Hypentelium nigricans* (LeSueur)

WHITE SUCKER *Catostomus commersoni* (Lacépède)


Maynard Reece

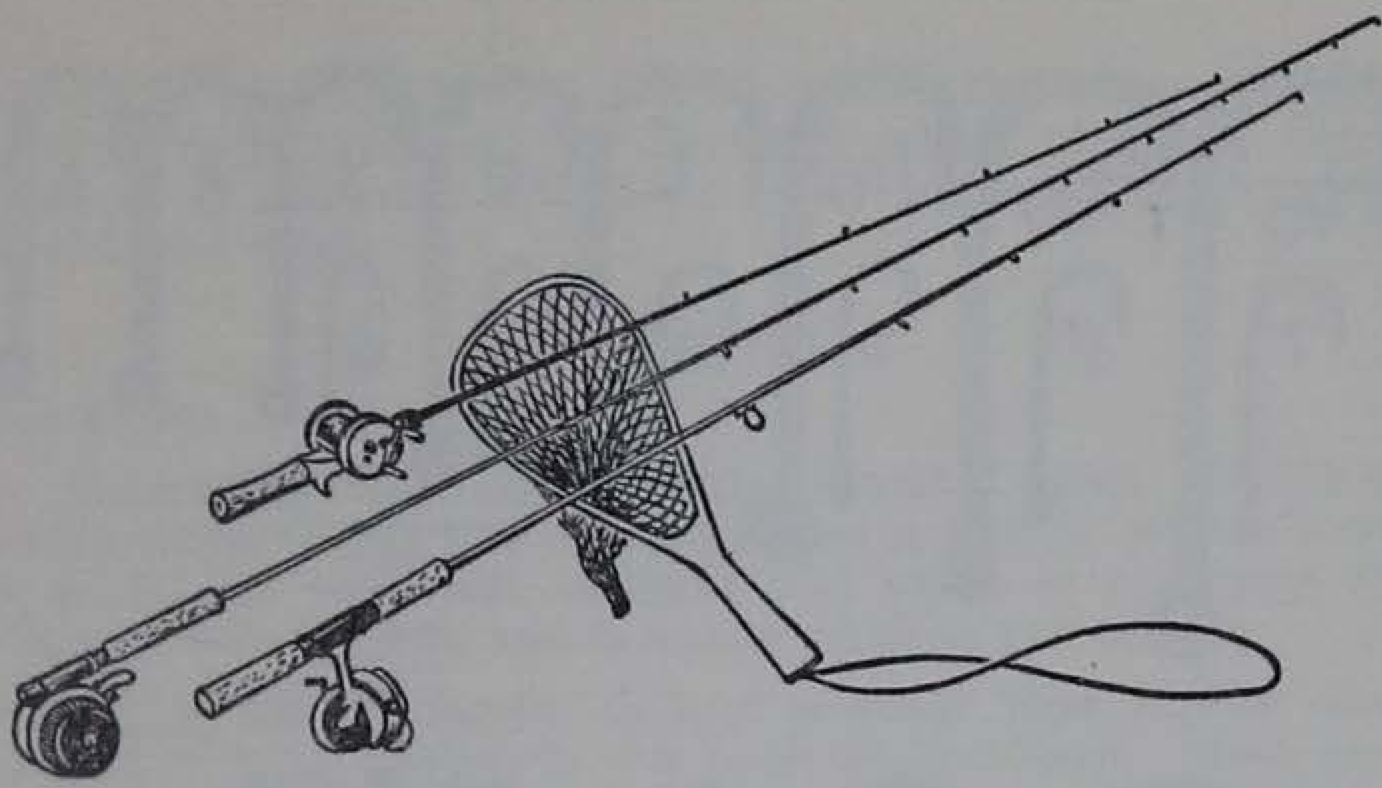
commonly while spading gardens. It is especially numerous in turned-over sod. Most bait hunters find grubworms by digging the soil around well-rotted straw stacks or manure piles.

For ice-fishing, one of the most popular perch baits is the larvae of corn borers. They are found during winter by simply splitting the standing cornstalks and picking out the borer grubs. The common corn earworms provide pan fish bait. Simply pick them out of the tips of field corn or roasting ears. The larval forms of bees and wasps are often used. The paper-making wasps provide an abundance of easily secured soft-bodied baits. Mud-dauber nests may be found under eaves and in barn lofts. Inside these familiar mud structures will be found excellent pan fish baits.

In addition to the terrestrial forms, many aquatic larvae may be found while seining, including dragonfly nymphs, stone fly, caddis fly, and many others. All are important fish foods and are worth giving a try.

Many of these soft-bodied larvae are very tender. Hooking them is a problem. A small hook should be used, as little damage to the bait by the hook as possible, many fishermen preferring merely to attach the bait to the hook with tiny rubber bands or with a wrap-around of several strands of cotton thread.

For carp and catfish, there are many kinds of animal or vegetable baits that cannot be classified as natural baits. They are dealt with specifically in the sections dealing with angling for these species.



Chapter XVII

NOTES ON IOWA FISHING TACKLE

John Madson, Editor

Iowa Conservationist

From farm boy to mayor, good tackle is within the reach of every angler. Maybe not the finest custom equipment, but at least the honest, working tackle so widely available today. Good fishing gear will not only "pleasure" its owner, but a carefully selected outfit can provide more fishing fun.

Every skillful angler has his pet fishing tools, and pet ways of using them. These vary widely. But here, we think, are a few basic tackle ideas—beliefs held in common by many veteran Iowa fishermen.

The Hook

The basic angling tool is a tiny, highly modified spear. Most of us take it for granted but there's no getting around the fact—the hook is the heart of the sport.

There are poor-quality hooks on the market but many American makes—and most English and Norwegian makes—are excellent. Buy the best hooks available; even the finest are cheap and a hook is a poor thing to save money on.

Generally, hooks of the simplest designs are best. Some tackle authorities claim that a simple, round-bend hook has the best hooking and holding ability. Many "gadget hooks" on the market fail to do the job; their gadget features may be easily broken or even hamper the hooking power of the hook. Many veteran anglers also believe that a single hook is best for most purposes, and that a treble hook has only limited use, especially for small-mouthed fishes.

Sizes and designs of hooks are legion. To really cloud the issue, size designations change according to design or maker. Four popular Iowa hooks for various uses are the Sproat, Sneck, the Aberdeen and the Carlisle:

A too-large hook can be a handicap; it may be hard to hide or too big for the fish's mouth. Fine, small hooks are usually the sharpest, and the finer the hook, the longer live bait will remain lively.

Some anglers may even use the same hooks for catfish and bluegills. Special hook sizes are required for almost every type of fishing, and there is no all-around hook. The choice of special hooks for specific fish is an arbitrary one and every angler has his own ideas.

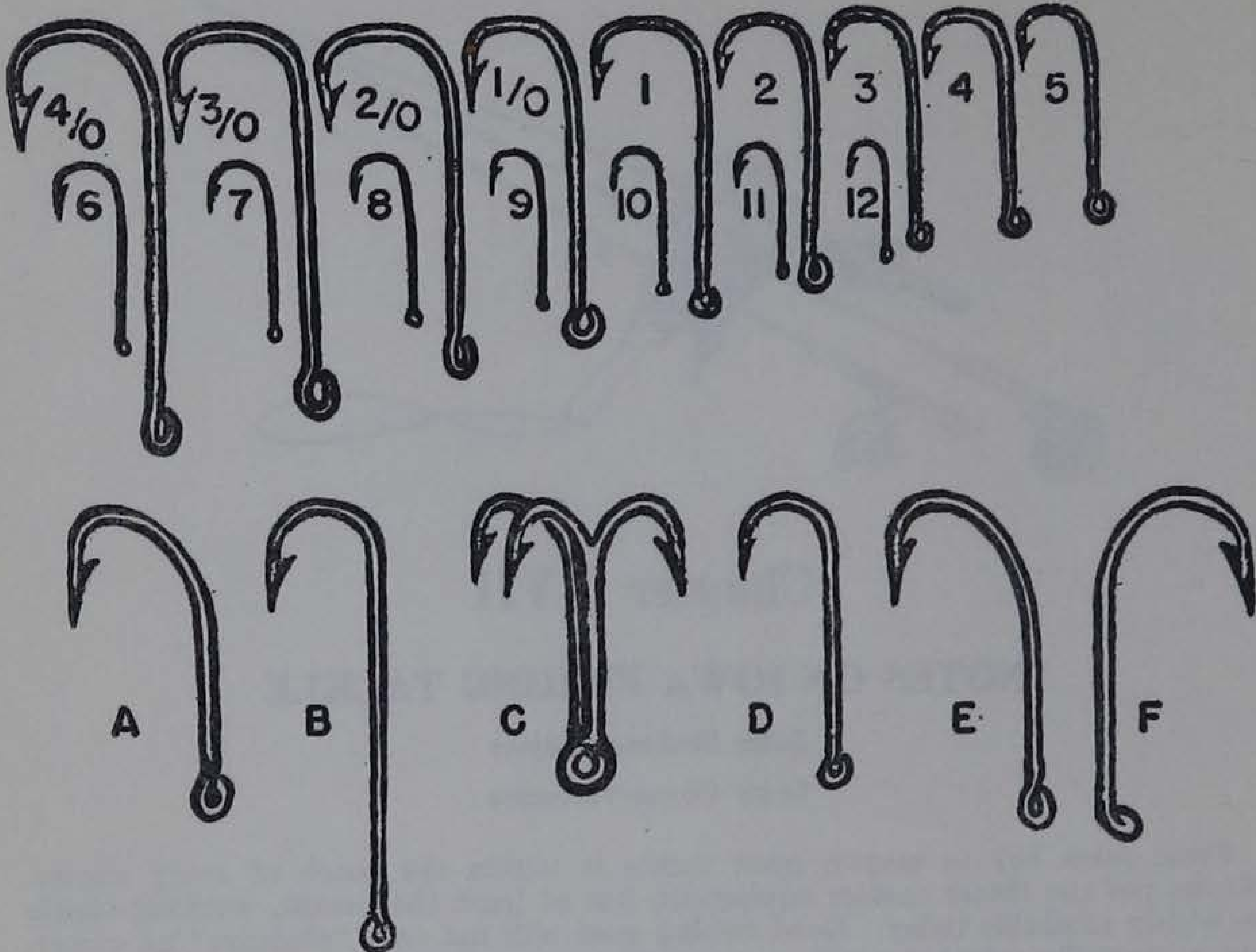
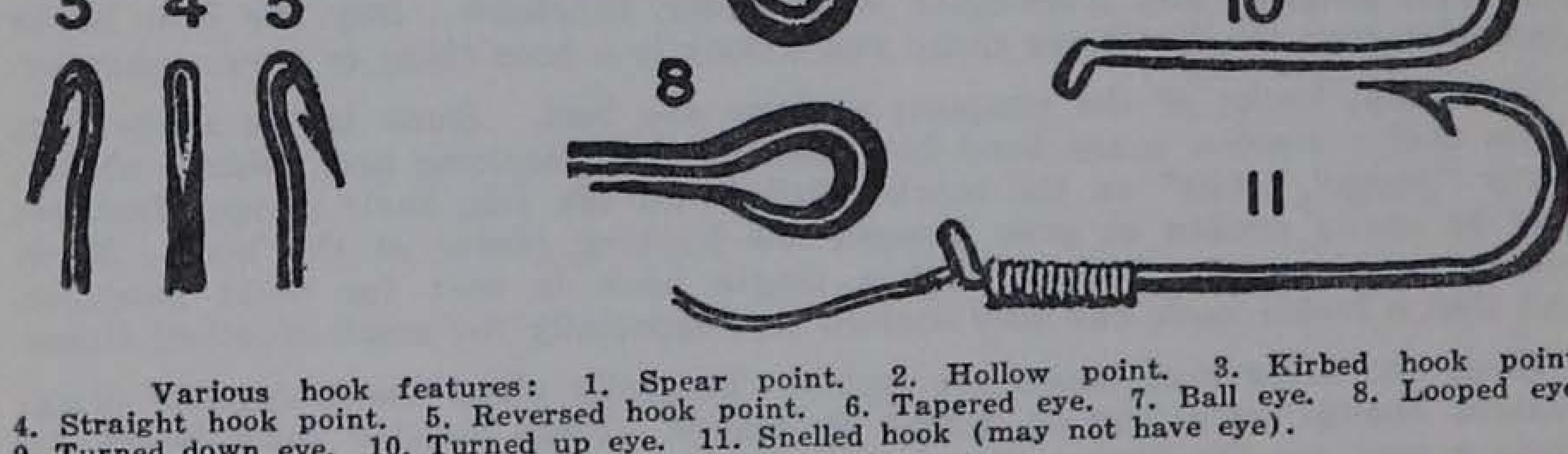


Chart of the sneck hook, actual sizes. A. Limerick hook. B. Carlisle hook. C. Treble hook. D. Kirby hook. E. Sproat hook. F. Pennell hook.



Various hook features: 1. Spear point. 2. Hollow point. 3. Kirbed hook point. 4. Straight hook point. 5. Reversed hook point. 6. Tapered eye. 7. Ball eye. 8. Looped eye. 9. Turned down eye. 10. Turned up eye. 11. Snelled hook (may not have eye).

Hooks for catfish and bullheads often have long shanks because of the fishes' habit of swallowing hook and bait. A long-shanked hook simplifies the job of unhooking the fish.

And you may have to unhook yourself. If a fishhook snags in a finger or loose skin, it may be possible to run the point on out through the skin, cut off the hook eye with sidecutters, and pull the hook on through. But watch such penetrating wounds—they can cause serious infection.

Dull hooks are not effective on bony-mouthed fishes—or any others. Carry a small pocket hone and touch up the hook points of plugs, flies and spoons now and then. A dull hook will drag freely across your thumbnail; a sharp hook will stick and catch.

The Lines

Baitcasting Lines:

Modern baitcasting lines are usually braided nylon available in "tests" (the breaking point of the line in pounds) of a few to over a hundred pounds. Formerly, such lines were silk or linen, and nylon is a modern blessing. It's uniform in size, will not rot, and is easily cleaned and dried.

However, nylon may be harder to knot securely than silk or linen and sometimes has a stiff, wiry quality in the hard-braided lines. Most casting experts prefer a "soft-braid" nylon that's supple and limp. The modern trend is to limper, softer lines of all types. Some of the newer nylon-dacron lines are said to achieve this, as well as having the same strength with smaller diameter.

The lighter the line, the easier and farther it will cast. The average nylon casting line is often too heavy. It's seldom necessary to use casting line of more than 10- or 12-pound test. Even lunker catfish and pike can be taken on lines of less than 10-pound test if the angler is careful, patient and doesn't "horse" his fish. You may use heavier line, but you'll sacrifice casting distance and accuracy, particularly with light lures and weights. An 18-pound test casting line is just about the limit for good casting.

Trolling and drift-fishing lines may be slightly heavier, since little casting is done. But such fishing involves having a lot of line out against a current. In drift-fishing, as much as 200 yards of line may be out and a thick, heavy line won't respond quickly to rod action when a fish is struck. The weight of such line is governed by reel capacity, but should be of at least 15-pound test.

Good casting line deserves good care, and should be frequently cleaned of dust, grit and mud. Synthetic lines can last for years, but they are subject to abrasion from grit and dirt. After a season or two, you might "swap ends", putting the reel supply to work and giving the terminal line a rest. Some anglers believe that a 6-foot leader will save line, since it takes the brunt of wear during casting.

Fly Lines:

These are of much larger diameter than casting lines, and are much heavier. In flycasting, the cast is not governed by the weight of lure or sinker, but by weight of line. The action of the fly rod is used to cast this heavy line out over the water, and a fly line may be cast with no lure whatever.

A fly line must be carefully matched to its rod. A stiff, heavy fly rod does not handle a light line well, and a very line causes a light-action, limber rod to be sluggish. The heavy lines are used with long, powerful rods for heavy fish or where long casts are required in big lakes and river. The light lines are used with shorter rods in smaller waters.

Fly lines are of two types, level and tapered. Level fly line is of uniform diameter throughout its entire length and is not tapered in any part. The size of this line is designated by letter, ranging from A (the heaviest common line) to H. For general Iowa use with a medium-action rod, a D or C level line is about right.

Tapered fly line is a special heavy line that tapers to a small diameter at one or both ends. "Double taper" line—tapering at both ends—can be reversed on the reel, greatly prolonging its life. Such line is often used for wary fish in clear water, since its design allows the angler to handle tiny flies and gossamer leaders more delicately than with level line. This taper permits line, leader and fly to drop on the water at once, or the fly and leader may touch the water first—the ideal situation. The light, tapered end of this line is smaller than a level line and will settle on the water more delicately, yet the heavy belly of the tapered line furnishes the weight necessary for the cast.

Another common taper is the "torpedo head" or "bug taper", which has a short, heavy belly section that tapers very rapidly to a small tip diameter. Thus the main weight is in the end of the line, and it can be cast long distances. It's popular for use with big bug lures that are heavy or offer wind resistance, and is highly recommended by many anglers for distance casting on big water.

In Iowa many flycasters use level lines. It is important to carefully cover the water being fished with short, frequent casts. For general fishing, level line is sometimes as effective as tapered line, and handles wet flies, streamers, and poppers well enough for most anglers.

In dry fly fishing, the fly line must float on the water's surface and not pull lure and leader under. A tapered line has definite advantages in this type of fishing. Special dressings are made for use on fly lines to enable them to float. Many new fly lines are hollow-braided, and the problem of sinking has been lessened. Although such lines need little dressing, they should be cleaned regularly to prolong line life.

Spinning Lines:

All modern, popular spinning lines are nylon—braided or monofilament. The monofilament line is a long, single strand similar to leader material and available in tests from 2 pounds to 12 pounds or more. This extruded nylon line is of a remarkably uniform material with high tensile strength. It's a favorite of many spin-fishermen for use with light lures. This single-strand line is a fairly recent development and has been closely keyed to the development of the American spinning reel.

Braided spinning lines of nylon are similar to light casting line, and soft-braid spinning line may be used on conventional bait-casting reels. Like all other lines, the spinning variety is tending to become limper, softer and stronger, combining great strength with small diameter.

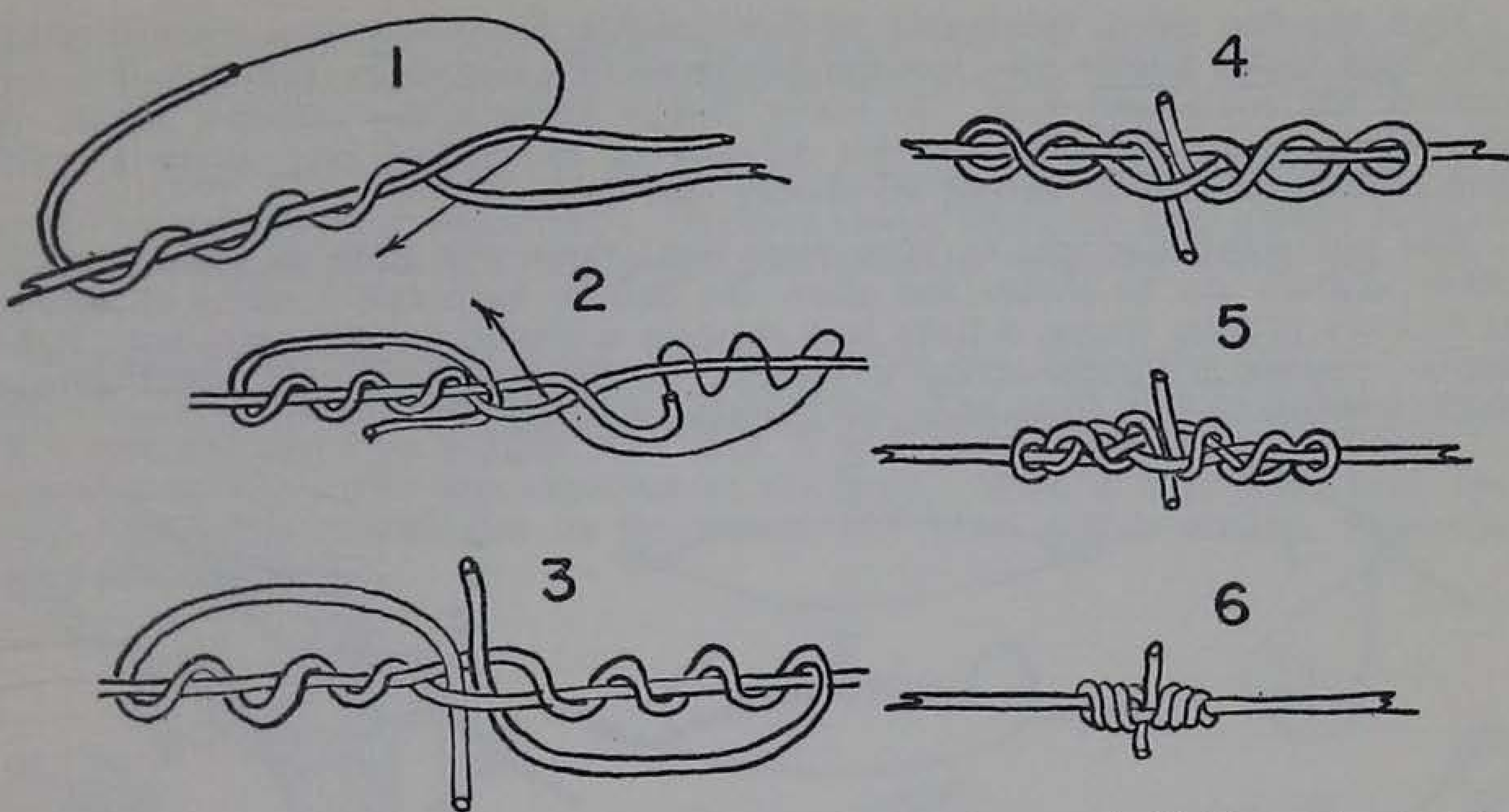
Whether using fly rod, spin rod, or casting rod, you'll be using nylon line. There are special knots used in tying nylon to nylon and nylon to hook eye. The illustrations are of four basic knots that should be mastered by the angler.

Leaders:

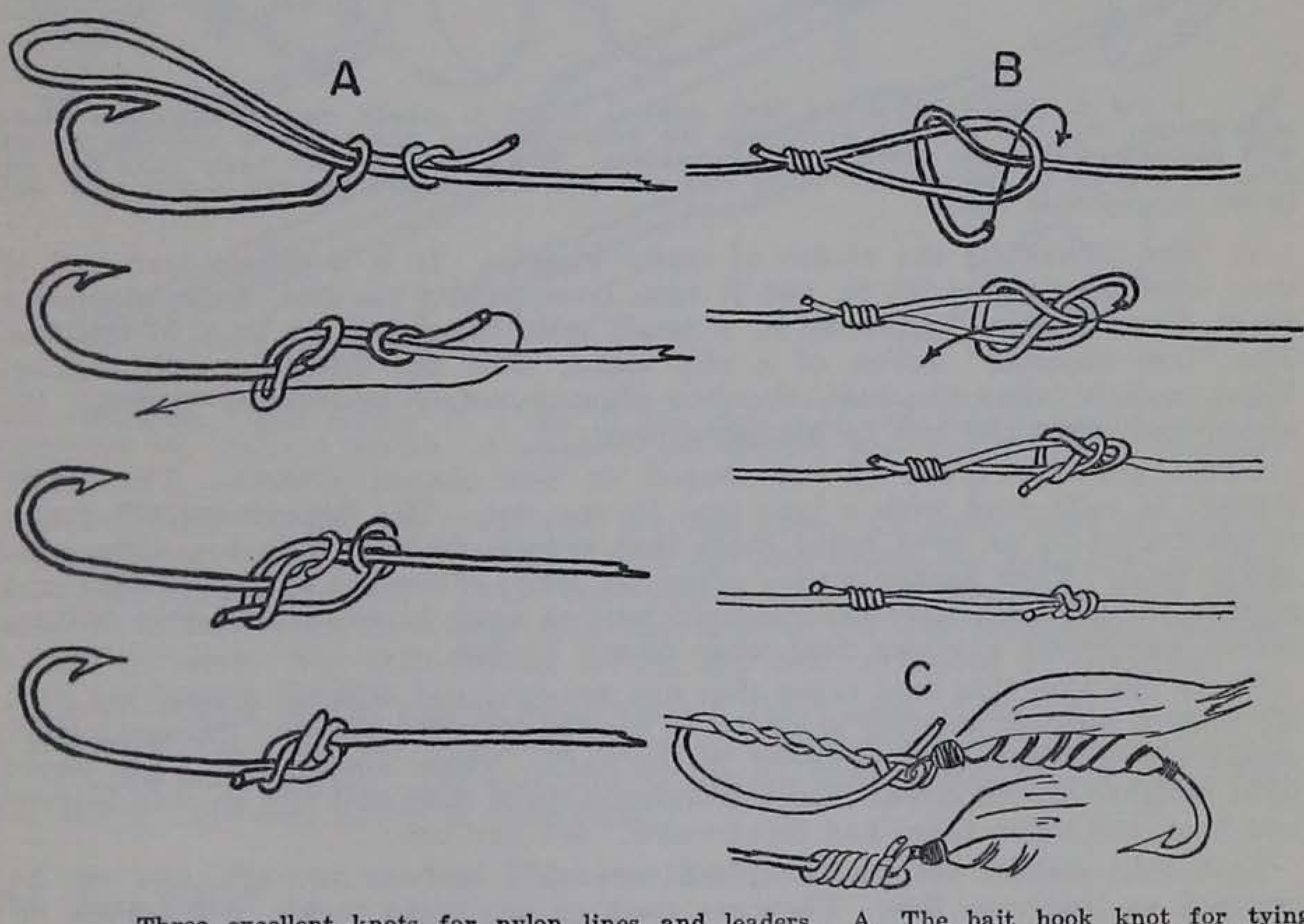
The leader is the connecting link between the line and the hook or lure. It does several jobs. With baitcasting equipment the nylon leader may be reinforced with wire to protect the line from the sharp teeth of pike and other game fish. Seldom over 18 inches long, such leaders are often equipped with a hook snap and swivel at each end to protect the line from twisting by the action of some lures.

In fly fishing, leaders are used for deception, not strength. Fly line is of large diameter, and can be easily seen in clear water by wary fish. So a fine gut or nylon leader is used, serving as an almost invisible link between the heavy fly line and the tiny lure.

Fly leaders may be 15 feet long, but an 8-foot leader is more practical, and even a 4-foot leader may be adequate in certain types of fishing. These leaders are not reinforced with wire and seldom have snaps or swivels. Like fly lines, they may be level or tapered, and for similar reasons. Some leaders are being made in a continuous knotless taper and are excellent for tiny wet or dry flies.



The famous blood or barrel knot is one of the finest ways of attaching nylon to nylon. It is commonly used for attaching long nylon leaders to baitcasting lines or for building tapered leaders.



Three excellent knots for nylon lines and leaders. A. The bait hook knot for tying nylon leader to single hook. B. Tucked sheet bend, for tying nylon line to leader. C. Clincher knot—a simple, effective knot for attaching flies and small poppers to nylon leaders.

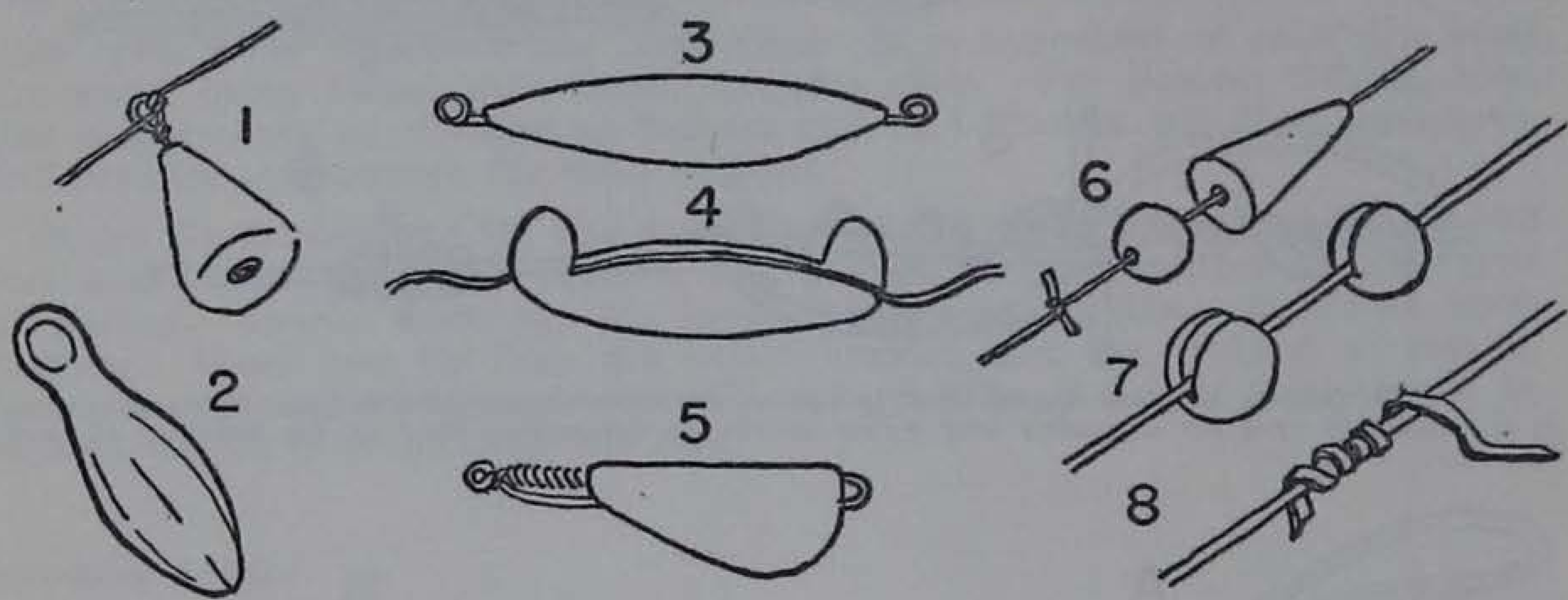
Leaders are practical for any type of angling. Pan-fishing with a long, light leader is much more effective than with a thick line tied directly to the hook. This is not an ultra-refinement, but a practical part of the terminal tackle.

Sinkers and Bobbers

Most tackle is far too heavy, and that's certainly true of the sparkplug-and-stovebolt school of fishing sinkers!

Fish are far more vulnerable to light tackle than to heavy, clumsy gear. The light tackle angler also has the "light touch", can easily feel fish, and can control his equipment well. A heavy sinker anchors the terminal tackle to the bottom, robs the angler of his delicacy of touch, and may alarm a wary fish that's not used to having his dinner tied down.

Use just enough weight to keep your bait where you want it, and no more. Many anglers use no sinker and allow the bait to have full freedom of action. If fish are in deep water, a light bait requires a sinker, but for most Iowa fishing a ¼-ounce or lighter sinker is plenty. The exceptions to this would include holding a line in a cross-current, or for deep trolling.



1 and 2. Dipsey swivel and bank sinkers; 3 and 4. spindle sinkers, may have ringed ends or tabs that are clinched down over the line. The keel sinker (5) is used for trolling with spoons and spinners; keeps line from twisting. Slip sinkers (6) slip freely along line and offer no drag to a striking fish. Split shot (7) and tape sinkers (8) are usually used with fly-rod and spinning tackle.

A "slip sinker" is the choice of many experts. It is a simple lead ball or cone with a hole through it, and it runs freely along the line, to be stopped a short distance above the hook by a small split shot, stick or knot in the line. The "free-wheeling" action of a slip sinker does not interfere with casting. When a fish takes the bait, the line slips smoothly and freely through the sinker and gives the bait no alarming drag.

There are two types of bell-shaped or pear-shaped sinkers. The "bank sinker" is solid lead with a hole cast in one end. The "dipsey-swivel" sinker is penetrated by an eyed brass shaft that swivels freely. Both are quite commonly used. They anchor well— often too well. They are hard to attach and remove in the dark, have designs that tend to snag in rocks and other bottom debris, and create a strong drag when moved by fish.

There are also thin lead tapes that are wrapped and crimped around the line. No knot is needed, nothing needs to be tied in the line, and the "wrap-around" sinker can be applied or removed in the dark. These sinkers are used where light weights are required. Some fishermen claim they will slip on thin leaders and lines, but we've never had this trouble. We like 'em.

Split shot sinkers are lead shot that are split halfway through, and can be crimped on leader or line. They are used on any light tackle, but mainly on fly leaders. They are good "stops" for slip sinkers, and are widely used in pan-fishing in conjunction with long leaders, small hooks and lively minnows.

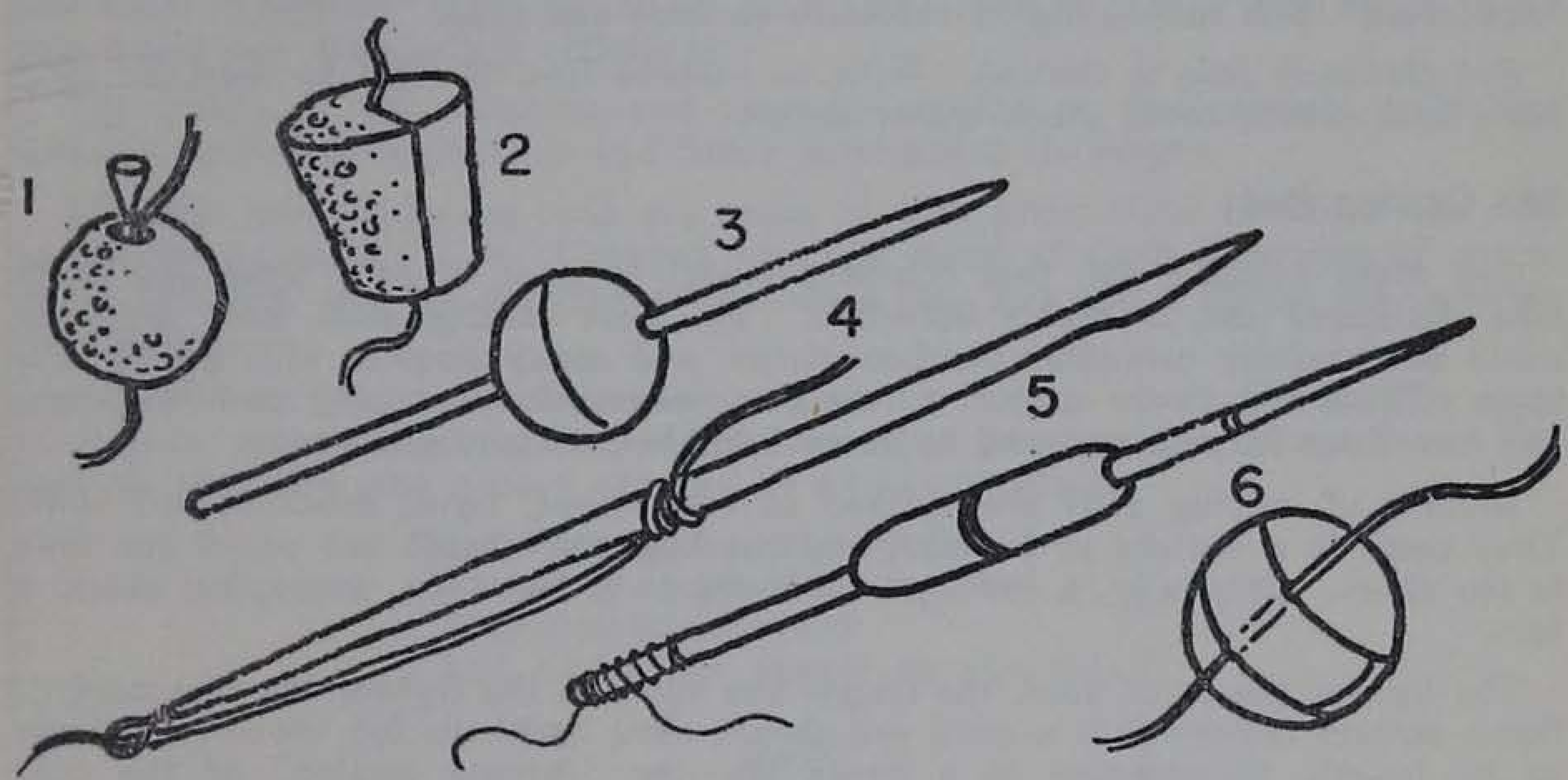
Keel sinkers are flattened weights with one side much larger than the other. This side rides down, and the sinker planes in a straight course through the water. Keel sinkers are widely used in trolling with spinners or spoons and help prevent the twisting of line that these lures can cause.

The old standby is the spindle sinker. It usually has lead ears at the end for crimping down over the line, and is available in many weights. However, it may slip on the line when it is cast. This can be prevented by simply wrapping the line in a loop around the sinker before the tab ends are crimped.

Fishing bobbers, the trademarks of boyhood, have a place in dad's tackle box. For almost any fishing in which constant casting is not employed, they are musts.

They serve two purposes, to keep bait suspended at a desired depth, and to act as indicators of biting fish. Bobbers range from the tiny plastic bubbles ¼-inch in diameter to the big glass jars used in southern states for "jug" catfish.

For trout and pan fish, some experts prefer the quill-type bobber. Most anglers, however, like the small plastic bubbles. The quill may be a by-product of a real porcupine or a light pine stick 5 to 6 inches long about 3/8-inch in diameter at the center and tapering at the ends. With a very light bait, the quill bobber lies almost flat on the water, and when a fish strikes, it stands erect and disappears.



1. The round cork bobber with plug; and 2. the common jug cork are old standbys for quiet still-fishing. Quill bobbers (3, 4 and 5) are often used with light tackle for still and driftfishing for trout and panfish. A pingpong ball wrapped with tape (6) is an all-around bobber.

Drift-fishing bobbers are usually of the ball type. Of cork, wood or plastic, they are painted white or a combination of red and white, and are large enough to be seen from a distance. These bobbers are vital to anglers who drift blood baits far downstream, since they hold the bait up off the bottom and protect it from abrasion. For drift-fishing almost any bait, a bobber is essential.

A good, simple bobber can be made from a short strip of adhesive tape and a pingpong ball. The ball is simply taped to the line and the tape is clinched to hold the ball in place. The ball may be loosened and easily moved along the line and is light and visible in poor light.

Poles and Rods

The Cane Pole:

Don't ridicule the cane pole—it's a kindly old friend. Cheap and readily available, it requires no special care and can be a deadly fish-getter if used correctly with light terminal tackle.

Cane poles are of bamboo—the tough, resilient tropical grass that is tailor-made for the angler. The finest are of selected tonkin cane with its straight, clean lines and small joints. A cane pole is long enough to get bait out where you want it without backlash and backcast worries. However, the fixed length of line doesn't allow the angler to really work a fish, and without reserve line a big fish can break loose. It is also a long pole, and often clumsy to handle in heavy warterfront cover.

For cane poles without reels, try using a line length about as long as the pole itself. You can move on at a moment's notice without wrapping the line around the pole; simply stick the hook in the butt of the pole and leave.

Some fishermen also tie their line in two places to a cane pole—tying it about 4 feet back from the tip and then running it forward and tying it again at the tip. Then if the slender tip snaps with a heavy fish, the line is still secured to the pole.

If shortening a cane pole, trim it at the butt rather than the tip. Leave as much slender tip as possible, unless it's downright flimsy. This limber tip will absorb the power of a big fish and will be insurance against breaking line. With a long pole and a short, fixed line, some anglers use artificial lures and special baits, handling them much as with a fly rod. The bait or lure is eased down on the water and skittered across the surface. Called "spatting" or "skittering", this can be highly effective on bass and pike.

But the cane pole is limited. With no reserve line, it can't be used for long casts and cannot cover much water area.

The Casting Rod:

Our most popular rod, this compact model is used to cast lures and baits long distances and is highly effective. The best casting rods were formerly made of carefully cemented bamboo strips, and many anglers still prefer this type. These rods were subject to moisture absorption, warping and breakage, and have been largely replaced by more durable steel and glass rods.

Actions of casting rods are classed as extra-light, light, medium, and stiff. They come in a variety of lengths, and the beginner should not select one that is too short. Generally, a casting rod is 4½ to 6 feet long, averaging about 5 feet.

The lighter the lures used, the longer the rod and the lighter the line needed. Some casters believe that a good rod should have backbone for about two-thirds of its length, terminating in a lively tip—the "driving section" of the rod. A casting rod that is too short and stiff simply cannot be handled effectively in casting. It's all right for some types of still-fishing, ice-fishing, and boat fishing, but the 5- to 6-foot length is best for general use.

It's tough to define all-around tackle. For the working fisherman, two rods might be the answer, one about 7 to 9 feet long with a full-length backbone for trolling in big water or drift-fishing, and a shorter rod with a lively tip for driving small lures. A good catfish rod for big rivers is seldom a good smallmouth bass rod for small streams.

Fly Rods:

The fly rod is a long, light instrument with great action. In flycasting, the weight of the lure has little to do with the cast; this is governed by weight of line. In spite of popular belief, the fly rod is simple to use. Simpler, according to the experts, than the baitcasting rod and reel. It has been said that a good instructor can teach a novice to flycast in an hour.

Fly rods are built in many lengths, actions and weights, depending on fish and type of water they are intended for. A rod may be a dry fly stick and weigh only a few ounces, or it may be a long powerful outfit used for salmon. The modern trend is toward shorter rods in all weights.

We've already mentioned that a fly rod must be carefully matched to its line. This is critical, and many good rods have a recommended line weight printed near the grip. If in doubt, consult an expert angler or a good sporting goods dealer. The finest fly rod in the world is useless if equipped with a mismatched line.

Unfortunately, fly line weights and designations vary with the makers, and there is a lack of uniformity. For general use, a 7- to 8½-foot fly rod of medium action and equipped with C or D level line is a good all-around outfit. If, for example, it handles a D level well, it will probably handle most HCH tapers.

The Spinning Rod:

To Iowans, the spinning rod is comparatively new, the product of a marriage between casting rod and fly rod. Most spinning rods are between 6 and 7 feet long—shorter than most fly rods, and longer than the bait rod.

Basic design and construction of spinning rods closely follow the fly rod, except that the guide nearest the spinning reel is usually a very large one. This is to allow for the lateral motion of the unlooping line, and to prevent the line from "whipping" the rod. If too close (less than 20 inches with most reels), this guide can cut casting efficiency.

The action of the spinning rod may be similar to the casting rod's "tip action", or it may be flexible and lively throughout its length.

The best glass spinning rods are made of thin glass cloth in which the filaments are extremely fine. Cheaper rods are made of cloth composed of coarse glass filament, and the difference between a fine rod and a cheap one is easily determined.

If you're an inveterate fisherman—or just a novice—don't skimp. In spinning rods, or any other kind, you get just what you pay for. A good one can last all your life, and a poor one can be an abomination.

"But a trusty rod, and tried,
Warp'd by service though it be
Toughens in adversity
And clings the nearer to thy side."

Reels

The Casting Reel:

A vital part of the casting process, this reel must be smooth, clean-running and in good shape if you're to cast well. The length and smoothness of a cast depends on several things, but the most important are rod action, line weight, and action of reel.

Casting reels are "geared up" so that the arbor or spool turns several times as the reel handles turn once. The internal gears of most casting reels are of bronze, but some models feature nylon gears. Don't retire a reel if it becomes noisy and rough. New gears and bearings for most reels can be found in good tackle shops. If your reel wears out, it probably isn't due to fishing, but to dust and grit picked up on river bank or in the car. Keep a reel encased when not in use.

For casting, many experts prefer light reels with light, narrow spools. Bulky "heavy duty" reels may be O. K. for trolling, but are clumsy and slow for light lure casting. Cork or plastic arbors are simple sleeves that clamp over the reel spool, enlarging its diameter and making casting much easier. An arbor helps fill up the reel spool with little added weight, and line will feed off a large-diameter spool much easier than from a smaller spool. It's the same principal as turning a wheel, which is easier to do on the rim than on the hub. Reels for trolling and driftfishing don't need arbors since line capacity is important and the angler isn't casting, anyway.

A well-balanced casting rod and reel can be used to toss artificial lures that are almost as light as many spinning lures. A good outfit can cast 3/8-ounce lures with great accuracy and good distance.

That old bugaboo, the backlash, is usually caused by a free-running spool that continues to turn after lure and line have stopped. The spinning spool overruns itself and causes the line to backlash and tangle. In an ideal cast the spool stops when the line has ceased running through the guides. However, with a wet line and heavy spool, inertia of the rotating spool is greater and chances of a backlash are multiplied.

Several makers have included anti-backlash devices in their reels. These usually put a slight drag on the line and prevent the spool from free-wheeling. If correctly used, the best anti-backlash device is the human thumb, breaking the turning arbor by pressing lightly on the edge of the spool. In a well-coordinated cast, the thumb will brake the spinning spool as the lure strikes the water, and backlash is prevented.

Don't fight a backlash or pull it taut. Instead—cussing quietly—gently pull the tangled loops free and patiently loosen the line.

The Spinning Reel:

Your spinning reel is a naturalized American citizen, but it was born in Europe. This reel first appeared in England about 1900, and although introduced in the U. S. before World War I, it was slow in catching on. After the war, however, it began to grow popular, and spinning reels have been in general use in some parts of this country for over 25 years. So it isn't a new reel. However, it has only been in the past 15 years that it has been given broad general use in Iowa.

The principle of the spinning reel is extremely simple; it's just a matter of unlooping line over the end of a stationary spool, just as one would pull sewing thread off one end of a wooden spool. Line is fed off in loops from the fixed spool, friction is at a minimum, and extremely light lines and lures can be used. And because the spool cannot "overrun" the line, the typical backlash is almost impossible.

On many reels, rewinding is done by means of a bail in the reel that picks up line and reloops it over the spool. On reels without such devices, the line must be picked up by the forefinger. Many spinning reels have friction clutches to control line tension on a fighting fish, and line pays out when either angler or fish exerts too much tension. This "give and take" tension can soon whip a big fish.

Many Iowa anglers are using spinning reels and fairly heavy rods for drift-fishing. It's a good idea—the spinning reel can contain a vast amount of monofilament line which is light, of little resistance in the water, and can be easily picked up on a strike. Very large fish can be whipped to a standstill with spinning gear.

The most important contribution that spinning has made to Iowa fishing is the proof that light line, light lures, and the "light touch" can mean more fish and better fishing.

Fly Reels:

These simple reels are intended only for storage of line. They are not used in the actual cast, when line is stripped from the reel with the left hand and fed into the guides while the rod is being flexed.

Fly reels are of two types, single action and automatic. The single action is almost as simple as a reel can get, sometimes without gears and with a direct drive that simply piles line upon the spool. It usually has a click feature, and some reels have an adjustable drag.

In the automatic fly reels spring tension is built up as line is stripped off during casting, and by depressing a lever the coiled spring will be released and rapidly retrieve the line. An automatic reel may be entirely operated with the hand that holds the rod, leaving the left hand free for manipulation of line.

As line is stripped from an automatic, the spring loading becomes greater and the drag increases. Slack line can be taken up swiftly.

In spite of some automatic advantages, many expert fly fishermen still prefer the single action reel. It is certainly easier to clean if dropped in sand, and is simple, durable and good. Most single actions are inexpensive, and most fly reels of either type are cheaper than many spinning or casting reels.

Some fans of the automatics prefer them because of their greater weight, believing that a fly rod should have plenty of weight on the butt. On the other hand, there are anglers who prefer balanced equipment offered by lighter reels.

It's a matter of taste; you pay your money and take your choice.

Fishing Lures

Flies:

The biggest angle in angling is fooling the fish, and in the development of artificial flies this deception has been raised to a high art. These flies—carefully tied of bits of hair, tinsel, or feathers—are brilliant camouflage hiding the deadly hook. To some purists, the tying and use of such flies is a way of life. No one can deny it's an art, and a deadly one.

Flies fall into two classes—the "wet" and "dry" flies. Here, very briefly, are their functions:

Some insects spend most of their lives under water, finally emerging in winged form to feed and breed briefly, and then die.

As "nymphs" or larvae, they cling and crawl on the stream or pond bottom, and are preyed upon by most every aquatic creature. These active larvae may be imitated by the angler with "nymph flies". Such lures are very effective early in the season. Fished near the bottom, they simulate nymphs that have been torn loose from stones and bottom debris by strong current.

As the nymph matures, it struggles to the surface, where it moults a final time, becomes a fully-winged insect, and takes to the air. During this ascent from the bottom, nymphs are heavily preyed upon by fish, and the angler enters the act with underwater wet flies that simulate the rising insects. Or wet flies may imitate adult insects that have been submerged.

When the nymph reaches the surface and makes its final moult, it may hesitate to permit its wings to dry—a fully-winged insect ready for flight. Then is the time for the dry fly. This lure usually has upright "wings", a stiff tail, and a stiff ruff of bristles to hold it upright on the water's surface. Some flies are doped with oily fly dressing to give them buoyancy. Dry flies may also imitate land insects that have dropped into the water from trees and bushes.

One of the most effective old standbys is the streamer fly—an artificial fly intended to resemble a small minnow or fish. These are streamlined flies with long, graceful wings that extend back over the body to impart a fishy shape. They are usually tied on long-shanked hooks, and fished with the darting, pausing action so common to minnows. Bucktails are streamer flies with hair wings. Streamer flies are old favorites in some smallmouth bass and trout streams, and are tied in a bewildering variety of patterns and colors.

An old favorite for walleye fishing in northern Iowa is the "killer rig", a spinner-fly combination that is often trolled with a keel sinker from a boat. Although flies are famous trout-killers, they are equally effective for bass, pan fish, and other fish. Even carp and catfish can be caught on wet flies under some conditions. We can't get into the colors and patterns of flies—that belongs elsewhere. But most good stores have a wide selection of pan fish flies, and as you become proficient, you may even tie your own.

Poppers:

Between the flies and plugs stand the poppers, or "bugs". In Iowa these rank among the favorite lures for bluegills and bass, and since so many Iowa waters contain these species, "poppers" are becoming increasingly important. The true popper, which has a small cork or wooden body, is fished on the surface of quiet water. The cork body is often brightly painted with model airplane dope, and tipped with hair or feather tail. Almost always used with the fly rod, the popper is deadly on placid bass and bluegill ponds early and late in the day. The writer believes that of all bass-bluegill lures used for fly fishing in small lakes and ponds, the poppers are best. They need not be dressed in order to float, they are easy to watch in dim light, and when tugged gently along a mirror-smooth pond they are pure poison.

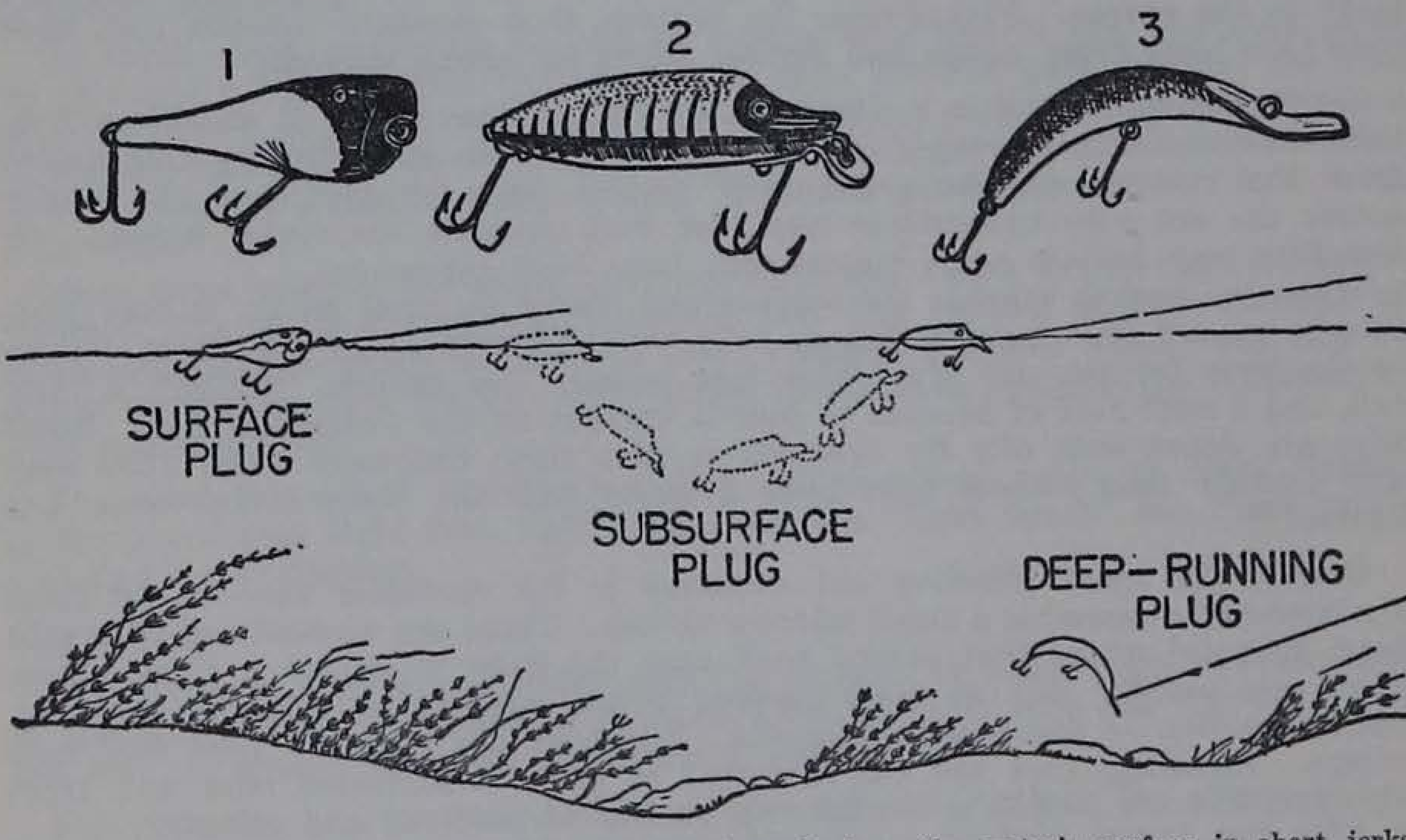
Made in many color combinations, a local favorite is one predominantly black, red and yellow. Some Iowa types have a small nylon loop mounted on the front of the cork body ahead of the hook as a weedless device.

Bass poppers and bugs are often quite large, and are used with fairly strong fly rods. Although small poppers handle well with level line, many fishermen prefer torpedo head taper for use with the big clipped-hair bass bugs which may be heavy or offer wind resistance.

Plugs:

Does a fish smash a plug because he's hungry, or because he's mad? Maybe he's mad because he's hungry. Whatever the reason, he will hit it, and plugs are among our most deadly lures.

Made of wood, plastic or metal, plugs simulate fish, frogs, mermaids or muskrats, but seldom insects. They are armed with treble or double hooks and come in an infinite selection of colors, shapes and actions.



Surface plugs (1) do not sink, but are tugged along the water's surface in short jerks while the head cavity causes a "chugging" or "plunking" sound. Sub-surface lures (2) dive underwater when traction is applied, popping to surface when line tension is relaxed. The sinking underwater plugs and some other plugs (3) drive deep if retrieved rapidly with the digging action of the front plate.

They fall into three general types: surface, sub-surface and underwater plugs. Surface plugs do not sink, and usually have a cupped cavity on the front to cause a disruption and commotion when drawn over the water's surface.

In Iowa, such plugs are primarily used for bass fishing, but they will take pike and other species. Surface plugs—like their cousins the fly rod poppers—are most effective early or late in the day when water is quiet and fish are feeding near the surface. Such lures may be used at night, and during a black midsummer night on a placid lake they are wonderful bass lures.

During the day most fish head for deeper water and may be reluctant to take surface lures. This is true of bass to an extent, and is certainly true of walleyes. Then a sub-surface plug may be tried. This lure has a planing surface near the front, usually a bent metal plate attached behind the head. The plug will float when at rest, but when moved the planing action of the shape or bent plate drives it under the surface. There it may wobble, twitch or hula, depending on the lure. As it bobs up to the surface it is allowed to rest for a moment before it is again drawn under by traction on the line. A strike may come at any time.

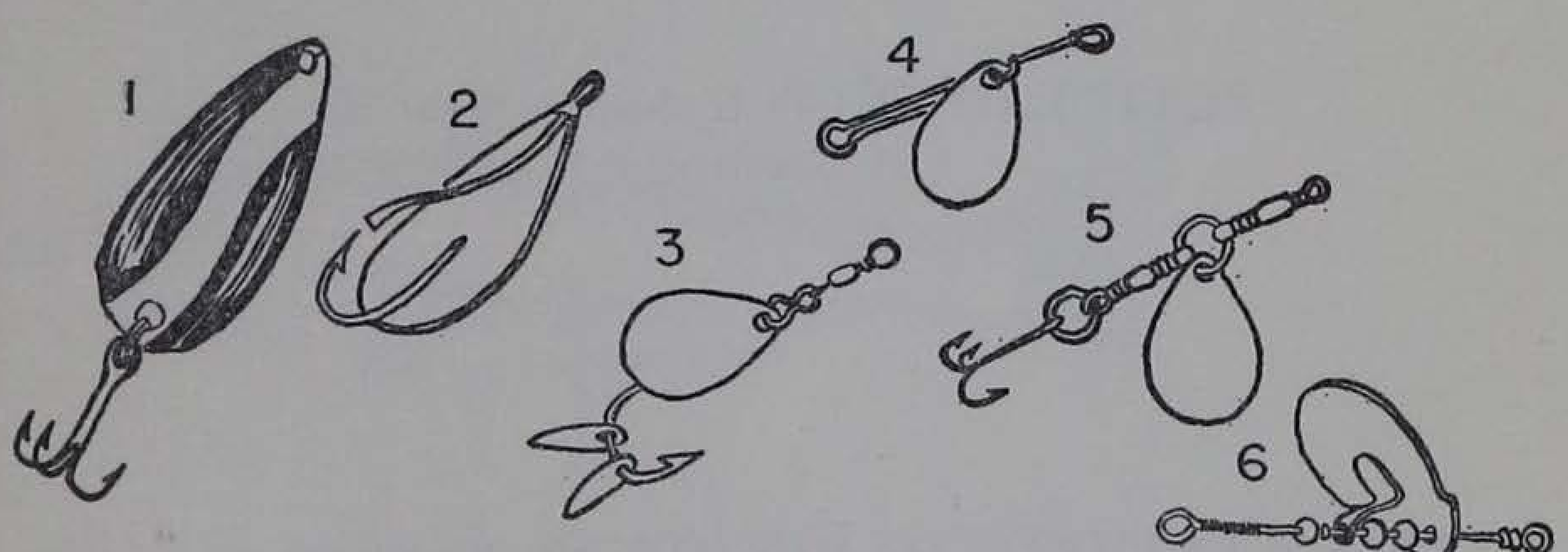
In warm weather or during midday, an underwater plug goes down where the fish are. Such plugs are usually solid plastic or weighted wood that sink naturally, with planing surfaces to give them action. The planing surfaces or vanes of the lure's body may cause it to wobble up and down or side to side, or the lure may simply follow the line of pull. Some anglers slightly alter the metal vanes of these plugs to increase or diminish their action.

Plug color may be less important than action, but fish do have a color sense and may ignore certain patterns and hit others. Experiments have shown that bass are more sensitive to red and other bright colors than to deep greens and blues. Fish may be attracted to color in surface waters where sunlight penetrates and color can be distinguished. In the depths, with little light, the deadliness of a plug may rest with its size, shape and action, rather than color.

Spoons and Spinners:

Spoons are ancient fish-getters that have evolved from the mother-of-pearl lures of the Polynesians to the highly polished metal spoons of today. These lures are bent metal plates, usually carrying a single or treble hook, that are shaped to give lively action when drawn through water. This may be a slow wobble or a fast twisting movement.

Spoons are usually meant to simulate fish, and are almost always fished below the surface. (Remember to fish them with swivels, or you may have a badly twisted line.)



The dare-devil type spoon with one side painted and the other polished (1) is an old favorite for pike and bass. Highly polished weedless spoons (2) are good lures for deep fishing or weedy waters. "Flicker spinners" (3) are excellent crappie and panfish lures. Simple spinners and colorado spinners (4 and 5) are often used with baits, streamers and flies. The June-bug spinner with its fixed blade, and used with pork rind, angleworm or minnow, is a deadly bass and walleye lure.

Many spoons have one surface painted, with the other surface of highly polished metal. Others are unpainted—of gleaming brass, copper or silver.

PLATE 14

GOLDEN SHINER ***Notemigonus crysoleucas*** **(Mitchill)**

CREEK CHUB ***Semotilus atromaculatus*** **(Mitchill)**

SOUTHERN REDBELLY DACE ***Chrosomus erythrogaster*** **(Rafinesque)**

WESTERN BLACKNOSE DACE ***Rhinichthys atratulus meleagris*** **Agassiz**

FLATHEAD CHUB ***Hybopsis gracilis*** **(Richardson)**

PLAINS SUCKERMOUTH MINNOW ***Phenacobius mirabilis*** **(Girard)**


Maynard Reece

They may be used in combination with pork rinds, or with tails of hair or feathers. Red and white, or black and white color combinations are favorites for pike, although highly polished spoons are excellent. In clear, sunlit waters some anglers use brass and copper spoons, while in turbid waters or on cloudy days they use spoons of bright nickel or silver. Spoons are widely used for trolling, and in the Midwest they are a necessity for the northern pike and walleye fisherman.

Many old-time anglers swear by spoons, and grow misty-eyed even talking about them. They say that if they could have but one lure, it would be a spoon. Probably a greater variety of fish under a wide range of conditions can be taken with spoons than with any other lure type.

Spinners are simply small metal spoons attached to a central axis around which they twinkle and revolve. They can be used in conjunction with other lures or baits, or may be used alone. Like their big brothers, these little spoons come in many patterns, shapes and sizes, and are most generally used to provide flash and action for more passive lures.

Small spinners, used with flies, are favorites for crappies, bluegills and other pan fish. The old "June bug" spinner, used with a worm or minnow, is a great walleye lure. So is the yellow bucktail-spinner team called the "killer rig".

Spinner combinations are excellent in murky or slightly turbid waters where they provide the glitter necessary to attract some fish. Maybe Iowa anglers are missing a bet by not working more with bait-spinner combinations. Worms and minnows, used with bright little spinners, can take any Iowa game fish in almost any Iowa waters—clear or cloudy.

The most important fishing tool hasn't even been mentioned. That's an open inquiring mind. The best anglers are men of imagination, ones who study nature and are willing to try something new. Remember: every basic angling rule was developed by some riverbank radical or lakeside looney that people laughed at.

Your buddies may call you the village idiot. But it's this type of man—armed with good equipment, imagination, and the caresses of Lady Luck—who kills the best fish.

Chapter XVIII

ANGLING

Dame Juliana Berner published one of the earliest English books on fishing in 1486. The title of the book was *Treatyses pertenynge to Hawkynge, Huntynge, and Fishynge with an Angle.* This and other early works inspired out patron saint, Izaak Walton, to write his immortal book, *The Compleat Angler*, in 1653. Since that time millions of words have been written on angling, but somehow we never seem to tire of the subject.

Angling might well be considered the universal sport, since its followers come from all walks of life and from all parts of the world. Neither wealth, position, creed, age nor sex serves to eliminate anyone from participation in this healthful and relaxing recreation.

Fishing is a competitive sport, although it is often difficult for the fisherman to realize this fact because the opponent is invisible. The life of the fish depends upon its ability to outwit the angler. For this reason the angler must concentrate his entire skill upon getting the individual fish to strike and bringing it to the net just as a pitcher concentrates on fanning out one batter at a time in a ball game. After the fish is in the creel there is ample time to think about catching the next one.

We, as fishermen, are depending more and more upon activity charts, super lures, and gadgets in our fishing. There is no lure or bait that will take fish under all conditions. The mechanics of angling, or methods by which a bait or lure is presented to a fish, are more or less easily learned, yet the expert caster may be a mediocre fisherman. He has developed a technique of placing the bait where he wants it, but he may not have learned where to look for the fish! Casting itself is highly enjoyable, but it must be the servant and not the master if one expects to be a successful angler. Ingenuity and experience will help to balance shortcomings in casting skill.

A knowledge of the habits of the fish sought is invaluable to fishing success as it often enables us to choose the combination of lure or bait and method of presentation that will take a fish. Too many of us make scatter-gun assaults on various lakes and streams, seldom returning to a spot which did not produce well the first time visited. This is a mistake, for a knowledge of a lake or stream is one of the prerequisites for regular fishing success.

We hope this section on angling will supply information that will enable the Iowa angler to put fish on his stringer and add to his fishing enjoyment. Space does not permit complete coverage of all species, nor the mechanics of handling all the different types of fishing gear. We have asked several colleagues and friends to contribute articles for this section of the book. Every angler has his own private formula for catching fish, but frequently he can learn some new tricks from others in this great fraternity. We hope you will enjoy these articles and profit by the experiences related in them.

Brief notes on angling are also contained in the section of the book dealing with the native Iowa fishes.

Angling for Channel Catfish

Harry M. Harrison

Biologist

State Conservation Commission

Just as there are more ways of killing a cat than by choking it to death with cream, so are there many ways of catching a channel catfish. But before we get into the business of drowning worms, it would be worthwhile to acquaint ourselves with something of the private life of the channel catfish. A knowledge of such things as where he lives, what he eats, and where in the stream he finds his food will increase your chances of success in the same way that the trapper's knowledge of animal habits increases in his catch of fur.

Channel catfish are found in all Iowa streams that are more than just a few feet in width. They become more numerous as the size of the stream increases and occur in their largest numbers in the big rivers such as the Missouri and Mississippi. Catfish seek shelter in the deeper water adjacent to and beneath drift piles, cut banks, submerged logs, boulders, piling, or in crevices in limestone bedrock. These serve to protect the catfish from its enemies and act as areas in which to loaf and rest. The amount of the aforementioned habitat has a direct effect upon the number of catfish living in a given area, and when angling for channel cat, reaches of stream abounding in these cover types should be sought.

Now, having settled where channel catfish may be found, the next thing of importance to the catfisherman is a knowledge of this fish's feeding behavior. The source of this information is drawn from almost fifteen years' research on the channel catfish, and although incomplete, it does present facts that explain in part, at least, why catfish are caught at times and not at others.

During periods of clear water, channel catfish feed largely at night. The heaviest feeding period will come with evening dusk as "Old Whiskers", hungry from a day spent in the seclusion of his favorite lair, sallies forth in search of his daily bread. He will continue to feed intermittently and move over wide areas of the stream all night. With the coming of daylight he will again fill his belly before retiring for the day.

For the most part, feeding during the twilight hours will be confined to the channel and in deep water. But as darkness sets in he will invade the shallower waters, and individuals weighing as much as six to eight pounds may be seen feeding in water barely deep enough to cover their bodies.

Daytime feeding during clear water periods is taboo in the best catfish society. However, a choice bit of bait offered under a snag or in other shelter during daylight hours frequently meets with success. Eating while in shelter areas is not customary with catfish, but is not unlike one of us snatching a chocolate from our night stand at midnight.

Increased catfish movement and feeding invariably go hand in hand with stream rises, and fishing for them at this time usually results in good catches, for it is then that the catfish is out hustling for food. The turbid waters that accompany the rise offer a certain measure of protection from exposure to too much light. The catfish is second to none when it comes to choosing food from the wide variety of terrestrial delicacies that are being washed into the stream by the flood. Also, during high water catfish are often found feeding in inundated grassy areas. These grassy areas act as strainers, catching and holding all manner of choice bits of food to suit the epicurean fancies of the catfish.

The temperature of the water has a far-reaching effect on whether or not catfish are in the mood to take sustenance. From an examination of 60 specimens taken from waters less than 40° F., only two were found to contain food, and in both cases the amount was very small. As the water warmed, the number of fish containing food, as well as the amount each fish had eaten, increased. Above 70° F. all fish examined contained food. The practice of catfish feeding in warm water is not new to the experienced catfisherman, who knows that June is the best month for fishing channel cat. However, an explanation as to why catfishing usually slumps in July at the time when water temperatures are at the highest for the year is now in order.

July is the month when catfish spawn in Iowa. The male prepares the nest and guards the eggs and young as long as they remain on the nest. During this period the male feeds very little, if at all. Hence we see in July that the catchable population of catfish is materially reduced by the number of males occupied with parental duties.

With the coming of fall, the declining water temperatures have an opposite effect on the feeding behavior, and instead of reducing the appetite as in spring, the declining temperatures apparently stimulate it. Late October and November fishing is apt to be very good, at least as long as the water stays above 40° F. for a part of each day. Below this temperature feeding ceases abruptly and will not begin again in earnest until the water has reached 60° F. the following spring.

Returning now to summer and hot weather fishing, "sore mouth" is a phrase often heard along the river banks and a reason frequently blamed for poor fishing. Actually the reddened mouth so often noticed on catfish in July and August is a condition caused by the catfish's probing the bottom and brush piles in an effort to get more food. This being the case, the $64,000 question is, "If catfish are so hungry, why don't they take that luscious gob of chicken gut I offer them at the end of my line?"

There is at least a partial answer to this question. The kinds of food eaten by catfish number into the thousands and include mammals, amphibians, birds, reptiles, insects, crustaceans, carrion, fruit, leaves, seeds, and oddities too numerous to mention. But even with such a versatile appetite, catfish seem to have the habit of selecting single items. Several good examples of whole populations of catfish eating of but one thing have been observed. The seeds of the American elm tree falling in the water are eaten every spring to the virtual exclusion of other foods. In August catfish are often found gorged with filamentous algae, at the same time not using a bountiful insect and forage fish resource present in the stream. At other times, particularly in the fall, the whole diet will consist of minnows.

In the examination of the visceral contents of more than 2,000 channel catfish, very few were found to be feeding on a wide variety of foods at one time. When they were eating insects, little else was found in the stomachs. When plant foods were consumed, other foods were conspicuous by their absence. When fish were eaten, plants and other animals appeared in limited amounts.

Such information as this certainly points to the advisability of using a wide variety of bait. In some of our researches into the problems of angling for catfish, we have set up experiments whereby catfish were offered different kinds of bait on conventional fishing gear. In this work, baits including live and dead minnows, crayfish, frogs, grasshoppers, cut bait and cheese, all time-honored good catfish-getters, were fished simultaneously in river areas known to contain quite large populations of catfish. The results of this study, although yet incomplete, indicate that none of the baits used were always better than any of the others. There have been times when all caught fish in about equal numbers, while at other times none of these baits took fish. Upon one occasion grasshoppers took large numbers of catfish at the total exclusion of the other baits. At other times cut baits were better while still at other periods frogs, crayfish or cheese were best. We have no answers at present to explain this phenomena, except for the possibility that the season of the year may have had some bearing. Be that as it may, one thing to remember is that a wide variety of bait often spells the difference between a successful fishing trip or a failure.

Now equipped with a knowledge of where to find catfish and a conception of his feeding behavior, we must now concern ourselves with the equipment needed to catch the catfishes. A complete catfishing outfit should include a good reel, a stiff rod not less than 5 feet long, 75 to 100 yards of good line, a float or bobber, and an assortment of hooks and sinkers. Hip boots or breast waders are optional equipment, but come in handy for wading in cold water.

Of this equipment, the best reel that you can afford will add more to your fishing pleasure than any other single item. A free-running reel aids in accurate casting, a must in catfishing, and one that is not given to backlashes is especially desirable for night fishing. A good stiff glass or steel rod 5 to 5½ feet long or Calcutta pole, if desired, ranks second in importance. Stiffness and length in a catfish rod are necessary for setting the hook on distant strikes. The long length of line is required for distant or float fishing.

You would be surprised at just how much the type of line that you select adds to your fishing enjoyment. As mentioned above, you need a good line, but this does not necessarily mean a heavy test outfit. As a matter of fact, a 15-pound test nylon is ample, and it is my personal feeling that a 10-pound line is much better. The light line will enable you to cast better and with more ease. In addition, you can get more line on your reel, and with light test gear, you know full well that it will be disastrous for you to land your quarry 40 rods back in the cornfield with one husky yank. The delight of any fishing trip is the play that you get from the hooked fish, so why not increase your pleasure with the light line idea?

The bobber should be white in color in order that it may be easily seen at a distance, and of a rather large size (1½ inches in diameter). Hooks should be of a variety of sizes and shapes, depending upon the baits used. Stink baits and blood should be fished on small treble hooks, while cut baits, chicken or carp guts, nightcrawlers, and live baits are fished on larger single hooks (2/0 to 4/0). Sinkers should vary in size from split shot up to at least 2 ounces. Small sinkers are used to hold the bait a little below the surface when float fishing, while the larger ones are used to hold the bait on the bottom while still fishing or floating the bait near the bottom.

Right here and now, it should be pointed out that one common cause for not catching catfish comes from the selection of the sinker. Most catfishermen have a tendency to use too much weight. This is particularly true of the bank fisherman and especially at times of high water. If you will ponder a moment the idea that you should present your bait to the fish as nearly as possible in the same manner as he gets his food naturally, it is readily apparent that catfish seldom find their food anchored to some heavy object in the middle of the river. In short, your sinker should be only heavy enough to hold down your bait in those places in the river where the natural foods are settling out. This will be in areas of reduced current, and quite often only a few feet offshore. A sinker the size of a large garden pea will usually do the trick. The time to use the larger sinker is during low water, at which times catfish are more apt to be feeding near the center of the stream.

The slip sinker is an innovation to come upon the fish scene in the past few years. This permits you to present your bait to the fish without its having the appearance of being tied down. The slip sinker allows the line to run freely through it, so that the fish is not "spooked" by the bait's being fastened to something.

Spinning equipment is becoming increasingly popular among the fraternity of catfishermen. It should be pointed out here that this is usually not the equipment with which you should first learn to catfish, but once you have mastered or have become quite familiar with the conventional rod and reel mentioned above, you can add to your pleasure astream by turning to the spinning technique. By reasons of its make-up, spinning gear falls into the category of light tackle, and because of the way in which the reel is designed, it is impossible to "horse" even a small fish out of the water. As noted previously, it is the play of the fish on the hook that really makes your fishing trips worth the chips. A foot-long catfish on a spinning outfit will give you all of the thrills of a three-pounder on a regular rod and reel!

Here again the selection of your equipment should be the best that you think you can afford. Good spinning equipment will add to your fishing delight for the very same reasons as mentioned above under the selection of your rod and reel.

Nowhere throughout the sport of angling, from trout to carp and sea bass to bullheads, is the subject of bait so controversial and diversified as it is in catfishing. The different baits in common use number in the hundreds, and the qualities of each are a source of argument whenever and wherever catfishermen congregate to talk over recent fishing experiences. Many catfishermen make their own, and the adroit catfisherman gets as much satisfaction from developing a good bait as the hunter gets from finishing a retriever. The concoction of some of these baits calls for the finesse required in compounding fine drugs, and the techniques and ingredients are often a matter of great secrecy with the inventor. The science of bait making, however, is something apart from actually catching catfish, so our remarks from here on will be confined to a discussion of the common baits in use. The fisherman who uses a variation of any three or four of these will usually catch catfish.

However, before getting into a discussion of bait, it would be well first to consider the techniques of still and float or drift fishing.

Still fishing is that technique whereby you work your baited hook into a particular spot in the stream where catfish are thought to frequent. The bait is worked into the area with the intent of holding it there until the fish comes to it. This can be thought of as passive fishing, and is a good way to present your bait to fish traveling channels or waterways in search of food. The technique also works well in fishing drift piles where the bait is held just outside the snag so that your quarry does not have an opportunity to foul your line in the entangled brush after being hooked.

Still fishing may be accomplished from the bank, a boat or while wading. in any case, it is always a good idea to position yourself as far as conveniently possible from the place you are fishing. Catfish are "skittish" critters and the least disturbance you can possibly make in the vicinity of your bait always pays off. To be consistently successful, another must to remember is to always *hold* onto your rod in order that you be ready to set the hook when the fish hits. A serious disadvantage to the still fishing technique is the tendency for the angler to lay his rod and reel aside, and many strikes are missed in the resulting delay between the hit and the time of the attempted setting of the hook.

Float or drift fishing involves the technique whereby your bait is kept continually moving. The difference between floating and drifting is only a matter of definition. Float fishing employs a bobber which holds the bait off the bottom, whereas drift fishing does not use the bobber and the bait is allowed to roll along or tumble over the bottom of the stream. The idea behind the technique is for the bait to seek out the fish rather than for the fish to come to the bait. Offhand, it may seem that this is the superior way to fish catfish. Most of the time this is the case; however, there are times when this procedure offers no particular advantages over the previously described method. Float fishing is best accomplished by wading, although it can be done from a boat or from shore.

While wading, the correct method is to start at the edge of the channel. Cast out a short length of line and let the current carry it directly in front of you. Then permit the remainder of your line to pay off as it moves downstream. When the line is all out retrieve it; step out a few feet more into the channel and repeat as before. Continue the procedure back and forth across the stream. When you get a fish or miss a strike on any drift, be sure to refloat the same spot.

Floating from a boat is accomplished in the same manner, but because of having to anchor in the middle of the stream or between drifts, the use of a boat becomes rather cumbersome.

It is possible to float or drift baits from the shore by casting out and upstream and then letting the current work its will on the bait. With a little practice you will learn just how much line to throw out so that the current will carry the bait alongside or under any shelter area you should choose.

Floating bait from a dry position, unless from a bridge, has two disadvantages. They are: (1) the bait always travels with the speed of the current, which is often too fast, and (2) snagging more often results when the hook moves in any direction other than with the trend of the current.

Returning now to the topic of bait, chicken blood is probably the best fish-getter of all, but has the disadvantages of being hard to handle and so attractive to small fish that they are apt to clean the hook before the larger individuals get a chance to hit. For the best results, blood should be used as fresh as possible and floated. If you have trouble with little fish getting your bait before it reaches a likely-looking spot for a big one, it is a good trick to float the bait on a small chip of wood to the likely-looking spot and then pull it off the little raft with a light flip. When still fishing with blood, ease it into the water as carefully as possible and do not move it after it has reached the bottom. Blood fishes by slowly dissolving, with the part that washes off forming a trail for catfish to follow to the hook. Movement of the bait may obscure this trail, and if not that, it will surely come off the hook.

Chicken blood bait is easily prepared. Simply collect the blood in a flat pan from any produce company killing chickens. Store and let it coagulate in a cool place, preferably the refrigerator. Pour off the juices that form, and then cut the remaining coagulum into strips. These strips are threaded on small treble hooks and fished as outlined above. To insure or increase its staying on the hook, blood should be taken to the stream and kept in a thermos or in a jar surrounded with shaved ice. In that blood is very apt to take a preponderance of smaller fish, it is particularly sportive when used on spinning tackle.

The so-called cut baits are becoming increasingly popular and in some areas are the most used baits. They have the advantage of staying on the hook. Little fish can "chomp" on them by the hour, and if the big ones are slow hitting, you can wait them out before the fiddlers steal the bait. Cut baits may be either still-fished or floated.

Cut baits are prepared by first scaling and then filleting any species of rough fish (carp, sucker or buffalo). The fillets are then cut into strips about one-half inch square and two inches long. These may be fished fresh, but usually do better if allowed to sour about a day in a glass jar.

When making cut bait, do not pass up the guts of the fish you are using. These make excellent baits when fished fresh. At this stage they are bloody and have a come-and-get-it appeal to catfish that chicken blood does. In addition, they are fishy enough to qualify as cut bait and, between the two, spell disaster not only to hungry fish, but full ones alike. Fish guts may be floated or still-fished. When nibbled at, however, they often string out behind the hook, and for this reason it is often a good idea to secure them to the hook by tying them on with thread.

Chicken guts rank high among good catfish baits. Some catfishermen use them as they come from the chicken, but a little "fixin'" makes them nicer to handle and also enhances their effects on catfish. To prepare chicken guts for bait, it is best to use only the foregut. This is the whitish gut which comes off the gizzard. It is rather fleshy and reaches back to the hindgut, which is bluish in color, much bigger around and thin-walled. The foregut should be strung out, cleaned of its fat, and cut in eight-inch lengths. These should be covered with cornmeal and allowed to sour before fishing.

Chicken guts may be still-fished or floated as desired. If the little fish are working, you may experience trouble with your bait's stringing out behind the hook and miss some good strikes in this way. To avoid this, bait your hook by folding the ends together and commence baiting at the loose ends. This will result with the ends of the bait at the eye of the hook and the fold at the barb. This accomplished, simply use your line to throw a half hitch around hook and bait just below the eye, and it will be impossible for your bait to come off.

Stink or cheese baits work well for catfish, but have the disadvantage of being cleaned off the hook by small fish. On the other hand, they find particular favor in being readily available in stores and sporting goods shops and require no special attention between fishing trips.

Stink baits may either be fished still or floated and seem to be particularly good for spring and fall fishing.

If you wish, you can make your own stink bait by using cheese trimmings for a base with such cereals as flour, oatmeal and cornmeal added to increase the capacity of the bait to stay on the hook. With these essentials, the sky is the limit as regards other ingredients that may be added to refine and perfect the bait. Such things as powdered milk, tankage, bone meal, fish meal, soya bean meal, asafetida, and oil of anise are but a few of the many other ingredients finding their way into stink baits. Just what or how much of these add to the effectiveness of the bait is not known, but it is a lot of fun to try some of them.

At certain times live baits are particularly effective for taking catfish. Either minnows, crayfish, hellgrammites, or frogs may be used. These may be still-fished, but floating will ordinarily result in the best catches. The technique for floating live bait is rather simple. It is just a matter of using enough line below the bobber or float so that the bait cannot carry the hook beneath a rock or drift log where it will snag, and enough sinker so that the bait cannot swim to and remain on the surface of the water.

With these live baits the gratification that comes with getting it may at times surpass that which comes from catching fish. If your fishing trip should happen to include a young son or daughter, by all means make a part of that trip a live bait getting excursion. The wiggling, crawling, creeping things that the minnow seine turns up, not to mention an occasional frog, turtle, snake or toad, are a source of interest to one and all. In addition, you will find that the live bait you get yourself will be of superior quality to that which can be had by purchasing it from a live bait establishment.

A good live bait should be of the right species and hale, hardy and strong. As is the case with other wild creatures, confinement is not conducive to their well-being, and for this reason the shortest length of time that elapses from the time of capture of the bait to that of use is directly related to its quality.

To further enhance the quality of your live minnow baits, you should learn to know a few good bait species. Remember, minnows are just not simply minnows! Their qualities for bait differ just as the quality of the larger fish differ for table use. Because of this, you should not crowd your minnow pail with a lot of "junk" fish. Of course, the final test of a good live bait species is the one that is active on the hook and lives well there. The best of these include the northern creek chub, common white sucker, stoneroller minnow, hornyhead chub, and the northern fathead minnow. The descriptions, pictures and other individual traits for these bait fish are given elsewhere in this publication. If you use live bait, it is strongly urged that you become familiar with that section of this book.

While on the subject of quality, it should be pointed out that the shiners or those fish that have the generic name *Notropis* connected with them are generally considered poor live bait species. The only exception to this may be in the case of the larger individuals, those longer than four inches, and even then they could rate no better than fair.

Dead minnows are also good catfish getters, but here again you should pay close attention to quality. All minnows by their very nature must be considered as soft fish. In other words, they fall apart or disintegrate rapidly after death, so the problem of selecting minnows for dead bait resolves itself to picking out the firmest fleshed species from a group of generally soft fish. Those kinds named as good live bait minnows all rate superior as dead minnow baits, too.

If you should ever happen to run into the trouble of keeping your dead minnows on the hook, a good thing to remember is to bait them by running the hook through the tail first and stringing the bait on so that the head of the minnow comes down against the barb. The bones of the head lend much support to the remaining part of the fish's body on the shank of the hook.

Other baits used for catfish include: clams, shrimp, liver, beef milt (spleen), white laundry soap, fishworms, nightcrawlers, unfeathered sparrows and starlings, young mice and rats, boiled eggs, and large insects, notably grubs and grasshoppers. These are fished in the same manner as the other baits mentioned above.

In a final word on bait, you will find that catfish take many things that are in season. For instance, at times of high waters with stream shore erosion and bank cave-ins, such things as nightcrawlers, fishworms and grubs will be taken. During the grasshopper season, grasshoppers, the yellow variety in particular, are good bait. And if you are ever fortunate enough to be at the river at a time when small frogs, those an inch or two long, are numerous along the water's edge, we can almost guarantee that they will take catfish for you, and the big ones at that.

With the background on where catfish are found, together with something on their feeding habits and a list of equipment and baits needed to catch them, we are ready to go to the river.

At the river the thing of prime importance is to remember that you are there to fish, not star-gaze or watch dickey birds. With the channel cat you are dealing with a fish as wily as any that swims. He is equipped with very delicate sensory organs that enable him to hear and see your presence the minute you set foot on the river bank. If he happens to be in an "I don't give a darn about eating" mood, the least disturbance will hurry him into shelter. So by all means do not make unnecessary noise when you fish. You may talk, but do not disturb the water or jar the ground next to the stream. Catfish are especially adapted for sending vibrations through the ground or water, and it is this type of disturbance that puts him on his guard quicker than any other.

Now as to where and when to fish for catfish. For the most part, catfish are nocturnal feeders. That is, they feed primarily during darkness and, as the name channel catfish implies, they spend much of their time in or near the channel. These are generalities, however, and it must be pointed out that there are no hard and fast rules that pin down the channel cat's feeding behavior. Every set of conditions that prevail in the river will have some effect upon his feeding pattern, and each of these will require changes in the way you should fish. If you learn to cope with several of these different conditions, your angling success will definitely increase. Every community has its successful catfisherman, and it is his finesse in fishing every situation correctly that sets him apart as the district's best "catfish getter".

Of course, almost every day or week offers things new and different in the river, and because of this it would become confusing to consider each and every set of circumstances and how they should be met with the rod and reel. The situations that are most important and require special fishing technique are as follows: high, normal and low water stages; spring, summer and fall fishing; and daytime, twilight and nighttime fishing. In addition, the factors of rising and falling water stages are worthy of special consideration. It goes without saying that these are for the most part inseparable conditions, but for the sake of simplicity they will be discussed as much as possible as separate situations.

High water is one factor that sends more fishermen back to the golf course than any other. If you are a bona fide catfisherman, however, high water can be taken in stride and oftentimes is very productive.

Catfish take much of their food by "sniffing it out" rather than by sight. Consequently a little thing like mud in the eye doesn't bother the channel cat one iota. Another thing, they are lazy critters and as such are adverse to strenuous exercise. As a result, they do not spend much time during high water fighting the current in the thread of the stream. Armed with basic information of this nature, the proper method of fishing catfish in high water falls into a sensible pattern. First, use a bait that gives off an odor. Such items as sour cut bait, dead minnows, chicken or fish guts, cheese bait, or sour clams are suggested. These should be still-fished close to shore or in dead water areas where floating debris is settling out. Float fishing at flood times does not offer any advantage, and live or fresh baits should be avoided. The time of day to fish is not too important, because the turbidity of the water that accompanies floods offers the channel cat all the security that he needs to draw him out of his lair. As a final word on fishing high waters, remember above all else *not to fish the middle of the river.*

Just what constitutes normal water level is rather hard to define. But be that as it may, the man who spends any length of time astream knows what normal stream flows are and the novice will be quick to learn. Normal, of course, implies usual, and by context the condition of normal waters will naturally ensue for the greater part of the fishing season. It is during this situation that finesse really pays off. During this period catfish may be found feeding at almost any time of the day at any place in the stream and on any of a multitude of different things. It will be left to you to find out the when's, where's and what's. Taking some of these into consideration now, the following, although not hard and fast rules, often pay off: (1) use a wide variety of baits, including both live and dead bait; (2) use the floating and drifting technique; (3) fish at night or, next best, the twilight of evening and morning; (4) if you fish the daylight hours, then drift your baits under snag piles or in and around submerged boulders; (5) wading or fishing from a boat helps; (6)

move about, that is, fish many different places; you will be more apt to find the hungry fish scattered rather than all in one place; (7) it is always a good idea to become very familiar with the reach of river in which you fish. Catfish school up. If you know or find the area in which they are gathered, you will be able to get your bait to them with very little or no disturbance.

Almost without exception, low water comes in late summer or fall. This is the easiest condition to fish and, if done correctly, produces a good number of fish for the creel. Low water congregates the fish into holes, which in effect reduces the problems of finding them. One thing about low water, it makes the fish more "skittish", and for this reason you cannot be too careful about making noise on the stream. The way to fish low water is to first pre-locate the holes. With the position of these well fixed in mind, wade quietly into the river fifty yards above, and then drift your bait downstream so that it tumbles along over the bottom of the stream into the area. Again use a wide variety of bait, but worthy of mention are live minnows and frogs, which work particularly well under these conditions.

With regard to spring fishing, the factor of high water is usually quite closely associated. Nonetheless, there are some things about fishing this season that are not necessarily related to all high water periods. For instance, catfish do not often bite well until the water has warmed up to about 60° F. It seems to take about this much heat to thaw them out of their winter dormancy. After the water has reached that temperature once, it may drop again without serious consequence to their feeding activity. So from this information it will seldom pay you to fish catfish in the spring until the water temperature has been in the neighborhood of 60° F. at least one time.

A second important consideration with respect to spring fishing has to do with your choice of baits for this time of year. Such items as dead frogs, dead minnows, dead crayfish, or cut bait are particularly good. Catfish, as pointed out before, are great hands to feed upon things that are in season; winter takes a heavy toll upon water life. Because of the effect of the cold and the dormancy of many aquatic organisms, those things that succumb during winter have a tendency to accumulate. With awakening of spring, this accumulation of goodies become available to and are fed upon by catfish. According to the prevailing water stage, fish these suggested baits as outlined above.

What about summer fishing? Our researches into the life history of the channel catfish have shown that more catfish are caught in June, July and August than for any other months of the year. In addition, other work has shown that catfish are almost continuously on feed during this season. By this we don't mean to imply that the catfish's life during these named months is a continuous search for sustenance, but in the several thousands of fish that have been examined for food habits study, we have found but very, very few which did not contain some food. In many instances the foods that were consumed could not be used as a bait, but by token of the fact that the fish had taken them means also they could have fallen for a baited hook. In short, you need not worry about running into long summertime lulls in feeding behavior of channel catfish. We know that there are times when it is next to impossible to catch the critters, but whatever the reason, it is not that the catfish is off feed.

Again the use of a wide variety of both live and dead baits is suggested. Fish these according to the stage of the stream as outlined previously. That is, float or drift your bait during normal or below water stages. Still-fish during high water. The grasshopper is a good bait to use in August and September.

Fishing catfish on our Iowa streams in the fall cannot be regarded as anything short of the supreme sport. With the coming of cool weather the algae, or little microscopic plants that are dispersed throughout the water and cause it to have a greenish opaque appearance all summer, disappear. As a result, the water becomes clear, and with the blaze of fall colors the stage is set so that every fishing trip is a joy indeed.

Catfish are especially vulnerable to the hook and line at this time of year. It is during the fall that the channel cat must take on sufficient food to see him through his winter dormancy.

Ordinarily fall fishing is accompanied by low water, so you should fish your catfish at this time of year as suggested above under fishing low water stages. You will find live baits such as minnows, frogs or crayfish are particularly effective at this season.

If you should like to try catching catfish on artificial bait, the best success will be had in the fall. The technique has been quite productive for a few catfishermen who have really worked out the art of "plugging" for channel cat. Plugs are most effective when used in rocky or riffle areas. A small drab-colored plug in the pattern of the Lazy Ike is the kind to choose. This is cast upstream at about a 45-degree angle to the thread of the current. The plug is then retrieved slowly as it drifts downstream. The retrieve should make use of your rod tip in order to get little spurts of action out of the plug.

As regards the time of day to fish, research has pretty well established that the bulk of the catfish's food is taken at night. It follows then that the best all-round time to fish is during darkness. There are extenuating circumstances which make for exceptions to this so that good catfishing may be had at any time throughout the entire day.

During the daylight hours most catfish have a tendency to remain in seclusion under brush piles, beneath or alongside a submerged log, in among rock deposits, at the bottoms of deep holes or beneath undercut banks. In the daytime, work your bait into such areas. Still-fish these spots for ten to fifteen minutes and then, if not productive, move on to another.

Evening twilight is the time of movement of catfish out of the cover area to the feeding grounds, while morning twilight is the time they return. You fish these periods about the same as suggested for the daylight hours, except it will not be necessary to get your bait as close to the fish. In other words, just fish near the cover areas. This is also an excellent time to use the float or drifting technique. Catfish, hungry from the day spent in their lair or looking for one last bite before returning to cover for the day, fall easy prey to a drifting bait.

At night, as stated before, most catfish are out hustling for food. This they take wherever it can be found throughout the breadth of the stream. If you are having normal or low waters the float or drifting method is the best way to fish during darkness. Catfish will be found from the deepest water to that which barely covers them and except during floods, from one shore to the other. If properly done, the drifting technique fishes all types of water, and if pursued diligently will almost always produce. Blood, chicken or fish guts, cut bait, milt, worms, dead or live minnows, small frogs and grasshoppers number among the best baits to be floated.

Without question, sudden rises in stream stage, due either to rainfall or the operation of hydro-electric dams, produce the fastest and best catfishing that can be had. That which motivates catfish to feed exceptionally heavily at these times is not well understood; it may be he senses "hard times ahead" under flood conditions and wants to meet it with a full belly. Regardless of his "reasoning" don't miss fishing the rise. The best success will be had from the instant that the rise begins and for the next five or six hours. Rises at a rate of no less than four inches per hour are the most productive.

Under these conditions, still-fish along and quite close to shore. Grassy areas or bushes that are being inundated are excellent spots to present your bait. Use cut bait, dead minnows, chicken or fish guts, worms, nightcrawlers, grubs, grasshoppers, crickets or cheese for bait.

Of the times that catfish are difficult to catch, periods of falling water stages top the list. And the faster the decline the harder it is to make them strike. About the best advice that can be offered as respects fishing catfish on the river drop is to recommend a game of golf or tennis. This pertains only to rapid drops in stage, those of eight to ten inches or more a day. When the fall is less than this, you can expect fair success, at least, by fishing the prevailing stage in accordance with the suggestion offered above.

Just why "Old Whiskers" gets cagey about taking the hook in response to falling water stages is not fully understood. We know from food habits studies that he continues to feed as much then as at other times, and on quite a wide variety of foods. A close guess at the reasons probably centers around the food supply. Floods, of course, wash into the stream a wide variety of food items such as fruit seeds and terrestrial insects not found in our rivers at the times of normal water stages.

Aside from fishing catfish in accord with water, seasonal and daily conditions as discussed above, there are yet several things of importance in developing your success as a catfisherman.

Of these, learning to know the area that you fish is high on the list. Some of our netting and food habit studies indicate that catfish may have rather definite feeding routes or feeding grounds. This information is based on data showing that nets or hooks set in very definite places catch more fish than they do in others. The success in taking fish by these devices is very critical in relation to their exact location in the stream.

You, then, as a fisherman will find that certain very definite spots often produce catfish. To make the most of this technique, it is suggested that you confine your fishing to rather limited areas; keep close records of where you catch fish on these, and always refish those spots on every return to the stream. Wading the stream to locate deep holes, submerged boulders and logs will give you clues as to probable feeding places.

Developing the techniques of hooking catfish is often a problem of the beginner. On this topic you will find at times Mr. Catfish is rather slow to take the bait. He seems to pick at it a little, then leave to return a little while later, then nibble again. Often he will move it a foot or so. When this happens, don't be too quick to set the hook. Wait until he makes a good run of at least five feet and then give a husky jerk. If you happen to miss, let the bait lie a few minutes to see if he will return. If he fails to come back, reel in your line and try to cast it back to the exact spot where he first started to bite. Often such a customer will return for the bait, and with a little persistence you will be able to hook him.

As a final point, the little matter of your confidence is an important item for consideration. When fishing for catfish have complete confidence in the bait you are using and be convinced all the time that a catfish is just about ready to "smack" your hook. If you do not you will not fish with the care that you should. An unnecessary splash or a listless movement may often spell the difference between catching a fish or not. Remember you are dealing with a coy animal, one that will outhear a woman on a party line, outnose a reporter on a scandal case, and come very near outseeing a sailor on shore leave. Treat him as such and, using the ideas listed above, you will not return from many fishing trips empty-handed.

Angling for Largemouth Bass

Ries Tuttle
Des Moines Register and Tribune

Pound for pound and scale for scale the largemouth black bass is the all-around champion of the fresh-water fish world. He's always ready for a bare-knuckled, knock-down scrap—and you don't have to go far to find him.

Mr. Big Mouth is found in every state of the Union, Canada, Mexico, and has been successfully introduced into France, Germany and South Africa. Depending upon where you live, he goes by a number of names—bronze-back, linesides, chub, trout, green trout, green bass, mossback, yellow bass, straw bass, bayou bass, Oswego bass, Welchman, slough bass, marsh bass, moss bass, grass bass, ad infinitum.

There was a time, before the present generation, when the largemouth bass was not widely known in Iowa. Fishermen who visited the lakes of northern Iowa came to grips with him, as did those who fished the Mississippi and Missouri river bayous or sloughs. Only occasionally was he found in central or southern Iowa.

But there's scarcely a county in Iowa now that does not have at least one body of water stocked with largemouths. This has been brought about by the state's ambitious artificial lake program, the creation of many city water supply reservoirs, and the advent of the farm pond program.

This wide distribution of black bass in Iowa has made game fishing popular with residents. The cane pole, line and bobber—generally speaking—has given over to the rod and reel as standard tackle equipment, from the youngster to the old-timer.

Since bait casting tackle is most commonly used for bass in Iowa, I will confine most of this discussion to that type of fishing.

While there is a place and purpose for all types of tackle—from heavy to light—the best all-around gear, especially if you intend to do a great deal of actual casting is the lightweight equipment.

My choice is a light action rod in 5½- or 6-foot length. I match this with a well-made light running reel that is equipped with an aluminum or other light material arbor. A level wind is recommended for most anglers.

Select a good quality nylon line testing not more than 15 pounds. Lighter is better. I prefer 10-pound test. A 50-yard spool is plenty, but the reel arbor should be large or built up with cork so that the line fills it out well.

Lines come in a variety of colors today with a trend away from the old favorite black. For most waters I prefer either a pale blue or green line, or one of the several types of camouflage lines where the nylon is alternately dyed in varying colors.

A nylon filament leader, testing from 2 to 4 pounds less than the line, is then in order. It should measure at least 3 feet, longer is better.

Many fishermen are content to join the leader to their line with the usual loop, but this frequently leads to fouled casts as the loop passes through the line guides.

For several years I have been using a longer leader, from 10 to 15 feet, tying it directly to the line with a blood or barrel knot. This makes a smooth, small and stout union that causes little, if any, drag.

Besides creating a greater illusion of having a bait appear as a "free agent", the long leader has an advantage in playing the fish when it is about to be landed. Many a fish is lost in that last lunge as it espies its captor with the leader

PLATE 15

NORTHERN COMMON SHINER ***Notropis cornutus frontalis*** **(Agassiz)**

BIGMOUTH SHINER ***Notropis dorsalis*** **(Agassiz)**

RED SHINER ***Notropis lutrensis*** **Baird and Girard**

BRASSY MINNOW ***Hybognathus hankinsoni*** **Hubbs**

BLUNTNOSE MINNOW ***Pimephales notatus*** **(Rafinesque)**

FATHEAD MINNOW ***Pimephales promelas*** **Rafinesque**


Maynard Reece

parting at its juncture with the line, ordinarily the weak spot in the terminal tackle.

By using a 10- or 15-foot leader it has been wrapped around the reel spool several times by the time the fish comes near the angler, thus eliminating the chance of the leader and line parting.

After attaching a small-sized swivel-snap to the leader you're ready for the gimmick—the lure that's to appeal to Mr. Big Mouth's fancy.

As a rule the black bass is not particular about his diet—he'll take anything from a fishworm to a shoehorn. Examining the contents of a big bass' stomach is an interesting study in itself. I've found it to contain all sorts of animal life from bugs to worms and small fish of all species. Occasionally he turns up with a small bird or snake. I've even discovered indigestible sticks of wood in those bottomless pits!

The fact that Blackie has such an unselective manner of feeding makes it difficult for me to use anything but artificial lures in tempting him from his lair. Lures, of course, fall in three classifications: surface or underwater plugs and spoons.

A black bass will take any or all of these types, but he's usually a sucker for a topwater tantalizer. And that brings out all of the swashbuckling, smashing, explosive pugnacity which puts him in the No. 1 spot with anglers.

It's for that reason that many fishermen, like myself, use a surface bait more than anything else. Anticipation of that slashing, splashing rise frequently causes a bass fisherman to continue using a topwater plug when he knows that a deep-running lure, under existing conditions, would take more fish.

There's quite a range of choice in surface baits, too, all proven fish-getters. Included are the injured minnow type with spinners fore and aft of the plug, the crawler type which imitates a swimming creature, the old reliable bass-oreno design, and the chugging plunker or popper.

I find myself using the latter much of the time because it seems possible to give it a more tantalizing effect. And in bass fishing the trick is to arouse the curiosity or ire of the fish even more than appealing to its appetite. A bass seems to strike most of the time out of pure cussedness.

A premium is placed on accuracy in bass fishing. It's seldom necessary to make long casts, but dropping that lure in the right spot pays off in more fish. Next to that, the most important thing in taking bass is fishing the lure slowly.

Shore line fishing generally is most productive. Not all bass inhabit that area, but many do. A big bass will select a stump, a rock, a pile of brush or clump of vegetation and make that his home. He'll defend that stronghold against all comers—including your lure if it's dropped in a challenging manner.

tiny cove.
In working a shore line, cast your plug just as close to its edge, or the object where you suspect Mr. Bass lies in wait, as you can. That's where accuracy in casting comes in. You may have to drop that lure between two lily pads or in a

If your plug goes wide of the mark, it may become tangled and you'll "spook" the fish in getting it free. At any rate you'll let the bass know that something is wrong.

You socn learn to "feel" that certain spots harbor bass. Don't try to hurry the fish. A bass will sometimes watch a plug for a long time before striking, just like a cat watching a mouse. So play your plug slowly.

It's usually wise to allow your plug to lie motionless on the water for some time, if you've dropped it in a likely-looking spot. I've seen bass come out and bang a plug a full minute after it hit the water. Every second that lure is on the water it's *working* for you.

We've all had the experience of getting a terrific strike while trying to untangle a backlash. Perhaps the bait has been lying there for minutes with only an occasional slight motion imparted by your jerking at the fouled reel. The same motions, deliberately given to your plug, will bring results.

It's an old joke that to start the bass striking, the fisherman needs only to stop and light up a cigarette after making a cast. But if you try it, be on the alert, for it happens as often as not.

In using the plunker or popper type plug, this "slow motion" is most essential. After the plug splats into the water let it lie until the ringlets of waves smooth out around it. Then barely bob the bait.

If that doesn't bring a strike, wait a few seconds, then "plunk" it moderately. After three or four such plunks and you have no success, you may as well retrieve the lure for a new cast. But watch closely for "follows" as you lift your bait from the water. A wily bass will often follow a bait to the edge of the boat without striking. If another cast still attracts his attention but he refuses to hit, make a quick change of lures—perhaps hooking on an underwater plug or spoon—and this "change of pace" often pays dividends.

Pay particular attention to little points of land in working a shore line. Cast to the other side of the point and retrieve your lure across it. This is a favorite haunt of fish as they lie in wait for victims to be washed or swim past.

When working a sunken treetop or log, never cast at right angles to it. Make the cast parallel. Retrieve your plug slowly and you can work the entire length of the log or tree at one cast. Hooks also are less likely to become fouled in the twigs.

After a downpour of rain seek out the inlets. The turbulent, discolored waters will be carrying worms, minnows, insects and certain terrestrial creatures that appeal to hungry bass.

Cast the lure into or across these tumbling waters and make it behave like something that is trying to escape to the shore. Drop the bait in the muddy water, then retrieve it toward the clear, quiet water, possibly taking it through an eddy. Strikes will come where the muddy and clear waters meet.

In lakes where there are great masses of weed beds you will find big bass lying in the edge of them just as they do along shore lines. Work them in the same manner, paying particular attention to small pockets and openings in the vegetation.

Other prime spots for bass are around stumps or the trunks of standing trees where bottomland has been submerged by changed water levels. We find a lot of this type of fishing along the Mississippi River since the advent of the locks and dams.

Lake Odessa, near Wapello, and other waters are typical of the above condition. It holds true in some of our artificial and "restored" lakes, also.

Speaking of the Mississippi River, one of the notable things about it is the change in predominant species since the pools were created. For the most part smallmouth bass, which once reigned supreme, have given over to their largemouth cousins. Mr. Big Mouth likes quiet waters such as those created by impoundments, and he's not averse to a certain amount of silt.

Perhaps I've placed too much emphasis on surface lures for largemouths, but before changing to deep runners don't overlook the pork chunk. Especially for reaching those hard-to-fish spots in vegetation.

I like the pork chunk, which comes already prepared in bottles, used on a Stanley hook with weed guard. Sometimes I add a "tail" of red yarn to the chunk for increased action.

Cast this into the lily pads or rushes and retrieve rather rapidly but jerkily, holding the rod tip high so the weight of the lines does not drag the bait under the surface. By skittering it over the top of vegetation you'll catch many a fish that can't be reached otherwise.

Another "sure-fire" lure for use in the weeds is a silver spoon with a single, fixed, weedless hook. Add to its appeal by slipping on a pork rind. Then slither it over the surface of the weeds and lily pads.

Pork rinds come in various shapes and sizes. I often trim or reshape the ones I use to get the ultimate in action with the lure I choose. The rinds are usually white, extremely pliable and when retrieved through the water produce an undulating, rippling motion.

These strips of pork rind ride close to the surface of the water, slipping over the tops of lily pads and thick weeds without entangling.

When casting into a jungle of reeds or rushes they slip and slide around them or climb right up a reed stem, then fall off with a soft "splat" just like some living creature falling into the water.

While we're on this subject of weed fishing don't overlook little pockets of open water back in a wilderness of vegetation. They frequently harbor black bass.

Now you can switch back to a plunker or popper bug. Let it float idly after the cast into the pocket, giving it an occasional twitch. And be prepared for a hard strike.

When you do hook a fish back in the weeds, hold your rod tip high and reel rapidly. Keep the fish near the surface, or right on the surface and skid him through the vegetation before he gets balled up in a mess of weeds.

Weed fishing can be mighty productive—often more so than the open water, but some anglers ignore it rather than to fight the entangling hazards.

One alternative to the above methods, of course, is using live bait and a long cane pole. Sometimes known as "dapping", you use a short line in this method, reaching out over the vegetation to an opening and dunking the live minnow or frog up and down in the water.

There's just one thing to do when you get a strike. That's to heave up the pole and lift the struggling fish into the boat as quickly as possible. Not much sport, but it puts meat on the platter.

While I've emphasized bait casting in this chapter the fly fisherman can use virtually the same methods. Chances are he'll hook even more bass, but many of them will be small.

Popping bugs and topwater lures usually pay the best dividends on big bass but there are times when streamers and bucktail-spinner combinations will take their share.

What has been said about bait casting can be applied to spinning, except that your lures will be smaller, of course. And one advantage of spinning is that you can use many of the fly and streamer combinations with deadly effect.

However, when you get into weeds with a spinning outfit you are definitely handicapped. It's impossible to "horse" a fish or entangle a lure through the vegetation—you've simply got to go to it and you'll mess up your fishing water doing it.

There are times when an undersurface lure proves to be most effective. During hot summer days the deep runner is more productive—except early morning and evening. It also brings a more ready response on windy days.

Here again the lure should not be retrieved too rapidly—a curse which most beginning anglers have trouble overcoming. It's not so much the number of casts that you're able to make as where and how you make them that counts in bass fishing.

Except during the hottest weather, most bass are caught in from one to 10 feet of water. That's probably what makes him so adaptable to Iowa waters, which generally are shallow and rather warm.

A nest-building species, the largemouths are prolific and the young grow fast—reaching a length of 8 inches or more in their first year. In combination with bluegills they have been found to fare excellently in Iowa farm ponds. The bluegills, themselves prolific, provide the food for the larger bass.

Farm ponds offer far better bass fishing than many of us realize, including the farmer. These ponds are given an initial stocking of fish, which frequently includes black bass, when the ponds are completed and are sometimes forgotten.

Perhaps the farm family will try fishing occasionally, hooking some bullheads or bluegills and then forget all about it.

One of two things generally is going on in one of these ponds. Either a few bass get enormously big preying on the smaller fish when they are unable to find suitable spawning grounds, or else the bass population grows tremendously and the waters are almost bursting with eager bass.

In any event scout around the countryside and ask your farmer friends for permission to fish their ponds. Few ponds are fished sufficiently to keep the population down to a compatible number.

Black bass get big in Iowa, too. Waldo Imus of Centerville has caught several from the Centerville city reservoir that weighed near 9 pounds. Green Bay bottoms used to produce 10-pounders. A 9¾-pound largemouth was taken from Lake Arrowhead, near Lake View, a few years ago, and Lake Manawa, near Council Bluffs, regularly turns out 8- and 9-pounders.

Eat black bass? Sure. If properly prepared they're excellent eating, even from warm waters. I skin all black bass, and if they're large enough I fillet them. That removes all objectionable flavors that sometimes are present.

That muddy or weedy taste that is sometimes found usually comes from tissues in or next to the skin. Skinning thus removes it. If you insist on scaling them, however, you may improve on their flavor by scraping the skin briskly with a sharp knife until the dark secretion is worked out of the skin tissue.

In fact, black bass were once considered tops by epicures. They brought fancy prices on the market, even above walleyes and other fish that now are favorites. It was with real wisdom that a federal law was enacted stopping all commercial sale of black bass.

May long live Blackie, the pirate of the piscatorial population. He asks no quarter, gives no quarter, and is always ready for a slugfest.

Angling for Pan Fish

E. T. Rose

Biologist

State Conservation Commission

The old saying that there is "nothing new under the sun" is particularly true in writing about angling for pan fish. Almost any issue of sporting magazines will carry an article about them, collectively or individually, and usually contain information on how to catch them. This version will stress the pan fishing in Iowa waters and include customary methods as well as some new approaches on angling for these popular little fishes.

Three types of fishes have been included in this pan fish group, the crappie, the bluegill, and the yellow perch. There are two species of crappies, the black and the white. The black crappie, often referred to as "calico bass", is the more abundant of the two species in most Iowa lakes. The bluegill is known universally as the bluegill, and there is little chance that he will be confused with his cousin the pumpkinseed sunfish or the green sunfish. Many of the boys along the Mississippi River, and especially south of the Iowa border, refer to the bluegill as the bream, or "brim". The yellow perch is perhaps less afflicted with regional names than any other popular fish.

Like fishing for any other species of fish you must, for success, attend to three cardinal principles: where, when and how. The following account is offered as a guide to these principles.

The Crappie

The crappie is Iowa's most abundant pan fish, and with the possible exception of the bullhead, it is the easiest fish to catch of all the 140 or so species in the state. For some unknown reason, we often find in our lake surveys, particularly in the southern Iowa reservoirs and artificial lakes, a super-abundance of crappies and at the same time local people demanding some fish be stocked in their lakes. I attribute this to one factor—people just won't learn how to fish for crappies, even though the lake is swarming full of them. I have seen many fishermen in the southern Iowa lakes sitting hour after hour fishing for bullheads (where there weren't any, or very few at least) who would gasp in amazement when shown the results of a few minutes' catch of crappies by a man who knew how. With very few exceptions these artificial lakes are teeming with crappies which need thinning out to prevent or cure stunting due to overpopulations. They are easy to catch, require no fancy tackle, and are one of the best in table qualities.

I have mentioned the southern Iowa lakes and reservoirs as one of the *wheres*, but to be a little more specific, I will mention a few by name that are productive and can stand all the angling pressure put on. These include: Lake Wapello, Lake Keomah, Lake Macbride, Red Haw Hill Lake, Lake Darling, Nine Eagles Lake, Lake Ahquabi, Springbrook Lake, and Lake Manawa. The location of these lakes is noted elsewhere in this book. These are just a few of the areas that come to mind as especially productive at this writing. The many city reservoirs throughout the southern half of Iowa almost invariably have too many crappies in them. My advice is, don't fish for bullheads in these lakes, for usually where high crappie populations exist, bullheads are seldom present in sufficient numbers to warrant wasting time on them. We do stock bullheads in some of these lakes simply because many local people won't fish for anything else, or won't learn to take the crappie.

The boys in the northern part of the state in the natural lake regions have been at this business of fishing for crappies a bit longer than the folks in the south. The natural lakes are as a rule less dominated by the crappie, due to several factors. Angling pressure is greater on them, and usually these lakes have higher populations of predatory types of fish such as the northern pike and the walleye, that tend to help control their abundance. However, many of these lakes provide the best crappie fishing both in quantity and quality, especially during their pre-spawning and fall concentrations. Particularly noted for excellent crappie fishing are the following lakes: East Okoboji, Spirit, Minnewashta, West Okoboji and Silver in Dickinson County, Clear in Cerro Gordo County, and Black Hawk in Sac County. Many more could be mentioned and, in addition, the many oxbow lakes along the Mississippi and Missouri and inland rivers. Many of the inland stream impoundment areas have excellent crappie fishing and should be investigated by the local anglers.

Concerning the *when* principle I can, of course, only generalize since conditions vary from lake to lake, and you must find the most productive seasons in your own locality. Since the crappie season is open continuously, you can usually find some period of the year that is more productive than others. As a rule, my choice of seasons is from around the first of May until June 15.

This is in the pre-spawning period during which heavy concentrations develop, particularly along small inlet areas and along abrupt banks with overhanging limbs of trees. During and after the spawning season, angling success usually drops off precipitously until late August. From this time on until around November 1, crappie fishing is usually very good. Winter fishing through the ice for crappies has not been attractive for the Iowa anglers. Of the 10,000 to 15,000 fish recorded in the creel censuses of the past five winters from West Okoboji Lake, the most ever reported was 161 crappies. Just why this condition prevails is not known, because in our neighbor state of Minnesota, crappies are the big item during the winter months. Perhaps it's because our fishermen prefer perch and walleye angling. There are a few winter fishermen who do take crappies consistently, though, by fishing in the dense beds of vegetation close to shore and using small minnows for bait. If the time and technique of fishing this species in Iowa are determined, the anglers in the southern part of the state are certain to have some excellent fishing.

Returning to the open water fishing and the best time of day for angling, we must consider the type of fishing being done before making general statements. For bait fishing, I consider the early morning period from about 6 a. m. to around 9 a. m. and the afternoon from 4 p. m to 6 p. m. as the best in the daytime. Again in the evening from dusk to 10 p. m. is especially good for the fly fisherman and those who fish under lights on the docks with minnows.

We must consider weather conditions in both bait and fly fishing. Don't try to catch crappies along lee shores during high winds. Fish the quiet waters of the windward shores. Wind is the most important weather factor to consider in crappie fishing. A little ripple on the surface won't adversely affect your success, but as a rule the quieter the water the better.

Now to consider the *how* principle. Crappies may be fished effectively in many ways. I will briefly summarize a few of the diversifications of the two principal methods, bait fishing and fly fishing. Since bait fishing is most widely depended upon we will consider this method first.

The most effective live bait for crappie is a small minnow (fathead or shiner) not over two inches in length. In still-fishing, the minnow is attached to the hook (size 8 or 10) by running the barb through the back just behind the dorsal fin. Be careful not to get the barb too low or you will sever the backbone and kill the minnow. Just hook them through the skin and the minnow will be very lively for a long time. The minnow is then suspended in the water from the bend of the hook in a lifelike fashion. When fishing from shore, it is best to wade out a little beyond knee depth. A long cane pole is satisfactory to get your bait out to a desired distance, although a casting rod is preferable. By all means use a bobber on the line or leader to regulate the distance from the surface to the depth the crappies are feeding. When they are actively feeding on the surface you can see them, so set your bobber about six inches above the hook and cast out to them. Maneuver your bait along very slowly toward shore and repeat as necessary. This type of fishing is most effective during the spring along the inlets and shores with overhanging boughs of trees. Always use a leader at least three feet long between the hook and the line. A two-pound test leader is ample for all crappie fishing and the lighter the less visible—and the more fish in the pan. Don't use a sinker for this type of fishing unless you have to get the bait down more than a couple of feet, and then just a small split shot about a foot above the hook. For this shallow water fishing quietness is mandatory. You can talk to your buddy, yourself, or the fish, but don't barge in like an amphibious jeep or permit your kids to throw rocks at the school of feeding crappies.

Most dyed-in-the-wool crappie fishermen who use bait, fish from a boat. The lone fisherman in his boat with a couple of long cane poles set at right angles to the boat like outriggers is the guy who takes the lion's share of the crappie. He slowly drifts along about 25 to 50 yards out from shore, around rocky areas, in front of docks, along edges of weed beds, and past overhanging boughs of trees. His bait will be about two or three feet below the bobber, weighted with a split shot or two. About ten feet of line is used from bobber to the pole. The rest of the line should be of leader material, as invisible as possible. You must be sure to move the boat very slowly, almost imperceptibly, in these likely areas. In still-fishing, once you have located a school of crappies, you must be very quiet; talk if you wish, but don't bang your tackle box around, stomp your big feet on loose bilge boards, or rattle around with loose oars. All fish are very sensitive to these vibrations, which are much more intense in the shallow water. Often while fishing for perch you will encounter a school of crappies in deep water—ten feet or more. Here you can use the same methods as for perch; however, you must stick to the small minnows for bait.

Care must be used in landing a crappie once he is hooked. In some regions they are known as "paper-mouths", which is a very descriptive term. Keep a tight line, or he will be off your hook right now, but don't "horse" them too much either, or the hook will tear out.

Trolling for crappies is fun and productive. Use the same tackle as before, but add a small spinner and hook your minnow as in walleye fishing—barb in mouth, out through gills, bring bend and shank through gills, then run the hook into the back behind the dorsal fin so that he will travel along headfirst. Troll slowly around the shores, particularly around rocky areas, rushes, brush piles, ends of docks, etc. Troll just fast enough to keep the spinner blade revolving or flashing. Use the bobber ordinarily about four feet ahead of the spinner for the trolling method.

Fly fishing for crappies is easier and requires less skill than bait fishing. When the crappies move in toward shore at dusk in the spring, the wader-clad anglers cautiously move out to about knee depth, and when they're in you can catch one on almost every cast. A beginner at fly fishing can learn the rudiments in about 15 minutes, and nobody knows all there is to be known about it. Here are just a few of the basic principles.

A pair of boots, or preferably waders, is a must, although you can, of course, use a boat; however, you won't be too popular around a bunch of fly fishermen standing shoulder to shoulder in these crappie concentration areas. So unless you like being a heel, keep your boat away from these boys. Almost any type of fly rod will do, but I prefer a fairly heavy bass action rod in order to lay out a long line if the occasion demands. A "bug-taper" or "torpedo-head" type line is excellent for this also. Keep the line well dressed with any of the advertised types to keep it floating. A water-logged line is an abomination. A single-action reel is preferred for most fly fishing, although this is mostly a personal item. Some favor the automatic and for good reasons. The main thing is to have a well-balanced outfit that you can cast easily, and you should rely on your tackle dealer, or a friend who really knows, in selecting your gear. You must have the ability to get the fly cast properly to the crappies, and the fly must be activated to simulate live bait or you will never be a successful fly fisherman. The fly is usually attached to about a six-foot tapered leader with no weight attached to the leader or line. Flies are tied on about a No. 8 to 10 hook in wet fly fishing. The wet fly simulates a minnow or an emerging insect and must be retrieved slowly, at best about six inches to a foot under the surface. Slow, jerky retrieves are most effective. I like to impart this jerky movement with the rod tip, although most anglers jerk their line by hand through the guides. The rod tip method is the more effective in creating lifelike movement to the fly. Dry flies are productive, usually in the quiet water at dusk. Here the trout tactics are in order and the sloppy caster is going home fishless. The dry fly, with its heavier, more abundant hackle well dressed with float dope, gives the angler the epitome of fishing. The fish are taken on the surface, and with the rod tip kept a little high, a good crappie will break the surface many times before you creel him. Small cork-bodied bugs or "poppers" are the next best for surface feeding crappies, but the purist will scoff at these monstrosities. Personally, I'll take the poppers and take more fish, too.

The printed page can hardly impart the rudiments of fly casting. Get a friend to show you. Use his advice on sizes and patterns of flies. Usually small feather or bucktail streamers are best for wet fly fishing. These should be tied sparsely in patterns of white, black, black and white, or yellow with a dash of red. Big bunchy flies are no good except for muskellunge. Patterns don't mean too much if you can get your fly to the feeding fish and activate it properly. Don't think that this fly rod fishing is not for you and that it's all too complicated. It is not fancy stuff—anybody can learn it in a short while, and these crappies are a whale of a lot of fun.

The Yellow Perch

This is one of Iowa's most highly esteemed fishes and in the minds of the epicure has no equal. A mess of perch from clear, cold water, fried to a golden brown, will surpass the lordly trout, pompano or red snapper for real eating in my cookbook. He is no great shakes as a battler, although on light tackle and given his head, a perch of a pound will cut some didos equal to that of a brown trout of equal weight.

Good perch fishing is limited in Iowa. The species is universally distributed over the state, but for the most part only northern Iowa lakes support heavy populations with sustained yields of good-sized fish. By far the best lakes to fish for perch are West Okoboji, East Okoboji and Spirit Lakes in Dickinson County. Little Swan and Silver lakes in Dickinson County also have fair perch populations and occasionally some good catches are made in them. But for the most of the best, the Okobojis and Spirit must in all fairness rank foremost. Other natural and artificial lakes have perch, but due to several factors incompletely known, they don't grow large, are infested with parasites and are a nuisance. The species is not adapted to streams anywhere except perhaps in flowage areas between lakes.

Since we must continue in the vein of generalities regarding the factor *when*, for the best seasons, times of day, and weather for any species of fish, I believe we can safely state that the fall season from August 15 until the lakes freeze over and again after freeze-up to the close of the season on February 15 are the best times of the year. Our creel census records bear this out, and of course the people around the lakes have known it for many years. The diurnal movement, as outlined for the walleye angling story, is most pronounced in the evening and especially on lakes having highly irregular shorelines. Consequently evening fishing from 4 p. m. to 6 p. m. I consider the best for shoal areas. For deep water fishing (10 to 60 feet) from daybreak to noon is about it. In winter, perch move into deeper waters about 6 p. m. as a rule and just prior to the inshore activity of the walleye. Perch don't bite at night.

The tackle, bait and methods of catching perch portion of this article if thoroughly expanded would require several pages in itself. We can only outline a few of the standard practices. Tackle may be a simple hand line suspended from the hand from boat or dock to an elaborate and costly fly rod outfit. In between are the standard long cane pole, the casting and spinning and jigging rods, all of which will take perch so long as the bait is presented at the right time and place.

The best bait for perch in my opinion for year-around fishing is the small minnow, a little larger than the typical crappie minnow. Determine the depth and keep your minnow about six inches to a foot off the bottom by a bobber. If the wind is blowing the least bit, your boat will swing with the wind and waves, so it is necessary to have two anchors, one for the bow and one off the stern to keep your bait in the right pocket among the weeds. A good perch fisherman will not stay long in one place if it is not productive. You must locate a school, and this generally involves trying several different types of habitat. Rock piles, reefs, points, weed beds along shore, stands of bulrushes and in deep water—all should be investigated before giving up. Minnows should be hooked as in still-fishing for crappies—lightly through the back. Many anglers, especially in the midsummer and early fall season, prefer crayfish meat for bait. This is obtained by splitting out the white meat from the tail portion of the animal. It's best to do this at home when you have more time. Get a few dozen crayfish, carefully peel out the meat, and freeze the baits in small paper cartons—saves a lot of time and handy, too. I have had good success when crayfish were scarce with small chunks of fresh shrimp, pieces of perch meat and perch eyes. Perch are notorious bait robbers and nibblers, so to avoid this use a very small bobber with just enough buoyancy to keep your bait off the bottom. They'll not fool you too often.

Fly fishing for perch during fall and early winter evenings is productive and is very similar to the previously mentioned crappie fishing, except that flies are a bit larger and generally a weighted fly or split shot is added to sink it rapidly. Small yellow or white bucktails are preferred, and the slow, jerky, animated retrieve of the fly is the secret. You won't find fly fishing for perch to be effective or productive every fall. During years of heavy hatches of bluegills or other forage types, the perch apparently do not have to scrounge for their feed. However, when forage is low, the large inshore movement of perch is very pronounced, especially on lakes with irregular shorelines. Usually about every third year or so, fly fishing is excellent, particularly in West and East Okoboji. I have often observed a huge school of large perch not ten feet from shore as they fed on young-of-the-year bluegills. This is one of their favorite diet items in the fall, and incidentally it is a good method of locating the schools of perch close to shore. If the baby bluegills are crowding right up onto the shoreline, you can be positively assured that a school of perch (or perhaps walleye) is in the vicinity. At these times you can catch your limit in no time.

When the weather really gets cold, just before freeze-up, and ice forms in the guides of the fly rod and numbs your fingers, there is still another good bet that will eliminate these discomforts. Use your spinning rod. The spinning line doesn't absorb water, so you can keep your gloves on and fish in perfect comfort while the fly rod boys freeze up and go home. Use small weighted flies and the plastic "bubble" if necessary to slow down the retrieve and keep the fly out of the bottom growths. You'll find that this business of good fishing is like good duck hunting—the more miserable the weather, the better success. Late fall angling for the perch and walleye is rough going; there's only one better time, and that's when it gets rougher—after freeze-up.

Fishing through the ice for perch is fun, fruitful and frustrating. When the perch are biting, you can catch a limit in just a few minutes. But when they aren't and you can sit in a shanty watching school after school of big, beautifully colored perch gliding through the crystal clear waters beneath without a second glance at your lure, you will know the meaning of frustration. After a few seasons of this, one gets used to this kind of abuse and just enjoys watching them.

As outlined for the walleye, fishing for perch in winter can be miserably cold or have all the comforts of a Fifth Avenue penthouse. Those who fish out in the open will catch more fish than the shanty men as a rule, but I'll take the difference in success for the comforts of a heated shanty.

There's little difference in angling methods in winter from those in open water. Minnows are the universally used bait, although corn borers, "golden grubs", caddis nymphs, and a variety of other natural organisms are used with varying success. When there is an abundance of young-of-the-year bluegills, minnows or other forage present in the lake, the use of artificial lures will be far better than natural baits. The jiggers of the tie-clasp variety as described for the walleye fishing are real killers for perch; however, they must be considerably smaller than the walleye lures. Rubber grubs, ice flies, pearl buttons, spinner blades, cranberries, and a host of other articles are used to entice the perch and sometimes with good results.

How many fish do the winter fishermen take from the lakes each winter, and has the extended season and take affected the population? This question is often asked by those who favor a short open season in summer while they are on vacation. The Biology Section's creel census records do not indicate any decline in population of perch, which is the big item in the winter fishing. Winter fishing has been permitted in Iowa since 1950, and census records have been taken to compare from year to year the angling success on West Okoboji and Spirit lakes, which are the major fishing lakes in this season. The catch records for West Okoboji range from 7,000 to 16,000 perch taken each winter since 1950 to 1955, and a gradual increase in the average catch per man-hour during this five-year period. Since the average catch per unit effort has increased and lake survey test seining records of the Biology Section show ample crops, it is indicated that winter fishing is merely harvesting a segment that would otherwise be lost by natural mortality. The records for Spirit Lake are similar, except that the increase in catch per unit effort has increased more rapidly each winter. The catch in the winter of 1952-53 was 7,000 and in the following winter 8,000, but in the winter of 1954-55 the catch increased to 16,000. The average catch per hour for these winters was as follows: 0.72, 1.02, and 1.19. If winter angling had been detrimental, these data would have doubtless been in the reverse order.

The Bluegill

For many Iowa anglers, the bluegill is the best in the business. From the small boy with the willow stick to the millionaire's fly rod, the bluegill is universally enjoyed as a scrapper and an epicure's delight. The bluegill is distributed all over Iowa, from the Mississippi to the Missouri and border to border. Backwaters, bayous, farm ponds, artificial and natural lakes all have their bluegills in abundance.

One of the delightful qualities of the bluegill is that when midsummer rolls around and fishing for many other species has dropped off, the bluegill puts on his feed bag and isn't too fussy what's in the bag. Angleworms, crickets, grasshoppers, dry flies, wet flies, and poppers all take bluegills in abundance when presented properly. Census records indicate that July and August are the best months in northern waters for taking bluegills. Evening is usually the best time of day, and from about 5 p. m. until just before dark. And like the crappie, quiet waters are best, especially for the fly fisherman.

Anyone can catch bluegills, and from almost any water except in streams. The weedy bays in lakes or river bayous with open areas along shore or pockets among the weed beds will produce bluegills in abundance. The old reliable angleworm takes the lion's share of bluegills from any lake or pond, and mostly by the women folks and kids. Use a bobber to keep the bait off the bottom about a foot or so. As usual, use a light leader and, since the species has a very small mouth, a small hook (No. 8-10).

Fly fishing for bluegills is hard to beat, especially dry fly or popper fishing. This requires as much skill as in trout fishing. Watch the surface for breaks of feeding bluegills among the open patches of the weed beds and flick the fly to this exact spot. Let it rest momentarily, then twitch the rod tip and you're in business. A half-pound to a pound bluegill taken on a light fly rod will test the skill of the best angler, for when they put their slab-sides into those tight spirals, it takes some doing to wear them down and keep your tackle all in one piece. In wet fly fishing, start out a little earlier in the day, say around 4 p. m. or earlier. Use small, sparsely tied, gaudy flies (red ibis, yellow sally, royal coachman, etc.) and allow them to sink into the pockets between weed beds. Slow, jerky retrieves from the bottom upward will do the business.

Ice fishing for bluegills has not been productive in Iowa except in a few areas such as the Mississippi River bayous, where they're taken by the thousands each winter. Some are caught in the lakes on corn and wood borers, and it is believed that a lot of good fishing is being passed up, especially in the artificial lakes and farm ponds. Don't pass them up, they're not nearly so dormant in the winter as we once believed.

Angling for Smallmouth Bass

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Fly Rod Equipment and Technique

The Iowa stream smallmouth black bass is a worthy adversary when taken on light tackle, and without question is one of our finest game fishes. This article is primarily for those who are unskilled in stream fishing for smallmouth. During the 1947, 1948 and 1949 seasons, the author and his fishing companions caught 710 smallmouths for which complete angling data were recorded. This experience is the basis for most of the following observations and recommendations.

We still believe that the fly rod is the most versatile weapon that can be used against the smallmouth. A wide variety of the natural foods of the smallmouth can be simulated with fly rod lures, and the light rod can be effectively used with the live bait. Wet flies, streamers, bucktails, etc., can be more effectively controlled and given more selective action with the fly rod than with makeshift bait casting or spin casting methods.

Since 1946, when postwar manufacture of fishing tackle was resumed, there has been a revolution in fly fishing equipment. Rods of glass fiber banded with plastic resins have all but replaced rods of split bamboo, which had predominated since the turn of the century. Steel fly rods have also gone. Bamboo rods are still available on a custom basis and at custom prices. The "glass" rod is made in many lengths, weights, grades and with several different methods of manufacture. For fly fishing only those rods tubular in construction with most of the fibers running longitudinally through the rod are light enough and stiff enough to do a decent job of fly casting.

As with rods of any material, care should be exercised in the selection of a fiber glass rod; the mere fact that it is "glass" does not mean that a rod will give satisfactory service.

The length of rod best suited to smallmouth fishing depends on the size and disposition of the angler, as well as the frequency of his fishing trips. Only powerful anglers who fish often can use the long powerful rods and the heavy lines that are necessary to bring out their action. A rod of 7 to 8 feet is far more satisfactory for most anglers. The author has used good glass fly rods in lengths from 5 feet 10 inches to 9 feet, and definitely prefers a rod of not over 7 feet 8 inches for fishing Iowa smallmouth waters.

Fly lines were the most unsatisfactory item of fly fishing equipment until the past few years. Even paying a premium price did not insure a good line. With the modern plastic finishes and floating qualities, the new lines are superior for most types of fly fishing (only for certain types of wet fly fishing is a sinking line desirable). These new lines cast, "lay out", and "shoot" well and are "unsinkable".

Lures on Which 686 Smallmouth Black Bass Were Caught in Small Iowa Streams, 1947-1949

Type of Lure	JUNE				JULY				AUGUST				SEPTEMBER			
	Number Caught	Catch per Hour	Aver. Size (In.)	Per Cent Legal	Number Caught	Catch per Hour	Aver. Size (In.)	Per Cent Legal	Number Caught	Catch per Hour	Aver. Size (In.)	Per Cent Legal	Number Caught	Catch per Hour	Aver. Size (In.)	Per Cent Legal
Live Bait	1	0.10	10.2	100	12	0.38	8.5	33	21	0.68	11.1	67	38	0.90	9.6	27
Wet Fly	16	0.99	9.3	38	30	0.83	9.7	53	12	1.14	9.4	33	1	0.19	9.8	0
Cork Floater	......	......	......	......	6	0.67	10.0	50	6	1.28	10.1	33	0	0.00	......	......
Hair Floater	2	0.50	11.0	100	32	2.46	11.0	78	64	1.61	10.4	45	24	2.20	10.2	46
Feather Streamer	17	0.85	10.2	47	34	1.09	10.6	68	166	1.54	9.5	37	19	2.04	9.8	37
Bucktail	1	0.50	14.6	100	12	0.85	11.0	92	2	1.54	10.1	50	......	......	......	......
Spinner & Streamer	21	0.74	10.0	48	2	0.17	11.1	100	2	0.22	9.6	50	0	0.00	......	......
Spinner & Bucktail	7	0.57	9.7	43	39	0.67	9.6	33	6	0.64	8.5	0	4	0.62	9.7	25
Spinner & Wet Fly	17	1.18	10.5	47	16	0.41	9.3	44	17	0.57	9.2	47	24	1.11	9.2	50
Spoon	0	0.0	......	......	4	0.77	11.8	100	2	0.45	11.8	100	......	......	......	......
Plug	2	0.87	13.0	100	2	0.33	13.1	100	5	1.85	12.8	100	0	0.00	......	......
Totals (All lures)	84	0.77	10.2	50	189	0.74	10.2	58	303	1.20	9.8	42	110	1.10	9.7	38

The fly reel is merely a rack for holding the line and plays no part in casting. The type of reel for fly fishing is a matter of personal preference and is the one item where the angler can get satisfactory service at a low cost. An "automatic" fly reel is too heavy to be used with a light stream outfit, but comes in handy to balance a heavy bass bug outfit. An automatic reel is particularly handy when fishing from a boat to prevent excess line from becoming entangled in oarlocks, tackle box, etc.; excess line can be wound on reel as it is retrieved.

The basic rules of the fly casting can be learned in 15 minutes by most anglers, and from there it's a matter of practice in short sessions to become proficient with the gear. Over 90 per cent of the trouble encountered with fly casting gear is caused by ignoring these basic principles and by using a line too light to properly develop the action of the fly rod. When a spinner casts better than a fly, the line being used is too light!

While silkworm gut is still preferred by many successful anglers, particularly for dry flies, nylon or nylon derivatives have replaced other leader substances for most fishermen. In smallmouth fishing, leaders play a more important role than most fishermen realize. It is frequently necessary to resort to long leaders in clear water in order to catch fish. Most packages of leader material show diagrams of proper knots for joining strands of different size to form tapered leaders. Tapered leaders will "lay out" better on casts and present the fly more accurately than level leaders. To cast well, tapered leaders should be made from various lengths of nylon monofilament. The heaviest section should be the longest, and each succeeding section should be of smaller diameter and shorter in length. Experiences of friends of ours, as well as our own experience, have shown that in very clear water a leader 10 to 12 feet long tapered to about 2-pound test will take smallmouth when shorter or heavier leaders frighten the fish.

Small snaps or split rings should be used with fly rod plugs and spoons. This will enable a livelier action and prevent the leader from wearing where it is tied to the lure.

Any lure or bait will take smallmouth if presented to the right fish at the proper time, but some lures are better than others under a certain set of conditions. One fisherman may have confidence in a lure or group of lures and use them with success, while another angler has a different group of "successful lures". Each angler has learned where and when to use his favorite to catch fish. In the accompanying table, the lures used to catch 686 smallmouth black bass during the 1947, 1948 and 1949 seasons are listed.

In June for all three years combined, wet flies and spinner and wet fly combinations took about one fish per man-hour of angling, but the spinner and fly combinations took larger fish and a greater percentage were of legal length. Plugs and feather streamers were also fairly productive in June. Plugs took larger fish than the other lures. During July floating hair lures, chiefly the hair frogs, were very effective, averaging almost 2½ smallmouths per man-hour of fishing. These fish averaged an inch over the legal limit of 10 inches. Feather streamers were also very effective in July. The spinner and fly combinations were not as effective as other lures in July. For August all artificial lures except spoons and spinner combinations caught over one fish per hour. Live baits, spoons and plugs took a higher percentage of legal fish. The fishing during September was confined to the first half of the month in all three seasons. Hair floaters were the most effective lures during this period. Fishing with live bait was better during this period than in the other months.

There was a marked trend in the depth in which smallmouth took lures in all three seasons. At the beginning of each season they took sunken lures almost exclusively, and usually the lure had to be well down toward bottom. Beginning about mid-July in each season, floating lures became very effective. Although the largemouth black bass has acquired a reputation for smashing surface lures, many fishermen believe that his smallmouthed cousin will seldom strike at the surface. On the contrary, 30 percent of the 710 smallmouth taken by angling struck at the surface. This figure does not include many fish that "broke water" when they took lures near the surface. Hair floaters, cork floaters, and feather streamers fished "dry" were very effective during the hottest part of each season. Again in late summer a preference for sunken lures was evidenced, although larger bass continued to use the floaters well into September. Live bait, spinner and fly combinations, plugs and spoons became effective during the last week in August. The best period for fishing with flies and bugs was from mid-July to mid-August in all three seasons.

When the season opened (June 1) there was a period of about two weeks when smallmouth readily took lures. During this time the smallmouths were actively feeding following their spawning period. Many adult males seemed to retain their nest-defending trait and struck lures retrieved close to them. Smallmouth were least susceptible to angling between mid-June and mid-July following the spawning and post spawning dispersals. By July 15, in all three years, low water levels and the extreme clarity of the water seemed to induce the adult smallmouth to concentrate in the larger and deeper pools. Schooling was first observed in mid-July in all three years. Smallmouth schooled as a species and with three other species of fishes, namely, quillback, river carpsucker, and white sucker. Large bass tended to school with the larger suckers. Smallmouth showed little fear when schooled and often allowed anglers to wade within 20 feet of the schools. They were highly susceptible to angling when schooled.

In all instances where concentrations of smallmouth were under observation, the majority of the individuals present showed no reaction or a negative reaction to lures, even when a wide variety of colors and types of lures as well as live baits were used. Angling success usually depended upon appealing to the individual smallmouth. Of 128 periods of angling, 119 produced more than one smallmouth. Smallmouth were taken on a single lure or bait during only eight of the 119 trips producing more than one fish!

When fishing along a bass stream, stay as far from the spot being fished as your casting range will allow, unless there are bushes or vertical banks to conceal your movements. White clothing should not be worn along the bass streams. Dress in darker neutral colors. All movements should be slow and deliberate. When possible fish from the shade or a spot where your shadow does not fall upon the water. In a fast current most fish will head upstream and, therefore, if you approach each pool against the current, you are less likely to be seen by the fish. Each pool should be approached with caution, and a few minutes of watching the pool will often pay off. A rising fish is usually a feeding fish, and a cast to a rise will often end with the bass wrapped in cornmeal.

One of the most productive spots for fishing is the head of the pool where the current enters. Cast into the fast water and let the current move your bait or lure through the pool. Submerged boulders, logs and stumps and undercut earth banks are also spots likely to harbor smallmouth. Every part of the first few pools fished should be covered thoroughly. If you see that the bass are in one particular location in each pool, such as in the riffle in the tail of the pool, then time and energy may be saved by fishing only the tail of the succeeding pools. When one fish has been taken, try the same location with several lures. The author once caught nine smallmouth from one location on eight different lures. Try fishing a good pool with several lures from different fishing locations, and if smallmouth aren't striking move along the stream. Occasionally fish are caught in only one or two pools in a mile of stream in an entire day.

Bait fishing for stream smallmouth may be successful with a casting rod or a cane pole, but the baits may be more accurately and naturally presented with a fly rod or spinning rod. If weight is needed to sink the bait to the level of the feeding fish, the sinker should be as light as possible. When using a bobber, use a small one weighted until it barely floats to reduce the drag when the fish takes the bait.

Use baits normally found in the stream being fished. Minnows, hellgrammites, crayfish, frogs, angleworms and grasshoppers can frequently be caught in or along the stream being fished and make the best live baits. Worms, hellgrammites and crayfish are normally found on the bottom and therefore should be fished deep. Minnows may be fished at any depth and are probably best adapted to bobber fishing. They also can be cast and retrieved in combination with a spinner.

Ordinarily when a bass seizes a bait, it will run a short distance, stop and turn the bait for swallowing, and then start a second run. After this second run has started, allow the line to become taut, then strike to set the hook. Sometimes a bass will take a bait and remain motionless. When this occurs cautiously tighten the line, and when there is a steady pull on the line, set the hook. Occasionally a smallmouth will take a bait with a terrific rush and move away so swiftly that it is almost impossible to feed line fast enough to prevent drag. Many such strikes are missed with any method of hooking. The best policy is to hang onto your rod and let the fish hook itself. A fish should be struck to set the hook only when the line is taut, and the strike should not be gentle. The mouth of a bass is bony and tough, and it takes a sharp, hard yank to overcome the friction and stretch the line and drive the hook barb home. Rear back and don't spare the rod!

The hook should be set immediately after the smallmouth has seized an artificial lure. This is difficult to learn, but you will not catch many bass until you have learned to strike hard and quickly when a fish takes the lure. After a fish has been hooked, let the rod do the work of tiring it, apply just enough pressure to keep it from reaching tree roots, rocks or other obstacles. When a fish strikes near a stump or submerged treetop, it can usually be stampeded away from its lair if it is "horsed" away immediately after striking. When a bass is hooked on a light fly and rushes toward the surface to jump, lower the rod tip so that the fly will not pull out. When fishing with plug or spoon, or even a spinner and fly, the line should be kept taut during jumps to prevent the smallmouth from throwing the lure while in the air. And the smallmouth will jump. Of 710 smallmouth taken by angling, 372 or 52 per cent, jumped completely from the water at least once. Many of them were "repeaters", and two acrobats jumped from the water six times during their struggle.

Do not attempt to land a smallmouth until it is tired enough to swim on its side. While playing a fish, possible landing sites should be located. Select a gently sloping bank or sand bar and head your fish toward it. When it is tired and its runs become short, lead the smallmouth toward the bar, keeping its head high. If it doesn't turn to run again, slide it quickly up on the bank. If the fish is tired enough to swim on his side, any effort on the part of the fish will help the beaching process. The best method of landing a fish is with a properly constructed landing net. The section of the hoop opposite the handle should be flattened so that it may be placed along the bottom for landing a fish in shallow water. Sink the net in the water and lead the tired fish into the net headfirst. The net should be inclined so that the fish is well over the bottom rim of the net before the leader touches the top of the net hoop.

Spinner and fly combinations are effective in early and late season fishing and during periods when the water is slightly turbid. Since the smallmouth feeds chiefly by sight, spinner and fly combinations are taken eagerly as the water begins to clear after the water has been muddy for some time. In fast water the willow leaf type is best. It spins in fast water and produces less drag during the retrieve than the broader bladed types. In deep, quiet water the Indiana spinner or other broad blade types are more satisfactory. They can be fished deeper because they spin readily with a slow retrieve.

PLATE 16

AMERICAN EEL *Anguilla rostrata (LeSueur)*

BURBOT *Lota lota* **(Linnaeus)**

AMERICAN BROOK LAMPREY *Lampetra lamottei* **(LeSueur)**


Maynard Reece

Popping bugs and other floating lures are effective in clear water, particularly along rocky shores, and along vertical banks in late afternoon and evening. Surface lures should be retrieved slowly with just an occasional twitch of the line. Usually the slower the retrieve the better they produce. Most strikes come when the floater is motionless on the water. Where the bank is undercut by a swift current, floating lures will bring strikes when cast close to shore and allowed to drift with the current. This technique took several good bass in midday. Repeated casts around stumps, rocks or logs often pay off. In our fishing more large bass were taken on the hair frog than on all other lures and baits combined.

When fishing with the wet fly, best results were obtained by allowing the lure to settle to the bottom and then slowly retrieving the lure with a twitching motion of the rod. Don't discard old bedraggled wet flies, for they usually resemble the insects you are trying to imitate more than the new ones. Lightly dressed streamer flies and bucktails that simulate minnows should be retrieved rather fast with a jerky motion. If a smallmouth starts to follow such a lure, don't yield to the temptation to slow the retrieve. The fish will discover that the lure is a fraud and refuse to strike. The speed of the retrieve should be increased if the smallmouth doesn't strike immediately. He's usually a sucker for the next cast in the same vicinity.

The heavily-dressed hackled streamers that are so effective in midsummer should be fished on or near the surface. These flies seem to imitate nothing that swims, flies or crawls, but are killers during the summer and early fall when the water is low and clear. We experimented widely with colors for these streamers during our fishing. Solid color streamers in brown, black, yellow, white, red, orange, green, and blue and two-color combinations of these colors all caught smallmouth. In addition, all the three-color combinations tried took fish. Brown and white were the most consistent streamers of one color, but other colors often took a number of smallmouth during a fishing trip. In general, brown streamers were very effective in clear, quiet water when the sky was clear and the light intense. Brighter colors were effective in faster broken water and when the sky was overcast or the surface disturbed by wind. Tri-colored streamers, of green, red, and yellow (or orange) occasionally took smallmouth in the riffles at the heads and tails of pools when other combinations failed. The bi-color combinations of red and white, black and white, and red and yellow were the most successful of the 28 tried. To insure success with the heavily-dressed hackled streamers, a variety of colors should be used.

Spinning Equipment and Technique

Although spinning has been widely practiced in Europe since the beginning of the century, spinning gear has become popular in this country only during the past decade. Spinning will never replace fly or bait casting, but aptly fills the gap between these two time-proven methods of angling. Light spinning gear can be used to cast "fly rod" plugs and other lures that overwork the fly rod, and can be used to effectively cast spoons, weighted spinners, weighted streamers and plugs that are too light to be cast with ordinary bait casting gear.

So many different kinds of spinning rods are now offered, it is difficult to select one. The type of rod chosen should be determined by the type of fishing the individual prefers. For fishing with plugs and spoons, bait fishing with sinkers, etc., a heavier action rod of 7 feet or longer is needed. The author, however, considers this type of fishing to be merely bait casting with the "backlash" removed. One of the chief fish-catching advantages of spinning gear over bait casting gear on small waters is the use of fine, invisible lines and small lures that don't blast all of the water out of the river. We have used spinning rods of various materials, from 5½ feet to over 9 feet in length.

For smallmouth fishing with spinning lures, a hollow glass rod of 6 feet to 7 feet 8 inches is our choice. The correct action is described as light-stiff, light enough to cast 1/8- to 1/16-ounce lure with light monofilament, but with plenty of backbone to endure battles with the occasional big fish that is hooked. With a rod of this type, landing a good fish is a long remembered event rather than just another fish on the stringer.

The picture is even more confusing when it comes to selecting a spinning reel. There are hundreds of different designs; some are mere gadgets, some too cheaply constructed to last if used often; some will give satisfactory service, but only a few are really sound in design and well-constructed.

A good spinning reel should be simple in construction and well-made of light but durable materials, so constructed that spools of different diameter line may be readily changed in the field. Only the occasional fisherman should need an automatic pick-up on a spinning reel. A reel with a manual pick-up is easy to learn to use and teaches line and lure control, which are so important to fishing success. After learning to use a manual pick-up, it is simpler to use than the automatic and much more durable. Most of the mechanical failures of spinning reels are caused by wear or breakage of the automatic pick-up.

The action of the spinning rod determines the weight of lures that can be cast, but by using small diameter, soft or limp monofilament, lighter lures can be cast than with heavier lines.

For smallmouth fishing the author believes that small diameter, mist-colored, platyl monofilament is superior to all other lines. The heaviest used with his light rod has a minimum test of 3.8 pounds and is very flexible. This line casts beautifully with lures down to 1/8 or 1/10 of an ounce. For casting hair bugs, fly rod plugs and spoons, and spinner and fly combinations (without additional weight), 1.9-pound minimum test platyl line is used. This light line will not last as long as heavier line, but will catch many more fish than heavier lines. You will lose some big fish in brush and snags, but in the end you land more good fish because these light lines won't scare them like the heavier ones will. Hooks on all lures and for bait fishing with these light lines should be kept needle sharp. Light wire, perfect bend, or Aberdeen style hooks should be used for bait fishing with light lines. They will penetrate readily when set by light rods and lines.

During the past few years many baits, plugs, spoons, etc., have been manufactured in spinning sizes. The author's experience has been that most of these are ¼-ounce and are not as successful as smaller lures for smallmouth, particularly in our smaller streams. Often it has been necessary to use 1.9-pound test monofilament and small fly rod size plugs in order to catch fish when the water is very clear.

Several types of lures should be included in the kit for smallmouth fishing. Plugs should include deep running, shallow running, and surface types in two or three contrasting colors. Small metal wobblers and spinners with bucktail or fly attached are also effective.

Start with a minimum of lures and add to your collection with those lures that prove to be fishgetters for your friends.

Spinning is effortless if your outfit, rod, reel and line, are matched. The bait is tossed with little effort, and long casts are possible even with light lures. To prevent a splash when casting, overcast your target slightly, and then by using the forefinger of your casting hand, slow or catch the line. This will take the slack out of the line, stop the forward progress of the lure, and it will fall noiselessly into the water. This can be mastered with little practice and prevents slack line as your lure strikes the water. Many fish are missed when they hit as the lure enters the water, unless this line control is learned. With a reel with manual pick-up, the line is picked off the forefinger by starting to turn the reel handle. With an automatic pick-up, the retrieve should be started while the lure is still in the air. If you wait until the lure enters the water, it will be necessary to step back or raise the rod to tighten the line so that the pick-up will engage the line.

Spinning gear with light line is the best for fishing live bait. The bait may be cast and drifted naturally through feeding stations of the smallmouth.

Minnows can be used with or without a bobber. For bobber fishing a minnow hooked behind the dorsal fin above the backbone lives well and provides lots of action. For fishing on or near bottom, a minnow two or three inches long can be kept near bottom with a split BB if hooked through both eyes.

For added attraction when fishing is slow, hook a minnow behind the dorsal fin and place a split shot 18 to 24 inches above the hook. The minnow will constantly struggle toward the surface and as it tires will be drawn down by the shot. This up and down action is deadly when other methods of fishing minnows fail.

Hard crayfish should be prepared for use by removing the large pinchers and the pinchers on the first two pairs of walking legs. Usually the "crawdads" 1½ to 3 inches long are taken more readily than larger crayfish. Pond crayfish that contrast to the stream bottom in color are more successful as bait. Hard crayfish should be hooked in the last tail segment or between the last two with a small hook (size 6 to 2), depending on the size of the "crawdad". The hook should be of fine wire and with a sharp needle point. The crayfish should be hooked from inside the tail out, so that the point and barb of the hook are through the back shell of the tail. Crayfish prepared in this manner and hooked as described are as effective as "softshells" as bait. Removing the pinchers prevents the crayfish from crawling under rocks and debris where the fish can't find it. When hooked as above, the fine wire hook readily pulls out of the bait and hooks the fish.

Nightcrawlers are probably one of the most effective baits for smallmouth, particularly early in the season and again in the fall. For smallmouth one or two "crawlers" should be hooked through the clitellum or band with the ends dangling. It is best to fish "crawlers" without additional weight, allowing them to drift with the current. It may be necessary to use split shot in swift water to keep the bait down at the feeding level of the fish.

Grasshoppers and hellgrammites are also excellent baits and should be fished with a natural drift downstream. Both should be hooked under the collar or prothorax immediately behind the head.

With minnows, crayfish and frogs it is necessary to wait out your striking smallmouth as described earlier under fly rod technique, but with crawlers, hellgrammites or grasshoppers, a pause of three counts, or three seconds, is sufficient wait before setting the hook.

The same fishy haunts that are reached by the fly rod may be fished with spinning rod, and in addition the larger and deeper pools can be more effectively covered. We believe that the fly rod will more consistently take smallmouth, but the spinning rod will often take as many and, occasionally, larger fish than the fly rod. Realizing that many fishermen cannot afford rods for each type of fishing, the author has extensively experimented with "combination rods". We have used hollow glass rods of good quality between 5 feet 10 inches and 9 feet in length for both fly casting and spinning, with good success. We believe that a light action spinning rod of 7 feet in length or a fly rod of 7 to 7 feet 8 inches in length makes an excellent rod for spinning or fly casting. Spinning guides may be added to a fly rod for conversion to spinning, and they will also aid in shooting a line while fly casting. Two pieces of adhesive or electrician's tape 8 to 10 inches long will secure either reel in the proper position.

All the necessary equipment, spare reel, fly box, lure box, leaders, hooks, and incidental gear can be carried in a small kit or in the pockets. It adds to one's fishing enjoyment and to his catch to have two productive fishing techniques available instead of one.

If our experience has taught us anything, it is that smallmouth do not follow rules. The comments and procedures outlined here are merely a starting point. Remember that any fishing habit is a bad habit. Conditions are never exactly the same any two times you go fishing. Try to retain the beginner's spirit, that is, a willingness to experiment with different lures, live baits and methods of fishing them. Treat the smallmouth as an individual and he will give you a treat.

Carp Fishing in Iowa Streams

By Jack Musgrove
Museum Director
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Words alone have seldom convinced a sportsman that the carp has merit as a sport fish. Not until they have given carp fishing a try and have tangled with this champion of tackle-busters do fishermen realize what sport they have been neglecting and become confirmed carp fishermen. It doesn't take long to find out what a carp lacks in beauty he makes up in sheer bull strength. He isn't the dainty cultured type of battler most of our game fish are, but a two-fisted back alley rowdy who never heard of the Marquis of Queensberry.

With the advance of agriculture and the accompanying siltation of our streams, the carp has found a perfect habitat in practically all parts of the state. No lake or stream is safe from this immigrant, and there is no denying the damage he has done in crowding out more desirable species. The carp is here to stay, however. Many of the streams that support carp are no longer suitable habitat for large numbers of the game species and can probably never be wholly reclaimed. This often means there is little choice—it is carp or nothing at all.

Carp fishing, moreover, can be as sporty as the finest game fishing. Once we make up our minds to enjoy what is available, we can match wits with this fish which is ever ready and willing to do battle and to slug it out to the very end.

The carp is no respecter of people or tackle. Probably more good fishing equipment has been broken by carp than by any other fish in our state. Rods used for carp range from willow poles, calcutta and bamboo rods, and casting rods on down to billiard cues, and, for the adventurous soul who really wants to give the fish all the advantage, up to fly rods. Carp as a rule run heavier than other fish and large size is not at all uncommon. The choice of the line and rod makes little difference to the carp. Long rods, commonly called river rods, do reduce the number of snagged lines and give the fisherman added control of the line—a necessity in carp fishing. While one rod is ample, there are fishermen who use two rods, and when two well baited rods are in use, there are times when the carp fisherman will find himself to be a very busy boy.

The carp is a wary customer, and for best results noise and movements on the bank should be avoided. Also, one must bear in mind that a carp in feeding is apt to pass up any bait which offers resistance when he tries to suck it up off the bottom, and he will often discard a baited hook as soon as he feels the weight of the sinker. This difficulty is easily overcome by using cone- or oval-shaped sinkers ranging from ¼ to ½ ounce in weight. These sinkers have a hole through the center through which the line slides freely. The sinker is kept from running down the line to the hook by tying a small piece of match stick or toothpick about 12 to 18 inches above the hook. With this rig the bait is free and the fish can pick up the bait and move with it without feeling the weight; also the fisherman is able to feel every touch of the fish as it is telegraphed to him through the line. In fast water, especially when fishing from bridges, some fishermen prefer a flat sinker cast in a teaspoon, with a hole drilled in one end. This is attached with a short length of light string to the end of the fishing line. This allows the bait to float free in the water. When the sinker is snagged, the string holding it is easily broken with no risk of breaking the line.

For his size, the carp has a rather small tender mouth. Best results are obtained by using small hooks No. 1 to No. 4, kept very sharp. Few carp fishermen recommend the use of treble hooks.

While most carp fishermen tie the hook directly to the line, some prefer to use gut or nylon leaders. Leaders are probably an advantage only when heavy lines are used, but if you use a leader, bear in mind that the quarry you seek is not a dainty trout. Use one strong enough to hold a real fish with fighting capabilities.

A wide variety of baits is suitable for fishing for carp. Most are readily available, the old standby being the doughball. Each fisherman has his own special recipe, but all are basically a dough made of yellow or white corn meal and cooked to a doughy consistency. Many forms of doughball have the disadvantage of being soft and washing away readily in the water. A favorite recipe used by many, one that will stay on the hook and can be cast into the swiftest water without difficulty, yet is soft enough to allow the hook to be set, consists of equal parts of yellow corn meal and white flour mixed together, plus enough water to give the mixture the consistency of biscuit dough. It is dropped into boiling water a spoonful at a time, much as in making dumplings, and allowed to cook for about five minutes or until it is cooked through. It can be tested by removing a good-sized lump and breaking it open; when the doughball is yellow clear through it is done and can be removed from the boiling water to cool. As soon as it can be handled, all the lumps of dough are kneaded together into a large ball from which individual baits are pinched as required.

Another favorite carp bait is the one recommended by veteran carp fisherman Art Williams, which for several years was marketed under the trade name of "Tacklesmasher", but because carp fishing is so much fun, he passed the recipe on free: 1½ cups Quaker yellow corn meal, 2 heaping tablespoons Quick Quaker oats, 1 level tablespoon sugar, 1 cup cold water. Stir water, sugar and oatmeal together, then add two-thirds of the corn meal and stir in. Place over a medium to hot fire and stir constantly for 5 to 7 minutes until the dough is worked into a stiff ball. Remove the pan from the fire, sift the rest of the corn meal into the cooked dough and work it well into the mixture. Place the resulting dry dough on a paper and thoroughly knead. Before wrapping the dough in paper for a fishing trip, allow it to cool as dough baits will sweat and soften if wrapped while warm.

While not as satisfactory as either of the above, but one that can be used in a hurry-up or emergency trip, is fresh bread with a little moisture added and then kneaded into a heavy dough.

Some fishermen have excellent luck by adding a small portion of salt, which will occasionally tempt carp when ordinary doughball fails. Others add vanilla, sugar, molasses, cinnamon, anise oil, etc., each to his own ideas as to just what carp prefer. As an all-around bait for carp, there is no doubt that a bait prepared in this manner will generally serve the purpose. In using any dough bait, best results can be expected when the bait is freshly prepared, and it is recommended that a new batch be prepared for each day's fishing. Stale bait does not stay on the hook nearly as well as fresh.

Other baits that are acceptable and often excellent are angleworms, the peeled tails of crayfish, chunks of green algae, sweet corn, either fresh or canned, boiled potatoes, marshmallows, and in many localities ripe mulberries.

Generally small baits are considered the best for carp. Some prefer a small, round ball of bait placed on the tip of the hook only; others use a pear-shaped bait covering the whole hook. Both methods give excellent results.

There are even occasions when carp can be taken by fly fishing. These are the times when the carp are feeding on small animal life that is floating on or near the surface of the water, and they will often strike or suck in a small white or light colored dry fly.

One advantage the carp fisherman has over all other fishermen is that he can find his sport on almost any stream, even in our largest cities. Wherever there is water adequate to support fish life of any size, there will be carp fishing. Below the dams on our rivers carp congregate in immense numbers, but they also are to be found in the still, quiet waters above the dams, where they often reach immense size. In general, anywhere on a river where other fishing is to be expected, carp will also be found. Deep holes and driftwood piles will produce good catches day after day, their supply of carp seemingly unlimited. In ponds and lakes carp reach tremendous size, but are much more difficult to catch than in streams. At times carp can be induced to bite by the method known as "chumming". Small quantities of bait are tossed into the water periodically to encourage the fish to feed more freely.

Excellent fishing may be had all through the day when the weather is cool, but, during the heat of summer, early morning and evening produce the best catches. Generally carp fishing is considered best during the months of May, June and July, with the fishing falling off only during times of high water. Carp bite best when the water is fairly clear and the weather not too warm, but good catches can be made all through the fishing season, even in early winter.

During the early spring, excellent carp fishing can often be found in creeks and smaller streams using angleworms for bait. As in other forms of carp fishing, best results will be achieved by fishing on the bottom, around snags, overhanging roots, driftwood piles and deep holes. Often a mixed bag of redhorse, suckers, chubs and carp are the result of such effort, but they are all a lot of fun. Fish from these streams in the early spring are always of excellent flavor when properly prepared.

The carp takes the bait from the bottom, sucking it up, generally giving one or two preliminary tugs on the line, then taking off with a vicious run that will make the reel handles hum. This run is generally short, and the hook must be set during this period when the fish has the bait well in his mouth. Those accustomed to this type of fishing generally regard the preliminary tugs as a warning and wait until the fish starts his run to set the hook. A carp's mouth, though fleshy, is tender, and great care is necessary—not only in setting the hook at the proper time, but in handling the carp once he is hooked. There are few fish that can shake a hook more readily than a carp. Great care must be exercised in landing carp when the fish is large, and it is well to play the catch until it is exhausted. The use of a landing net is a smart practice for the carp fisherman.

A carp has a lot of tricks that other fish never heard of. Sometimes he will head for the nearest snag, but perhaps instead of running directly away, he may try to secure the necessary slack line by making a quick dash directly at the fisherman. Once a carp finds he is hooked, he doesn't give up easily and can never be counted on as whipped until he is on the stringer. Probably more carp are lost just as the fisherman is about to remove them from the water than any other fish; he seems to have an uncanny ability to shake the hook at the very last opportunity. Pound for pound, I don't believe there is a game fish alive that can put up any more battle than the carp.

The carp is not only an excellent sport fish, but when properly prepared for the table can be superior to many species thought more desirable. Carp are often cast aside and wasted by those who have not learned the value of this species as a food fish. Granted, if the carp is prepared as are most game fish, it is apt to be bony and strong flavored. This is easily remedied by investing only slightly more work than required in dressing game fish, and then the fisherman can enjoy carp without the hindrance of either bones or strong flavor. Like other fish, carp that are to be used for food should not be allowed to die on the stringer, as the flesh will soften and will not be nearly as good as when the fish are kept alive or are killed as soon as caught.

Carp two or three pounds in weight are best fried. They are prepared by skinning the fish and filleting it, removing a fillet from each side so as to eliminate the backbone and fins. The dark meat of the sides of these fillets is then removed with a sharp knife by making a shallow V-shaped cut and removing in one strip the dark flesh along the median line. This dark flesh is one of the finest of catfish baits, and if you are contemplating another fishing trip in the next few days, save it and give it a try. The fillets are then scored crosswise with a sharp knife, using strokes that go almost through, spaced from 1/8 to 1/4 inch apart. The pieces are then rolled in flour or corn meal. However, pancake flour is preferred. French-fried in smoking hot deep fat, they produce fried fish worthy of any man's table. In this process the small bones are cooked up, and aside from the large rib bones, none should be left if the scoring job was properly handled.

Large carp can be filleted or fleeced and baked or broiled as are other species, but in any method of preparation the dark flesh along the sides should be removed, as any strong or muddy flavor is apt to be contained in this portion of the fish. Carp can also be cooked in a pressure cooker, which cooks up the bones; they can be ground up and made into fish patties or carpburgers. Pickled or smoked they provide a delicacy thought by many equal or superior to any other fish. If you have never eaten smoked carp, you are definitely missing something. Sportsmen's Clubs will do well to include it in their menus. After you have once tasted smoked carp you will be convinced. Directions for cleaning and smoking carp are available from the State Conservation Commission; write for a copy of the carp smoker, build your own smoker and enjoy some of the finest eating the outdoors provides.

Confirmed carp fishermen utilize their catch in many ways. Some process them and can them for winter use, but as a rule carp should not be held in refrigeration too long.

The flesh of the carp is not as firm and flaky as that of a pike or bass, but generally it is fine flavored. Even when taken from shallow ponds or bayous during the middle of summer, carp will be found an excellent food fish and often more firm-fleshed than certain game fish taken from the same water. Nor does one seem to tire of eating carp once the appetite for them is whetted. Bring home your catch and try it.

Carp fishing can afford unlimited enjoyment and outdoor recreation. He is here to stay and should be utilized; each year more people turn to carp fishing and, believe it or not, many of them by preference rather than necessity. What fishing is faster and what other fish gives you the chance of hooking a 30 to 50 pounder? Give it a try!

Trout Fishing

R. E. Cleary
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Probably there have been more books written on the art of fishing trout than any other sport save duck hunting. Therefore, it would be presumptuous of me to expect to cover in a few pages a subject which took trout specialists like Hewitt, LaBranche, Gordon and Bergman, among others, whole books to discuss. This will be nothing more than a digest of fishing techniques, and I will tend to cover only some of the generalities gleaned from writings and discussions of a horde of trout fishermen I have known or read. These accounts will be well-laced with some of the less closely guarded tips on how to take Iowa trout, for even the expert never tells all.

Fishing is basically similar to other competitive sports such as golf or tennis. In the latter two sports the fundamentals are taught about the same to each individual, and only in the matter of advanced know-how and individual ability do competitors differ in the won-lost column. Therefore, it behooves the trout fisherman who has a firm grasp on the fundamentals to improve his know-how and ability. The average trout fisherman usually works for the limit. Soon this becomes boring, so he concentrates on that trophy fish. In the final stage, fishing becomes a contest of skill, with neither size nor numbers affecting enjoyment. Then only fish taken under the most difficult conditions will satisfy. And believe me when I say there are trout fishermen in that final stage right here in Iowa!

By nature, trout as a group of fish, are secretive and very intolerant of changes in the streams in which they live. Our only native trout here in Iowa, the brookie, has perhaps the most rigid set of needs of any of the three species inhabiting our streams. The brook trout does best in water less than 60° Fahrenheit. It is also intolerant of silt, turbid water, and lack of cover or shade. On top of this, he is very susceptible to diseases and can't stand crowding. Brook trout waters in this state are limited to the extreme upper ends or spring runs of our trout streams. The combination of these close limits of tolerance and the fact that the brook trout is a voracious feeder and quite easy to catch, makes it a rather poor candidate for a "headliner" in the Iowa trout program.

The rainbow trout was introduced from the west coast and rapidly rose to a starring role in the Iowa trout picture. The rainbow is more adaptable to changing conditions, more rugged physically and, while not a push-over for any kind of bait or angler, it readily succumbs to average angling ability. From the angler's point of view, the rainbow possesses a slightly undesirable feature, in that it seldom grows to much over 15 inches in Iowa waters. Most of them either move out or are caught out of the streams before they attain the lunker size. I'd be willing to bet that nine out of ten rainbows over three pounds in weight are brood stock culls, that is, fish which are released from the hatchery after serving the major portion of their lives as a source of artificially produced trout. In fact, in three years of electro-fishing surveys on Iowa's trout streams, we haven't taken over a half-dozen rainbow trout over three pounds (that is the 18- to 20-inch class). And yet these same trout stream surveys gave indications that under adverse natural conditions, the rainbow could resist these environmental pressures as well as its cousin from across the sea, the brown trout, which are usually the lunkers in Iowa's streams. Perhaps the answer lies in the fact that the brown's feeding habits make it less susceptible to being caught and therefore give it an "odds-on" chance of growing larger.

This brown trout can grow into quite a beast—in fact, a 17¾-pound monster was taken a few years ago out of Elk Creek in Delaware County. In the fall and spring trout stream surveys, brownies over 18 inches are not a rarity, and there is usually at least one in each quarter-mile of most streams. The brown trout was introduced from various sources in Europe, Scotland and Germany being quite famous for their brown trout. This accounts for the derivation of the names Loch Leven and German brown trout. The big browns' penchant for feeding at twilight or in darkness makes them almost invulnerable to Mr. Average Trout Fisherman, who quits at the first horde of bites—mosquito, that is. However, since the brownie is a late fall spawner, the species becomes very active at this time of year and can be taken quite readily by the astute angler during the daylight hours.

Whether you are fishing for any of the three species, it is always well to keep certain things in mind. A "seen" trout is seldom caught. In other words, if you can see them, they can usually see you, and even your shadow can put them off their feed for as long as you care to stick around. Incidentally, these fundamentals are meant to apply to the acclimated trout, not those which have just been stocked. Through our surveys, we have come to the conclusion that 90 per cent of the trout which can be seen quite easily on the bottom of bare pools or other areas devoid of cover are trout which haven't a home. These trout are usually in excess of the stream's carrying capacity. In other words, the stream has only so many good living spots or hiding places, and when those are taken, the remaining fish are forced to occupy poorer living quarters. These are the fish that furnish the quick creel limit. So when you can't see any fish in a likely spot, that's the time to fish it cautiously, because an unseen "residenter" that would put all the trout you had seen that day to shame may smash out at your bait.

Trout also have to be stalked like the wily game they are. They are especially leery of noise—the bank- or water-jarring type. Besides having extra sensitive eyes and acute hearing, trout have a good sense of smell or taste, too. Recent experiments have shown that salmon runs in the Pacific Northwest can be temporarily stopped by a man sticking his hand into the water, or by the addition of bear or sea lion "scent". The salmon, which is first cousin to a trout, knows who its predators are. So think twice before you clean that fish above the pool where you are going to fish, or wash your hands free of the dirt after you have just baited up that juicy crawler.

Clothes that blend in with the surroundings put you one up on the color perceptive trout. It's pretty easy to follow a red shirt's progress along the stream. Since the major proportion of Iowa's streams are in open pastures, the problem of keeping screened from the fish is a thorny one; however neutral clothes and studied movements will pay off in fuller creels.

In the summer and fall when the water is low and generally clear, it is well to fish "long and light". In other words, have a long leader, try to fish as far ahead of you as you can, and have that leader light. You'd be surprised at the size of a trout that can be taken with a carefully used 1½-pound test leader or tippet. Too many trout are spooked by a heavy leader. Fish all large pools from below, and then you can land fish in the lower end without spoiling your chances in the upper end. When conditions permit, fish so the bait floats downstream, since trout lie in the water with their heads facing into the current and a bait drifting down to them is the natural procedure.

A trout often strikes with surprising speed, depending on how fast the water is flowing in its feeding area. It doesn't wait around munching the bait as do some fish; therefore, the angler must always be on the alert to set the hook. In swift water, keeping the rod tip up and the line taut often causes the fish to hook itself. It's a good idea to watch either the leader or the bait or lure if the latter can be seen. If the leader twitches or if there is a fishlike swirl or bulge near the bait, strike, for the trout is a dainty feeder and doesn't often advertise his presence with the slam-bang strike of a bass—that is, the normal stream-sized trout of less than 12 inches doesn't.

There are nearly as many techniques of fishing and types of bait as there are fishermen. The baits can be roughly divided into two classes, natural and artificial. Under the classification of natural baits come such live, natural trout foods as worms, nightcrawlers, grubs, grasshoppers, crickets, adult and immature forms of other insects, and minnows.

The use of natural bait such as worms is more effective early in the spring and late in the fall; however, trout can be taken all summer long on worms, hoppers, etc., if they are fished correctly. Worms should not be threaded on the hook, but hooked through the so-called collar or in two places, depending on size.

Allow both ends free movement. Crickets and grasshoppers can be hooked through the tough segment above the front legs or threaded on the hook. These baits are usually fished downstream or across and down, either with or without a shot sinker, and allowed to run with the current. With the angler directing its course, the bait can be worked into various nooks and crannies, which often shelter fish of a surprising size.

The neophyte bait fisherman often concentrates the majority of his efforts in large, deep pools. This pays off if the treads of the fish truck tires are still apparent in the dust of the road adjacent to these pools. However, if the stream hasn't been stocked for a period of two weeks or more, the trout have often moved out of these large depressions, which are often as sterile of trout food as your bathtub. Another thing we have noticed in late fall and early spring trout surveys is that seldom are the residual trout, or those which have found a home, in water any deeper than three feet or in the big deep pools. So take the hint—if they don't bite in the big pools, try the rocky runs or the small pockets.

Now, even as you and I, trout enjoy variety in their meals. Believe me, after the "wormers" or the "salmon-eggers" have worked the stream to a froth, the simple expedient of fishing the same waters with something different, such as burrowing Mayfly larvae or crane fly worms, really adds weight to the creel. Both of these baits and many others can be found in the streams you are fishing as they are aquatic in nature. The larval or immature forms of land insects, such as the various corn worms, caterpillars, and the like, also provide that gourmet touch to the trout's diet.

After brief rainstorms when the stream is discolored, and when the worms and other land forms are likely to be washed into the streams, trout can easily be taken on live bait. The angler is screened from the fish by the discolored water and can fish likely-looking spots more closely and therefore more accurately. At this time a bait fisherman would do well to fish the riffles or rocky runs, as these are the pantries and the kitchens of the streams, and it is here that the trout does much of his feeding.

The tackle used in trout fishing is entirely a matter of personal preference or purchasing ability. It is not difficult to see that the short, stiff casting rod puts the angler at a disadvantage. He must fish practically under his feet, and when he does get an average-sized trout on, the small fish can't put up much of a scrap against tackle meant for fish 10 to 20 times bigger. However, the days of the cane pole and the casting rod trout fisherman are numbered, and even the younger members of the fishing fraternity have come to associate the limber fly rod with trout fishing. This situation may either be the result of written or oral advice on trout fishing or just a sign of the economic good times. In the last two or three years we have also seen more and more trout anglers using light spinning tackle when they go bait fishing. It certainly has the advantage in getting into those places where even a roll cast is difficult to make with a fly rod. At the same time one can extend his casting area without running the chance of snapping the bait off on a false cast, as so often happens when using a fly rod to gain distance.

The winter of 1954-55 was the first one open to fishing under Iowa's year-around open season on trout. Some of the better trout fishermen in eastern Iowa were polled as to their thoughts and results on winter fishing. They were equally divided as to their results on winter fishing—half thought it poorer, half better than summer fishing. Almost all felt that the average fish taken was larger, and all agreed that the best time to fish during the winter was from 10 a. m. to 2 p. m.—the warmest period of the day. They were also in agreement that in December through February, at least, small pools furnish the best fishing, with areas bordered by vegetation in the spring runs being second choice. Three out of four winter anglers preferred natural to artificial baits, with a definite preference for the stream-dwelling aquatic larvae. Of the artificial baits, small plugs and spoons were most effective. A few stated that they tried fishing through the ice, and they observed that things had to quiet down for a period of one-half to one hour before the trout would bite. Late winter angling and flies didn't mix consistently according to those who tried.

The artificial lures can be subdivided into two classes. These are flies and plugs, both made to resemble the fisherman's conception of how certain insects and other natural foods should appear. Flashing objects, such as spoons and spinners, serve to attract the trout and excite him into striking, or simulate the flashing sides of shiner minnows. Artificial lures in one sense give the purist an advantage over the bait fisherman in that they have a large selection from which the trout can take his pick. Yet artificials put the burden of proof on the angler, for he must present his artificial in a lifelike manner in order to trick the trout into believing that it really is a Mayfly or stonefly dropped into the water.

Fly fishing is considered by many to be the most sporting method of taking trout. The fly fisherman is rewarded by his catch and in the knowledge that he has fooled the trout into believing that the bit of hair, feather and tinsel was really a juicy insect or minnow.

The same general rules which apply to bait fishing apply to fly fishing. In addition, the fly must be presented to the water in a lifelike manner with a minimum of disturbance from the line or leader and in such manner as to be instantly appealing to any trout in the immediate vicinity.

Basically there are two classes of trout flies, dry and wet. The dry fly is designed to rest and ride on the surface and to represent an insect which has by accident alighted on the surface, or one which has just emerged from the water. Fishing with the dry fly is considered to be the highest order of fly fishing and is the most difficult method to execute skillfully and properly. The cardinal rule, and the most difficult to execute in fly fishing, especially with dry flies, is that the fly and the leader should alight gently on the surface of the water before the line.

Dry flies are subdivided into two general classes, winged flies and hackles. The first class, the winged flies, are patterned after the adult insect complete with wings, and the second represents the undeveloped or wingless insect forms.

In order that the dry fly remain buoyant, the practice of using preparations to waterproof the fly insures against the tendency to sink. The dry fly is usually not "worked" by the angler, but allowed to float free with the current until there is danger of the line's causing a drag on the fly and altering its free movements. At this point the fly is retrieved and whipped into the air several times to remove water droplets and allow for proper line length and direction for the next cast. The line should be cast up and out and the fly allowed to rest under its own force of gravity.

Dry fly fishermen do not need to be early risers, because the insects they are trying to imitate generally become active after the sun is well up. Fishing the "rise", or the immediate area where the trout are observed to be surface feeding, is relatively successful, but more fish will be taken if you "search" the fly over all likely-looking spots.

Wet flies are made to represent several different types and stages of insects. The largest of these represented groups are the nymphs, which are that in-between stage in an aquatic insect life when it resembles a "nothing but a nothing". During this stage it spends its time crawling about on the bottom or under rocks. Another stage in an insect's life represented by the wet fly is the larval or wormlike stage. Wet flies are also made to represent adult insects which have just emerged from nymphal or larval stages and are on their way to the surface and a new life in the open air. Others represent drowned beetles, winged insects, ants, spiders, and a multitude of other creeping, crawling things. Another type of wet fly, known as a streamer fly and made of hackle, long, flimsy feathers, and either chenille or tinsel, represents a minnow.

For some reason flies representing the larval or nymphal stage of insects are not found to be popular with the average angler. These flies are dull, drab, unappetizing things compared with the flashy reds, whites and yellows of the winged representations. Perhaps these gaudy flies are more appealing to the angler than to trout, for it has been discovered that over 80 per cent of the trout's diet consists of larvae or nymphal stages of insects. Sometimes the smallest of these little nymphs are just what that 18-inch brown wanted.

The wet fly should be retrieved through the water in a deliberate manner, the action to be given the fly depending on the type of creature it is to represent. A good plan is to hesitate after the fly hits the water and then draw it over the prescribed territory with a pause-and-go manner of retrieving. Flies are best played on the surface with an up-and-back rod movement and under the surface with an up-and-sideward motion.

Another category of flies known to anglers as poppers or bugs are used effectively in the twilight hours on big browns. The hair-type poppers representing frogs or mice are especially effective on brown trout in large pools or behind beaver dams, where the disturbance created by the popping action of the bug draws the trout more than the shape or color of the bait.

The choice of pattern, size and type of fly to be used is largely a matter of individual angler's opinion. Any book on trout fishing will name individual "killers" or lists of them that are to be recommended by that particular author. So choose your author and procure the flies he lists or, better yet, consult a successful fly fisherman in the area you plan to fish and heed his recommendations on different patterns and when to use them.

Some fishermen buy flies off the cards in the sport shop, others have their flies tied to their own specifications and patterns, and still others add to their sport through the winter months by tying their own.

To go back to this question of what patterns to have on hand, it should be understood that types of natural insects vary from zone to zone, state to state, and even stream to stream. Other forms may be universally distributed or over continental limits. Basically both types of insects and their appearances during the season are governed by the climate. Specifically certain insect forms appear at certain times of year and day. A wingless underwater nymph in the morning may be a winged adult later in the day. To balance the uncertainties of nature, it is well to have an adequate selection of patterns, types and colors, for there is nothing so disconcerting as to have trout surface-feeding all over the area on a certain insect of which you lack a facsimile.

Trout fishing, just like any other sport or hobby, is only what one makes of it. The hatchery truck follower gets his kicks just as the dry fly specialist. One can be a meat or sport fisherman or somewhere in between. Many anglers got a sour taste in their mouths from the old shoulder-to-shoulder opening day fish-out. This has been virtually eliminated except on some heavily fished waters just after the word gets out that the stream has just been stocked. Even in this instance there is one fisherman along the bank where there used to be ten. Trout streams are pretty difficult to fish out as our late fall surveys show. Some have as high as 400 residual trout to the mile after 99 per cent of the fishermen have hung up their rods for the year. Of course, the poorer the class of stream, the poorer the fishing, because a trout won't stay around to be caught if conditions aren't to its liking or well-being.

All that glitters is not gold. Neither does cold water alone make a trout stream. It takes a combination of many factors, year-around cool water among others, to make a good trout stream. Of all the waters in the state, trout streams are managed the most carefully, since there are so few of them and since so much more is known about trout management than any other form.

The old idea that one must be a specialist with a world of fancy tackle to catch trout is now a thing of the past. It takes know-how to catch any type of fish today, and with the present multiple-purpose fishing tackle, angling for trout is well within the reach of everyone.

Iowa may not have any world-famous trout streams; the streams may be small and consequently the number of trout may be limited. But fish for fish, Iowa can match its average-sized trout against any state in the Midwest and even take a handicap against some.

Bullhead Fishing

Tom Moen
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From the time the ice goes out in the spring until freeze-over in the fall, no fish enjoys more widespread popularity than the bullhead. This popularity is due to many factors. Among the more important are their state-wide distribution, abundance, and readiness to take a baited hook, and last but not least, they are fine eating. When we compare these popularity traits, it is hard to separate distribution from abundance. Bullheads, sometimes called horned pout, brown catfish, yellow-belly, and other names, are found in considerable numbers in nearly every pond, lake, river and stream over the entire length and breadth of Iowa. They will live in nearly every unpolluted habitat except trout streams, where the year-around cool water temperatures discourage them.

Black, brown, and yellow bullheads are native to Iowa waters, but the black bullhead outnumbers the other two species by a wide margin and furnishes nearly all the hook and line fishing for bullheads.

In any given body of water the number or abundance of bullheads will vary from year to year, but generally speaking, they are common to abundant if present at all. The number of bullheads in some of our Iowa waters often reaches astronomical figures. So numerous, in fact, that they are subject to stunting or slow growth. Evidence of their abundance can be found by examining the results of lake surveys, rough fish removal operations, lake and pond drainage projects, creel census figures, population estimates, and other activities carried on by the Conservation Commission.

An examination of the records covering some of these activities on Lost Island Lake will furnish a good example. In 1941 the lake survey records show that an average of 39,000 young bullheads were collected in each haul of 500 feet of ¼-inch seine. These bullheads were so abundant that they did not grow well, and by 1946 the Conservation Commission decided to remove the catch limits for this lake in an effort to thin out the bullheads. Creel census figures for Lost Island Lake show that during the following three-year period of 1946-48, fishermen caught a minimum of 842,000 bullheads, most of which had hatched in 1941. During this period the bullheads made a satisfactory growth, gaining nearly three times as much in weight in the last three years as they had in the first five years. Lost Island Lake continues to supply many thousands of bullheads each year.

Lost Island Lake is not the only lake in Iowa where bullheads occur in large numbers. During the 1946 and 1947 seasons bullhead fishermen caught 100 or more pounds per acre each year from Center Lake. Of course, this represents an unusually large harvest from an individual lake and cannot be expected each year. A summary of creel census data from eight northwest Iowa lakes during 1953 (May 15—July 1) reveals that 84 per cent of all the fish caught were bullheads. On three of these lakes, West Okoboji, East Okoboji, and Spirit, where a year-around creel census has been taken for the past three years, we find that bullheads make up about 45 per cent of the total catch of fish, with a range of 15 to 80 per cent bullheads when individual lakes and individual years are examined.

Bullheads are often present in large numbers in the rivers, smaller streams, and dredge ditches. Preferring quiet water, they will be found in the backwater areas, above dams, in overflow pools along the larger rivers, and in deep pools along many rivers and streams. They are not well suited to riffles or fast water. Surprisingly large numbers of good-sized bullheads have been found in relatively small streams. Most streams having a year-around flow and pools with a depth of about three feet will have their quota of bullheads. The occurence of bullheads in small streams has been demonstrated in nearly every attempt to eradicate undesirable fish from the watershed creeks of new artificial lakes.

Bullheads in farm ponds seldom furnish good fishing, unless a satisfactory predator population such as bass is maintained at a high level. In fact, they usually become so numerous that eradication measures are necessary. With few exceptions bullheads are not suited for farm ponds unless considerable effort is expended in management to prevent overpopulation. Remember, one of the best management practices is to fish it hard and don't throw back the little ones.

At the other end of the abundance scale we find the artificial lakes and city reservoirs. On a per acre of water basis the artificial lakes are at the bottom of the list as far as bullhead populations are concerned. There are, however, a few exceptions to this, especially where the lake is relatively shallow. At the same time, the artificial lakes often produce the largest bullheads of any waters in the state, with catches occasionally averaging a pound or more per fish. In the light of our present knowledge, artificial lakes and reservoirs are about the only waters where the number of bullheads can be augmented by moderate stocking without danger of overpopulation.

As mentioned above, the popularity of bullheads is due to several factors in addition to their wide distribution and abundance. One of the most important is their catchability. When you couple this with the fact that special skill and special tackle are not necessary, you have a true democrat among fish. Even Henry Thoreau of Walden Pond had a few words to say about the appetite of bullheads, or horned pout as he called them: "They stay near the bottom, moving slowly about with their barbels widely spread, watching for anything eatable. They will take any kind of bait, from an angleworm to a piece of tomato can, without hesitation or coquetry, and they seldom fail to swallow the hook."

A piece of tomato can may not be an entree on every bullhead's menu, but there is no denying that bullheads are far less temperamental in their feeding habits than most other species of fish. These horned pout are apt to eat whatever is available, including insects and their larvae, snails, frogs, aquatic vegetation, and occasionally small fish and eggs of fish, but above all, they like a large portion of earthworms or nightcrawlers. Other less natural baits include liver, beefsteak and shrimp. If meat market prices are too high and it is too dry to dig worms, try cutting open a few stalks of horseweed or giant ragweed for worms or larvae that live in the stems.

No discussion of fishing would be complete without some reference to the type of tackle to use. Although special skill and special tackle are not necessary requirements for bullhead fishing, a little knowledge of both will produce more fish and greater enjoyment of the sport. Almost any fishing gear, from trout rods to willow pole and from chalk line to spinning line, can be used for bullhead fishing. Hooks are more nearly of a standard size with large (1/0 to

3/0), long-shanked hooks predominating. A short-shanked hook just adds to an already difficult job of removing the hook from a fish that has swallowed the bait. A good supply of hooks in your tackle box is a worthwhile investment. When the hook is swallowed you can cut the line and tie on a new one, retrieving your hook in the process of cleaning the fish. For river or stream fishing a long (9- to 12-foot) bamboo or cane pole with an equal length of line attached is usually sufficient, but if you are going to fish the lakes, a rod equipped with a reel will be helpful in getting the bait out to the fish. A standard casting rod and reel with a good grade of 9- to 18-pound test line make a useful combination. The ideal bullhead tackle consists of a stiff glass or bamboo pole 7 to 9 feet long, equipped with guides, a good line and a reel. This outfit will give you plenty of "backbone" in the rod to make long casts and set the hook when you get a bite.

There are other parts of your terminal tackle to consider besides a line tied to the hook, namely bobbers, sinkers and leaders. There is more to the use of a sinker than meets the eye. The weight should be just heavy enough to enable you to get a little distance to your cast, usually a half-ounce sinker is sufficient. A heavy sinker may bury the bait in the soft mud or silt bottom and thus reduce your chances of attracting fish. A heavy sinker will also discourage a bullhead from trying to make off with the bait; he finds the bait anchored solidly, spits it out and moseys on with the angler none the wiser. The best sinker is one that the fish do not feel. Catfishermen have made use of an excellent idea that also works very well in bullhead fishing. Simply thread the line through a hole in the sinker, thus allowing the line free passage as the fish moves off with the bait. A knot in the line about one foot above the hook will prevent the sinker from interfering with the hook and bait. These sinkers may be purchased or easily made by removing the wire from a bell-type or dipsy sinker. The bullhead fisherman who uses a cane pole should not use a sinker, or at least a very light one. He does not need distance as in casting, and the hook plus the bait will naturally go to the bottom. A current strong enough to interfere with the line and bait indicates an area unsuitable for bullheads. The fisherman should seek a more quiet place with less current. Leaders are not essential in bullhead fishing, but many fishermen prefer to use one. They can be useful in extremely clear water where it is necessary to trick the fish into thinking there is nothing wrong with that big nightcrawler.

Our final item in terminal tackle is the use of a bobber or float. For the most part a float will only hinder bullhead fishing. There are several reasons for this. First and most important is the fact that in order to catch bullheads the bait should be on the bottom or very near the bottom. A float or cork may often keep the bait too far off the bottom and away from the normal feeding area of this species. It also makes casting next to impossible and presents some difficulties in setting the hook and landing the fish. So leave the bobber in the tackle box when you go bullhead fishing. Watch your line for tell-tale movements and you will have very little need of any type of indicator attached to your line.

Now that we have covered bullhead distribution, abundance, food habits, bait and tackle, we should discuss a few points concerning the private life and behavior of bullheads. After all, it is often his behavior that influences your catch. The fish with the India rubber skin spends the greater share of his lifetime near the bottom of the pond, lake or stream, so close to the bottom, in fact, that his chin whiskers or barbels touch the bottom. Bullheads seem to have a sense of taste or smell in these barbels. Thus in roily, turbid water the use of these barbels helps the bullhead locate his next meal. Bullhead fishing need not wait "until the water clears up". As a matter of fact, when fishing rivers, a rise combined with the inevitable turbid water actually means better bullhead fishing. The fish sense that angleworms and other foods are being washed into the river, and a little dirty water just sharpens that sense of smell and excites the feeding instincts.

PLATE 17

BANDED KILLIFISH *Fundulus diaphanus menona* Jordan and Copeland

BLACKSTRIPE TOPMINNOW *Fundulus notatus* (Rafinesque)

TROUT-PERCH *Percopsis omiscomaycus* (Walbaum)

BROOK SILVERSIDE *Labidesthes sicculus* (Cope)

SLIMY SCULPIN *Cottus cognatus* Richardson

BROOK STICKLEBACK *Eucalia inconstans* (Kirtland)


Maynard Reece

In the region of the natural lakes this turbidity and rise in water level cause the same reactions, but the circumstances are slightly different. First of all, turbidity, or roily water, is created by waves on lee shores and by incoming water at inlet areas. The waves stir up food organisms, and the bullheads are going to be there looking for something to eat. This means that you will catch more bullheads on the windy side of the lake. Turbid water is also created in the vicinity of inlets following a rain, and here again the bullheads congregate to hunt for insect larvae, angleworms, and other food brought to the lake by rising waters. Some of the best bullhead fishing in lakes is found in the inlet areas after a warm spring rain.

With plenty of natural food on hand, bullheads grow rapidly reaching a weight of one-half pound in two or three years. When competition is present in the form of carp, other bottom-feeding fish, or just too many relatives, their growth is much slower. Serious competition means small, stunted bullheads. Increased fishing pressure is one of the best remedies for this situation; occasionally removal by other means is necessary.

Bullheads do their best in warm water, preferably 60° F. or above. They just don't thrive on cool temperatures. Bullheads seldom bite for the ice fisherman, and they are rather slow starters in the spring. As the water warms up in the larger lakes after spring break-up, bullheads migrate toward shore. This shoreward movement serves at least two purposes; one involves looking for a nesting site, and the other concerns searching for food in the warmer waters of the shallows after a long winter fast. Once near shore, they remain in fairly deep water during the day and then move closer to shore and into shallow water at night. This means good shore fishing after dark and comparatively poor shore fishing during the day. Boat fishing often pays off during daylight hours.

In late summer and early fall after parental duties have been discharged, bullheads head for deep water again, leaving the shore fisherman high and dry. Bullhead angling continues to be fair to good if you take a boat and go out after them, but once the water gets near the freezing point, the biggest nightcrawler will be of little value and you may consider bullheading over until next spring. The behavior outlined above holds true for smaller lakes and other bodies of water, but on a much smaller scale and with some variations. For instance, the bullhead fishing in the artificial lakes takes place during the spring and fall with relatively little midsummer success.

There is a good reason for the poor success during midsummer in the artificial lakes. During July and August there is no oxygen in the deeper portions of these lakes and the fish move out of this deep water into shallow water containing more oxygen. This phenomenon is described in another article in this book (see page 257). The bullhead fisherman who habitually fishes from the edge of the dam of an artificial lake, casting a heavy sinker and bait to the deepest part of the lake, will catch fish early in the season and again late in the fall, but during the summer months he will likely have poor luck. He should try fishing in much shallower water, or adjust a bobber at different levels, casting out and reeling in until the bait touches bottom. In this manner he can determine where the bullheads are located.

The food qualities of the bullhead, like many other fish, are often debated. In general, the flesh is firm and well-flavored when taken from clean water. Bullheads caught in muddy water may have a disagreeable muddy flavor. The flavor can be improved by keeping the fish alive in clear water for a week. Stock water tanks are often used for this purpose.

If you have trouble skinning your bullheads, the best advice is to ask someone who knows how; it will pay you dividends. With a sharp knife, a pair of pliers, and the know-how preparation of bullheads for the frying pan is a matter of less than a minute's work per fish. Fried in deep fat, he is a gourmet's delight.

Angling for Walleyes

E. T. Rose

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To many Iowa fishermen, the walleye reigns supreme over all the finny tribes. In line with this royal position, the walleye often exercises his kingly temperament and will not bite or strike the most tempting lures of the angler. Perhaps this is one of the reasons for his high esteem among the angling fraternity. The angler who is successful in taking walleyes consistently is justly considered an expert.

We cannot tell you how to become an expert walleye fisherman, since the printed page cannot reveal all the secrets. The best advice is to get acquainted with one and find out how he catches them in the "off seasons" as well as in the spring and fall when even a dub can catch them.

In case you are a little reticent about contacting some expert, or like to do your own investigating, there are a few cardinal principles that are essential and basic for successful walleye angling. These principles are: *where, when* and *how.*

Obviously fish can't be caught where there aren't any, so let's consider the first principle, the *where* of the walleye in Iowa. Iowa has a limited number of waters in which the walleye thrives. The following lakes and streams are classified with a rating of one and two, which will serve as a guide to some of the best producers in the state. In the number one category, I place the following areas: Spirit, East and West Okoboji, Clear and Storm lakes. Also included in this category is the Mississippi River. The huge channel dams have created a series of lakes and an environment suitable for this species. Excellent fishing the year around may be had near the tail waters of these dams, particularly in the reach from the northern Iowa border to Bellevue. In the number two category I include: Lost Island, North Twin, Silver (Dickinson Co.), and Ingham lakes. Several inland streams are included with them in this category: the upper reaches of the Des Moines, Cedar, Raccoon and Wapsipinicon rivers. There are other areas that are good producers of the walleye, but at this time they must be ranked lower than the above. Remember that fluctuation, not stability, is the rule governing all wildlife populations. Iowa is a borderline state for walleyes and will probably never have the slogan "The Walleye State" emblazoned on license plates. Thus the waters listed here are good at this time for the walleye, but ten years from now we will rank them differently.

Now let's consider *when* to fish. Dates and time of day are important. A lake may be full of "bug-eyes", but if the season is wrong you'll have poor success and for good reasons. According to fish census work done by biologists, the dates during which most of them are caught are from May 15 to about July 1, and again from about September 15 to the close of the season on February 15.

Why are these periods best? The reasons are obvious if we think about it a little. Fishing is generally good in the spring primarily because of the shortage of natural foods. The walleyes are hungry and will take almost any lure during this period. After July 1, or thereabouts, practically all of the other species of fish have reproduced and the waters are crowded with young fish, all of which are the natural foods of the walleyes. Until these young fishes have grown beyond forage size, or until they have been thinned out by the predatory fish, angling is bound to be poor. This accounts for the normal decline in fishing success from around the first of July to September.

Apparently walleyes will feed during most of the hours of the day and night; however, they are on different feeding grounds during various periods of the 24 hours. An example of a known activity pattern should be helpful to walleye fishermen, particularly those who fish in lakes. Test netting by Iowa biologists have established that walleyes make two inshore migrations every day, and that their cousin, the yellow perch, makes one similar movement in the evening. They call these the "diurnal movements". Smart anglers know when these runs occur and take a lot of fish in their favorite shoal areas. Usually these periods occur just at dusk and again early in the morning before sunup. Perch precede the walleyes to these feeding grounds in the evening; consequently, anglers with time, patience and know-how often catch perch and walleyes on the same trip. Lakes having very irregular shorelines, with long jutting points and reefs, have more pronounced diurnal movements due to the constrictions of shoals, which cause higher concentrations of fish in these regions. Don't expect these periods to be as effective in midsummer since usually the heavy component of forage fish precludes good fishing as explained previously. However, in the spring and fall, fish the shallows (four to nine feet) around the rocky points and inlets in evening and morning.

How to catch walleyes. Sporting magazines and books are replete with the full directions, personal experiences and never-fail methods of the outdoor writers. Many of these accounts are very good, containing some very practical hints on improving your catches. Here we will try to summarize basic methods and interject a few personal tactics that have proved fruitful in Iowa waters.

By and large, the vast majority of the walleyes taken in open water are caught by trolling the old reliable spinner and minnow. The most likely areas are rock reefs, sand bars, rock piles, or in the deep water mud-flats. Trolling is most effective during the daylight hours and usually a considerable distance from shore in waters of more than ten feet in depth. In West Okoboji and most of the artificial lakes, avoid the so-called thermocline regions during the midsummer months. The water below the thermocline is without sufficient dissolved oxygen to support fish life, so you're wasting your time fishing in it. In many of the artificial lakes the thermocline is just a few feet below the surface, while in West Okoboji it is usually at around the 60-foot level. (See "Three-Layered Lakes", page 257.)

Walleyes are very finicky at times, and you may have to try several different colors of spinners before getting one to their liking. It is best to troll very slowly with the weight occasionally bumping the bottom. Maintain just enough speed to keep the spinner blade revolving nicely. There are times that a little added speed will be more effective, but these are unusual. Most successful trollers row their boats, although drifting with the wind or using an outboard motor are frequently just as effectual. Avoid the outboard motor in shallow lakes or in trolling around shoal areas, especially in the off-season period of midsummer when you really have to coax them to strike. At Storm Lake the usual method is to drift across the lake with the wind, trolling with not more than about eight to ten feet of line out. Upon reaching the lee shore, the lines are reeled in and the motor used to propel the boat to the windward shore where the process is repeated—it's very effective when conditions are right.

When aquatic vegetation such as coontail or water milfoil covers the bottom of the lake or in the bays where you like to fish, it is impossible to troll just off the bottom. Then adjust the weight and speed of trolling so that your spinner just clears the beds of weeds. You'll get fouled up occasionally, but some very good walleyes can be taken in this manner.

Regardless of where you troll, over reefs, bars, weeds or in the mud, when you get into a school of feeding walleyes continue to fish this area by trolling back and forth through the region. If it's not too deep, anchor and cast with the spinning or casting rod you take along for this purpose. By all means don't drop small buoy markers overboard when you locate a school of fish, even though some noted sports writers do advocate it. Other anglers foul their lines and propellers on the buoy lines, which doesn't add pleasure to their fishing, to say the least. And, too, in Iowa there is a state law prohibiting these markers.

Another method of trolling should be mentioned that may appeal to the sizable sailing clan in Iowa. When winds are favorable, angling from a sail boat can be most enjoyable and effective for walleyes. I have taken several good walleyes while sailing alone, but believe me, manning jib and mainsheets, the tiller, and a four-pound walleye all at the same time calls for some doing. In the excitement you're apt to pull a "Chinese jibe", and the wildly slamming boom may carry away your head as well as the mast and rigging of your boat. Best to let a crew do the fishing and a skipper man the boat. However, in light, steady winds you can, with a fair degree of safety, belay the mainsheet, leaving both hands free to handle your tackle when a fish strikes. From this time on till he's landed, operate the tiller with your knees, putting your boat "in stays" if necessary. More sailors should try this, especially the day-sailing group who just wander about, anyway. Obviously the advantages of trolling by sail are many—no stinking fumes from a motor, no aching back from rowing, and no spooked fish due to noise. Try it sometime.

Just as spinning, casting or still-fishing equipment are specialized gear, your trolling rig should be designed for this purpose. The Calcutta solid cane pole about eight or nine feet long, equipped with guides, reel seat, and trolling reel has the action and backbone necessary for proper response to the strike. Use 20- to 30-pound test line with a 10- to 12-foot heavy nylon leader at the terminal end. To this attach a good-sized swivel snap with a properly selected weight (size depends on depth and speed of trolling) suspended from the snap on a 10-inch nylon-coated cable leader. This should be attached by barrel swivel to prevent twisting the line. Also attached to the snap at the end of the line leader is another 8- to 10-pound test leader about two to three feet long (with swivel) to which the spinner and hook are attached by snap. A long-shanked 2/0 to 3/0 hook (sneck type) is used for hooking the minnow in place; this is the business end of your equipment. It is most important that the minnow be properly placed on the hook so that it will "ride" correctly. First insert the point of the hook in the mouth cavity and out through the gill opening; then slide the shank of the hook back so that the point can be forced through the minnow just back of the dorsal fin. Done correctly, the minnow will not spin while being trolled.

In recent years, many of the lake anglers have found that a fairly heavy stiff-actioned spinning rod with 6- to 9-pound test monofilament line can be used effectively in trolling the spinner fly or the so-called "killer rig" as a lure for walleyes. A small, very thin piece of pork rind strip adds much to the effectiveness. To prevent line twisting, which is an abomination to spin fishermen, use a keel-type sinker about two feet ahead of the spinner. Since this outfit can be used for casting as well as trolling, it approaches the much desired universal gear.

Still-fishing for walleyes, using large minnows or chubs, is very effective, especially in the fall of the year. It's best not to use an anchor; use oars to keep your boat in the desired position over reefs or along "drop-offs" in deep water. Anchor lines will spook walleyes when the water is clear, as it usually is in the fall and early winter. Don't fish the deep areas of West Okoboji between the first of July and the first of October. During this summer period the lake is stratified and depths below about 60 feet are usually devoid of sufficent dissolved oxygen to support fish. While still-fishing or just slowly drifting over the very deep areas, your tackle should be of the heavy duty type as described for trolling, with an ample length (8-10 feet) of heavy leader and a 4-ounce weight, from which is suspended a 4- to 5-foot leader with 4/0 to 5/0 hook of the "eagle claw" type. The bait is hooked through the flesh, just back of the dorsal fin, care being taken to avoid the backbone. Keep the bait about one foot off the bottom. A small contrasting colored thread firmly attached to the line to mark the proper depth helps in relocating when rebaiting your hook.

Still-fishing from shore at night is often very effective. Here the casting rod with stout line and leader is used, with a heavy sinker and chub hooked from a dropper. This is cast out as far as possible from shore and allowed to remain stationary. It's used extensively at Lost Island and Storm lakes.

Bait casting and fly and spin fishing come into their own toward evening, when schools of adult walleyes move shoreward to feed upon the young game and forage fishes. Trolling in deep water is often a waste of time at this period of the day. In bait casting anything from short steel casting to spinning rods are used to cast the bait (usually minnows) into likely areas close to shore. Most frequently this is done from docks under lights. The terminal tackle consists of a light leader (5- to 10-pound) about 5 feet in length, a small bobber, and a couple of small split shot weights a foot or so above a No. 4 to 6 hook. The unwieldy outfit is side-swiped out as far as possible and very slowly retrieved. The method is effective for small hammer-handle walleyes, perch, white bass, etc., which are attracted to insect concentrations around the brilliant spotlights used at the end of the docks. Most real walleye fishermen are contemptuous of this type of angling. The night fishermen, clad in breast waders, red plaid shirts, fishing jackets and slouch hats and reeking with mosquito dope, are those who have "arrived"; their halos are properly adjusted, and all others are base neophytes in their eyes. These boys really do catch a lot of big walleyes, sometimes starting at midnight in their favorite shoal or inlet areas. They definitely don't like noisy company, just a quiet buddy or two at the most. High quality tackle is a must, including spinning, casting or fly rods. The spinning and casting lures are usually small, highly active plugs with small split buckshot attached to shanks of the treble hooks or a foot or so ahead of the plug to keep the lure running deep. Fly fishermen use mostly dark-colored streamer flies in the same areas to very good effect. The flies or plugs are activated by slow retrieves and erratic jerks of the rod tips. Some spin fishermen use the plastic bubble adjusted for proper weight and buoyancy to cast streamer flies. To all this clan, angling for walleyes by starlight is the epitome in sport fishing.

So far we've discussed the lake fishing for walleyes in some detail. But any angler who knows the streams mentioned previously is aware of the increased population and angling success in recent years for this species; consequently, some further reference should be made to this type of fishing.

Most of the walleyes caught in the streams are taken on live bait—mostly chubs or large minnows. Some of the most effective spots are along sheer walls of bridge supports, wing-walls, piling or natural limestone banks. The bait should be cast out and beyond the wall and worked in as close to it as possible, bringing it upstream slowly and snugly against the wall. A small spinner ahead of the minnow adds to the effectiveness at times. Artificials will work, too, in these situations, but not as well. Another system known by some as "dabbing" has taken a lot of walleyes from the small inland streams. This consists of dropping a chub in and out of small openings in log or brush jams. The method involves use of a powerful long rod (10 feet or more) of fiberglass or cane. The suspended chub is fished by a series of drop-in-and-lift, drop-in-and-lift, or "dabbing" until a strike is felt. Wait a moment until he really grabs on, then give him all you've got and out he comes! If you let him run with it, you'll have "snafued" your line in the submerged logs and lost a nice fish. Live bait can be drifted through holes in the river bed by bobber, too, and often with good results. You must know your river bed to have good success with this method.

In areas where the smallmouth bass and walleye are found in about equal numbers, the artificial lures will take about an equal number of each species by using your smallmouth tackle. Spinner flies on fly rods or spinning rods fished in the likely smallmouth spots will do the job nicely. Below riffles, at heads of pools, drop-offs, behind and beside midstream boulders, deep cuts of bends, ledges, immediately below dams, and along wing-walls are all good areas.

Since the State Conservation Commission extended the open season for angling to February 15 in 1950, fishing through the ice has become a major item in winter sports in the lakes region. The boys on the Mississippi River have had winter angling for years; however, it's mostly from boats in the fast water back of the channel dams. In the lakes, techniques have been developed that are considered standard, but probably some are new or interesting variations of those used elsewhere. Most of the walleye fishermen use heated shanties, especially in the rugged weather, although some hardy ones fish in the open regardless of the sub-zero cold or blizzards.

The best areas and times are similar to those outlined for open water fishing. Hit the diurnal movement periods when the walleye activity peaks are reached. Many of the anglers like to fish in less than 20 feet of depth in order to see the walleyes when they pass through the water beneath the shanty holes. In fact, this is one of the great pleasures of winter angling.

The tackle used is as varied as the anglers themselves. Some use their summer casting outfits, some have hand lines wrapped on short-cleated poles with steel points to jab in the ice to keep them upright; however, the best rigs are shortened versions of casting rods with guides, handle and reel. Obviously summer casting outfits are too long to be used in shanties. Very few tip-ups have been used by the Iowa fishermen. By far the best bait is the creek chub of about three or four inches in length, although small stonerollers, suckers, large fathead minnows, or common shiners are frequently used when chubs are scarce. Unlike open water angling, don't use a heavy sinker in either deep or shallow water during the winter. A split No. 4 buckshot 18 inches above the hook is most universally used. I have observed some very successful anglers who used no sinker at all—and the line, 4-pound test monofilament. Many shanty fishermen like to use small luminous bobbers during the dusk period. This adds immeasurably to your sport to see them bob around at the approach of the walleye to the hapless, frantic chub. Then after the strike, watch the bobber start slowly down, down, past the 24 inches of ice and out of sight. This is what puts a pounding heart in your throat and is what you endure the hardships for. Don't try to set the hook at the instant the fish strikes the bait. Most experts agree that five, ten, or even twenty seconds time should elapse between the strike and setting the hook, and during the seeming eternity feed line a little faster than your fish takes it—remember, no drag or as little as possible. Walleyes invariably take their prey sideways, run off a short distance, and then turn the minnow head-first in order to swallow it. If your timing is right, you'll set the hook just before he starts to swallow the bait and then you're in business.

The most successful walleye anglers never have a light on in their shanty except maybe a small candle at a far corner to help in rebaiting their hooks. This is especially true in waters less than 20 feet in depth. A light or shadow above the hole will spook walleyes in the dusk or pitch dark period, and banging around on the ice with chisels or anything else should be avoided. In order to keep on friendly terms with others, it's best to chisel new shanty holes and move your shanty during the daytime so your neighbors can fish in peace during the few minutes of peak walleye activity.

Usually the major reefs and rocky areas have a shanty-town appearance soon after the season starts. These are good areas, but if you like to experiment a bit and get away from the crowd, select some good summer fishing sites that are not occupied with shanties or fishermen in the open. Often you'll have splendid success in getting away from the crowd and into an undisturbed area.

In recent winters the use of the "jigger" as a walleye lure has resulted in sizable catches and increased interest in experimenting with different methods. Once the "hang" of jigging is learned, you won't be without one or two of these deadly little deals in your tackle box. Most of these lures are adaptations of casting baits, usually of more or less flat, shiny metal, resembling a tie clasp, that are snapped to a 6- to 8-pound test monofilament line. A short, stubby rod is usually best for this, although I use the butt section of my split bamboo spinning rod and the conventional spinning reel. Let the lure down to the bottom (usually among the rocks of a good reef or bar) and raise it about a foot. Now set your drag heavy enough to set the hook; then check to prevent reverse winding and you're ready to go to work. This consists of simply raising the rod tip sharply about three or four inches, then lowering it to the original position. Wait about five seconds and repeat the process. The lure will literally dance a jig in this process, making diagonal sweeps and fluttering gyrations that will attract walleyes away from even the best natural bait. Usually you won't get the walleye during the active movement of the lure, but be ready to strike right after it has quieted down. Walleyes are lazy critters, and if they can take a bait momentarily quiet, so much the better—I think. Of course, if you're going to be much of a success in angling, you've got to think like a fish, and in order to catch him your mental processes must be a little bit sharper! It takes a little while to get accustomed to jigging and to know just when to strike, but after you've learned it, the bait bucket won't need replenishing nearly so often.

Now, what about the success of the winter fishermen? Do they catch a lot of fish, and are they fishing the lakes and streams too hard? Creel censuses are conducted annually in the Okoboji and Spirit lakes by the Conservation Commission's fisheries biologists. These censuses indicate that about twice as many walleyes were caught in the winter of 1954-55 than during the first winter season. Lake surveys show an increasing abundance of walleyes in spite of the increased angling pressure. Since less than 2,000 walleyes are recorded caught each winter from West Okoboji, the take is probably less than the number that would be lost due to natural mortality each winter. Results of fish tagging in this lake during 1955 indicate a population of around 70,000 adult walleyes; consequently, the few caught by anglers in winter are of little significance. Total tag recoveries throughout the entire year of open season suggest a total catch of approximately 25 per cent of the adult crop annually. With recruitment through natural reproduction and stocking, the lake's walleye population is being adequately maintained.

Now to return to the subject of angling for the walleye, a few concluding remarks should be in order. First of all, whether you fish every day throughout the open season, or just a few days in summer or winter, remember this: you are out there for recreation. It's something you can't buy at the butcher shop or have prescribed for you at the drug counter. I have seen some anglers fish so hard and long that they were ready to drop from exhaustion. So take it easy and have more fun with your fishing. Also, you don't need a tackle store full of equipment along when you fish walleyes. If you still-fish or troll with live bait, your tackle is simple and inexpensive. Casting equipment can and should be of high quality and in the long run, the cheapest is the best you can buy. A half-dozen well-chosen lures is about all you will find the experienced walleye fisherman using, but these have been selected from hundreds of virtually useless creations. If you're the creative type and have a do-it-yourself complex, the home workshop can turn out the equal to any commercially made plugs or flies.

Concerning the time to go fishing—there is really only one best time, and that is when you can. If you don't have time—take it. Disregard barometric pressure, moon phase, zodiac, temperature, wind direction, season and all other so-called influences, especially the gadgets that predict best periods. Sure, some times are better than others, but walleyes can't read the tables! The old adage, "God does not deduct from man's alloted time those hours spent on fishing" is not true, but rest assured your ulcers won't get bigger while fishing.

Growth Rates of Iowa Fishes

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The growth rate of fish is more flexible than is that of most other animals. If conditions are unfavorable, fish may live for several months or even years with little or no growth. Then, if conditions favor growth, they may grow very rapidly. Man grows in his youth and usually shows no further growth after he reaches maturity (except, too often, growth around his middle). Fish, on the other hand, retain the ability to grow rapidly whenever environmental conditions are favorable. The study of fish growth is therefore a valuable indicator of the degree to which the environment is favorable.

The most important cause of slow growth in fishes is probably overcrowding. When there are too many fish in a lake or stream, none of them seem to get enough to eat. There is also a possibility that crowding has some psychological effects on the fish, resulting in slow growth. The extremely abundant populations of four- to five-inch bluegills or bullheads in many farm ponds are examples of overcrowded, stunted fish.

Water temperature also greatly affects the growth of fish. Most fish do not grow in the winter, and the water temperatures must usually be over 60° F. before bass or sunfish will grow. The length of the growing season for fish is longer in the south than farther north, roughly paralleling the growing season for field crops. Furthermore, the growth rate increases as the water temperature increases, up to certain limits, where growth may again decrease or even stop. Because of the longer growing seasons and higher average water temperatures, most fish grow more per year in the south than they do in the north. Northern fish usually live longer, however.

Biologists usually determine the age and growth of fish from the study of rings on the scales, on the spines, or on certain bones of fish. The rings formed during the winter when growth is slow or stopped are closer together and appear darker than those formed in summer. The age of the fish can be determined by counting the number of winters through which the fish has passed, much as the age of a tree can be determined from the rings in the stump.

The table which follows gives the average sizes which may be expected for several species of Iowa fishes at different ages. Individual fish may differ greatly from these averages. For example, some Iowa walleyes were only 10 inches long when three years old, while others were 18.5 inches long at the same age. The averages are based on many scientific studies in Iowa and neighboring states (references to these and other studies are listed in "Handbook to Freshwater Fishery Biology" by Carlander, 1953). The sizes are averages for midsummer when most fishermen see the fish. Thus, for example, the one-year-old fish are about 13 to 15 months old.

Sizes at Each Year of Age

	1	2	3	4	5	6	7	8	9	10
Bass, largemouth										
Length in inches	6.5	10.0	11.6	13.1	15.0	15.9	17.1	18.0	18.4	19.4
Weight in ounces	2.0	7.8	12.3	17.6	26.6	31.7	39.4	46.0	49.3	57.0
Bass, Smallmouth										
Length in inches	5.4	8.1	10.0	12.1	13.1	14.0	14.5	15.4	16.2	16.4
Weight in ounces	1.1	3.9	7.5	14.0	17.0	20.5	23.1	28.7	32.2	33.5
Bass, Rock										
Length in inches	3.0	4.8	5.9	6.6	7.3	8.0	8.5	9.3	9.7	10.2
Weight in ounces	0.3	1.2	2.3	3.3	4.4	5.8	7.0	9.1	10.4	12.2
Bass, White										
Length in inches	9.0	10.6	13.7	14.1	14.5	14.8	15.0	15.3	16.3	
Weight in ounces	5.0	8.5	18.1	20.5	23.0	24.5	26.0	27.5	35.0	
Bass, Yellow										
Length in inches	5.0	6.9	8.6	9.5	10.0	10.3	10.5			
Weight in ounces	1.0	2.8	4.8	7.1	8.4	9.8	10.5			
Bluegill										
Length in inches	3.2	5.5	6.4	7.0	7.8	8.2	8.5	9.1	9.4	
Weight in ounces	0.4	1.8	3.2	4.2	6.1	7.0	8.0	9.7	10.7	
Bullhead, Black										
Length in inches	3.2	6.5	7.5	8.0	9.1	10.3	11.2	11.9	12.2	
Weight in ounces	0.4	2.0	3.9	5.1	7.5	10.0	13.0	16.0	18.0	
Carp										
Length in inches	9.7	14.5	16.0	17.3	19.5	19.7	20.7	21.6	23.0	24.0
Weight in pounds	0.5	1.4	2.0	2.6	3.1	3.6	4.1	4.7	5.9	6.5
Catfish, Channel										
Length in inches	5.5	9.5	11.7	13.3	15.6	17.8	21.0	22.0	24.8	26.0
Weight in ounces	0.3	4.0	7.3	11.3	18.7	29.0	49.0	57.0	86.0	102.0
Catfish, Flathead										
Length in inches	6.1	10.0	12.0	16.0	17.6	21.2	25.7	28.0	33.2	34.6
Weight in pounds	0.1	0.5	0.8	1.9	2.6	4.5	8.2	10.5	17.5	20.0
Crappie, Black										
Length in inches	5.2	7.2	8.5	9.9	10.5	11.7	13.6			
Weight in ounces	1.0	2.9	4.7	7.8	9.0	12.6	20.5			

Sizes at Each Year of Age

	1	2	3	4	5	6	7	8	9	10
Crappie, White										
Length in inches	5.6	7.4	8.4	9.7	11.5	12.0	13.8			
Weight in ounces	1.1	2.9	4.3	6.5	11.6	13.3	20.0			
Perch, Yellow										
Length in inches	4.4	5.9	7.1	8.1	9.0	10.1	11.2			
Weight in ounces	0.6	1.5	2.6	3.9	5.5	7.3	10.1			
Pike, Northern										
Length in inches	11.5	16.0	19.8	21.1	23.2	27.0	29.0	32.0	35.4	38.0
Weight in pounds	0.4	1.0	1.8	2.4	2.9	4.6	5.6	7.6	10.2	12.7
Pumpkinseed										
Length in inches	2.2	4.1	4.8	5.4	6.0	6.8	7.2	7.8		
Weight in ounces	0.1	0.9	1.3	1.9	2.6	3.9	4.5	6.0		
Trout, Brook										
Length in inches	5.5	7.4	9.0	12.0						
Weight in ounces	1.2	2.0	3.2	10.0						
Trout, Brown										
Length in inches	6.0	8.0	11.8	13.0	15.0	21.4				
Weight in ounces	1.2	2.9	9.5	12.6	19.4	56.0				
Trout, Rainbow										
Length in inches	6.2	9.5	12.0	14.0						
Weight in ounces	1.3	5.4	9.5	15.3						
Walleye										
Length in inches	8.1	11.7	14.0	16.1	18.1	18.9	21.2	22.5	23.5	24.9
Weight in ounces	2.9	8.8	14.9	22.7	32.4	37.0	54.5	61.6	72.0	85.0
Warmouth										
Length in inches	2.9	5.2	6.8	7.6	7.9	8.2	8.7			
Weight in ounces	0.2	1.5	3.2	4.8	5.5	6.0	6.8			

Three-Layered Lakes

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Many a youthful swimmer has dived into the old swimming hole on a hot summer day and come up exclaiming, "Sure cold down there!" His buddy says, "There must be a lot of springs down there." On the other side of the pond a fisherman is muttering to himself about poor fishing, wondering why a fish won't grab that big nightcrawler lying there on the bottom. Both the swimmers and the fisherman were experiencing the effects of the curious but important phenomenon where the waters in many lakes and ponds separate into a warm upper layer, floating on top of a cold bottom layer during the summer months. The boys were noting the change in temperatures and not springs. The fisherman was actually trying to catch fish from the bottom of the pond where there were not fish because of a lack of oxygen.

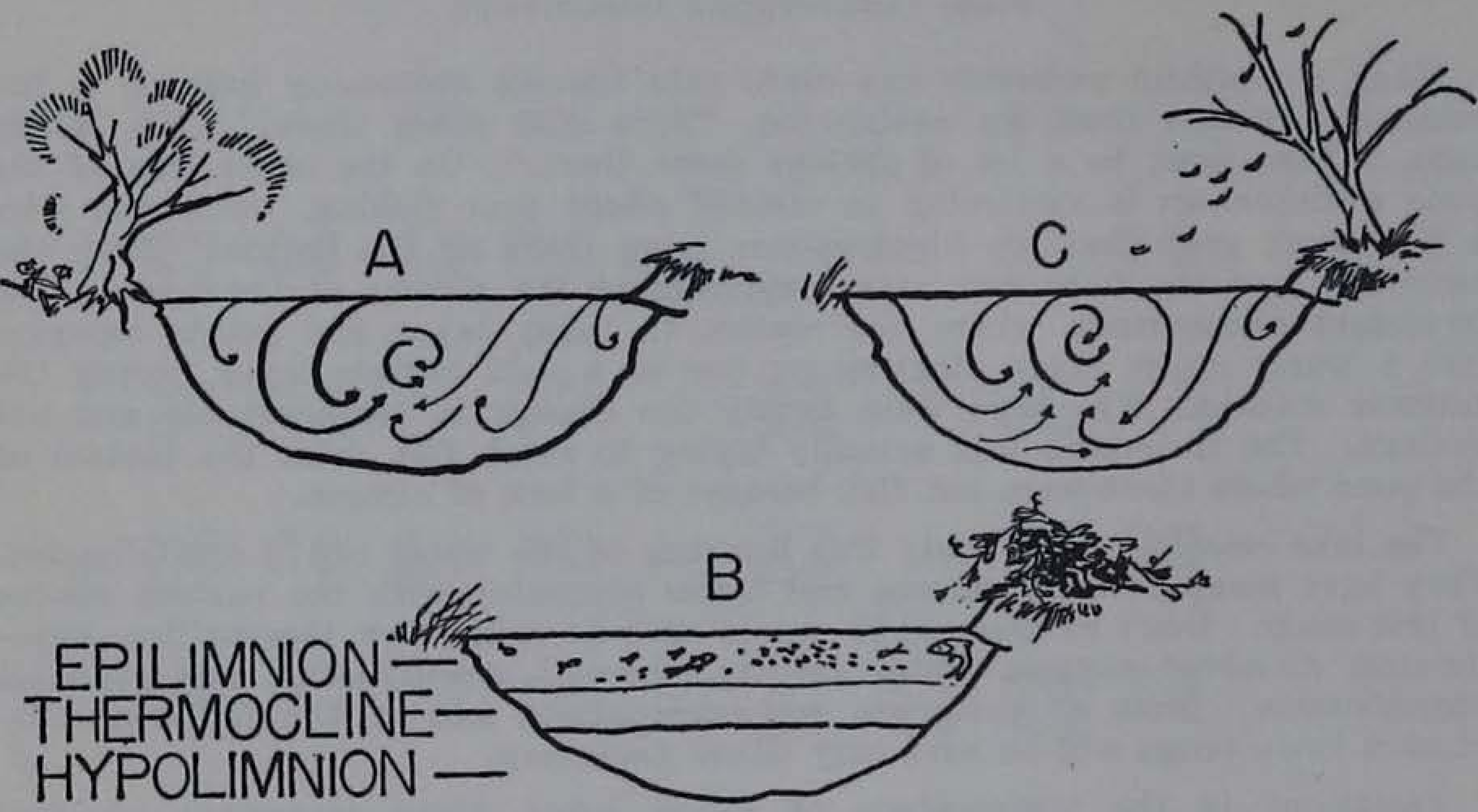
The lake scientists who study this layering of the water call it stratification. They have many technical names and terms connected with the various phases of this study. Don't be alarmed by words such as epilimnion, thermocline, hypolimnion, dissolved oxygen, water density, thermal stratification, and chemical stratification. Most of them are self-explanatory, and in the following discussion these terms will be used only where necessary.

Variations in the temperature of water bring about important physical changes. These eventually influence not only fish but most other aquatic life in certain lakes and ponds. Water actually becomes more dense or heavier as it is cooled and lighter in weight with an increase in temperature. Strangely enough, water does not reach its maximum weight at 32° F. or the freezing point. Water is heaviest at 39.2° F.; at temperatures below this, water again becomes less dense. When the surface water is cooled, becoming heavier, it sinks, thus forcing the warmer bottom water to the surface. This warm water is then cooled and the cycle repeats itself. The speed and extent of this circulation depends on many factors such as air temperatures, amount of wind, size, shape and location of the lake or pond.

In the fall of the year with a reduction of air temperatures below that of the water, the surface water is cooled day by day, sinking to the bottom until all the water is at the same temperature, 39.2° F. At this point the entire body of water is easily mixed by wind action, and the water takes on large quantities of oxygen that will be needed by fish and other aquatic animals during the winter months. The surface water continues to cool and to become lighter and finally freezes.

Right after the ice goes out in the spring, we have a condition in which warmer and heavier water lies beneath colder but lighter surface water. As this surface water warms, it becomes heavier and sinks, thus setting up another period of circulation that lasts until all the water is once again at 39.2° F., and again the entire body of water is mixed from top to bottom by wind. These two periods of circulation are appropriately called the fall and spring overturns. The finer details and variations in the fall and spring overturns are governed, as mentioned above, by air temperatures, wind action, size and location of pond or lake.

Following the spring overturn the surface water continues to be warmed by the rising air temperatures, becoming lighter and thus losing the tendency to sink. The surface temperature continues to rise until this layer of water is much warmer, possibly 20° F., than the underlying water. This comparatively warm water has less resistance to circulation or mixing by wind action, and therefore the wind mixes the water to lesser and lesser depths until even a summer storm may mix the water only part way to the bottom. At this point a series of temperature readings at regular intervals (usually three feet), from surface to the bottom in the deep part of the lake, would reveal that there were actually three distinct layers of water, each having very definite temperature characteristics.



After the ice melts in the spring a lake circulates thoroughly. A. During the summer the lake may stratify thermally. B. The epilimnion is usually warm, with good oxygen supply, the thermocline, or middle layer shows a drop of temperature increasing with depth. The hypolimnion is cold, stagnant, containing little or no dissolved oxygen. C. In the fall there is again a complete mixing of the lake water with oxygen found at all depths.

In the series of temperature readings we would find very little difference in the first few feet of water or surface layer. Then there would be an abrupt change of several degrees, as indicated above, possibly as much as 20 degrees. This abrupt drop brings us into a second layer of water where the temperature changes rapidly, getting much cooler each time we take the reading at a deeper point. This second layer is known as the thermocline, and by definition this layer qualifies as a thermocline only if there is at least 1.62° F. drop in temperature for each three-foot greater depth. The third or bottom layer is reached when this qualification is no longer met, in other words, a layer of cold water of fairly uniform temperature clear to the bottom. The technical names of these three layers from top to bottom are as follows: epilimnion, thermocline, and hypolimnion. For simplicity the terms surface layer, thermocline, and bottom layer will be used in the following discussion. This layering of the water according to temperature is called thermal stratification.

Now you might think that this layer of water on the bottom would be just what the doctor ordered for fish—a nice cool layer of water in which to retreat on a hot summer day. But that is not the way it works.

Our fishing waters drain rich fertile soil, and thus the water has a high fertility and the bottom deposits are rich in organic material. Fertility produces large quantities of small plant and animal organisms, as well as fish. All these need oxygen for respiration. When these organisms die, the resulting decomposition reduces the supply of dissolved oxygen in the water. In the upper or surface layer of water there is an ample supply of oxygen that is continually being replaced by wind action and by plants. Decomposition and loss of oxygen is taking place in this upper layer, but the oxygen consumed is more than offset by oxygen added by circulation and plant activity.

On the other hand, profound changes occur in the bottom layer, where oxygen cannot be replenished because of its isolation from the upper layer by the thermocline. Wind action does not reach this deep area, and plant life is limited by the depth to which sunlight can penetrate; therefore, there is very little oxygen produced or added to this bottom layer. Bottom deposits and suspended organic material in this lower layer soon exhaust the supply of life-giving oxygen. As the summer progresses the oxygen supply is often removed or reduced to lethal levels even in the thermocline. There are several other chemical changes that take place along with the decline in oxygen, but the loss of oxygen is the most important and the only chemical change that will be considered here. These changes in the chemistry of the water layers are called chemical stratification.

Stratification takes place in most of our state-owned artificial lakes and most of the city reservoirs. Farm ponds, gravel pit lakes, and strip mine waters also stratify. West Okoboji Lake is the only natural lake in Iowa that becomes stratified. The other natural lakes go through a modified spring and fall overturn, but do not stratify during the summer. Their temperature is about the same from top to bottom during the summer months.

The degree of the thermal and chemical stratification is as varied as the lakes and ponds themselves. The upper layer may vary in thickness from 60 feet in West Okoboji to as little as three feet in a farm pond. Some lakes and ponds do not have a typical stratification as we have described; they often lack a definite hypolimnion layer. There are borderline waters where the temperature layers are not produced each year, or perhaps only temporarily during summers of favorable weather conditions. In a few lakes in certain years there is enough oxygen in the thermocline to support fish through the summer. (In some of the deep infertile lakes of northern United States, thermal stratification takes place but the chemical stratification does not, and therefore sufficient oxygen remains in the cold bottom layers to support fish life.) In the artificial lakes and the city reservoirs the surface layer extends from 6 to 15 feet, occasionally as little as 5 feet and rarely over 21 feet.

Thermal stratification in southern Iowa has been noted as early as the first week in May, but the loss of oxygen in the bottom layer is not usually evident before the first week in June. By the middle of August there is often insufficient oxygen in the thermocline layer to support fish.

This brings us to the most important part of our discussion, consideration of what happens to the fish population in a lake that is thermally and chemically stratified. No doubt you have put two and two together by now and figured out why you failed to catch any fish near the bottom in that deep area last August when you fished in the same deep water where you caught a nice string of fish on the 15th of May. Of course, the lake had stratified in the meantime and the oxygen was reduced to a point where the fish were forced to move to the surface layer where the water contained enough oxygen. Yes, in lakes that lose oxygen in the lower layers, the entire fish population residing there move toward the surface and then finally into the surface layer. A few individuals may forage on the bottom or within the bottom layer, but only for very short periods of time. Experimentation has shown that fish cannot long survive in the bottom oxygenless layer.

Thus stratification can actually limit the species of fish that can live in these lakes. Only those that can adjust themselves to the relatively warm surface layer of water do well. Largemouth bass, bluegills and crappies seem to be the best adapted to the southern Iowa waters that stratify, while walleyes, perch and northern pike require cooler water in order to prosper.

Although there is no way for the average fisherman to determine just what the conditions are at any one time in the lake he is fishing, there are a few simple ways that may help to determine whether or not the lake is stratified. One method involves the use of a pop bottle. Weight the bottom of the bottle and tie a long length of stout cord to the neck. Then fasten a cork to the cord about three to six inches above the mouth of the bottle. Insert the cork, lower the outfit into the water to the desired depth, and give the string a healthy tug, thus pulling the cork and filling the bottle with water from that particular depth. The temperature of the water can then be checked with a thermometer or by pouring a little of the water on your wrist. If you have live minnows, put one small minnow in the bottle of water and observe his reactions. The minnow will soon let you know whether or not there is enough oxygen. Also smell the samples from various depths. Water from the deeper parts of the lake often has a strong odor of decomposition that accompanies the lack of oxygen.

Another way consists of lowering a large sinker about five feet into the water and leaving it for about five minutes, then raising it quickly and touching it to the inside of your wrist, making a mental note of whether or not it feels warm or cold. Repeat this at about two- or three-foot intervals until you feel a sharp change in the temperature of the sinker. This will give you a rough idea of the depth of the surface layer. If you are using minnows for bait, drop one to the bottom in the deep area and leave it there for a period of time, remembering that even with low oxygen conditions it may take a half hour to kill the minnow. Once you have determined that the deeper areas are low on oxygen, you can be sure that conditions will not improve until the fall overturn.

Each fisherman cannot carry special thermometers and a chemical kit to determine to what depth the surface layer extends or how much oxygen the thermocline contains, but each angler should realize that stratification does take place in many of the lakes in which he fishes and that this stratification can affect his catch. The bullhead angler who habitually fishes from the edge of the dam of an artificial lake, casting a heavy sinker and bait to the deepest part of the lake, will catch fish early in the season and again late in the fall, but during the summer months he will likely have poor luck. He should try fishing in much shallower water, or adjust a bobber at different levels, casting out and reeling in until the bait touches bottom. In this manner he can determine where the bullheads and other bottom-feeding fish are located.

In the evening or early morning, the fly fisherman has little to worry about, since the fish he is after come to the surface to feed. On the other hand, the boat fisherman going out during the day should consider the business of stratification quite seriously. As a rule, the adult fish will avoid the bright light of the surface waters in clear ponds or lakes, but they cannot go too deep if the oxygen has been depleted in the lower layers. The trick then is to fish at the correct depth. You may catch crappies at the six-foot level in one lake and at the 12-foot level in another. During the day, in the heat of the summer, big bass will retreat as far down as they can go without actually resting in the oxygenless water, then work into the shallow weedy areas to feed during the twilight hours. All species of fish seem to show a tendency to be distributed according to size, with the smaller individuals in the shallow water and the larger ones in progressively deeper water. The principal thing to keep in mind is that in the lakes that stratify you will not find fish near the bottom in the deep areas.

Don't let this business of stratification upset your fishing; through a little change in technique you should be able to turn it to a good advantage. Keep in mind that all Iowa lakes and ponds do not stratify, that stratification is present only during the summer months, and that fish are going to move out of the deep areas into upper layers of water containing more oxygen in those lakes that do stratify.

Biologists of the Conservation Commission have gathered information in regard to the stratification of a number of the artificial lakes and reservoirs. These can be placed in three groups: one, those that do not stratify—Allerton Reservoir, West City Reservoir at Osceola, Lake McKinley, Summit Lake; two, those that have a temporary stratification or stratify only during favorable weather conditions—Lake Macbride, Loch Ayr (Mt. Ayr city reservoir), Lake Darling, Corydon Reservoir, Fisher Lake (Bloomfield city reservoir), Green Valley Lake, Rock Creek Lake, Lake of Three Fires, Crystal Lake (Chariton), Humeston Reservoir; and three, those that stratify each year—Fairfield Reservoir (No. 1), Nodaway Lake (Greenfield Reservoir), Geode Lake, Lake Keomah, Lake Keosauqua, Lake Wapello, Des Moines city reservoir, Lake Ahquabi, Afton Reservoir, Albia Reservoirs (both upper and lower), Cold Springs, Centerville Reservoirs, East City Reservoir at Osceola, Corning Reservoir (old), Montezuma Reservoir, Nine Eagles Lake, Williamson Pond, Red Haw Lake, Springbrook Lake, and Beeds Lake. As we mentioned earlier, the only natural lake that stratifies is West Okoboji. We know that there are many farm ponds and other waters that also stratify, but such a list would be impractical at this time.

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PLATE 18

SLENDER DARTER ***Percina phoxocephala*** **(Nelson)**

NORTHERN LOGPERCH ***Percina caprodes semifasciata*** **(DeKay)**

CENTRAL JOHNNY DARTER ***Etheostoma n. nigrum*** **Rafinesque**

BANDED DARTER ***Etheostoma zonale*** **(Cope)**

RAINBOW DARTER ***Etheostoma caeruleum*** **Storer**

STRIPED FANTAIL DARTER ***Etheostoma flabellare lineolatum*** **(Agassiz)**


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Chapter XIX

THE DISTRIBUTION OF THE FISHES OF IOWA

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INTRODUCTION

It has long been the practice of the business world to take periodic inventories of stocks on hand. Since conservation is a big business, annual inventories are made on the principal fish and game species in the state. The status of less important species, however, are either little understood or are found in scattered references here and there throughout the chronicles of the state and its resources.

Records on the distribution of a state's fauna, besides being of academic interest, are highly important to those entrusted with the management of the fauna, in this case the fishes of Iowa. A knowledge of the ecological or habitat requirements of a species of fish, coupled with a pin-pointed distributional pattern, indicates where these ecological conditions exist in the state. For instance, certain species such as the darters generally are not found in polluted areas; other species such as the sculpin live only in water where the requirements are suitable for trout; the presence or absence of certain species indicates turbid water and so forth. Therefore, with the distributional patterns as indicators of water conditions, the fishery technician is better equipped to manage that resource on a scientific basis.

In addition, a knowledge of past as well as present distributional patterns serves as an accurate gauge to changing conditions in our rivers and lakes. In many cases, especially in rivers, this may be a water quality reduction or a senescence of compatible habitat. The fact that many non-game species are no longer found in the waters of the state should serve warning that this extirpation can also happen to much sought-after species. A glance at some of these distribution maps will give some indication of the retrenchment which some species have undergone.

This study is based chiefly on 1,561 recent collections made at 809 different locations over the state. During the period 1945 to 1955, E. T. Rose and Tom Moen made and identified 491 collections in the natural and artificial lakes of the state, H. M. Harrison made and identified 498 collections from the streams of central and western Iowa, and the author made and identified 572 collections in eastern Iowa. Unusual or difficult specimens were identified or verified by Dr. Reeve M. Bailey. The locations of these collections are shown on Map 1, and are denoted on the individual distribution maps as solid dots. Obviously, all waters of the state could not be sampled in the time allotted to this study, and undoubtedly certain species were missed due to the vagaries of the fish and of the collecting techniques employed.

In order to enlarge this coverage and to allow for comparison with fish distribution as it was reported prior to 1945, every effort was made to utilize fish lists made in published literature, unpublished field notes, catalogued collections, and even unworked fish collections which were still in their original preservatives. In addition to the above sources, numerous collections were made at some 21 Iowa locations in 1946 and 1948, on the Mississippi River by the Upper Mississippi River Conservation Committee (UMRCC). All collections not made in the last decade by the four state fisheries biologists mentioned above appear as open circles on the species distribution maps.

In order to avoid confusion in symbols, if recent and early collections were made at the same location, only the solid dot, signifying a recent collection, was mapped.

Standard collecting procedures were used. Most recent collections were made with a short drag seine; however, various types and sizes of seines, hoop-nets, trapnets, and electro-fishing devices were also used. Specimens observed or taken by anglers and commercial fishermen, and those observed during various fish-kill investigations were also incorporated into this work.

Many of the early collections, especially those of Meek's, are scattered in various museums throughout the country and could not be verified by the author. Rather than to disregard arbitrarily these and all other unverified published and unpublished distribution observations recorded by competent observers, all records except the obviously confused ones were accepted at face value and included in this work. Such literature or manuscript reports were denoted as such by open circles on the maps.

The recent collections are housed in part in the various stations of the Iowa Conservation Commission. Portions of the collections are also in the museums of Iowa State College, Iowa State Teachers College, Coe College, Wartburg College, and the University of Michigan. Collections made by Salyer, Hubbs, and Speaker in the 1930's are, for the most part, in the University of Michigan Museum of Zoology (UMMZ); collections by Bailey are stored mainly in the Iowa State College collection (ISC), with some specimens stored at the University of Michigan. The collections of the UMRCC-Northern Section are stored at the University of Wisconsin. The small-fish collections of the Southern Section of the UMRCC which were from the Dubuque, Iowa-Caruthersville, Missouri, section of the river will be housed at the Illinois Natural History Survey Museum and the University of Michigan. These collections are being processed and have not been studied by the author. This accounts for the paucity of small-fish annotation in the southern section of the Mississippi River.

The annotation of abundance is relative and is based entirely on the individual collector's judgment. Since certain populations may shift in abundance with time, individual sample abundance is of relatively little importance in distributional work and is used only as an index to the findings at the time each collection was made.

Historical

In 1884, David Starr Jordan and Seth Meek made several collections of fish in the state and published on their findings in 1885. This was the first recorded collection of fish, as such, from Iowa. In 1889 and 1890 Meek also published two short discourses on the native and food fishes of the state.

Following these brief studies, Meek, while a professor of biology at Coe College, Cedar Rapids, made an intensive survey of the state's fish distribution during 1889 to 1891. In 1892 he published a comprehensive bulletin on his findings. This publication has been both valuable and annoying to later students of Iowa fish distribution. Despite transportation difficulties, Meek made a valuable contribution to fishery science by collecting at 67 locations in the state. It is unfortunate that some of Meek's records and identifications are confused, especially in the genera *Carpiodes*, *Moxostoma*, and in those species of *Notropis* having a black lateral band. In 1892 Ellsworth Call reported on collections in the Des Moines River basin which were made by him personally or in company with Meek. Meek also published special species lists for the Cedar River (1893) and for the waters of western Iowa (1894).

In 1896 Evermann and Cox published a report on their collections of fish of the Missouri River basin, which included some collections made in western Iowa. In 1909 Forbes and Richardson published their classic volume "Fishes of Illinois", and of their collections made from 1876 to 1901, several were located in the Iowa-Illinois stretch of the Mississippi River. These were in the vicinity of Keokuk, Burlington, Davenport, and Dubuque and were made in the river proper, not in adjoining lakes or streams.

There was a lapse of 25 years in fish distribution work in Iowa, then in 1926, Larrabee reported on the fish of the Okoboji lake region, in Dickinson County. In addition to collections made from 1921 to 1925, Larrabee also drew on other investigations and previous collections to round out his annotated check-list.

In 1928, Potter and Jones revised the Iowa fish records. Their compilation, besides bringing previous literature collections into a single check-list, attempted to bring the nomenclature up to date. In 1930, Coker reported on collections made in Lee County and in the Mississippi River in the vicinity of Keokuk. This publication was based on collections made from 1913 to 1929. Churchill and Over, drawing on information collected from 1926 to 1928, published on the fishes of South Dakota in 1933. Some of their ranges were based on collections made in the boundary waters between Iowa and South Dakota, the Missouri and Big Sioux rivers.

In 1935, Greene published on the distribution of Wisconsin fishes, drawing on several collections made in the Iowa-Wisconsin portion of the Mississippi River. He also used some collections made by Hubbs, Salyer, and Speaker in eastern Iowa in 1932 to delineate the range of some Wisconsin species. These latter collections, while never published, were used as a basis of the fishery recommendations in the Iowa Twenty-five Year Conservation Plan (Wheeler and Olcott, 1933). They are included in this paper since access to the original field notes has been made through the courtesy of E. B. Speaker, Iowa Conservation Commission.

Aitken (1936) published a list of Iowa fishes in which the nomenclature had been brought up to date by Dr. Carl L. Hubbs. Aitken further revised his check-list in 1941. In 1945 Bailey and Harrison reported on the fishes of Clear Lake, and in 1948 on incidental collections made on the Des Moines River in Boone County. In 1950 Starrett published an annotated check-list of the fish of Boone County. In 1951, Harrison published his Annotated List of Fishes of the Upper Des Moines River Basin.

Bailey (1951) drew on more than 200 collections that he made from 1939 to 1944 which were never reported, as well as collections and observations made previous to that time, and devised a check-list of Iowa fish with keys for identification which was included in "Iowa Fish and Fishing" (Harlan and Speaker, 1951). Further, in 1951, Barnickol and Starrett published a report on collections made by the UMRCC field crew in 1944 and 1946 in that portion of the Mississippi River from Dubuque, Iowa, to Caruthersville, Missouri. Fifteen of these collections were made in the Iowa-Illinois portion of the river. Cleary (1952 and 1953) published check-lists of the Wapsipinicon River and the Iowa-Cedar River drainages. These lists covered more than 300 recent collections.

In 1953 a revised check-list of the Upper Mississippi River fish was published by the Upper Mississippi River Conservation Committee (UMRCC). It was drawn up by Lyle Christenson, Wisconsin Conservation Department. This list covered collections made in the Mississippi River from 1944 to 1948, from Hastings, Minnesota, to Dubuque, Iowa. The check-list was augmented through the use of the original collection notes; thereby locations more specific than pool numbers were incorporated into the present work. Bailey and Cross (1954) discussed the American distribution of the sturgeons of the genus *Scaphirhynchus* which incorporated collections made in the Iowa portions of the Mississippi and Missouri rivers. The most recent publication on the fishes of Iowa was made in 1954 by Harrison and Speaker. This was an annotated check-list of some 120 collections made by the authors in streams tributary to the Missouri River. In addition to this, the literature on the Missouri River fishes was covered.

In addition to the above publications, discussions on various inland river and stream collections were made by Cleary (1949) and Harrison (1949 and 1951). These were published in mimeographed form in the Biology Seminar Reports of the Iowa Conservation Commission. A manuscript on file at the Lakeside Laboratory on West Okoboji Lake, prepared by Dr. Raymond Johnson and entitled "Fishes of the Okoboji Region", was also used in this study.

Factors Influencing Distributional Patterns

The State of Iowa has been covered at different periods in the past with portions of four glaciers. The Wisconsin glacial drift covers that part of the state which we now associate with the flat lake country of the north-central and west-central parts of the state. The steep, eroded hills of the northeast and southwest are covered by Nebraskan drift. The low bottomland of the extreme southeast gives evidence of action of the Illinoian glacier. The balance of the state, including the southeast and central as well as the northwest, is covered with drift from the Kansan glacier. The last portion is moderately hilly land and is especially suited to farm pond construction.

The drainage of the state is accomplished by two great waterways. The Mississippi River and its tributaries drain roughly three-quarters of the state to the east, while the Missouri, with its major tributary, the Big Sioux River, takes the drainage of the remaining portion to the west. The natural lakes are primarily confined to the northwest and north-central parts of the state while the artificial or impounded lakes are found, by and large, in the southern half of the state.

Since the state's rivers and lakes are covered specifically as to their environmental features in Chapter I, suffice it to say that the natural lakes vary in size from less than 50 acres to nearly 6,000 acres and are normally clear. The rivers of northeast Iowa, as bounded on the west and south by the Iowa River, have relatively clear water, with rock and sand bottoms and light silt loads except in the lower reaches and after heavy run-offs. The upper Des Moines River watershed is substantially similar, but the river and its tributaries become more turbid to the south and east. The streams tributary to the Big Sioux are relatively clear, but those tributary to the Missouri in the south and west have heavy silt deposits and are for the most part turbid except during periods of extended drought.

Since specific information on distribution and habitat requirements is presented in the individual species accounts elsewhere in this book, this section covers only generally the distributional patterns presented by the fishes of the state. Geological, geographical, biological, and ecological influences may work alone or in conjunction with one another in determining the distribution of individual species. For instance, Iowa's trout streams are located in the northeastern part of the state, a geographical factor; they are all spring-fed, a geological factor; they offer a particular type of habitat, an ecological factor; and trout, which tolerate only constantly cold, well-oxygenated water, are limited to this type of stream, a biological factor.

In order to get a broad picture of distributional problems, it is necessary to deal in generalities concerning the factor or factors which limit fish to various localities. In this discussion only the visually obvious factors are used as delineators, and in most cases it is reasonably certain which was the dominant factor influencing species distribution. Certain species have such wide distributional ranges as to preclude the selection of a dominant factor in their distributional pattern. Other species are omitted from this discussion because there are insufficient data concerning their occurrence in the state.

General Distribution

The original distributional patterns of many Iowa species have been confused and extended by artificial transplants or stockings. Of the 140 species and subspecies found in Iowa waters, 89 are common to both major drainage systems of the state, the Mississippi and Missouri rivers. Of the remaining species, 47 are found only in the Mississippi drainage.

There are four fishes which are found only in the Iowa portion of the Missouri River drainage. The inclusion of the silverstripe shiner as one of the four may be erroneous due to a mislabeled collection.

Hybopsis gracilis, flathead chub
Hybopsis gelida, sturgeon chub
Hybopsis meeki, sicklefin chub
Notropis illecebrosus, silverstripe shiner

Two species seem presently confined to the natural lakes and are found in no other waters in the state. These are the banded killifish, *Fundulus diaphanus menona* and the scaly Johnny darter, *Etheostoma nigrum eulepis*.

There are several groups of flowing-water species which have similar habitat requirements in Iowa. In the major or large rivers certain species inhabit the deeper parts of the channel where the current is of varying velocity, usually moderate to strong. There is also a group of fishes which are found primarily in large streams and most often in rock or gravel riffles where the water is shallow and the current swift. Both groups inhabit that portion of the river which has a hard sand or gravel bottom with occasional limestone or igneous rock rubble.

Channel Forms

Polyodon spathula, paddlefish
Acipenser fulvescens, lake sturgeon
Scaphirhynchus platorynchus, shovelnose sturgeon
Hiodon tergisus, mooneye
Carpiodes, forbesi, plains carpsucker
Carpiodes velifer, highfin carpsucker
Hybopsis storeriana, silver chub
Hybopsis aestivalis, speckled chub
Notropis atherinoides, emerald shiner
Notropis blennius, river shiner
Notropis amnis, pallid shiner
Notropis volucellus wickliffi, channel mimic shiner
Pimephales vigilax perspicuus, bullhead minnow
Pylodictis olivaris, flathead catfish
Stizostedion canadense, sauger
Percina shumardi, river darter

Riffle Forms

Hybopsis sp., gravel chub
Noturus flavus, stonecat
Percina phoxocephala, slenderhead darter

Certain fishes are found most generally in small, clear, warm-water streams which have a moderate current and a hard bottom of sand, gravel, or rock rubble. Certain forms inhabit the riffles of this type of stream and, for the most part, are not found in any other habitat.

Stream Forms

Hypentelium nigricans, northern hog sucker
Hybopsis biguttata, hornyhead chub
Notropis rubellus, rosyface shiner
Notropis dorsalis, bigmouth shiner
Notropis deliciosus, sand shiner
Pimephales notatus, bluntnose minnow

Campostoma anomalum, stoneroller

Clear-water Riffle Forms

Moxostoma duquesnei, black redhorse
Etheostoma zonale, banded darter
Etheostoma caeruleum, rainbow darter
Etheostoma s. spectabile, northern orangethroat darter

Certain Iowa species are limited in their distribution to cold, clear water, usually in small, spring-fed creeks. In addition to the three species of trout, the brown, *Salmo trutta*, the rainbow, *Salmo gairdneri*, and the brook trout, *Salvelinus fontinalis*, whose populations are primarily maintained by artificial hatching and stocking, there are three other forms, as follows:

Rhinichthys cataractae, longnose dace
Cottus cognatus, slimy sculpin
Eucalia inconstans, brook stickleback

There are also certain Iowa forms which have an affinity for rooted vegetation and possibly for soft bottom covered with plant detritus. These species are found in lakes, sluggish areas in streams, and river overflow ponds. Certain of these forms are sometimes taken from non-weed areas, but our collections show a definite preference for a vegetated habitat.

Amia calva, bowfin
Umbra limi, central mudminnow
Esox americanus vermiculatus, grass pickerel
Minytrema melanops, spotted sucker
Erimyzon sucetta, lake chubsucker
Notemigonus crysoleucas, golden shiner
Chrosomus erythrogaster, southern redbelly dace
Notropis chalybaeus, ironcolor shiner
Notropis roseus, weed shiner
Notropis heterodon, blackchin shiner
Notropis heterolepis, blacknose shiner
Fundulus diaphanus menona, banded killifish
Fundulus notti dispar, starhead topminnow
Fundulus notatus, blackstripe topminnow
Aphredoderus sayanus, pirate perch
Chaenobryttus gulosus, warmouth
Etheostoma chlorosomum, bluntnose darter
Etheostoma exile, Iowa darter
Etheostoma microperca, least darter

Since almost all our streams and some of our lakes are without the vegetated habitat required by the above species, it is not surprising to note that with the exception of the bowfin, all other species are either very limited in abundance and location or are actually thought to be extinct in the state.

The extirpation of fish species from state waters is a gradual process, and a vestige of a population may remain unnoticed for years, only to be discovered long after the species has been thought to be extinct. For instance, the blacknose shiner, *Notropis heterolepis*, collected by Meek in the 1890's, was thought to be extinct in Iowa. However, in 1941 Dr. Raymond Johnson collected this species in a small stream feeding into West Okoboji Lake. This collection marked at that time the only recent incidence of this species in state waters. In 1955 it was found to occur in average abundance in Trumbull Lake, Clay County. Therefore, in the following, the listed species are *thought* to be extinct. At least they are so rare they have not been taken in any of the recent collections in Iowa.

Scaphirhynchus album, pallid sturgeon
Alosa chrysochloris, skipjack herring

Alosa ohiensis, Ohio shad
Esox masquinongy, muskellunge
Moxostoma carinatum, river redhorse
Erimyzon sucetta, lake chubsucker
Gila elongata, redside dace
Hybopsis gelida, sturgeon chub
Notropis illecebrosus, silverstripe shiner
Notropis chalybaeus, ironcolor shiner
Notropis heterodon, blackchin shiner
Lepomis megalotis peltastes, northern longear sunfish
Percina evides, gilt darter
Ammocrypta asprella, crystal darter
Etheostoma microperca, least darter

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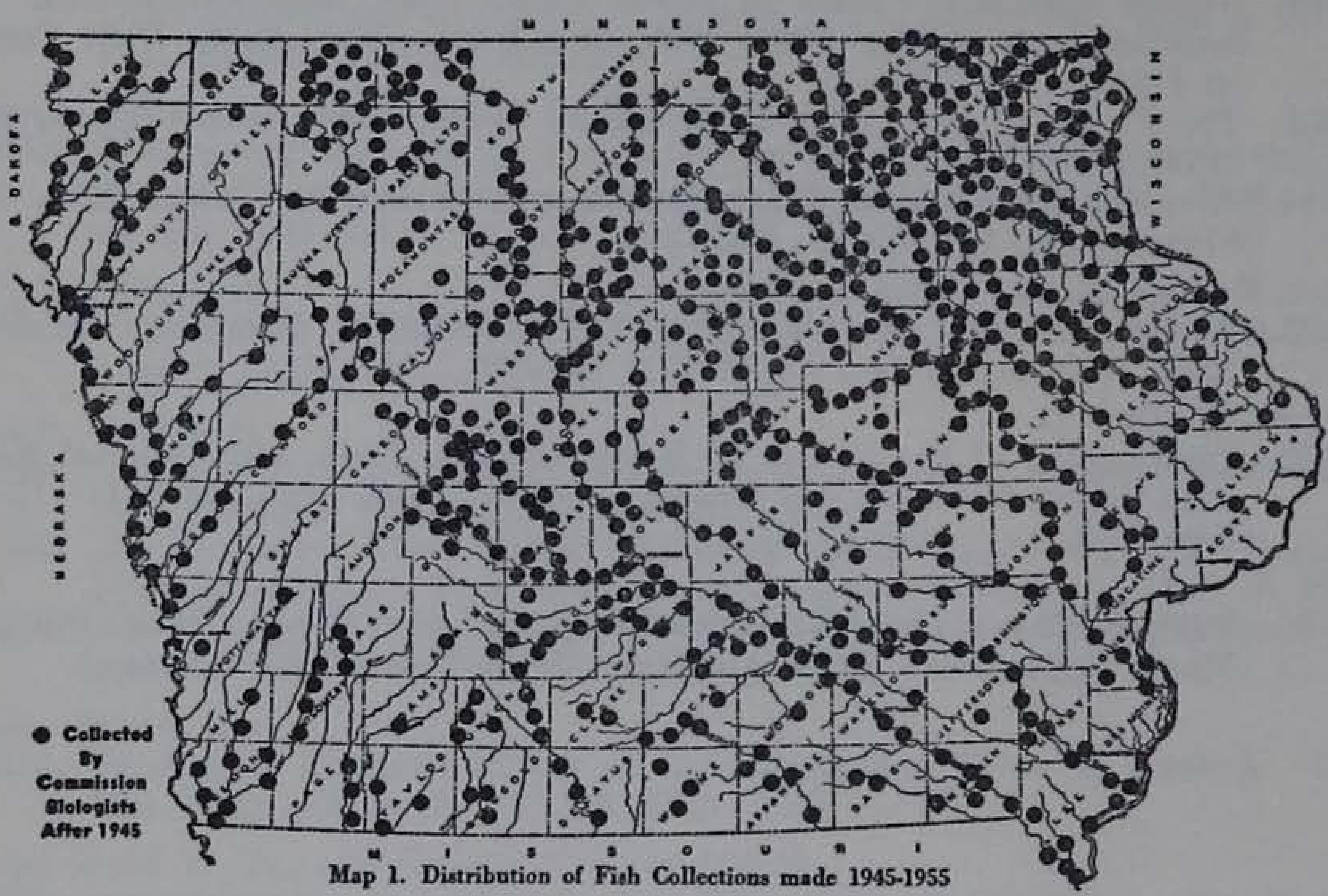
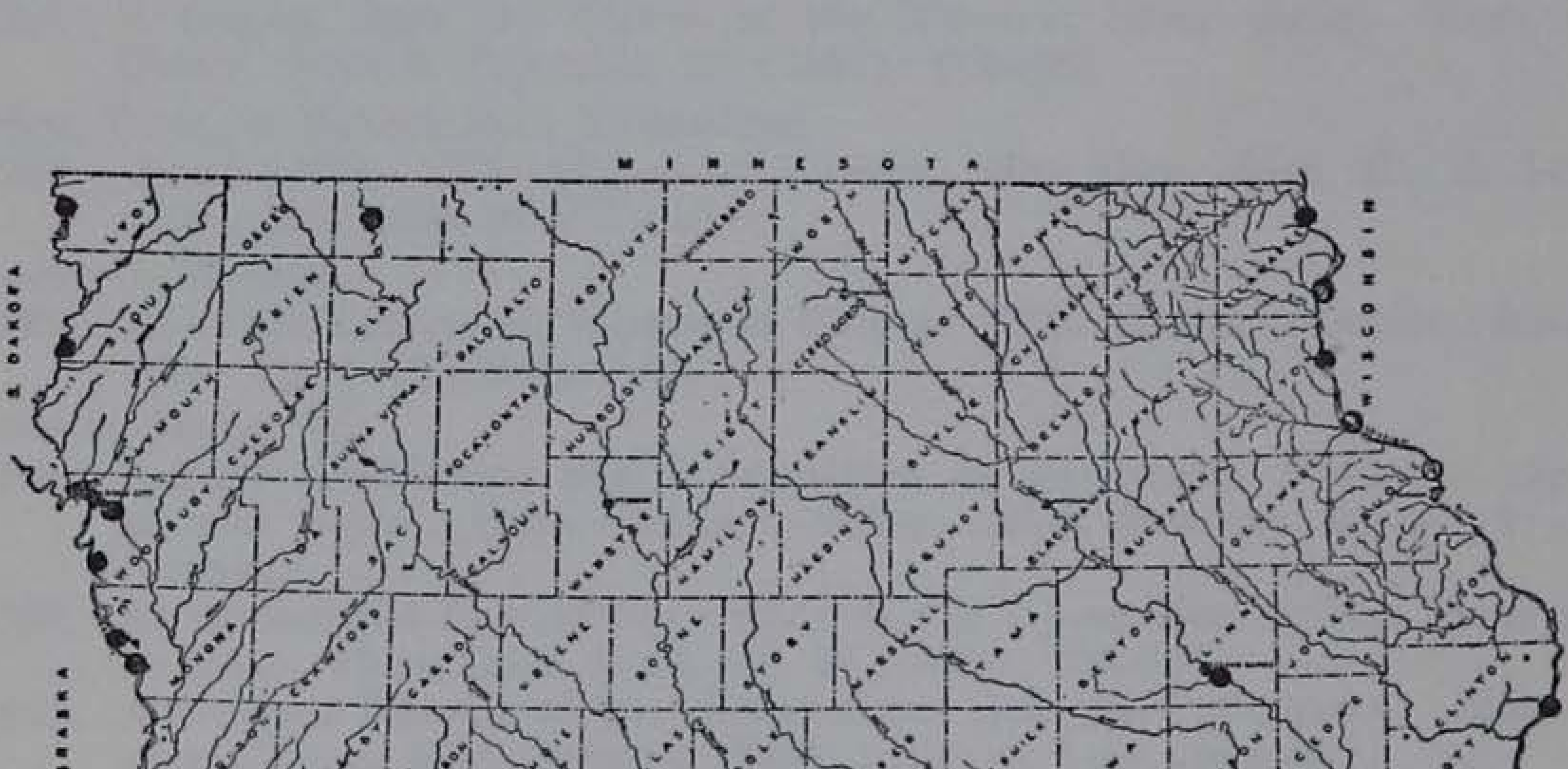
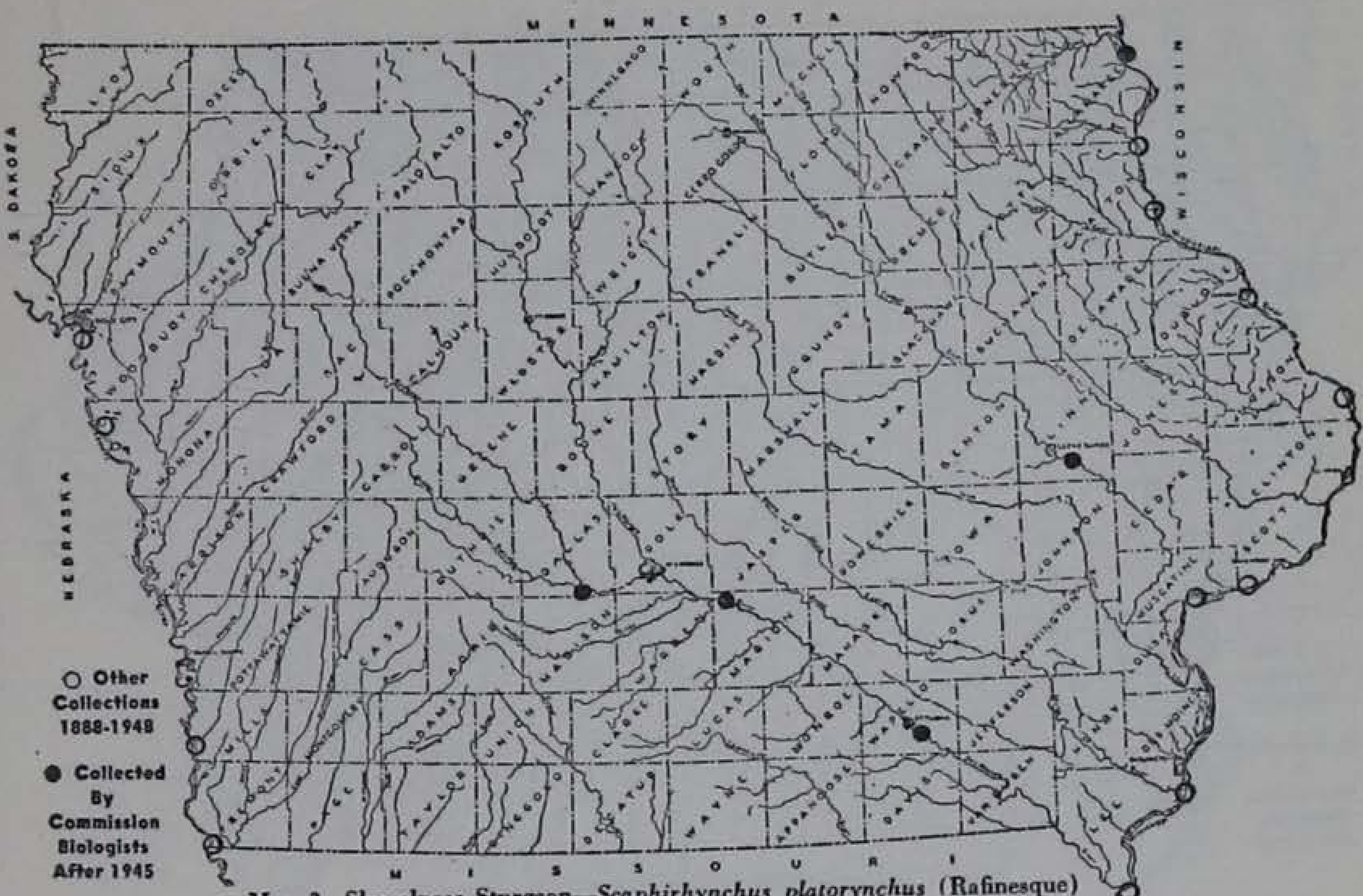


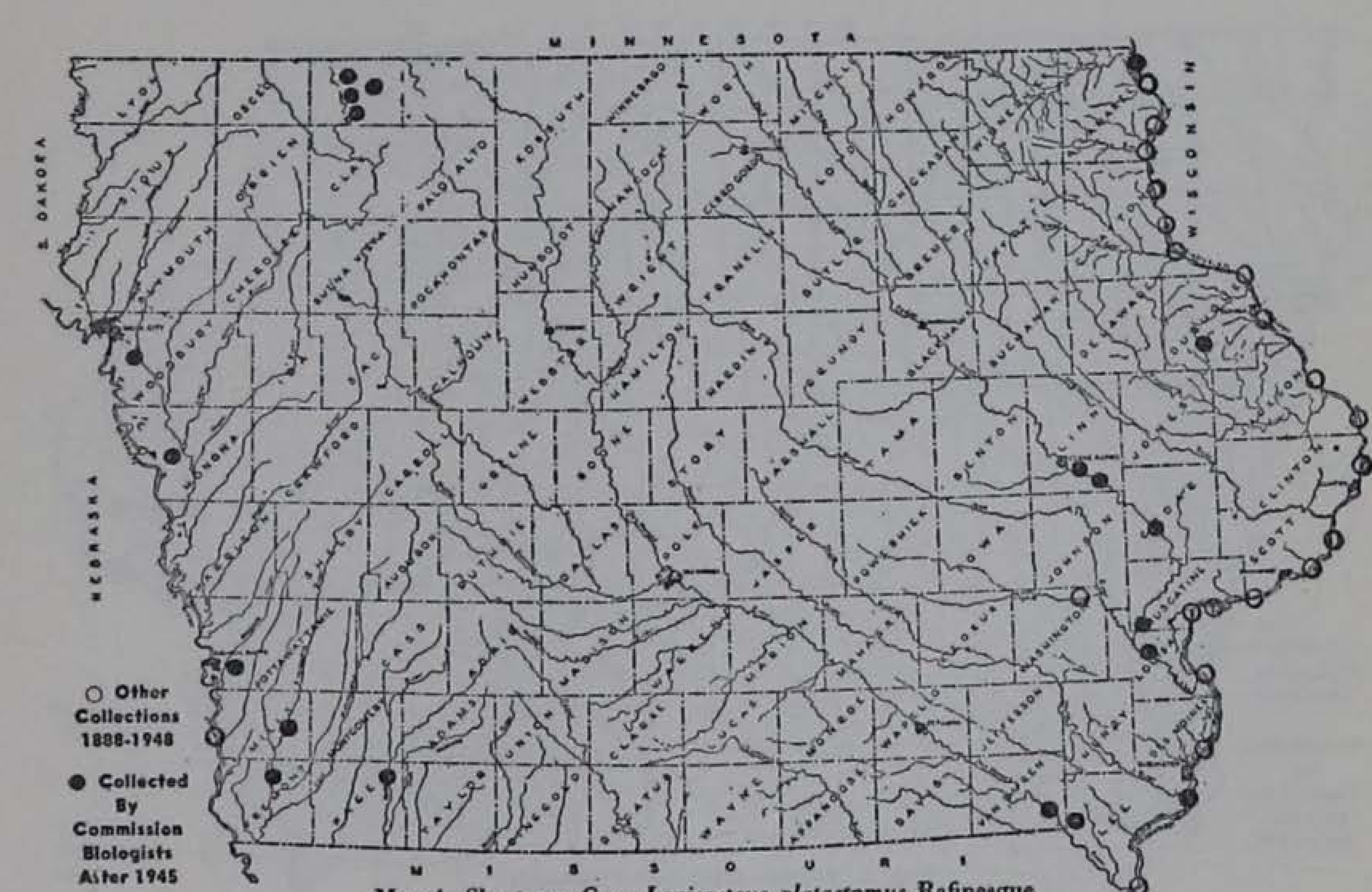
Map 1. Distribution of Fish Collections made 1945-1955



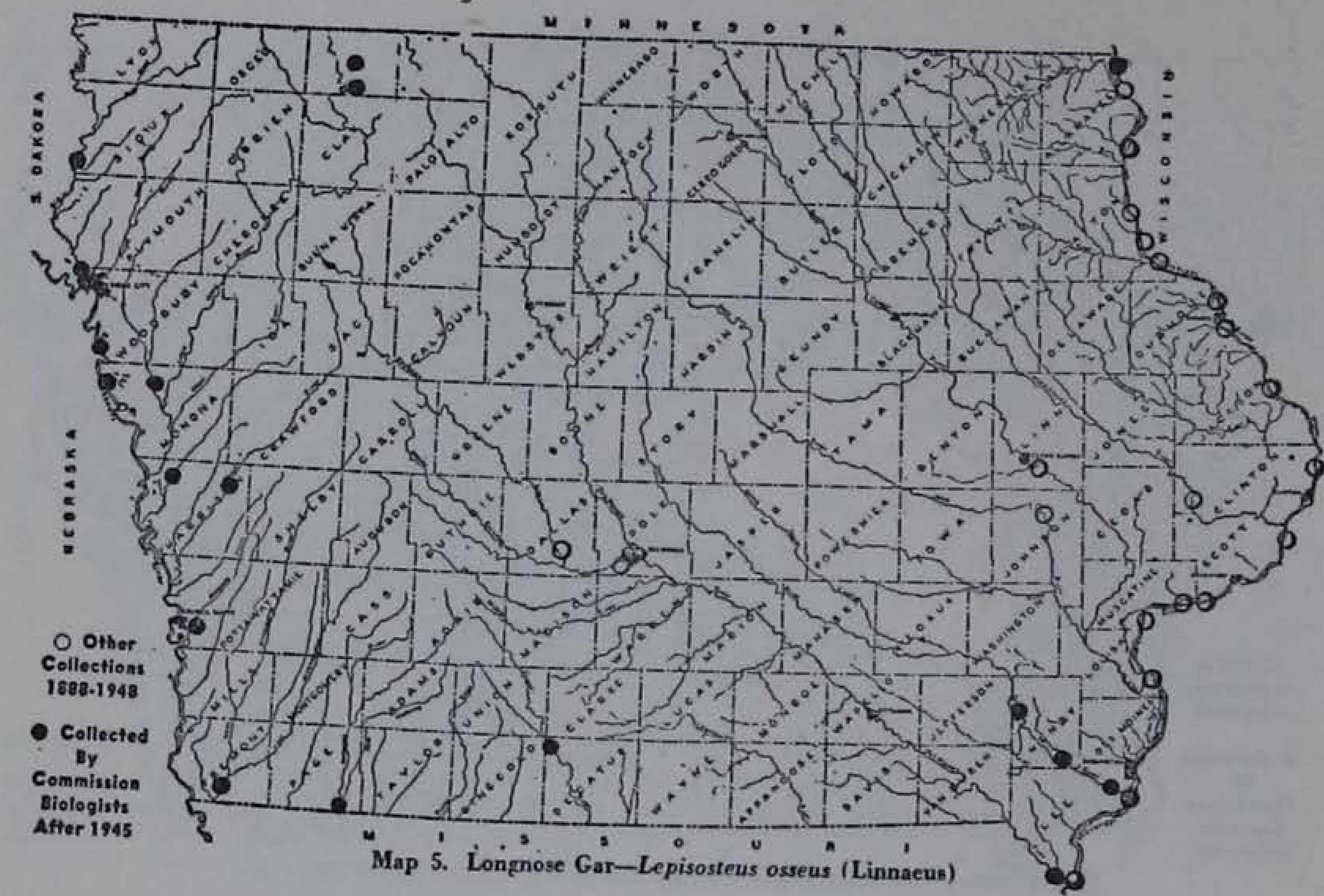
Map 2. Paddlefish—*Polyodon spathula* (Walbaum)



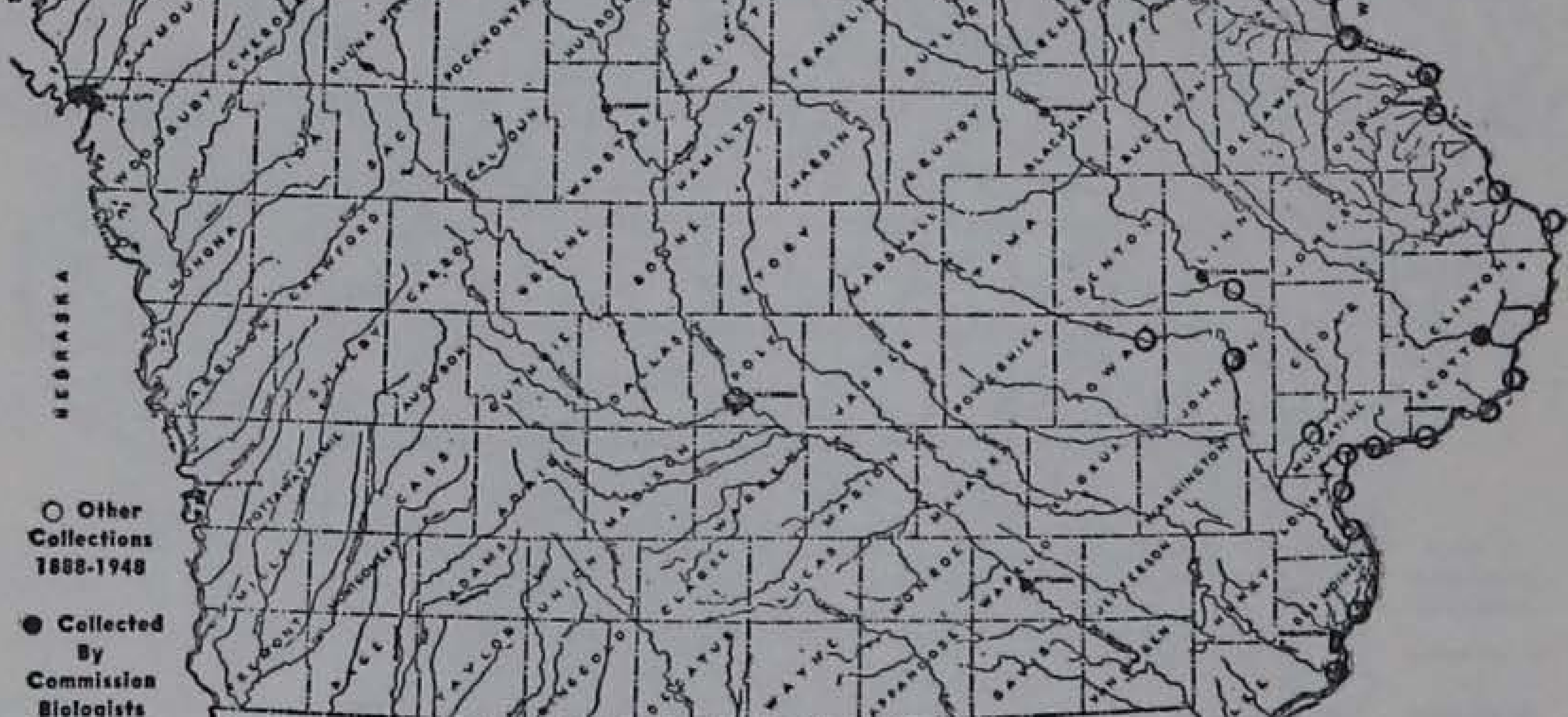
Map 3. Shovelnose Sturgeon—*Scaphirhynchus platorynchus* (Rafinesque)



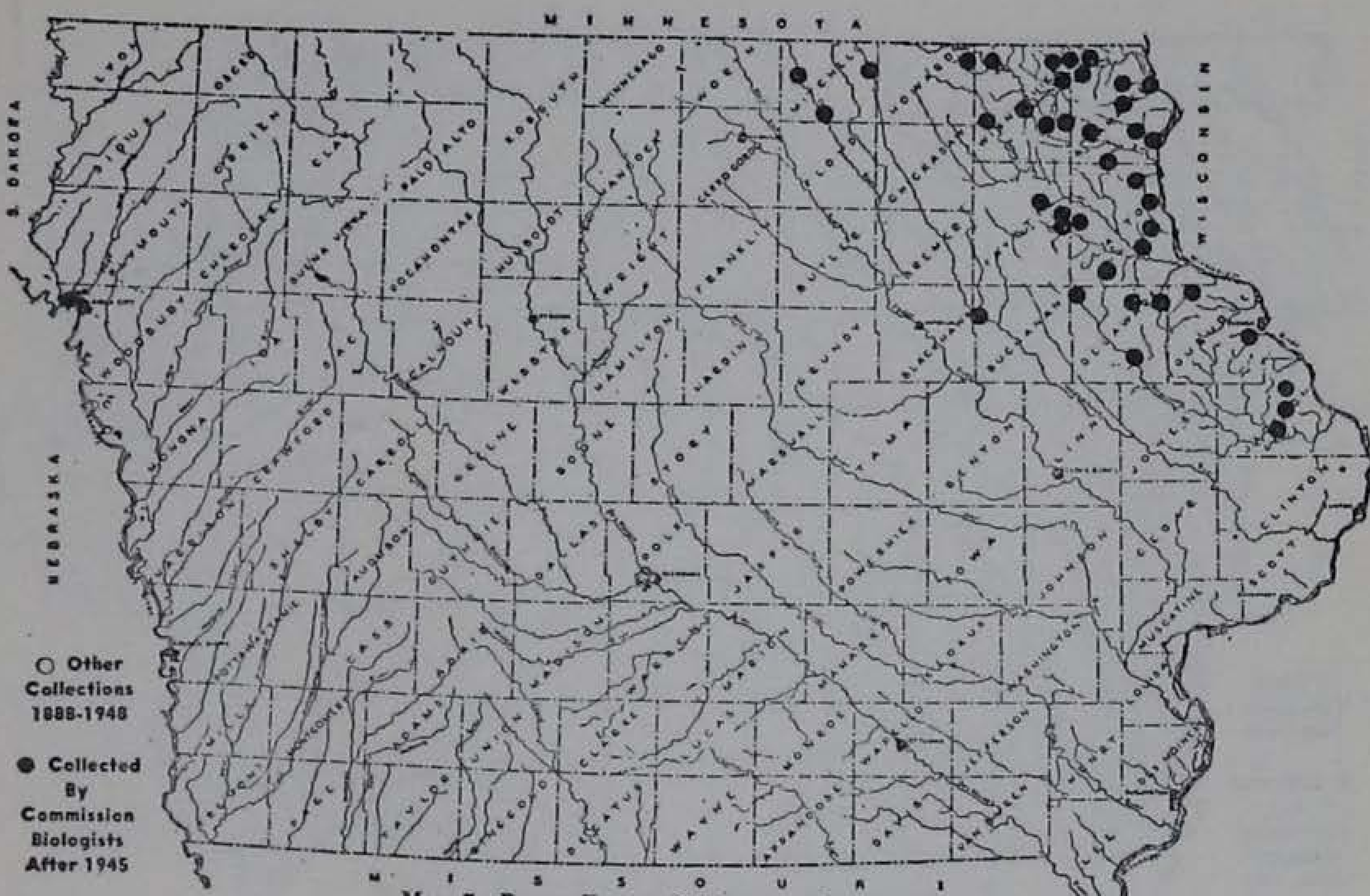
Map 4. Shortnose Gar—*Lepisosteus platostomus* Rafinesque



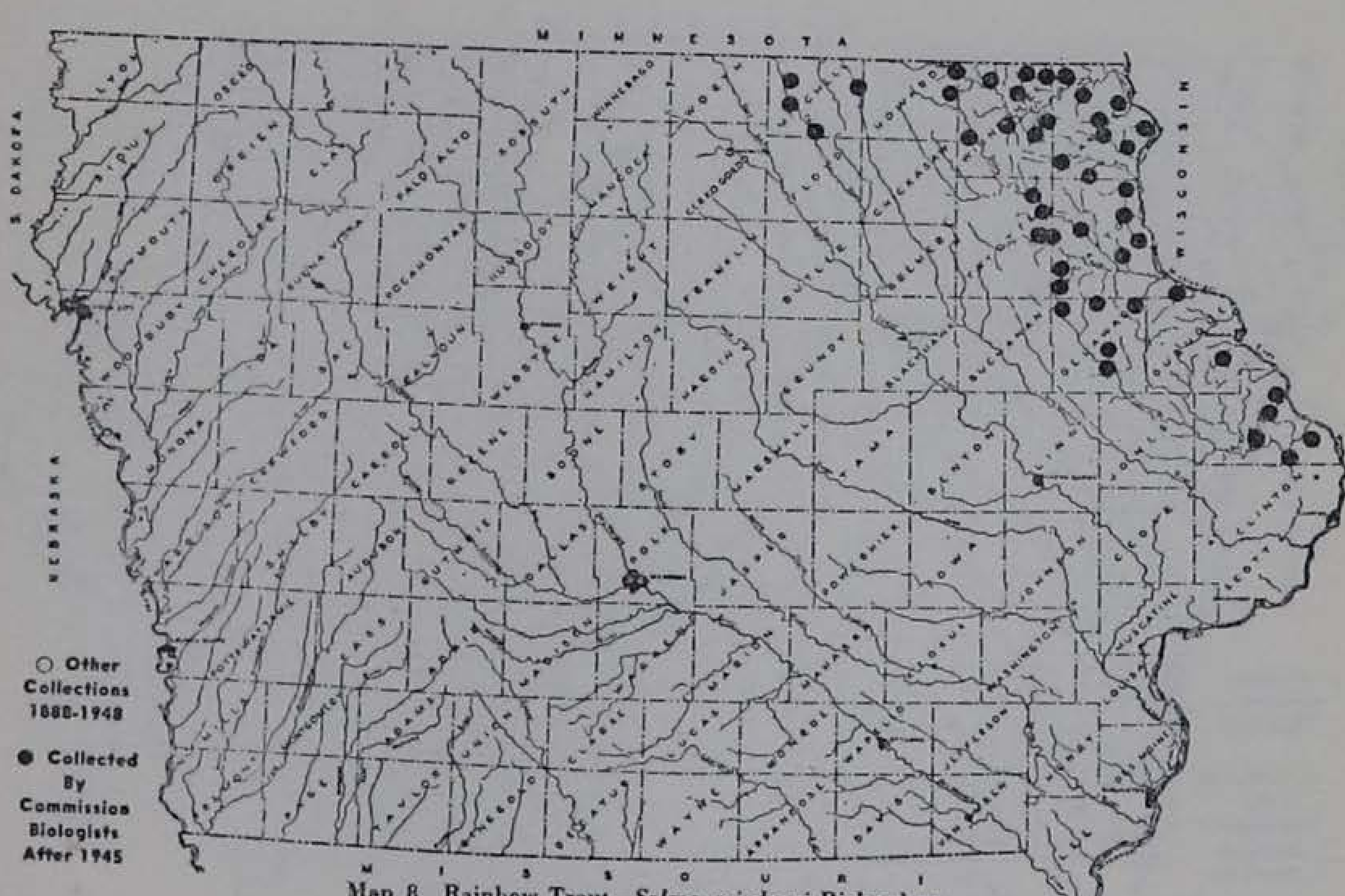
Map 5. Longnose Gar—*Lepisosteus osseus* (Linnaeus)



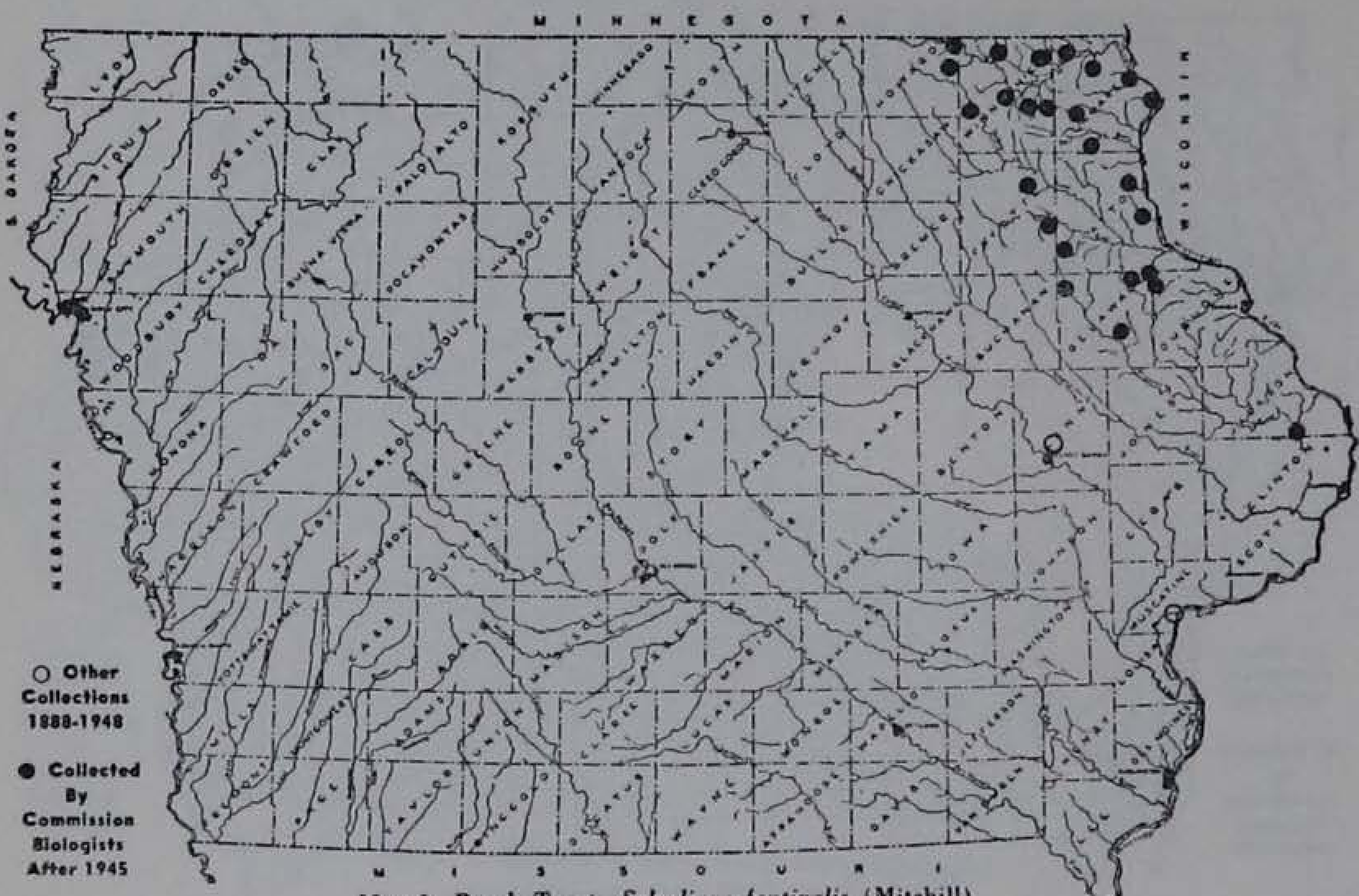
Map 6. Bowfin—*Amia calva* Linnaeus



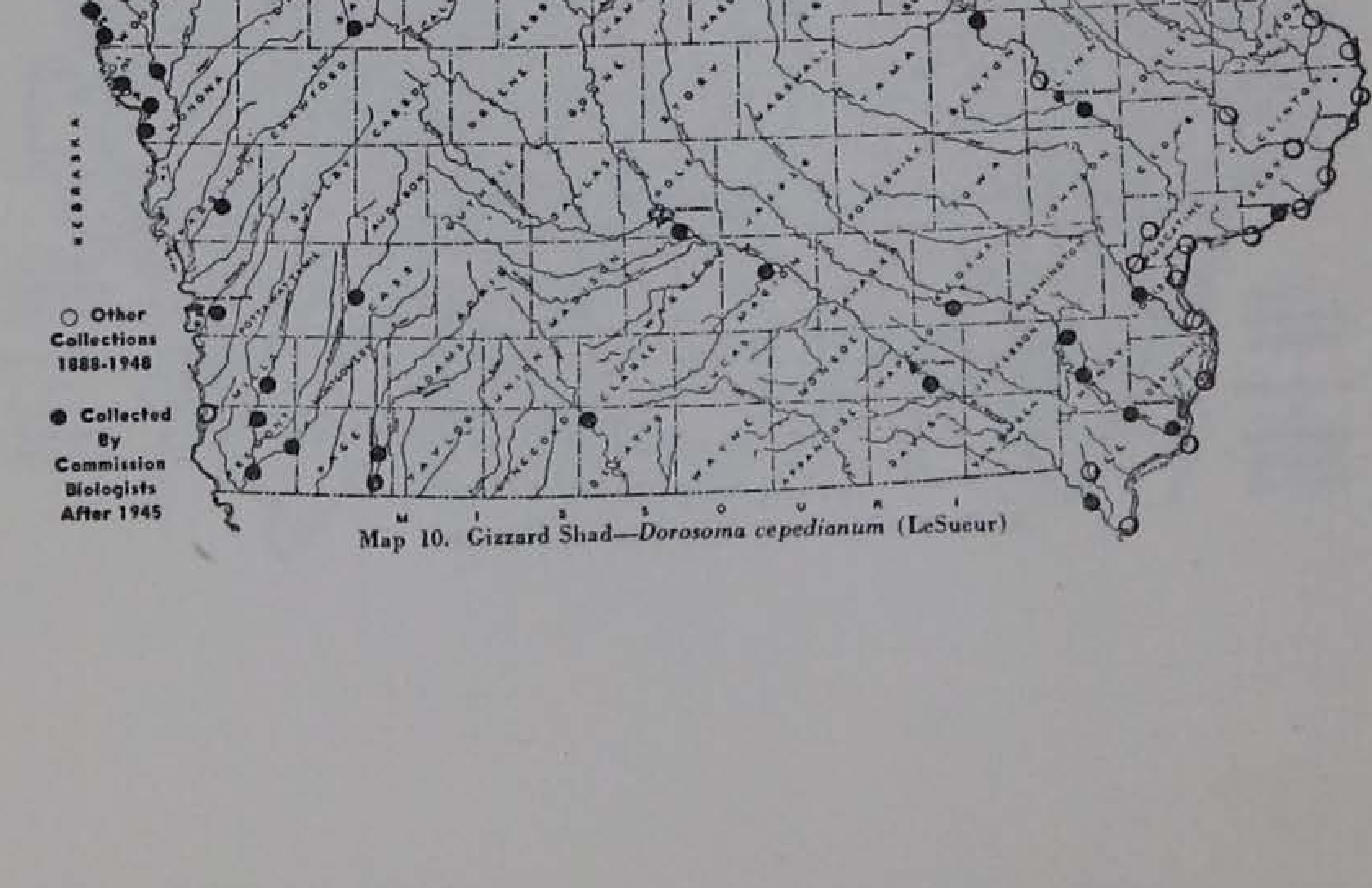
Map 7. Brown Trout—*Salmo trutta* Linnaeus



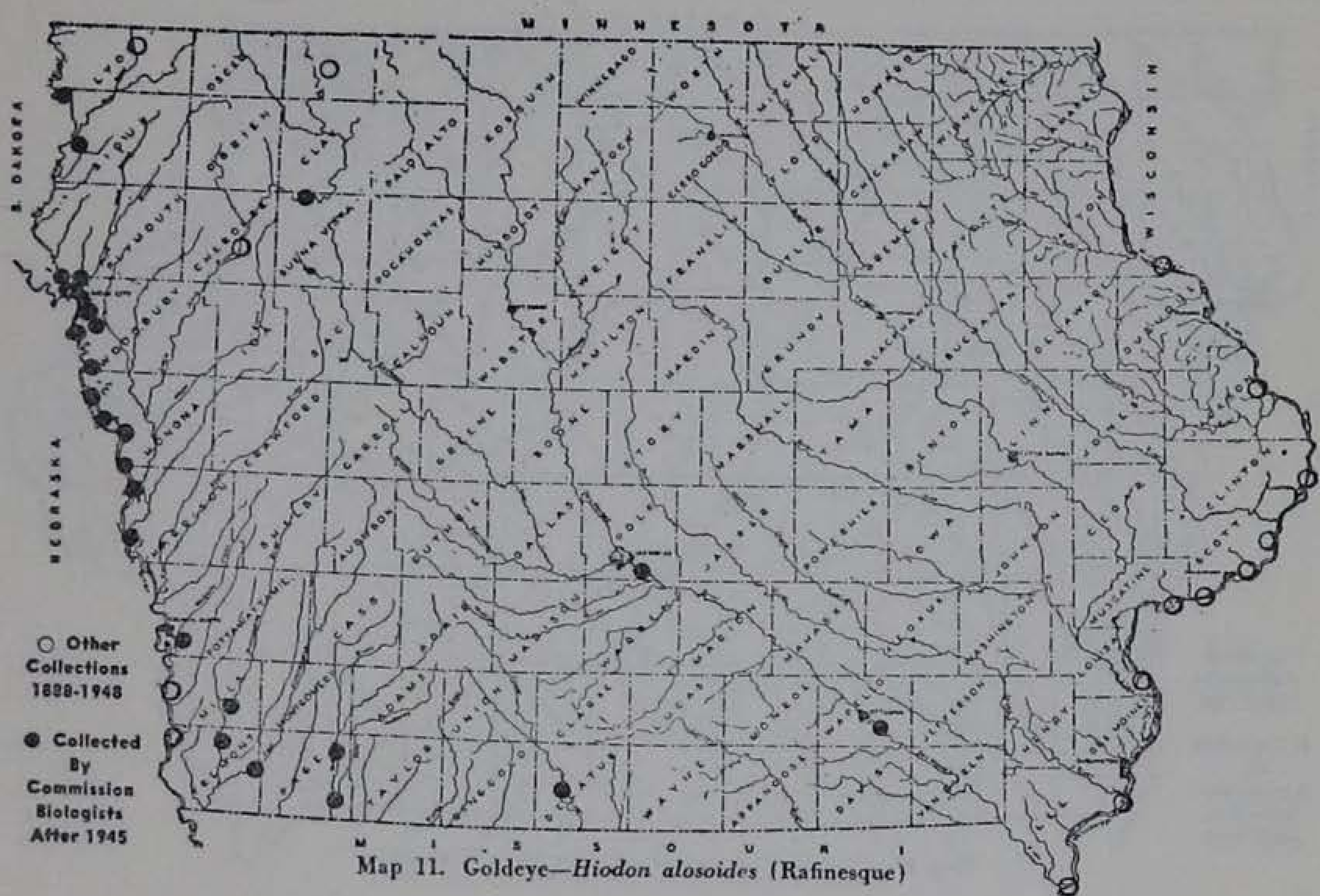
Map 8. Rainbow Trout—*Salmo gairdneri* Richardson



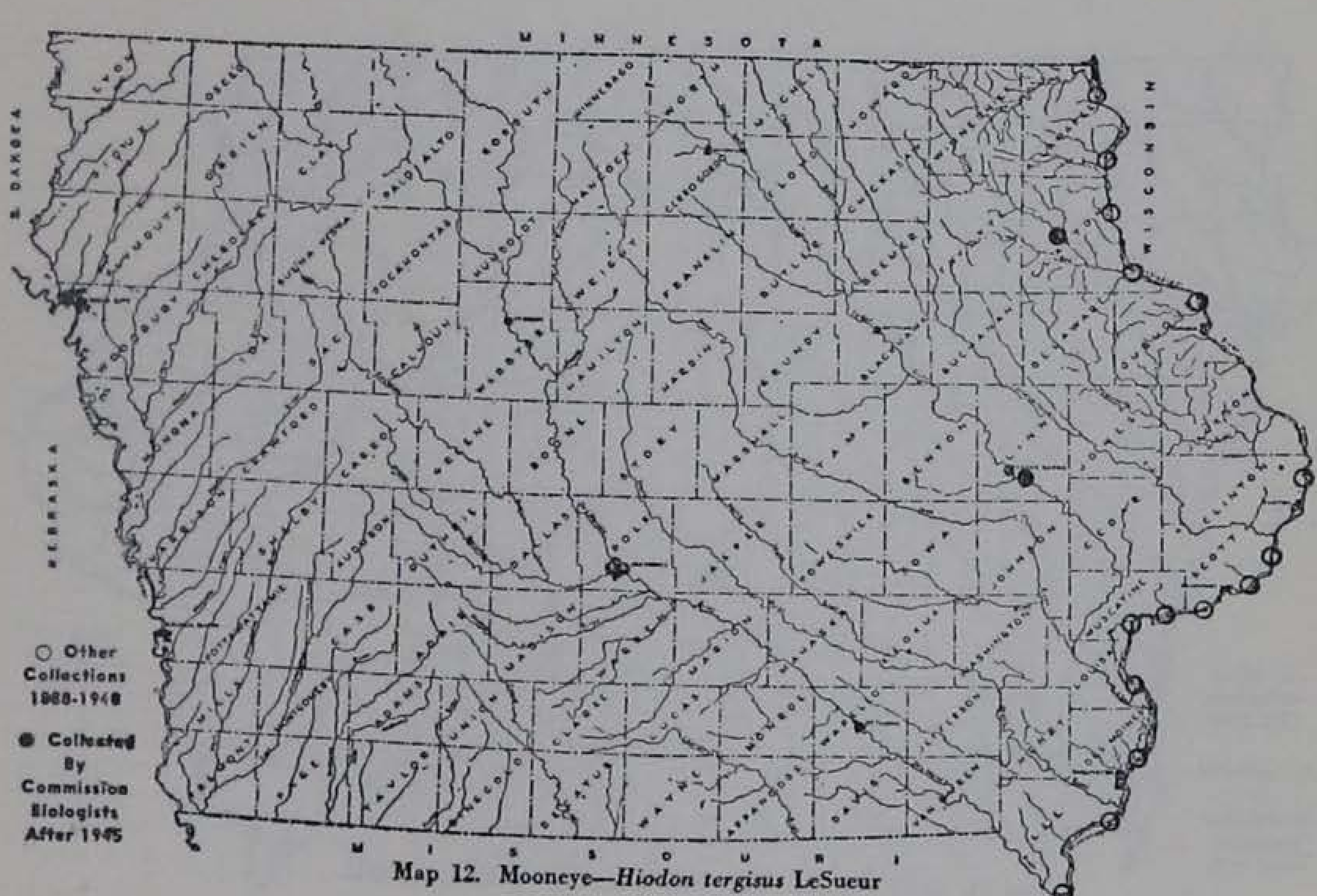
Map 9. Brook Trout—*Salvelinus fontinalis* (Mitchill)



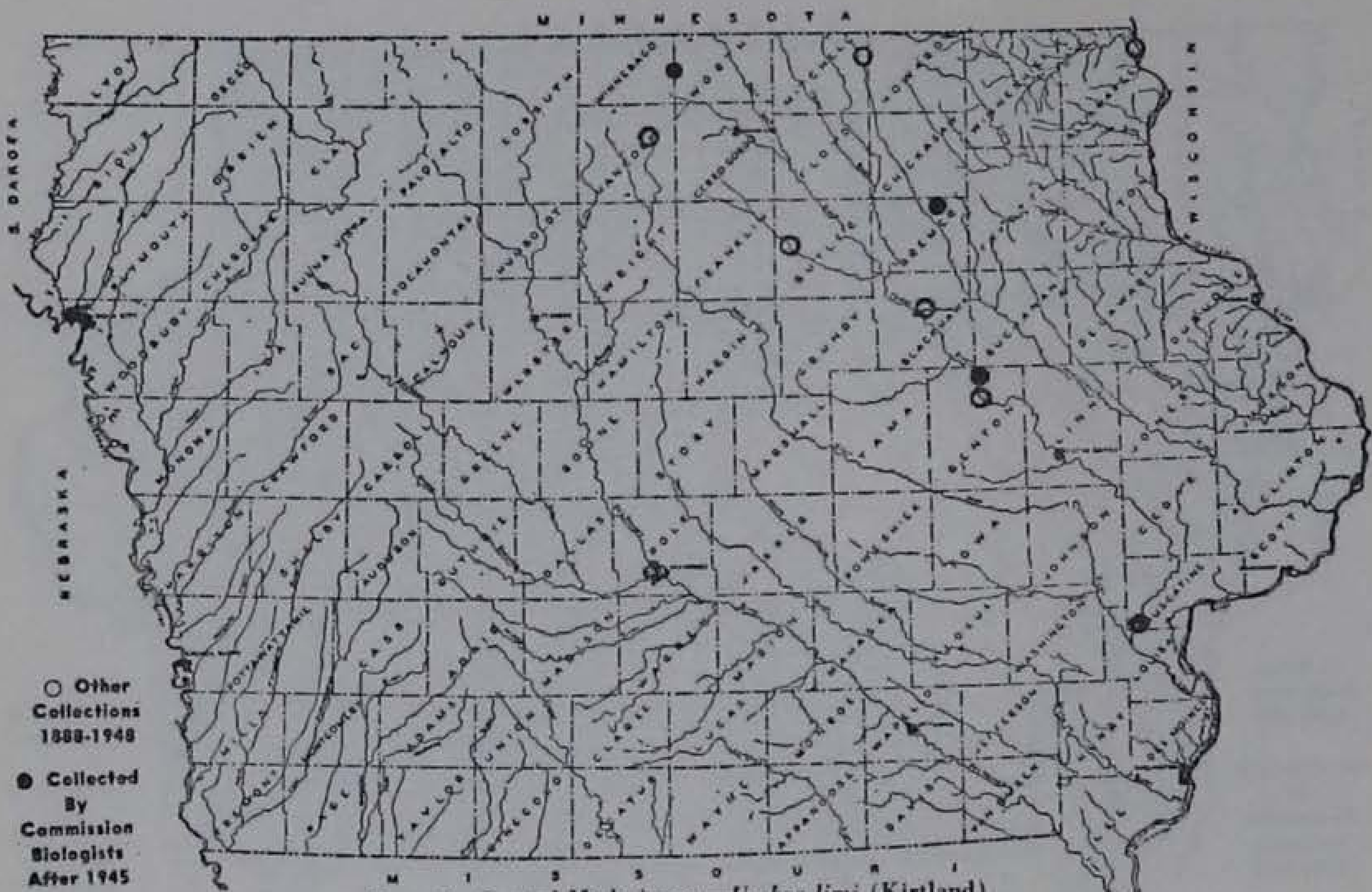
Map 10. Gizzard Shad—*Dorosoma cepedianum* (LeSueur)



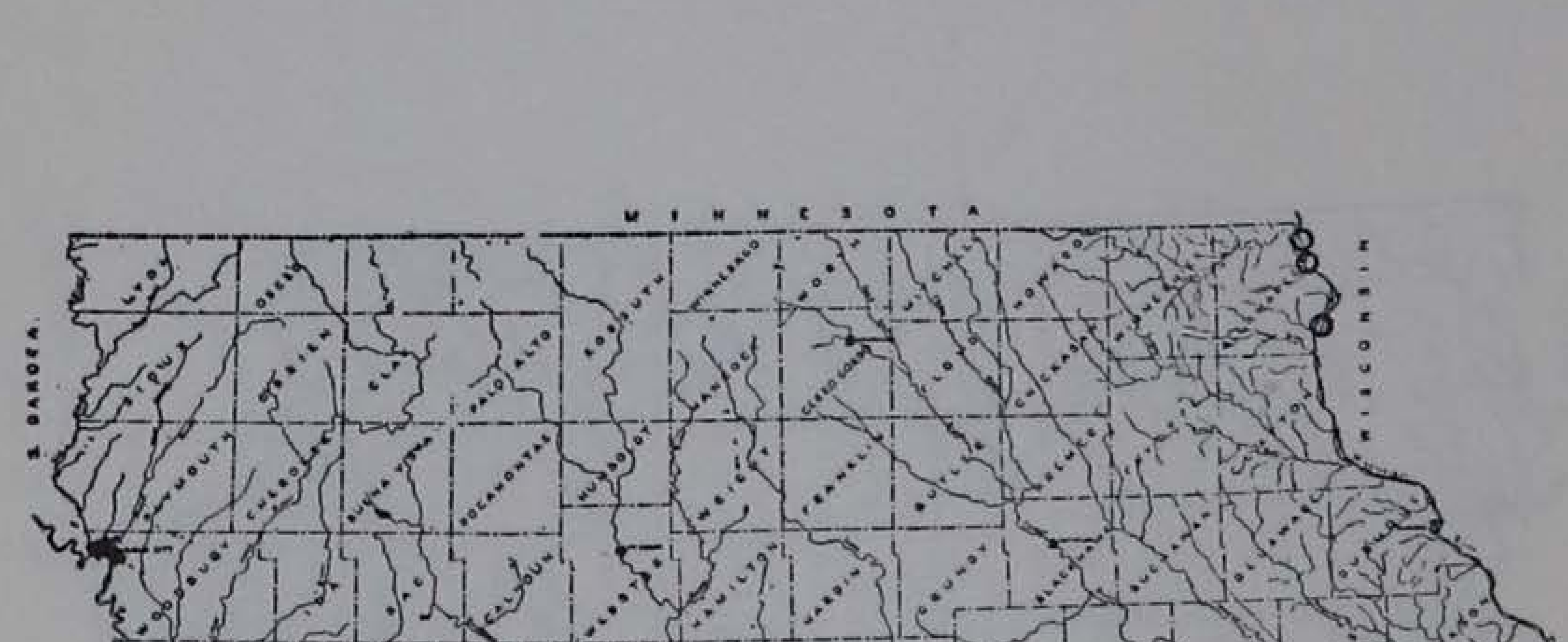
Map 11. Goldeye—*Hiodon alosoides* (Rafinesque)



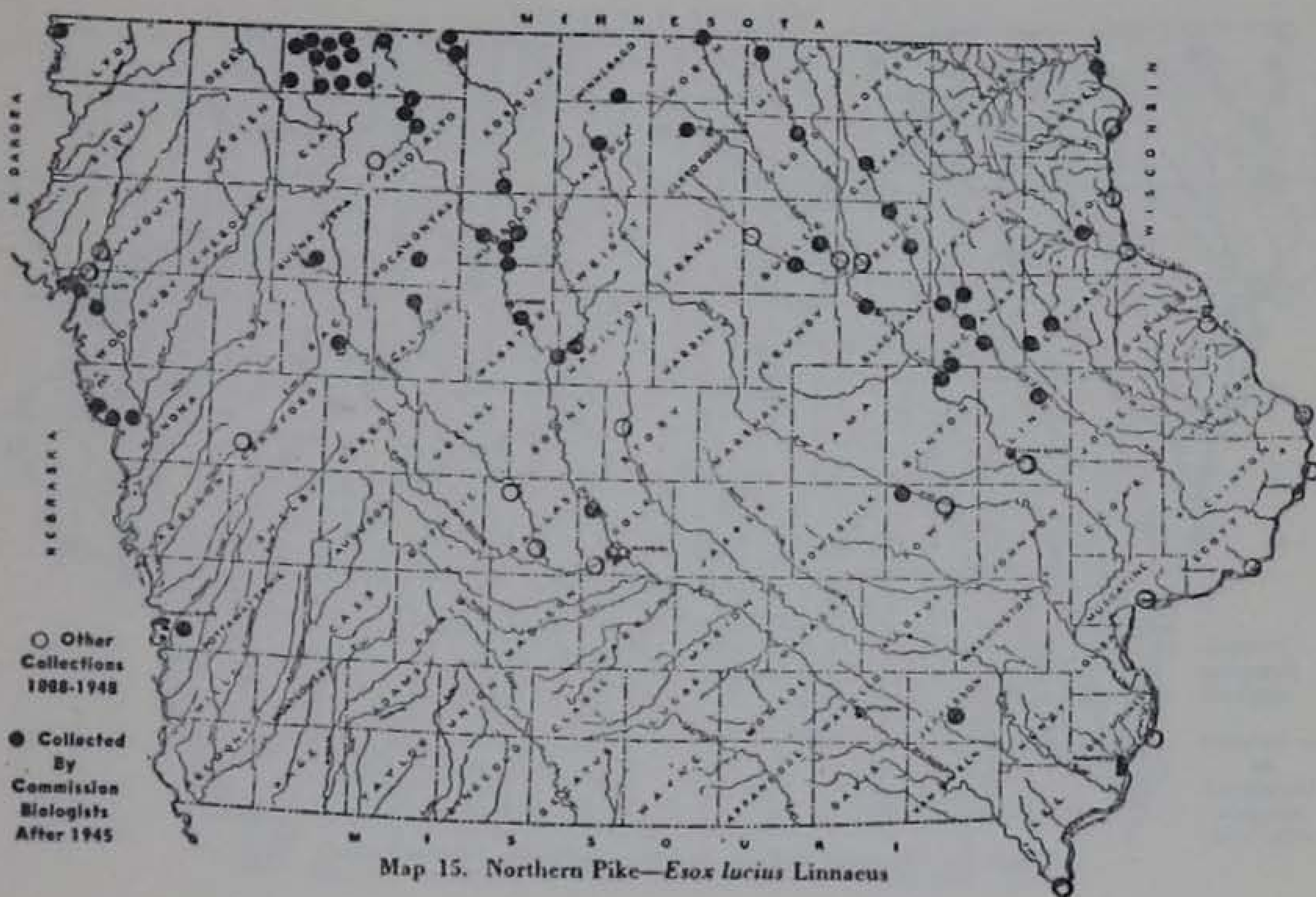
Map 12. Mooneye—*Hiodon tergisus* LeSueur



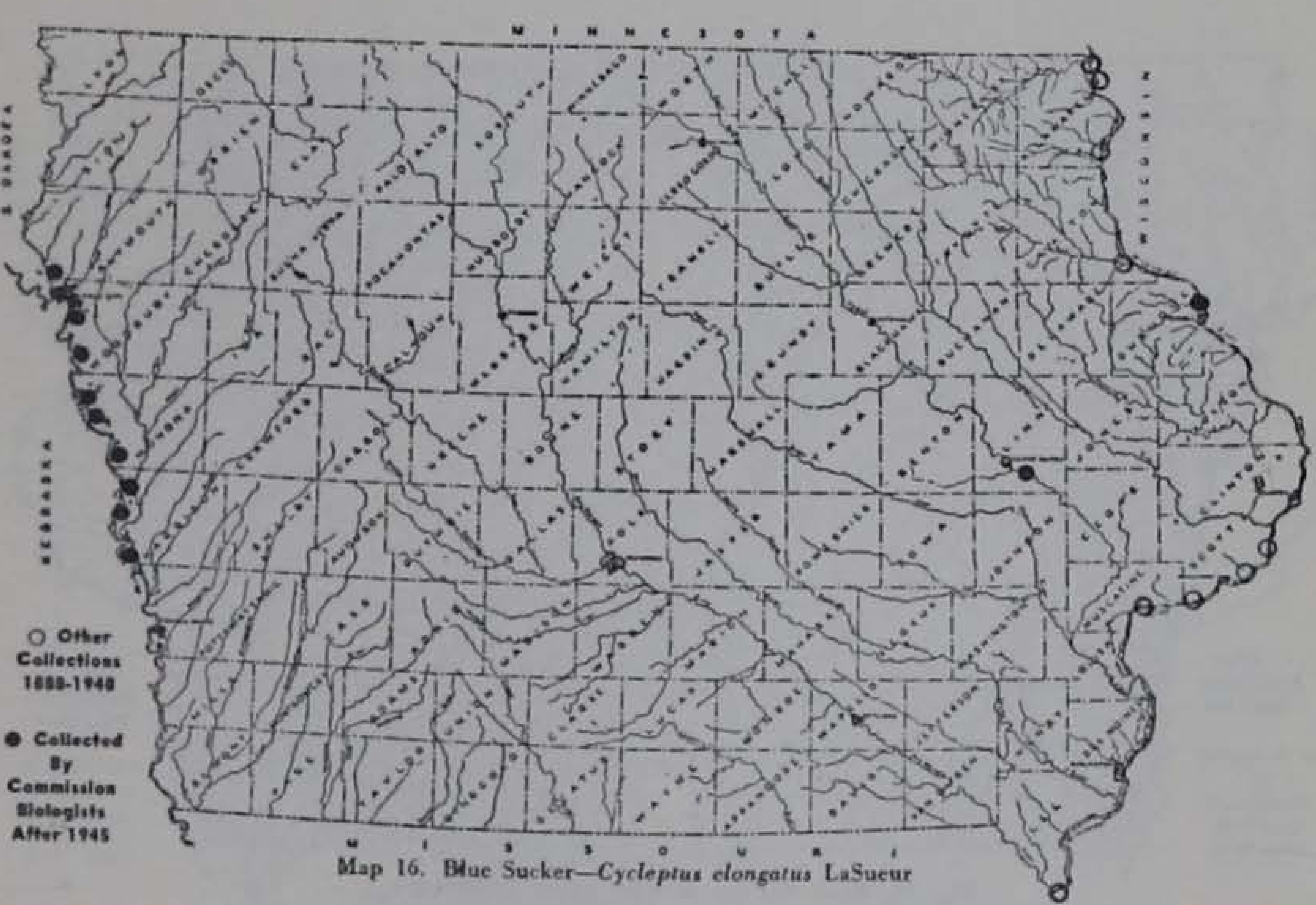
Map 13. Central Mudminnow—*Umbra limi* (Kirtland)



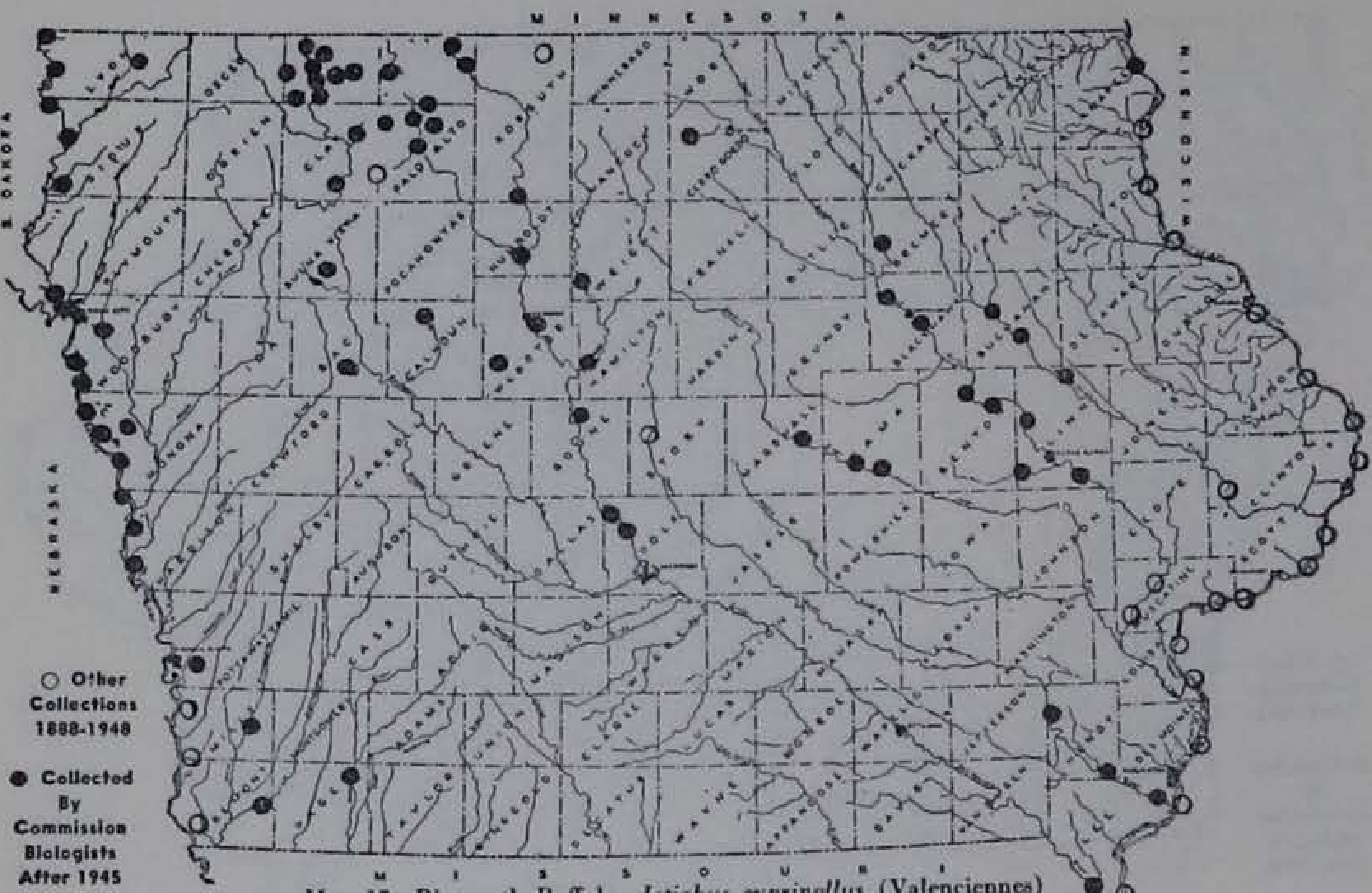
Map 14. Grass Pickerel—*Esox americanus vermiculatus* LeSueur



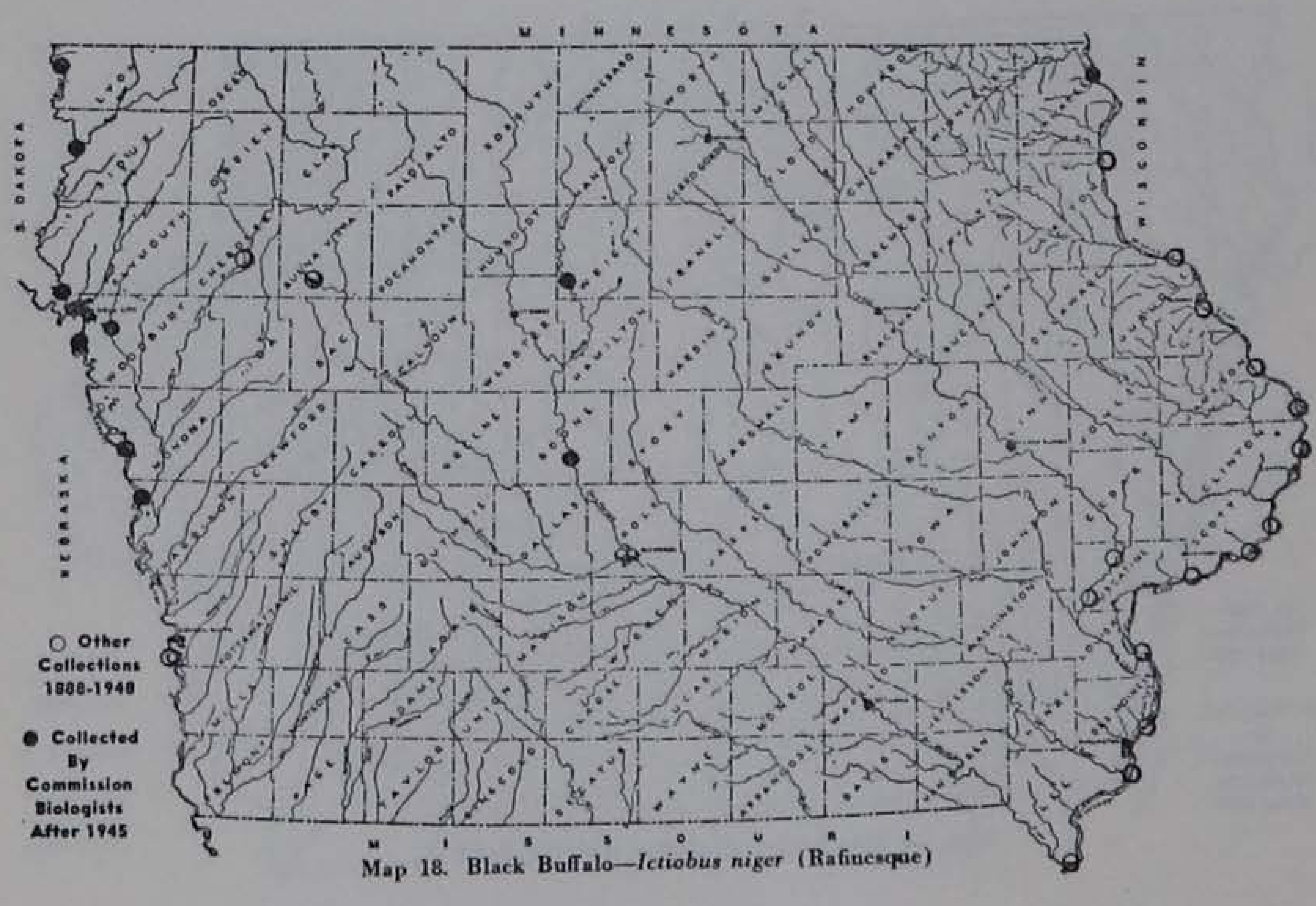
Map 15. Northern Pike—*Esox lucius* Linnaeus



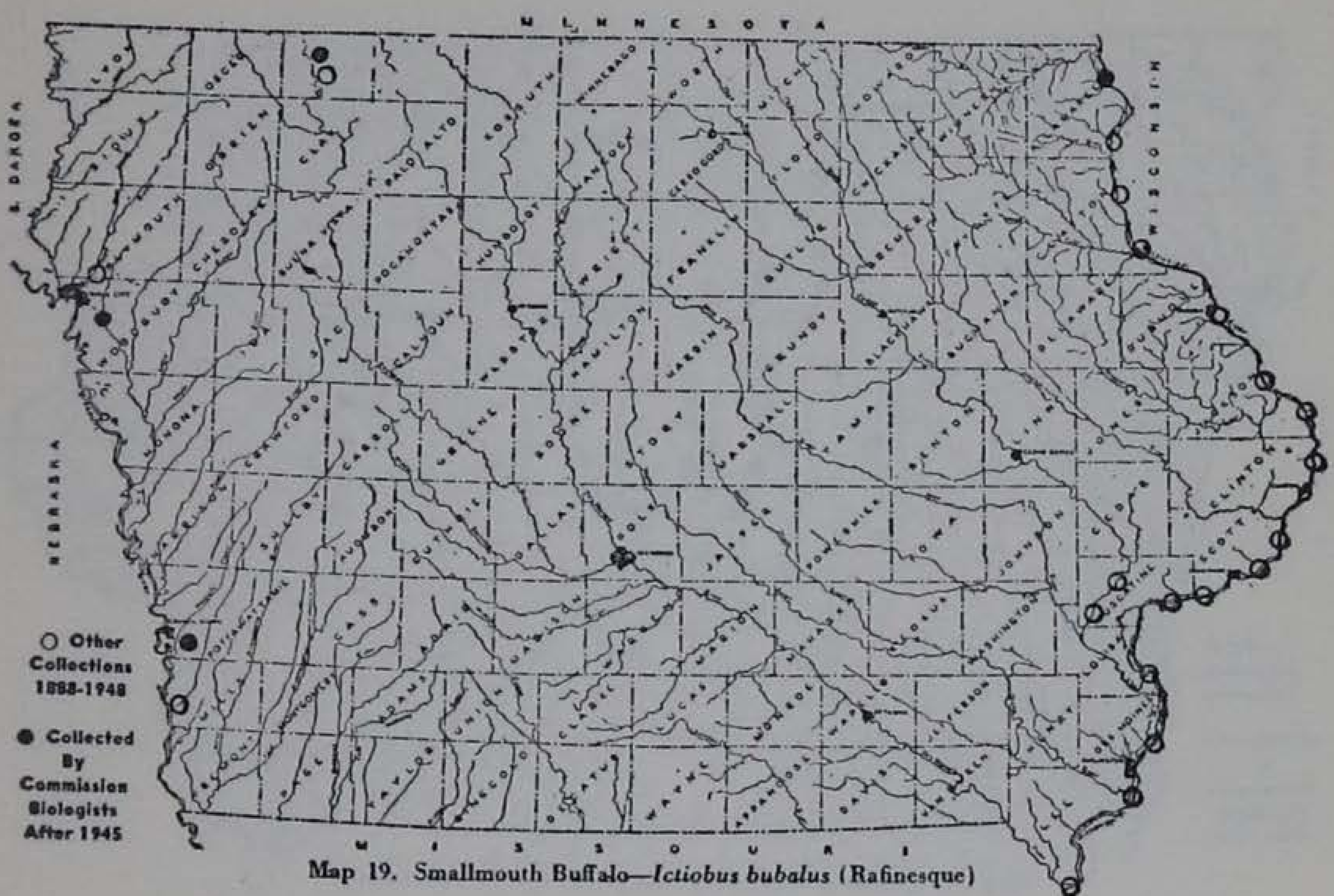
Map 16. Blue Sucker—*Cycleptus elongatus* LaSueur



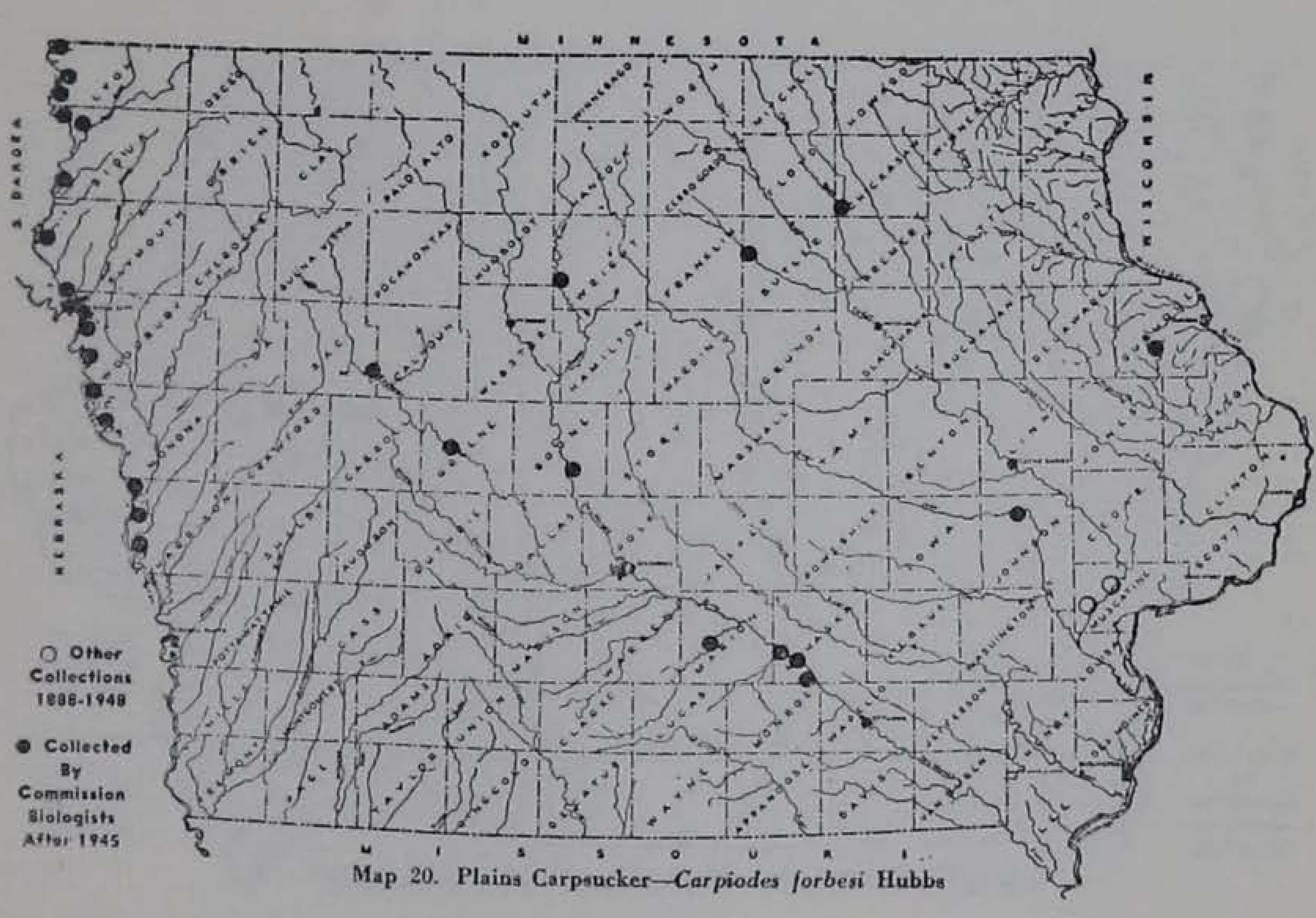
Map 17. Bigmouth Buffalo—*Ictiobus cyprinellus* (Valenciennes)



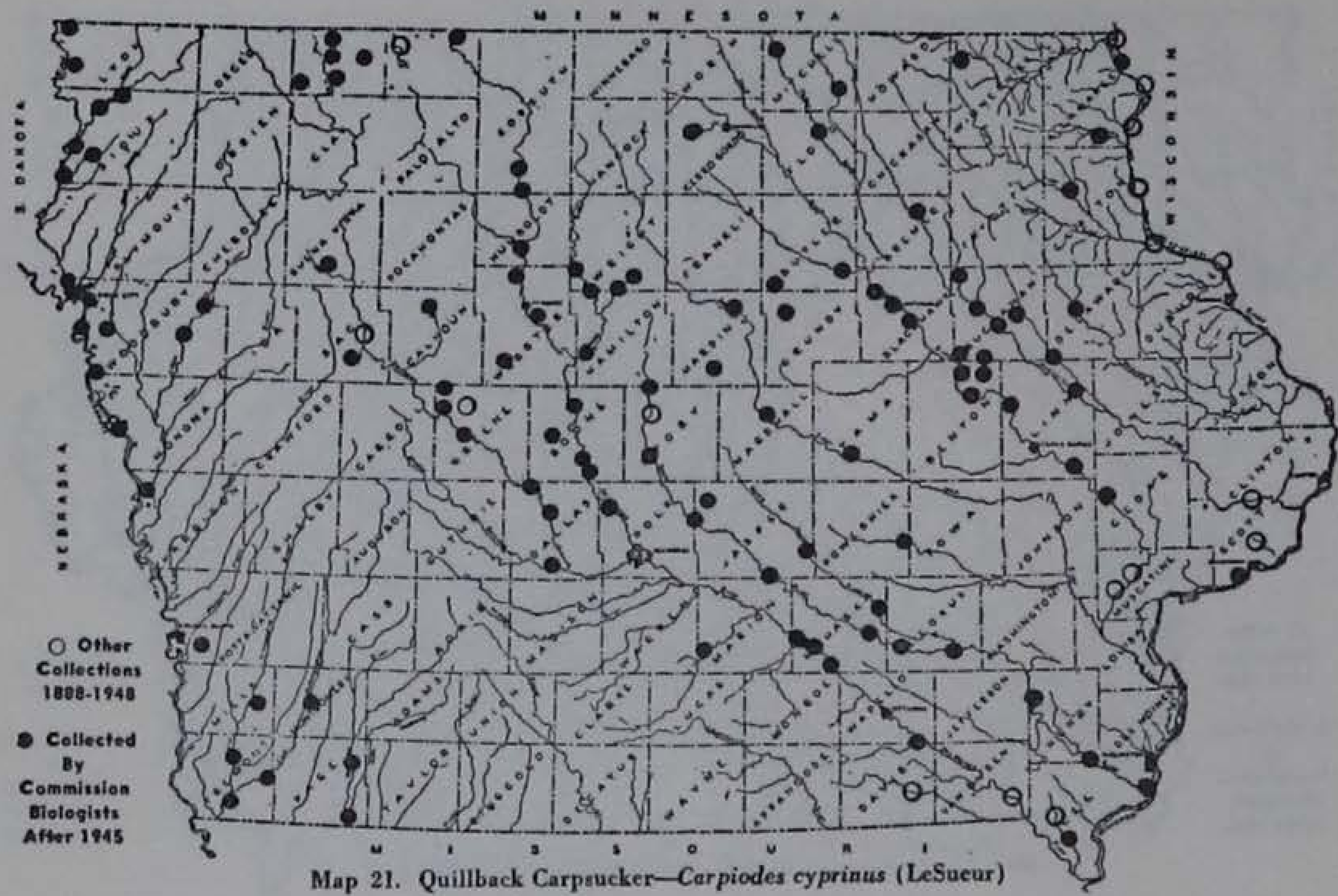
Map 18. Black Buffalo—*Ictiobus niger* (Rafinesque)



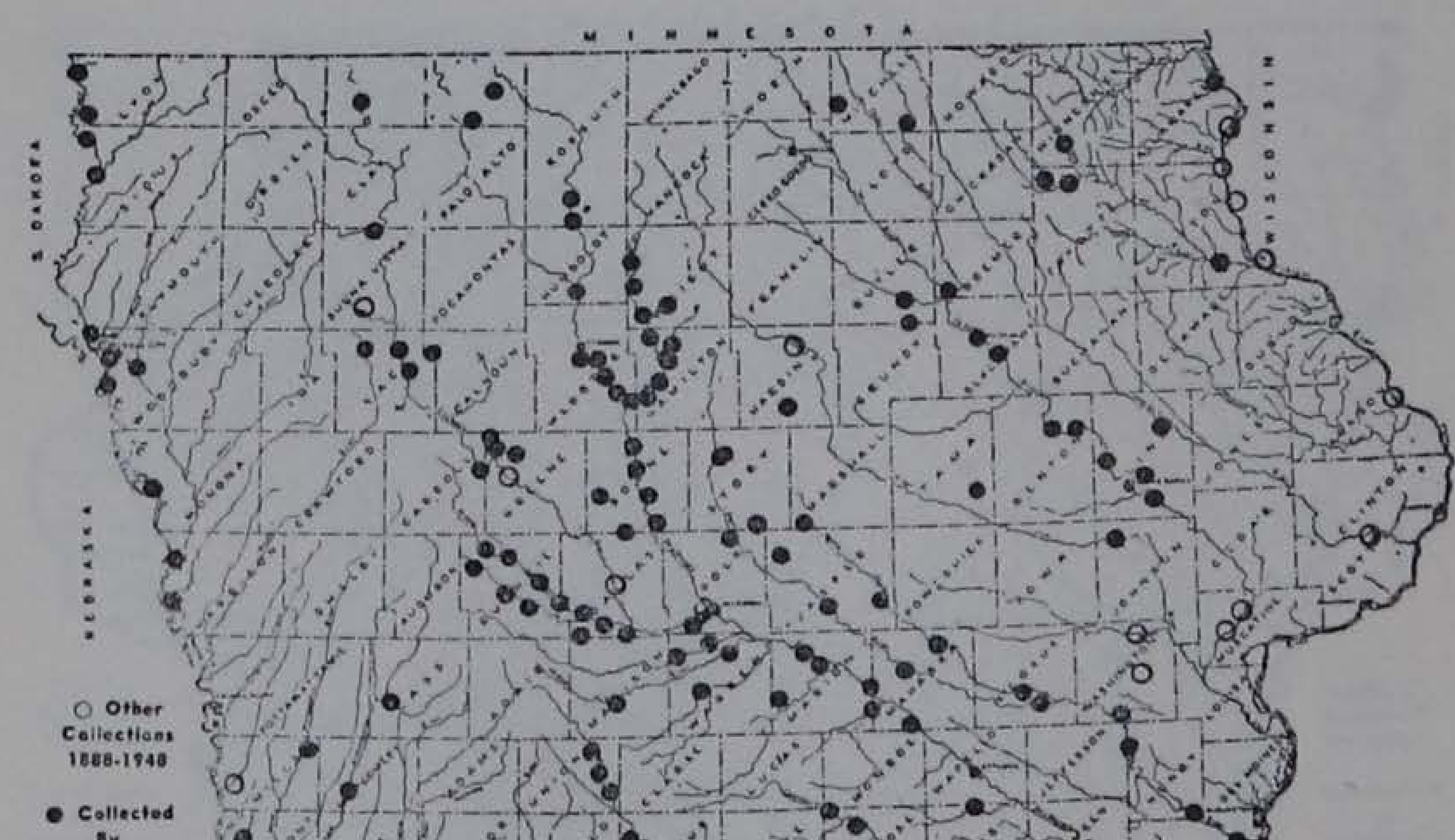
Map 19. Smallmouth Buffalo—*Ictiobus bubalus* (Rafinesque)



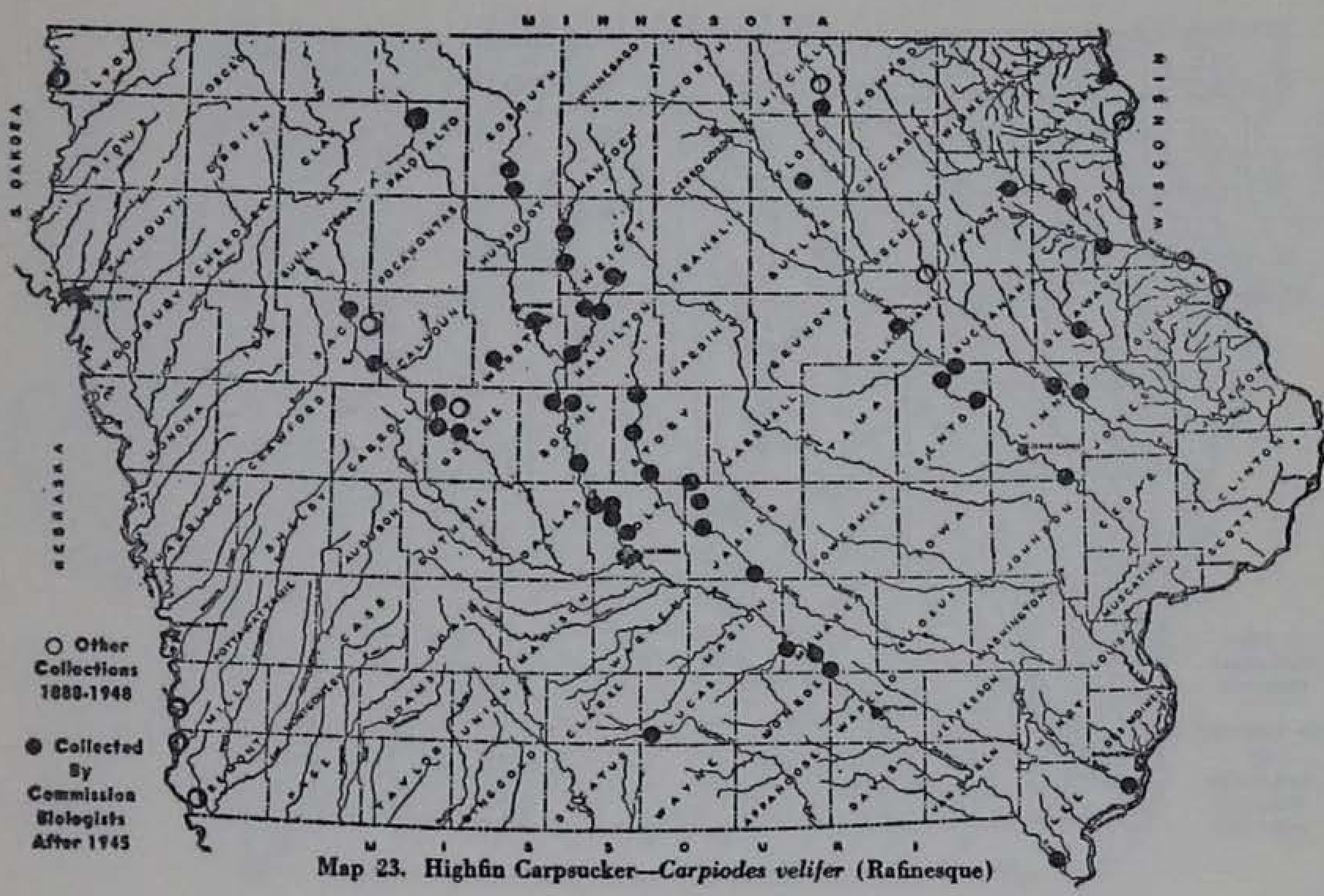
Map 20. Plains Carpsucker—*Carpiodes forbesi* Hubbs



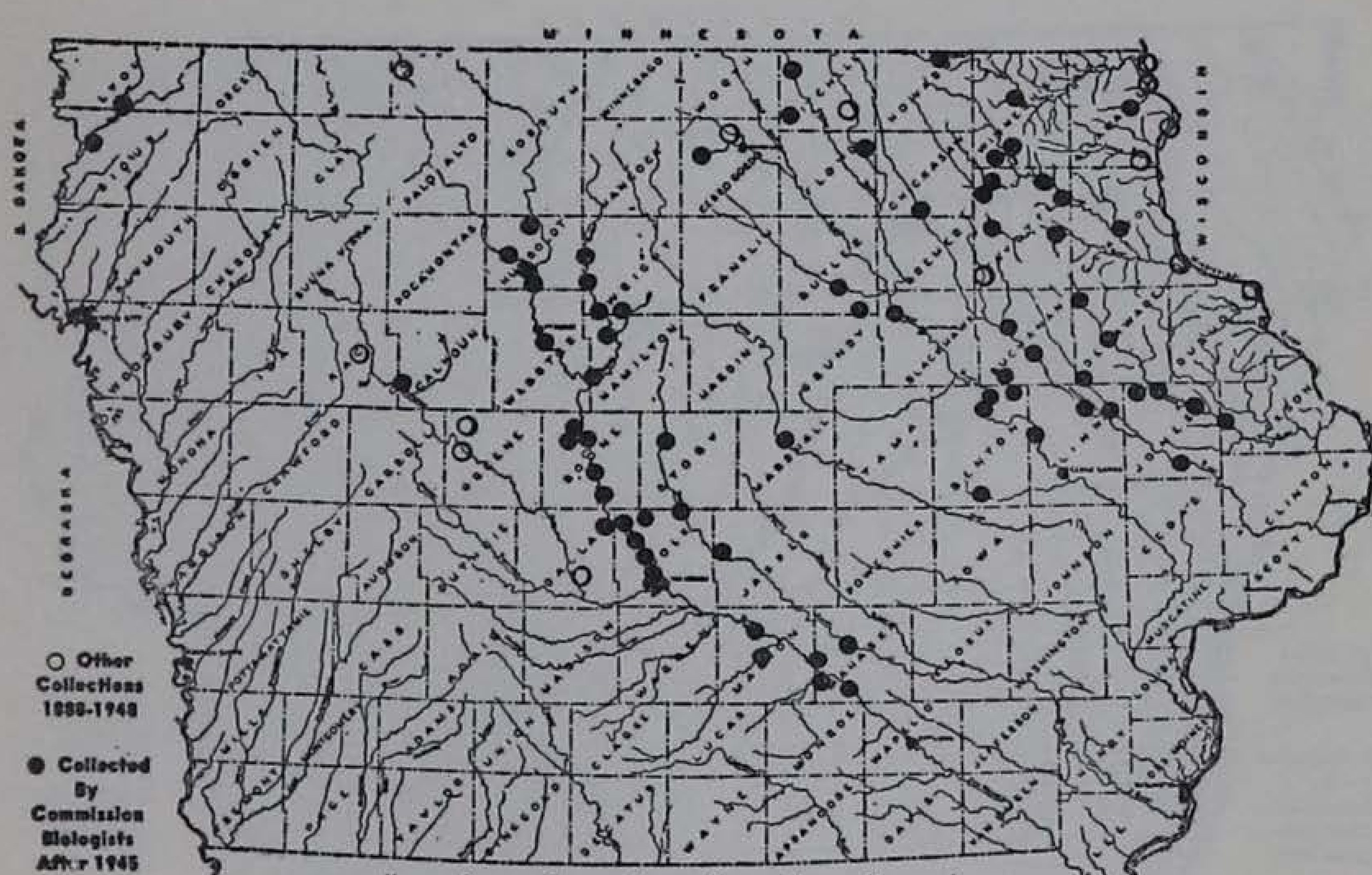
Map 21. Quillback Carpsucker—*Carpiodes cyprinus* (LeSueur)



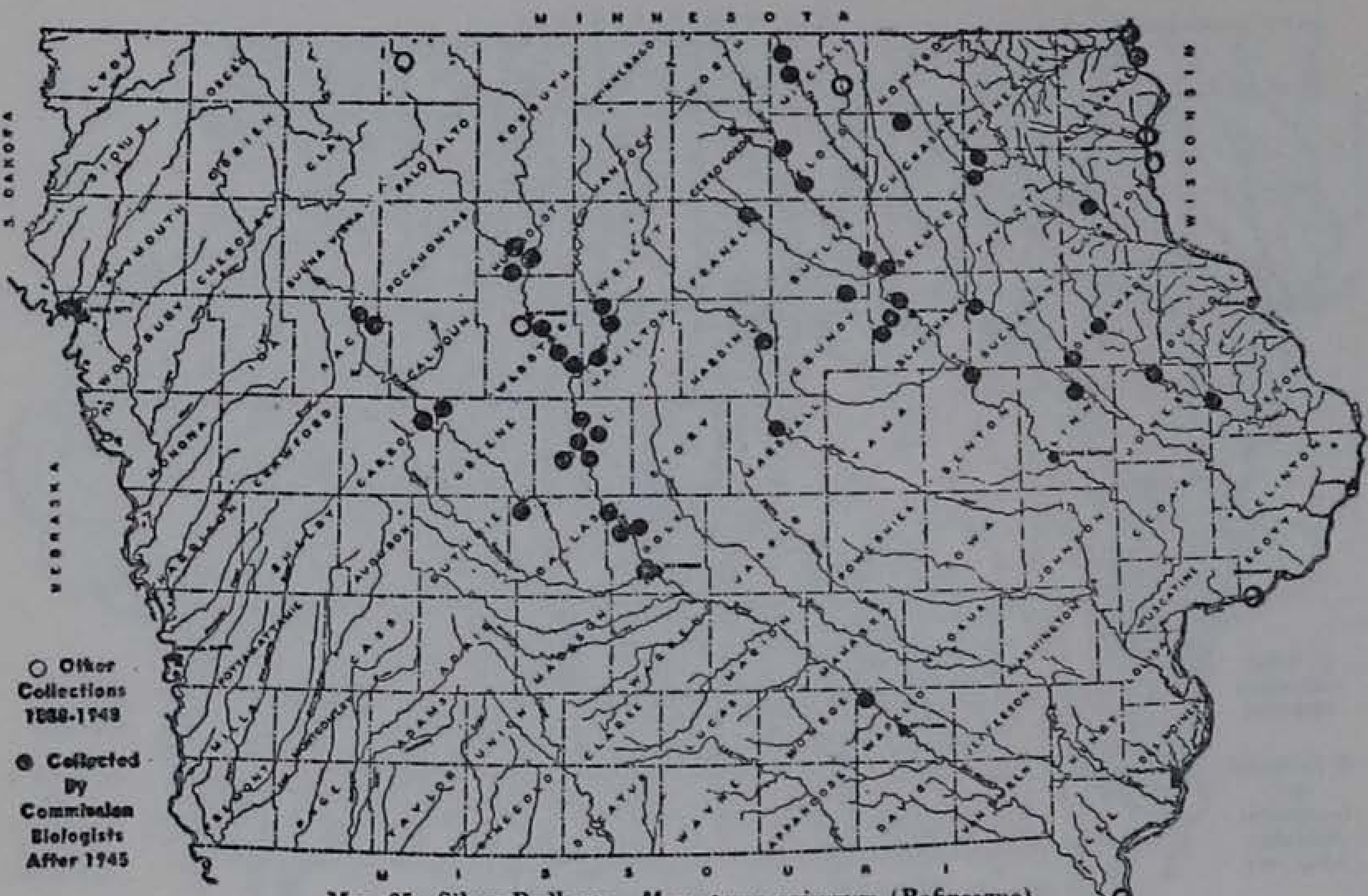
Map 22. River Carpsucker—*Carpiodes carpio carpio* (Rafinesque)



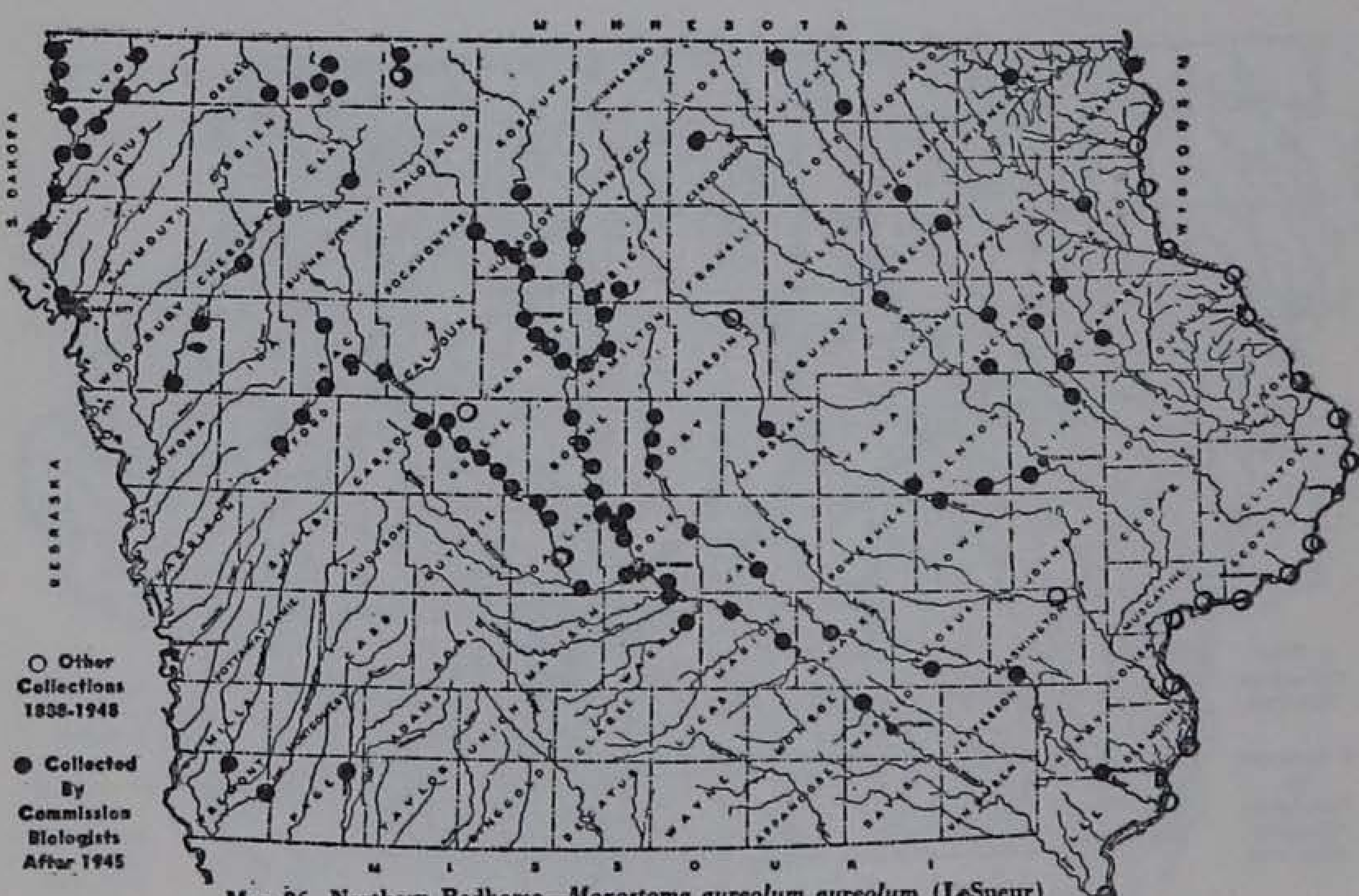
Map 23. Highfin Carpsucker—*Carpiodes velifer* (Rafinesque)



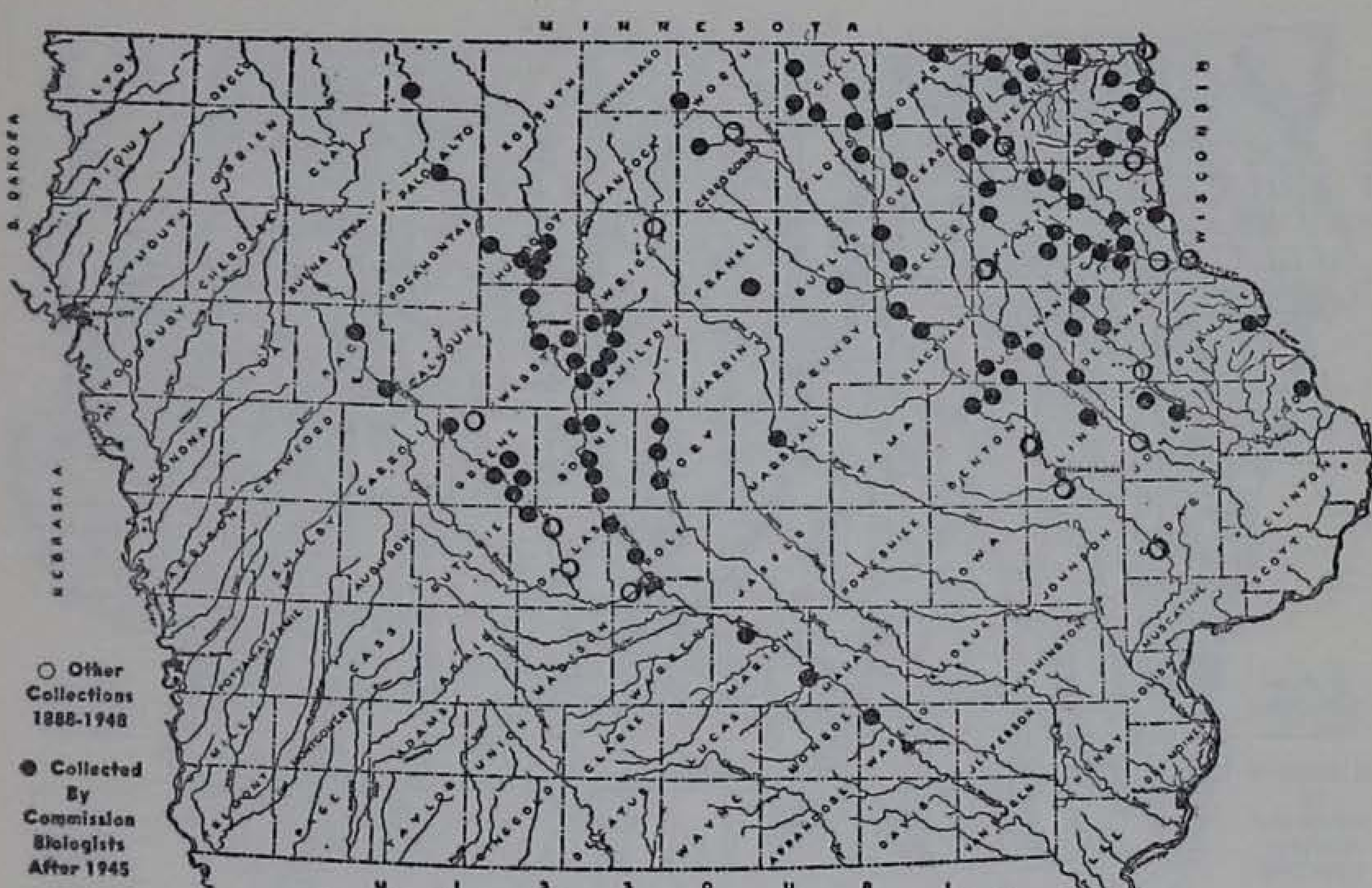
Map 24. Golden Redhorse—*Moxostoma erythrurum* (Rafinesque)



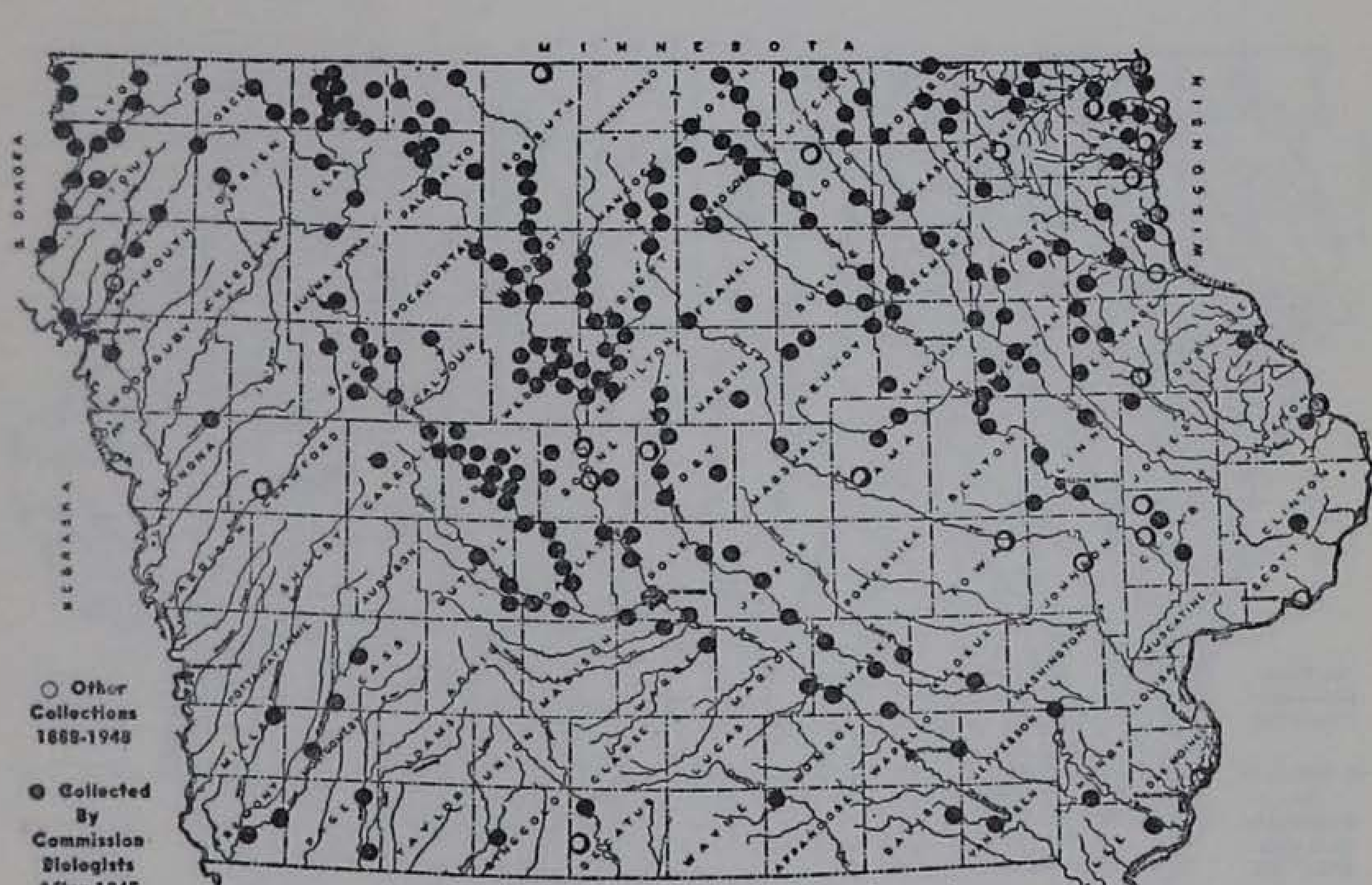
Map 25. Silver Redhorse—*Moxostoma anisurum* (Rafinesque)



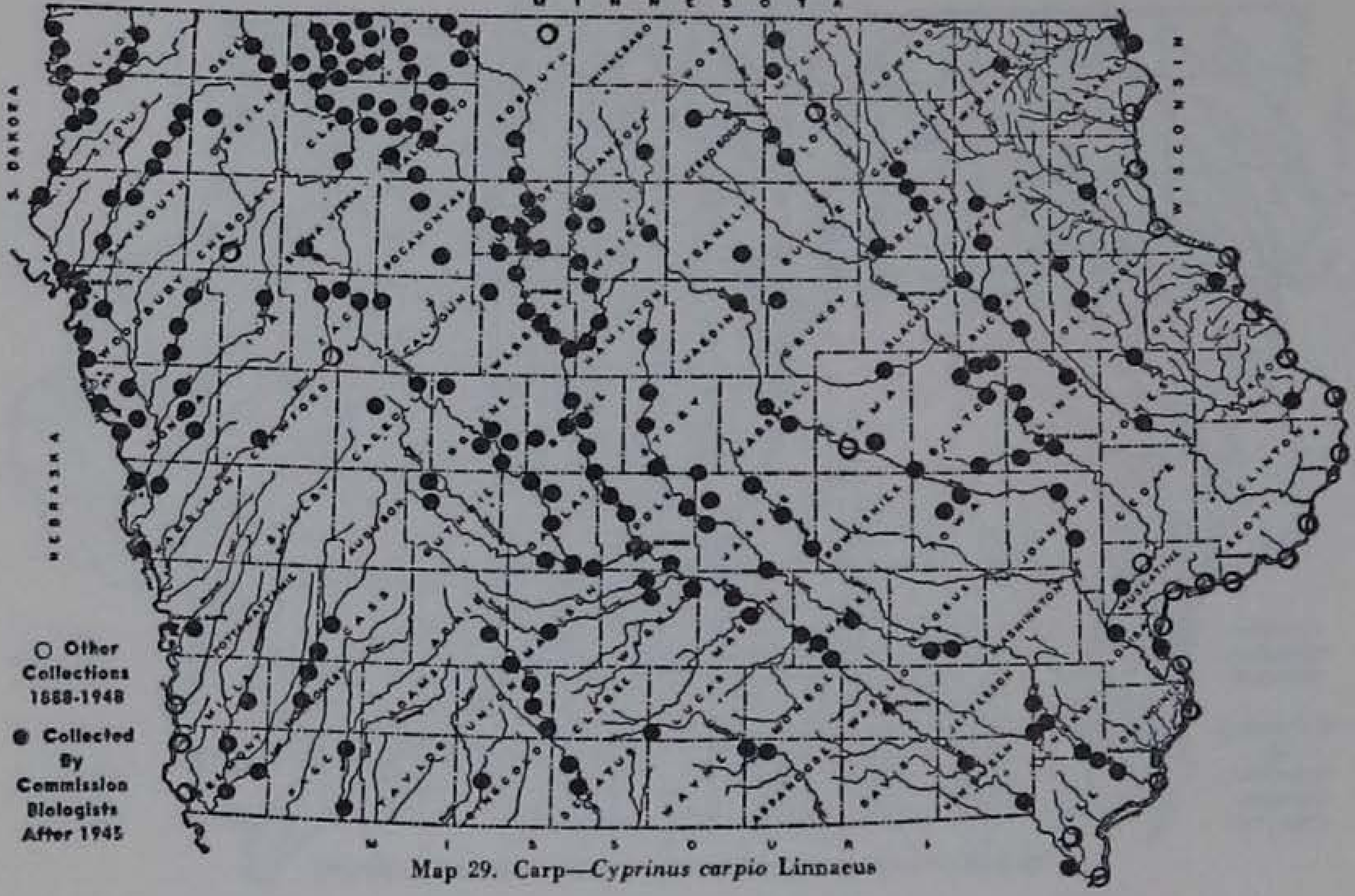
Map 26. Northern Redhorse—*Moxostoma aureolum aureolum* (LeSueur)



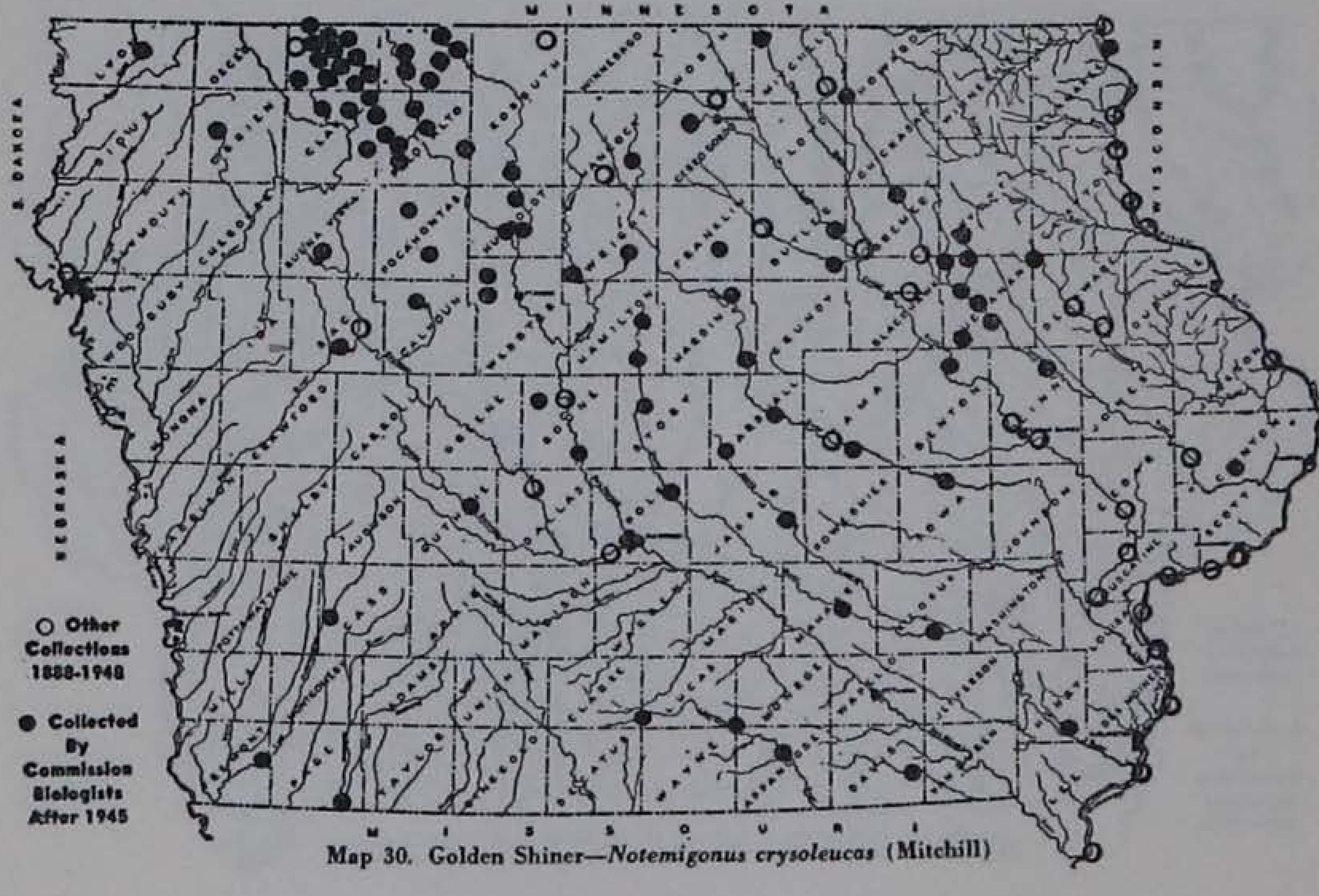
Map 27. Northern Hogsucker—*Hypentelium nigricans* (LeSueur)



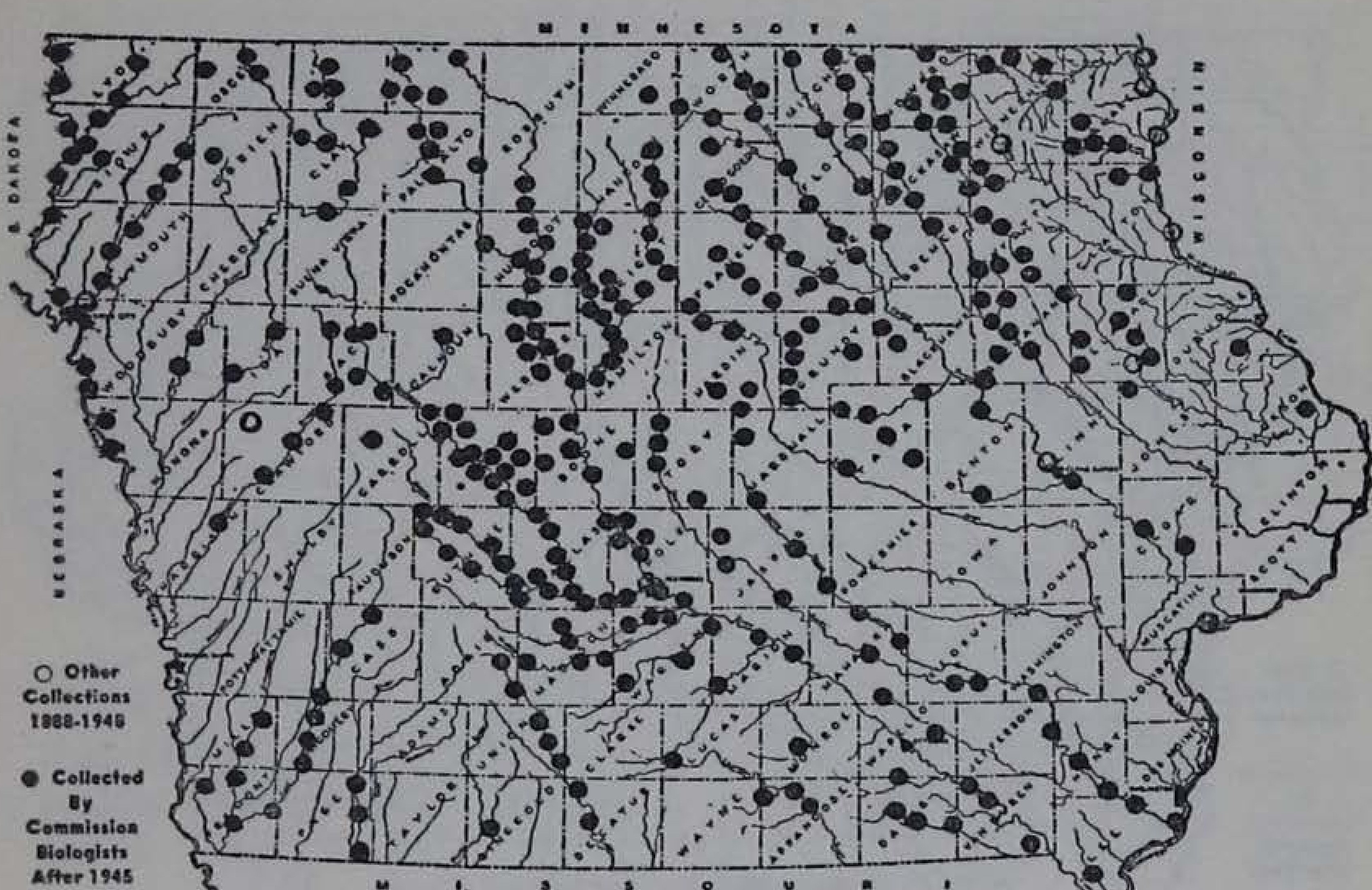
Map 28. White Sucker—*Catostomus commersoni* (Lacepede)



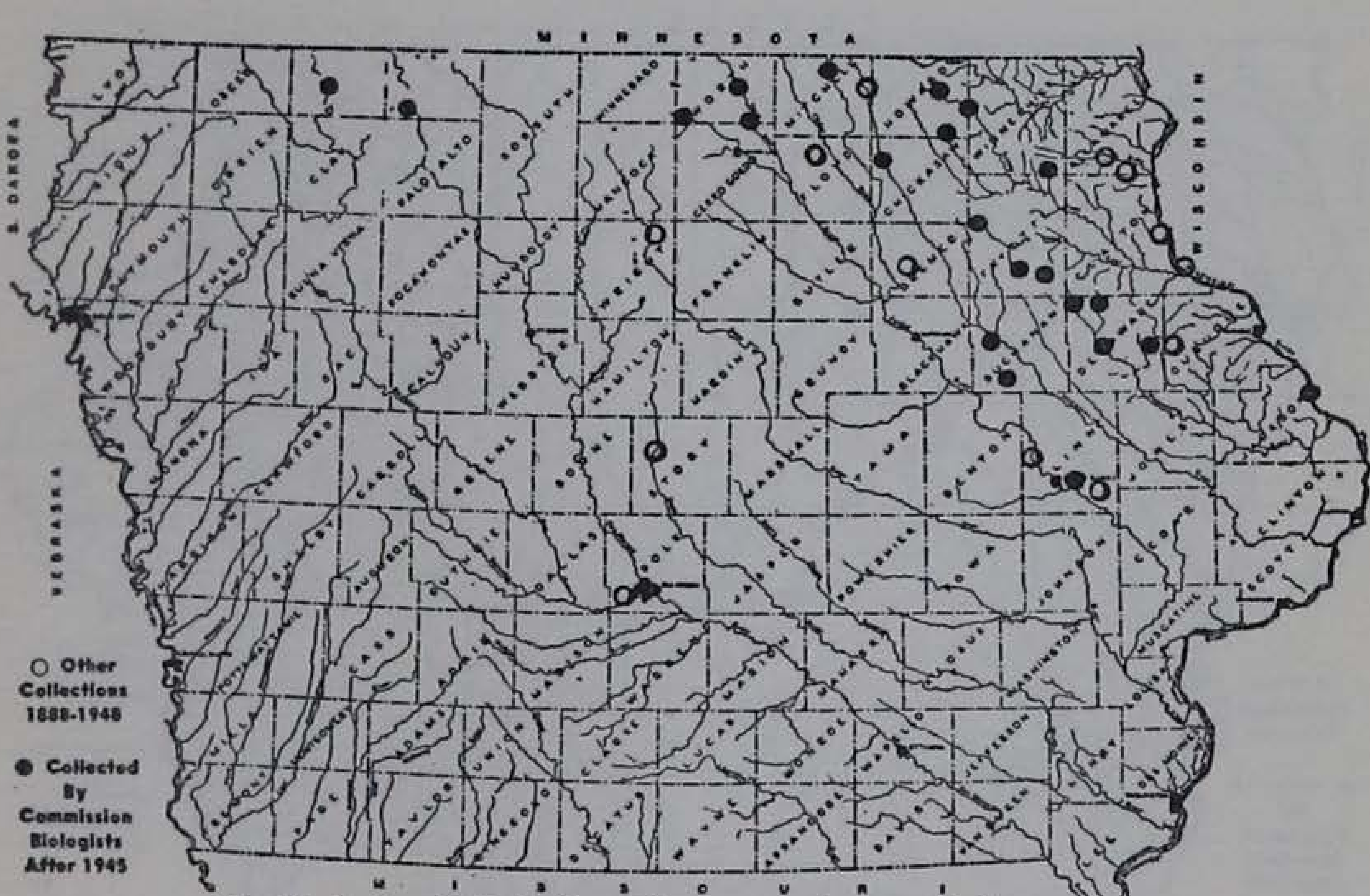
Map 29. Carp—*Cyprinus carpio* Linnaeus



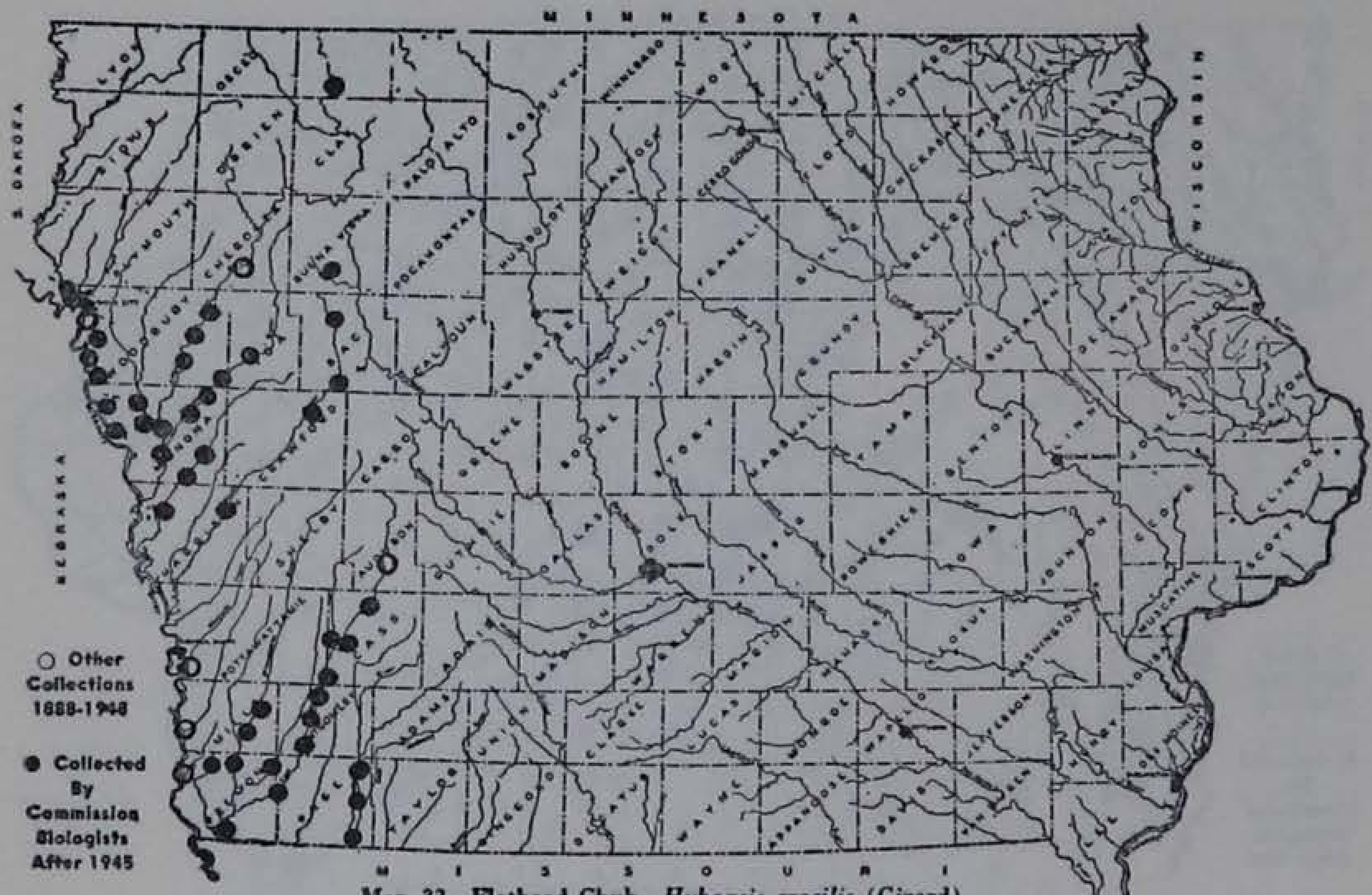
Map 30. Golden Shiner—*Notemigonus crysoleucas* (Mitchill)



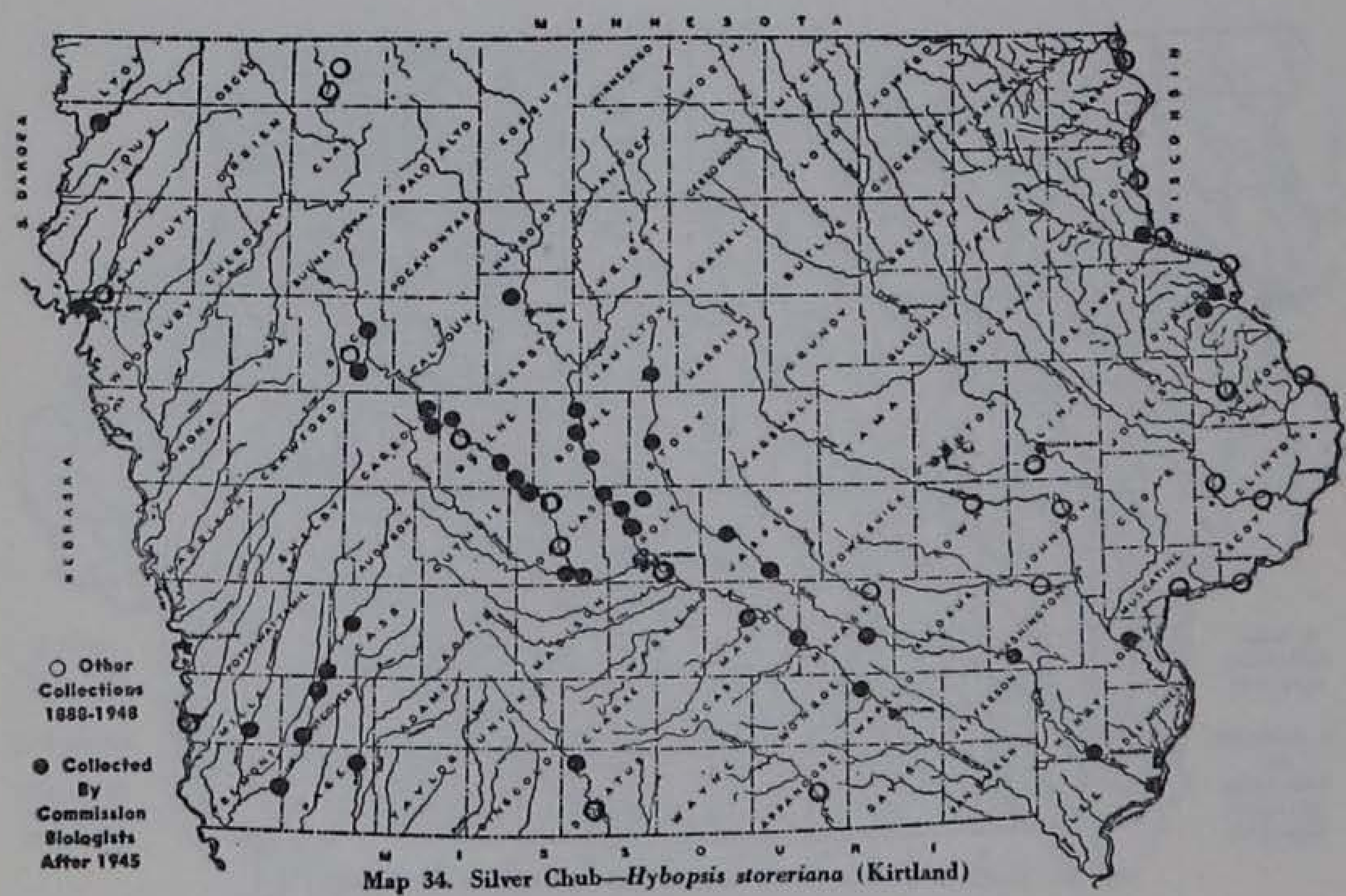
Map 31. Creek Chub—*Semotilus atromaculatus* (Mitchill)



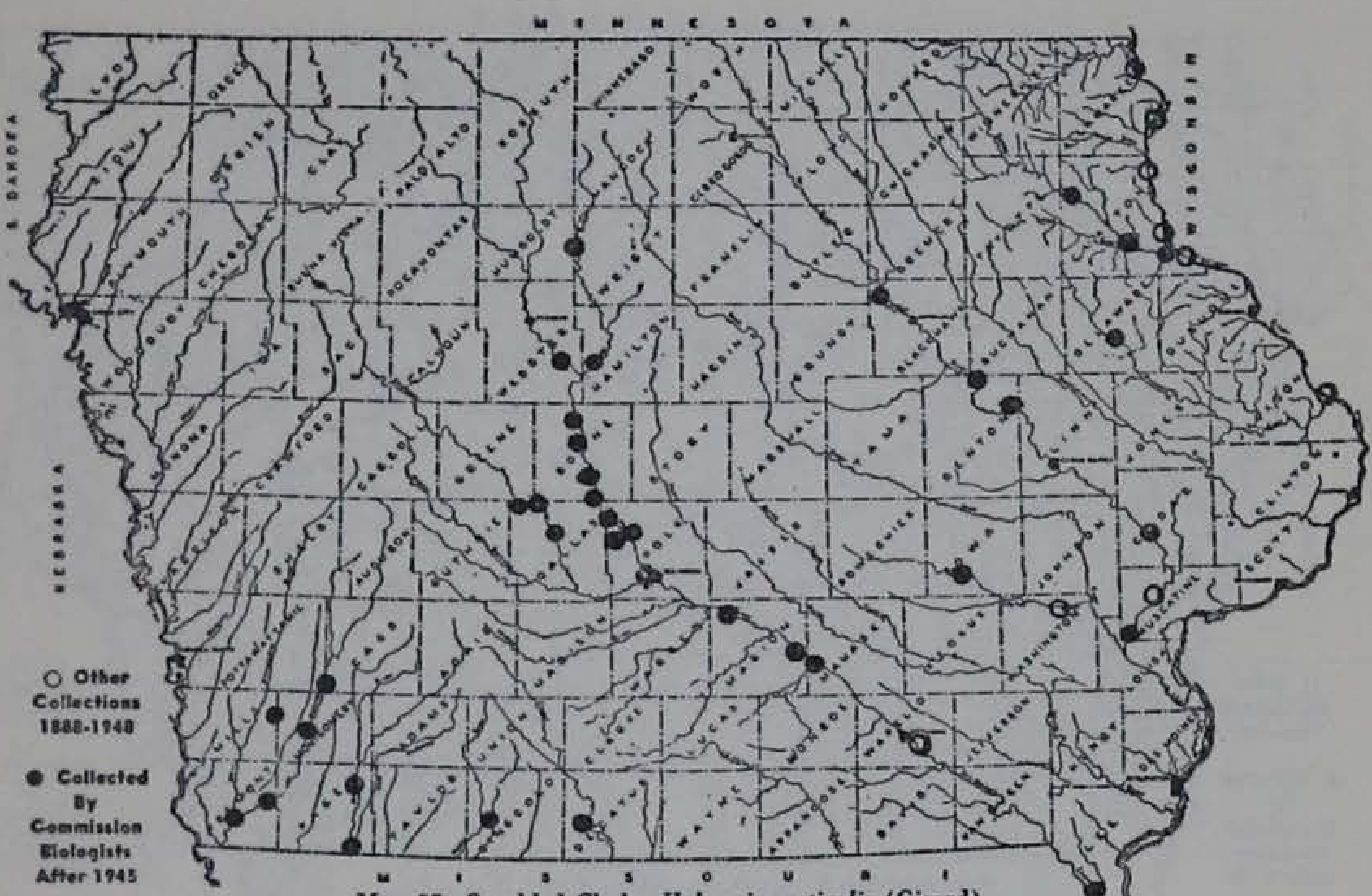
Map 32. Southern Redbelly Dace—*Chrosomus erythrogaster* (Rafinesque)



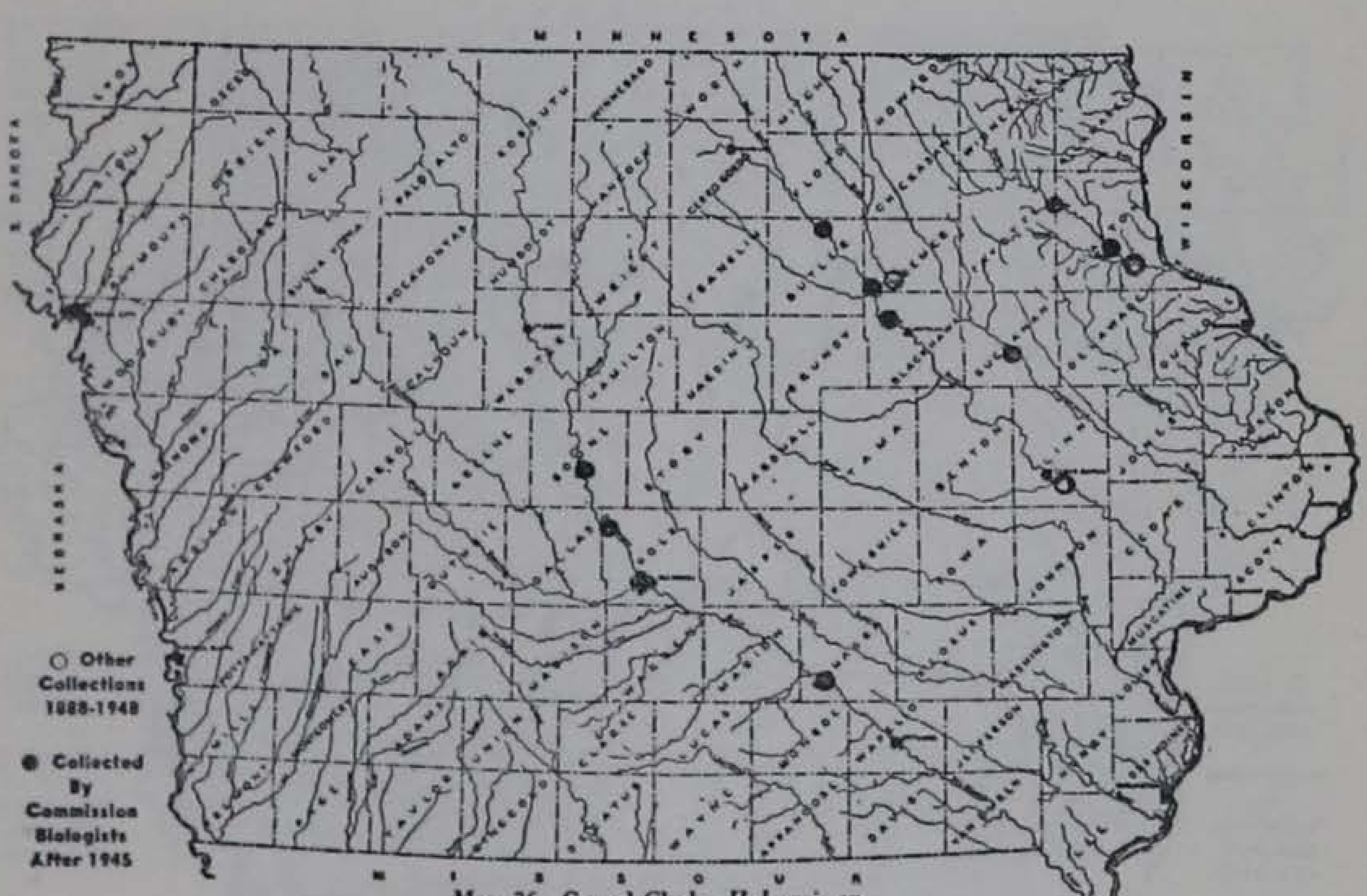
Map 33. Flathead Chub—*Hybopsis gracilis* (Girard)



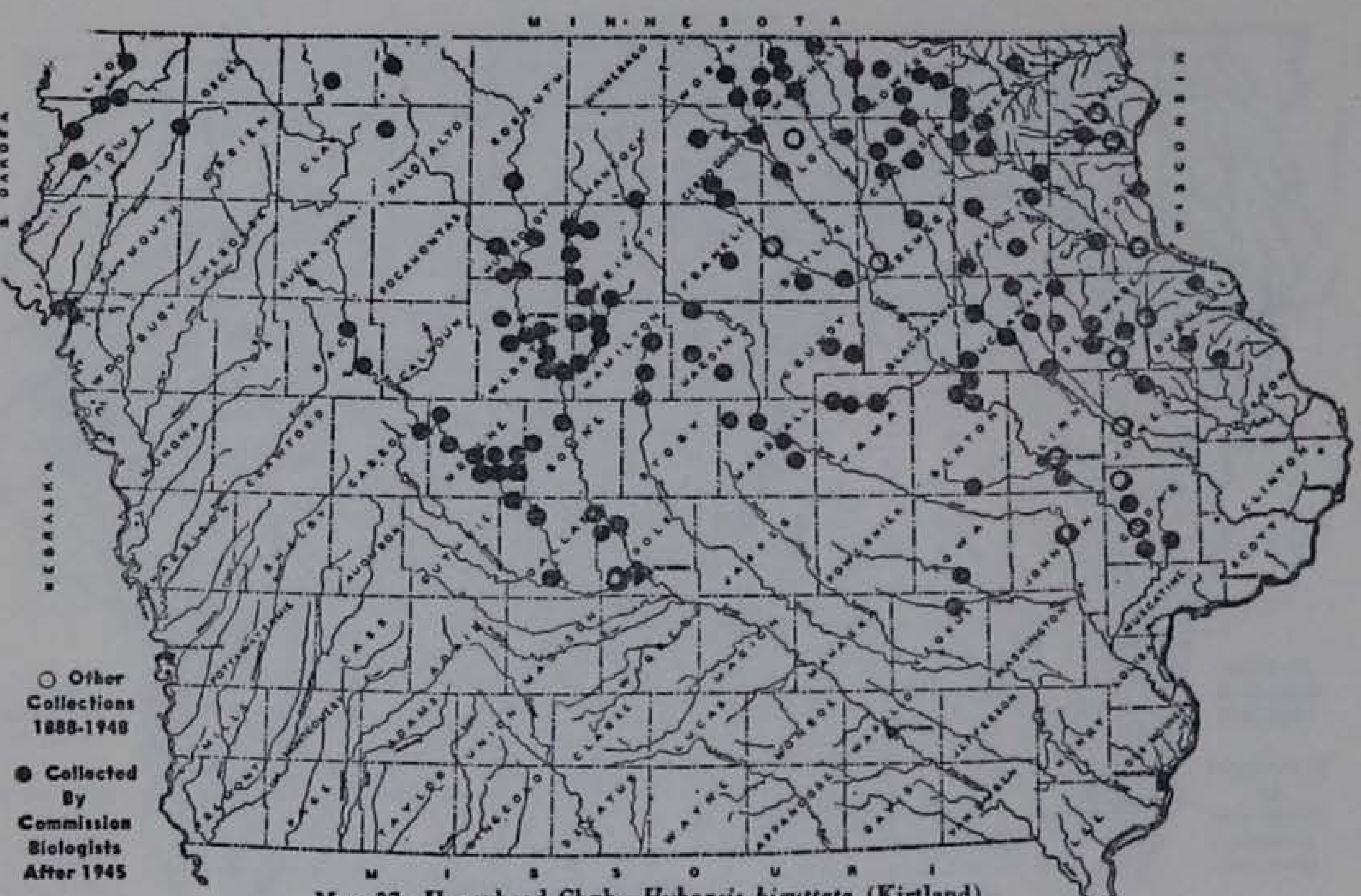
Map 34. Silver Chub—*Hybopsis storeriana* (Kirtland)



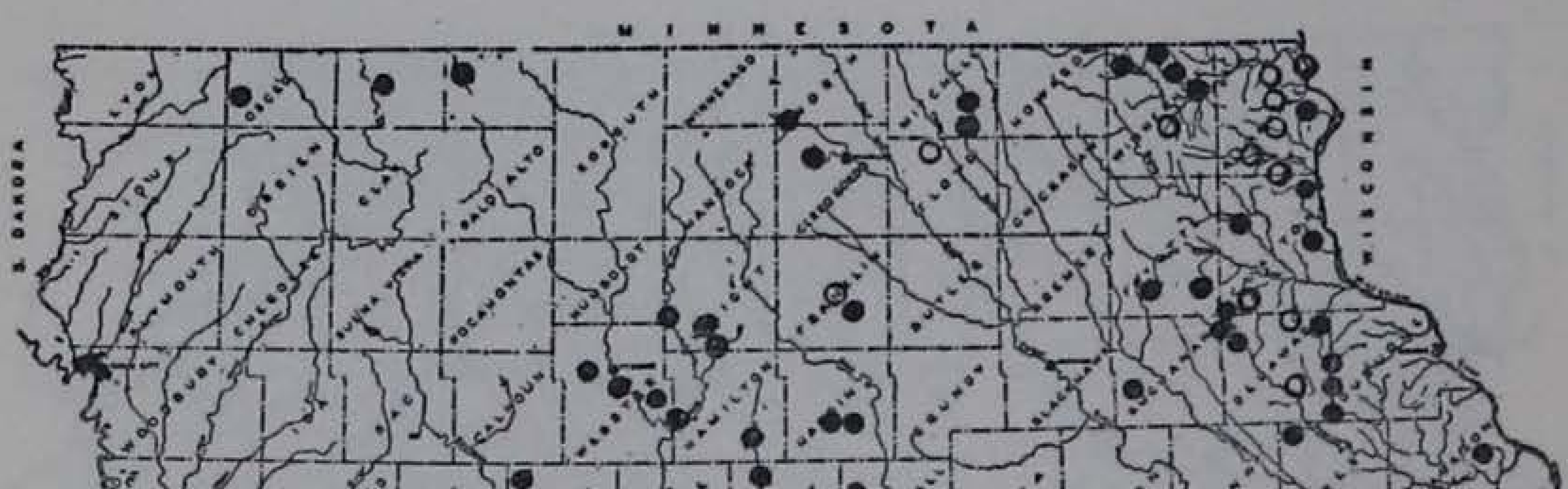
Map 35. Speckled Chub—*Hybopsis aestivalis* (Girard)



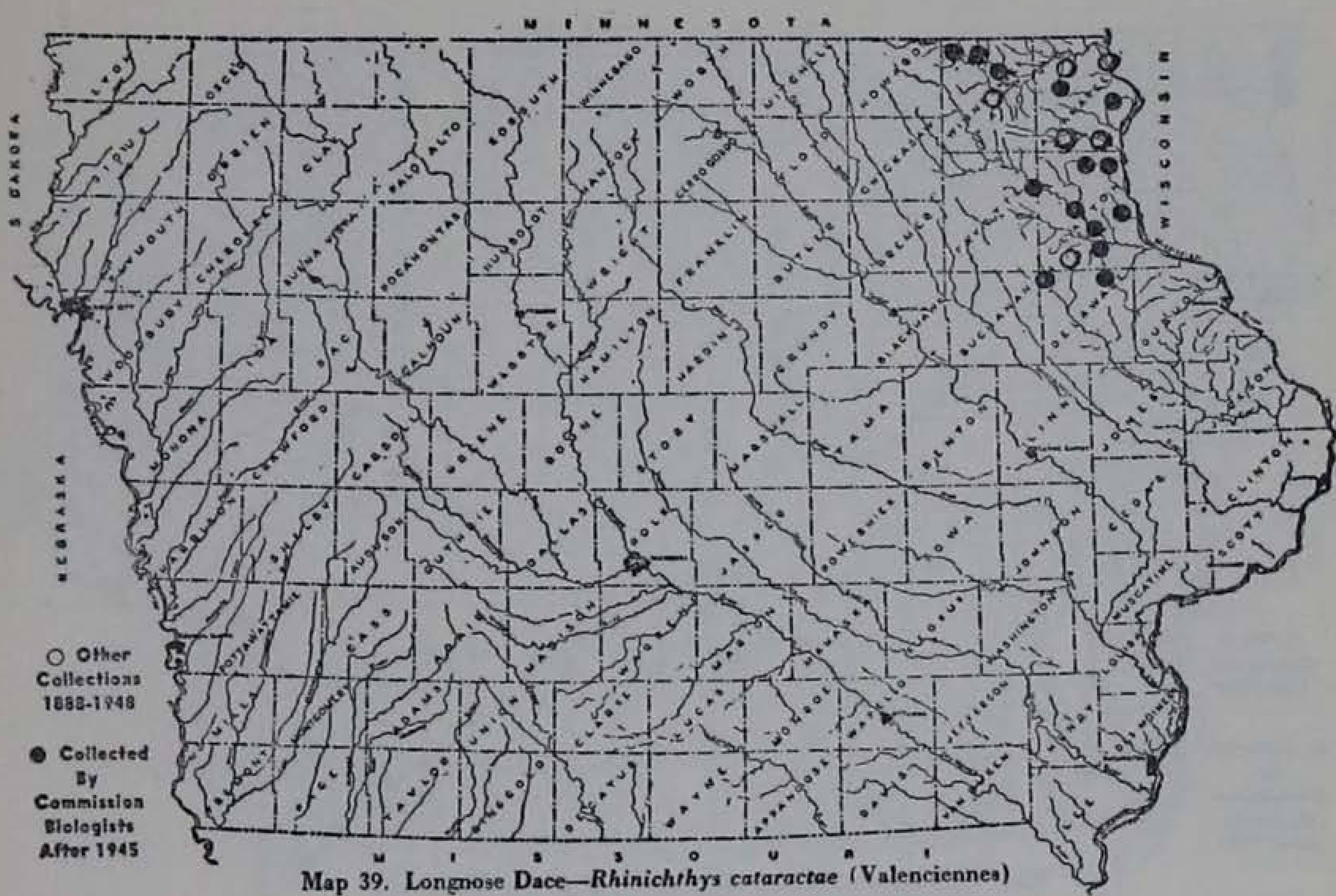
Map 36. Gravel Chub—*Hybopsis sp.*



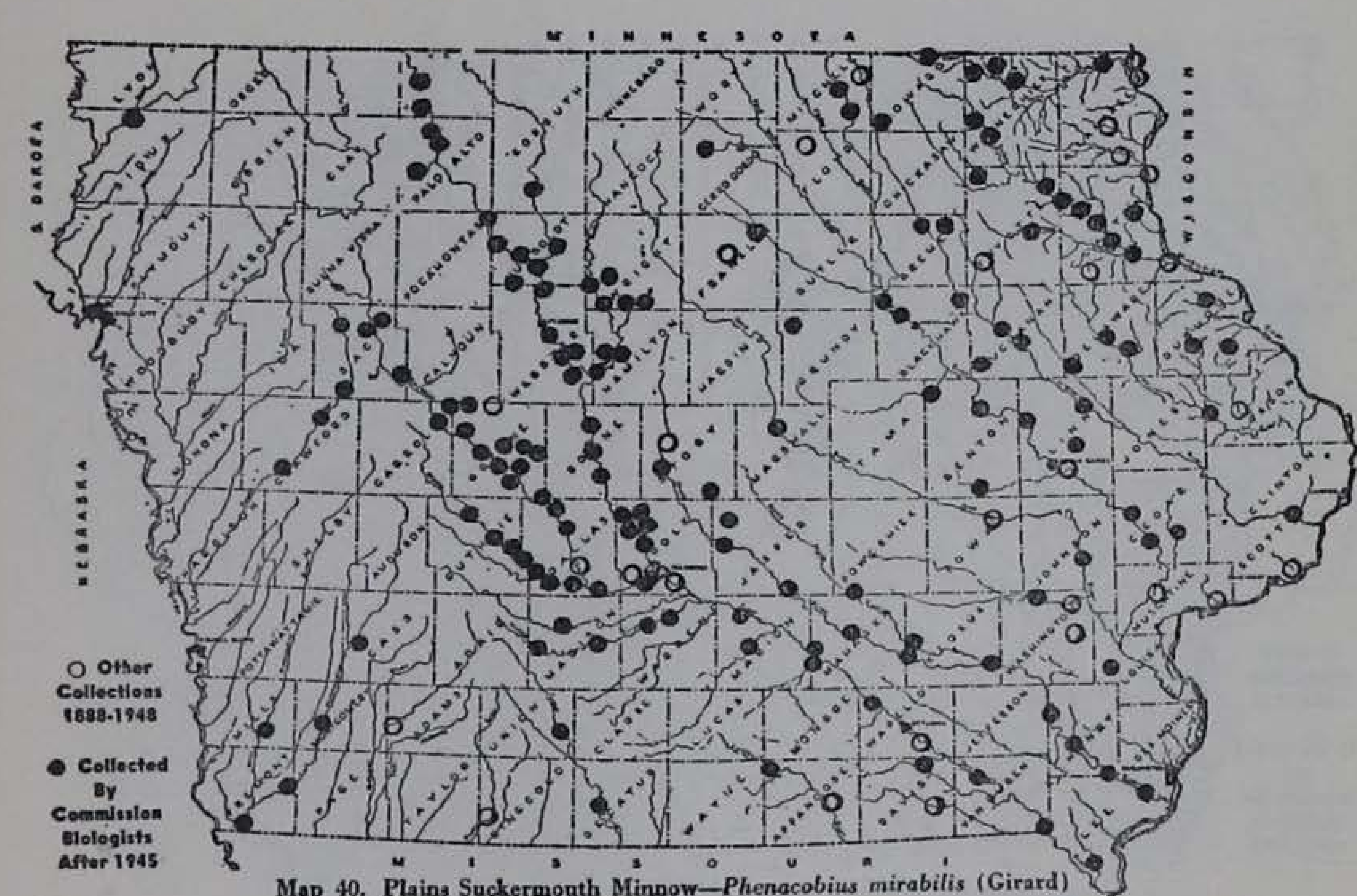
Map 37. Hornyhead Chub—*Hybopsis biguttata* (Kirtland)



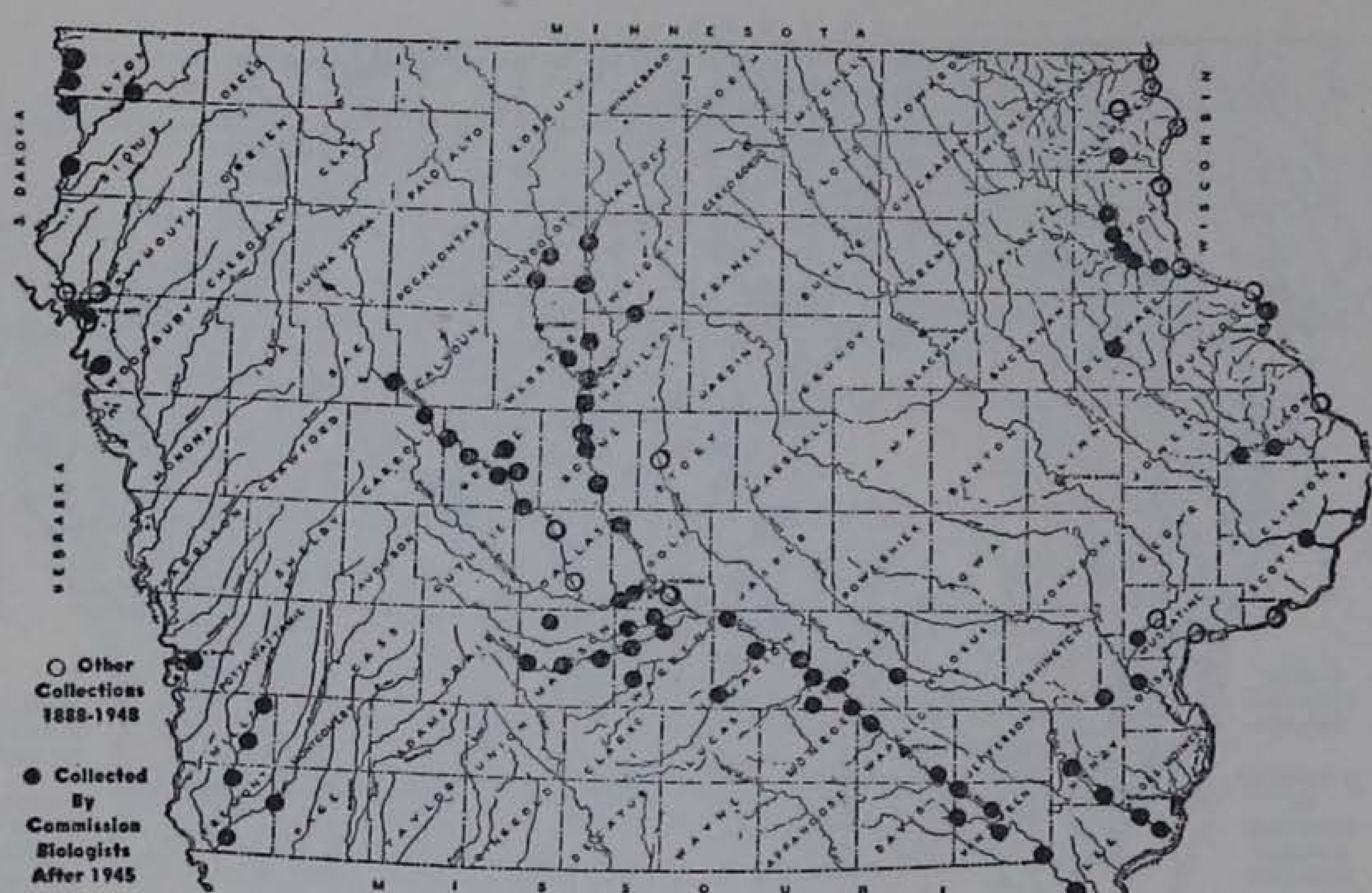
Map 38. Western Blacknose Dace—*Rhinichthys atratulus meleagris* Agassiz



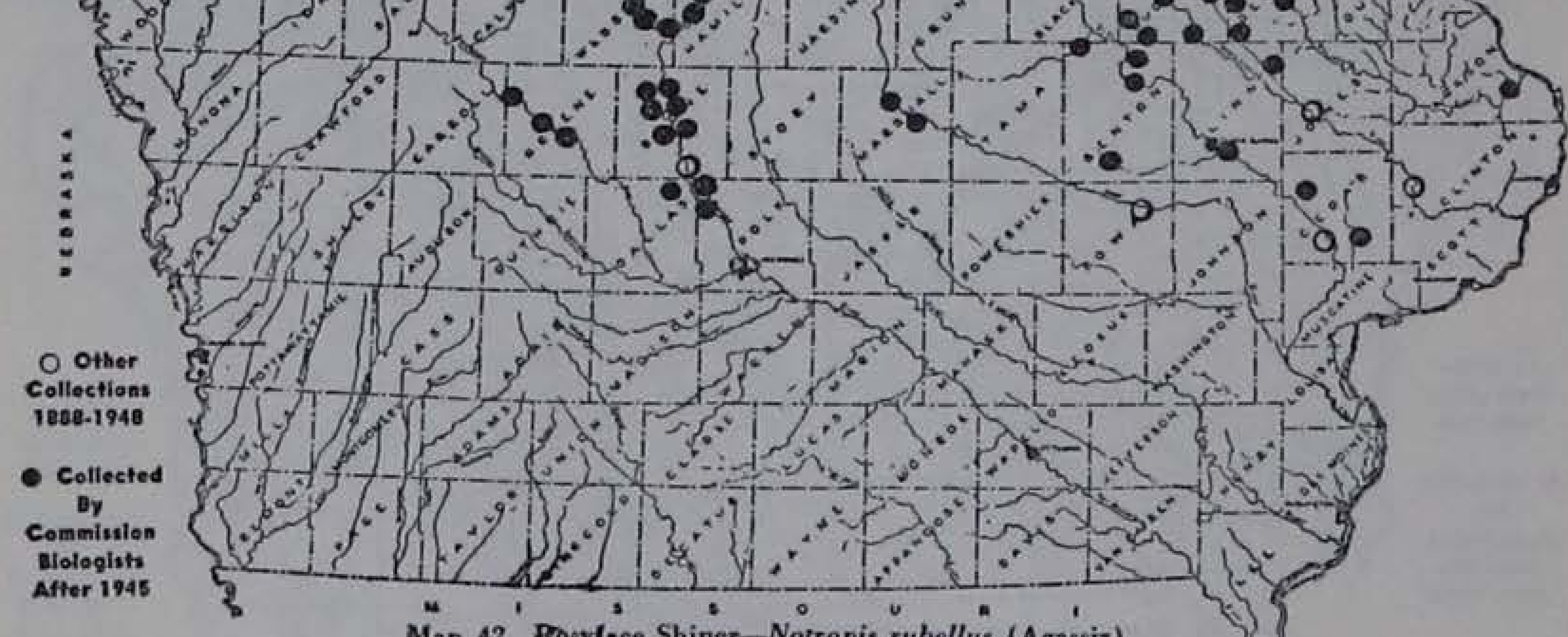
Map 39. Longnose Dace—*Rhinichthys cataractae* (Valenciennes)



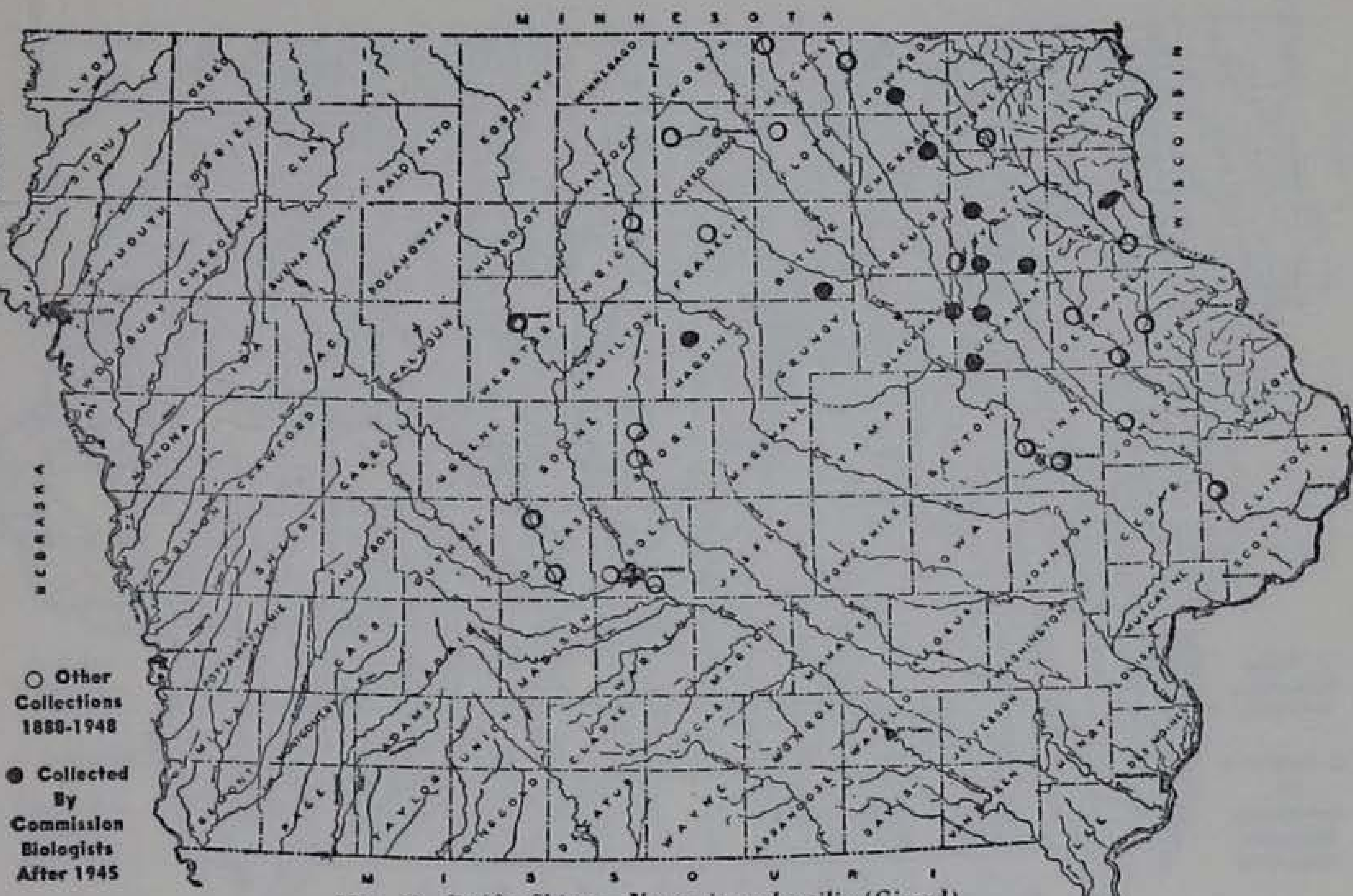
Map 40. Plains Suckermouth Minnow—*Phenacobius mirabilis* (Girard)



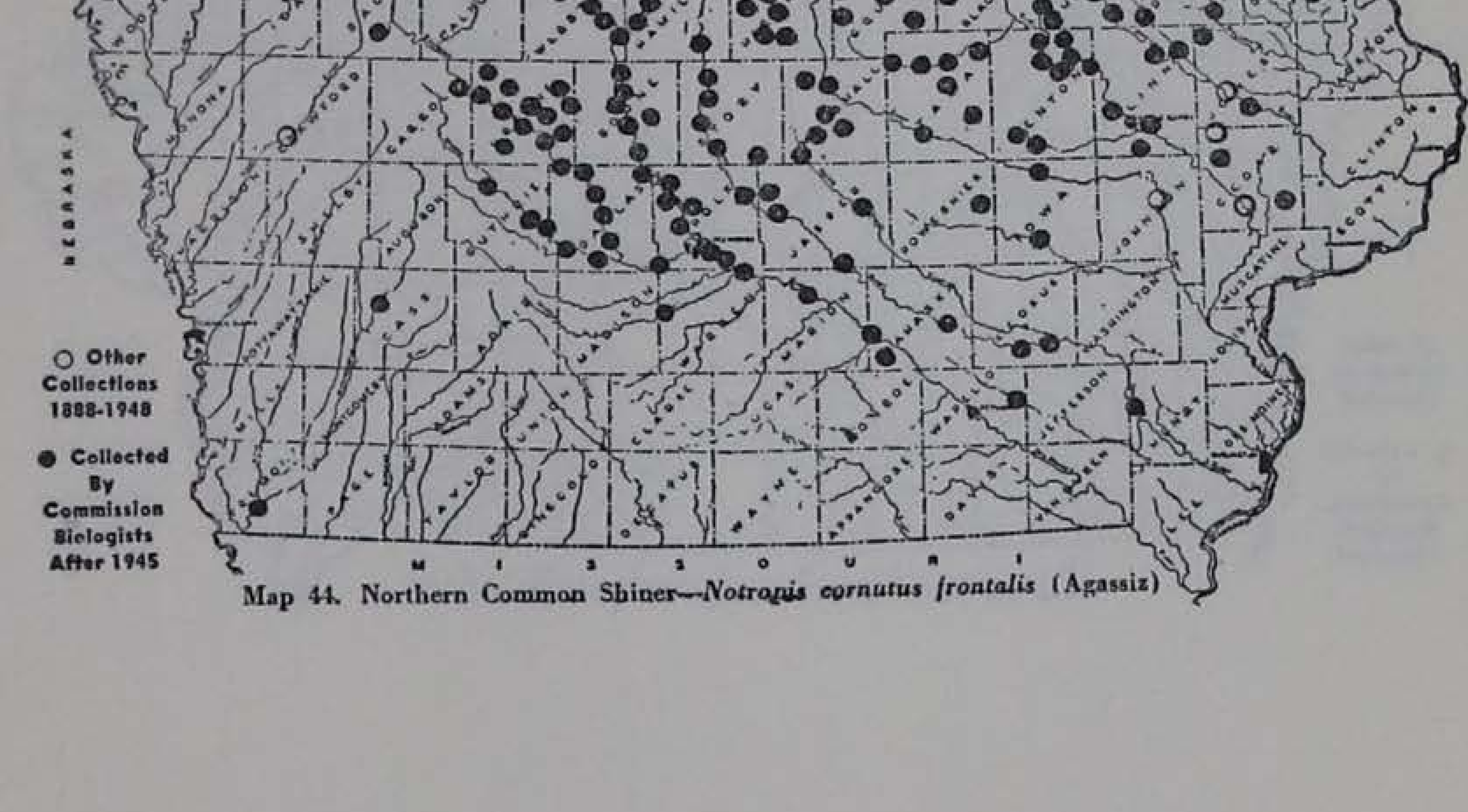
Map 41. Emerald Shiner—*Notropis atherinoides* Rafinesque



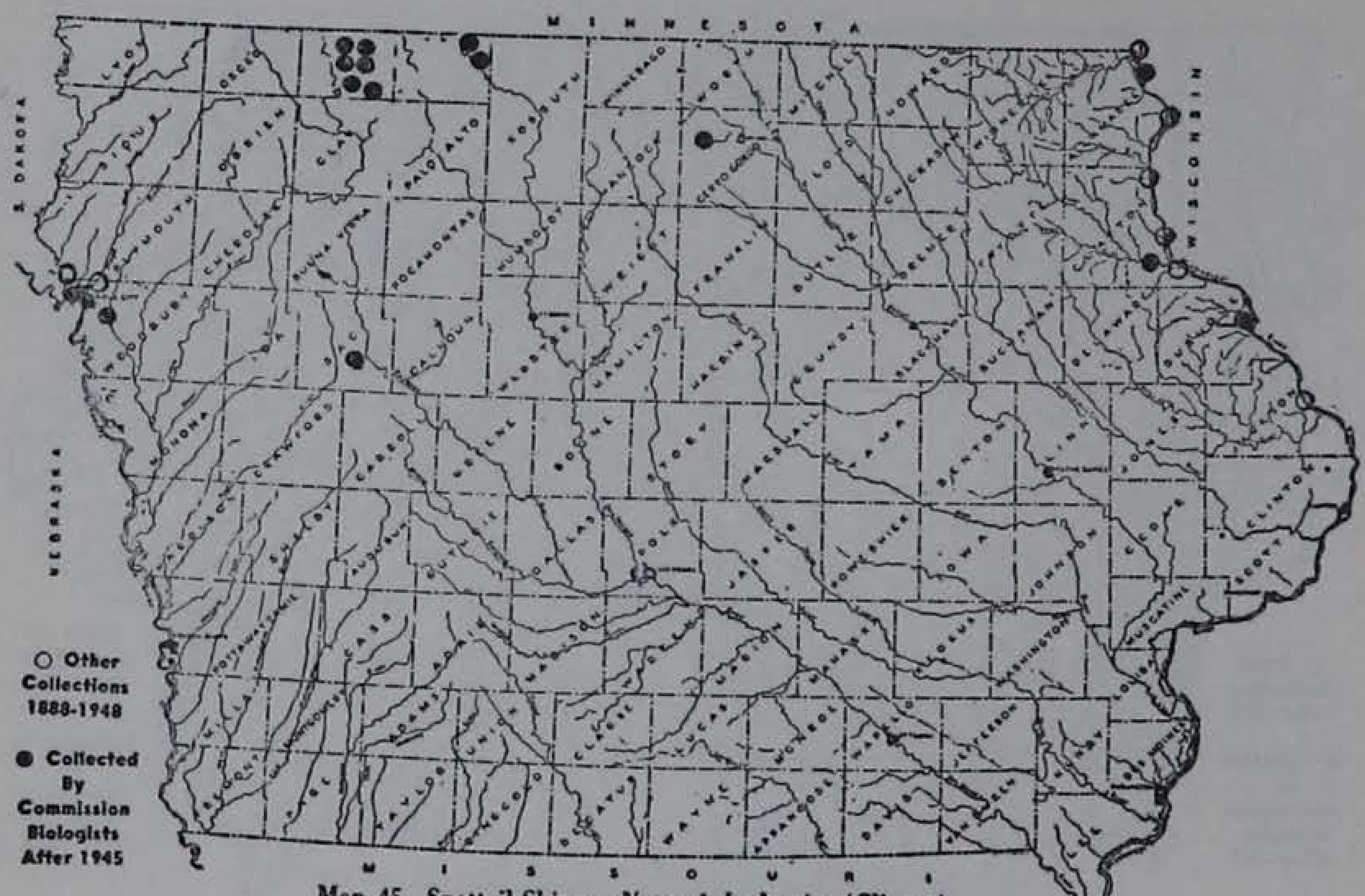
Map 42. Rosyface Shiner—*Notropis rubellus* (Agassiz)



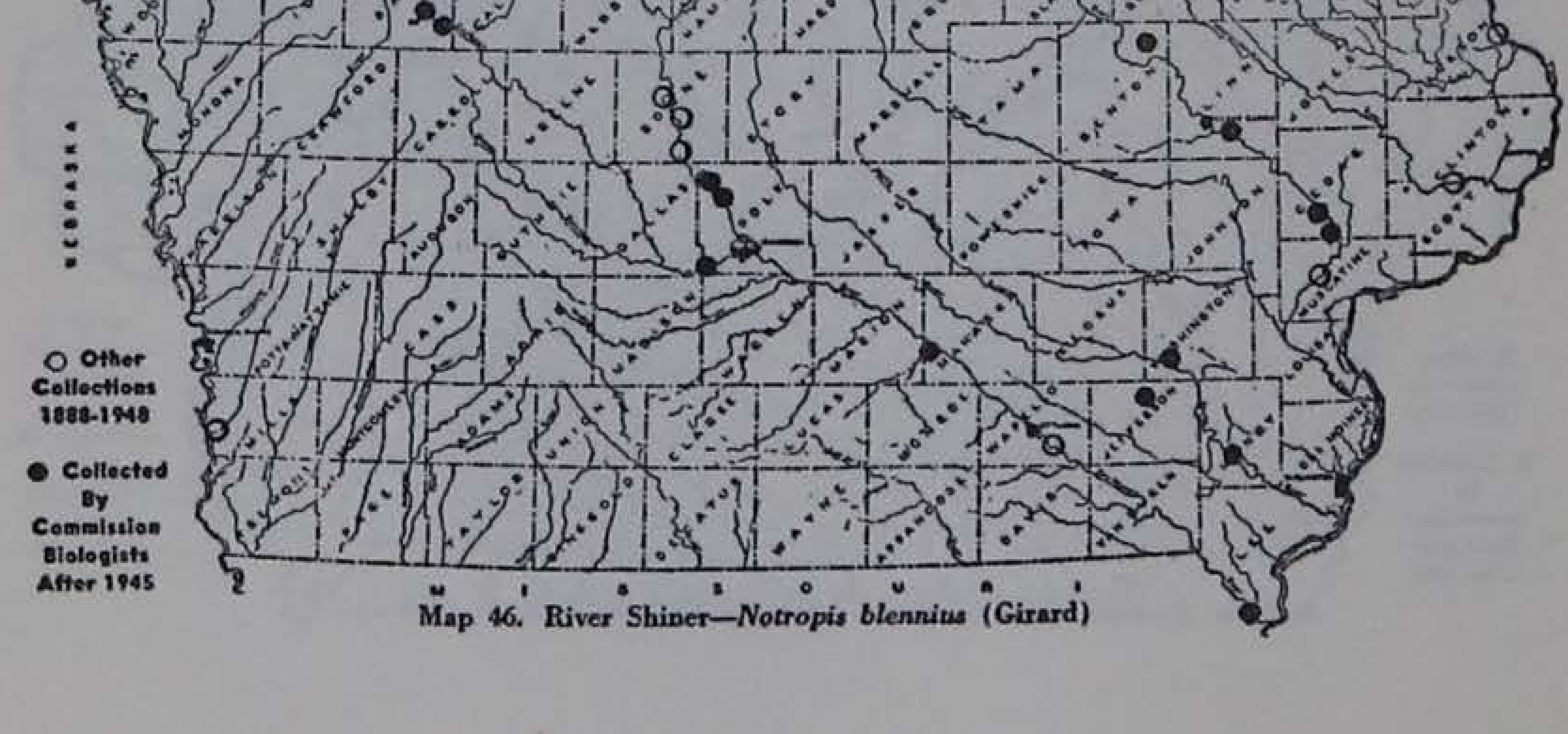
Map 43. Redfin Shiner—*Notropis umbratilis* (Girard)



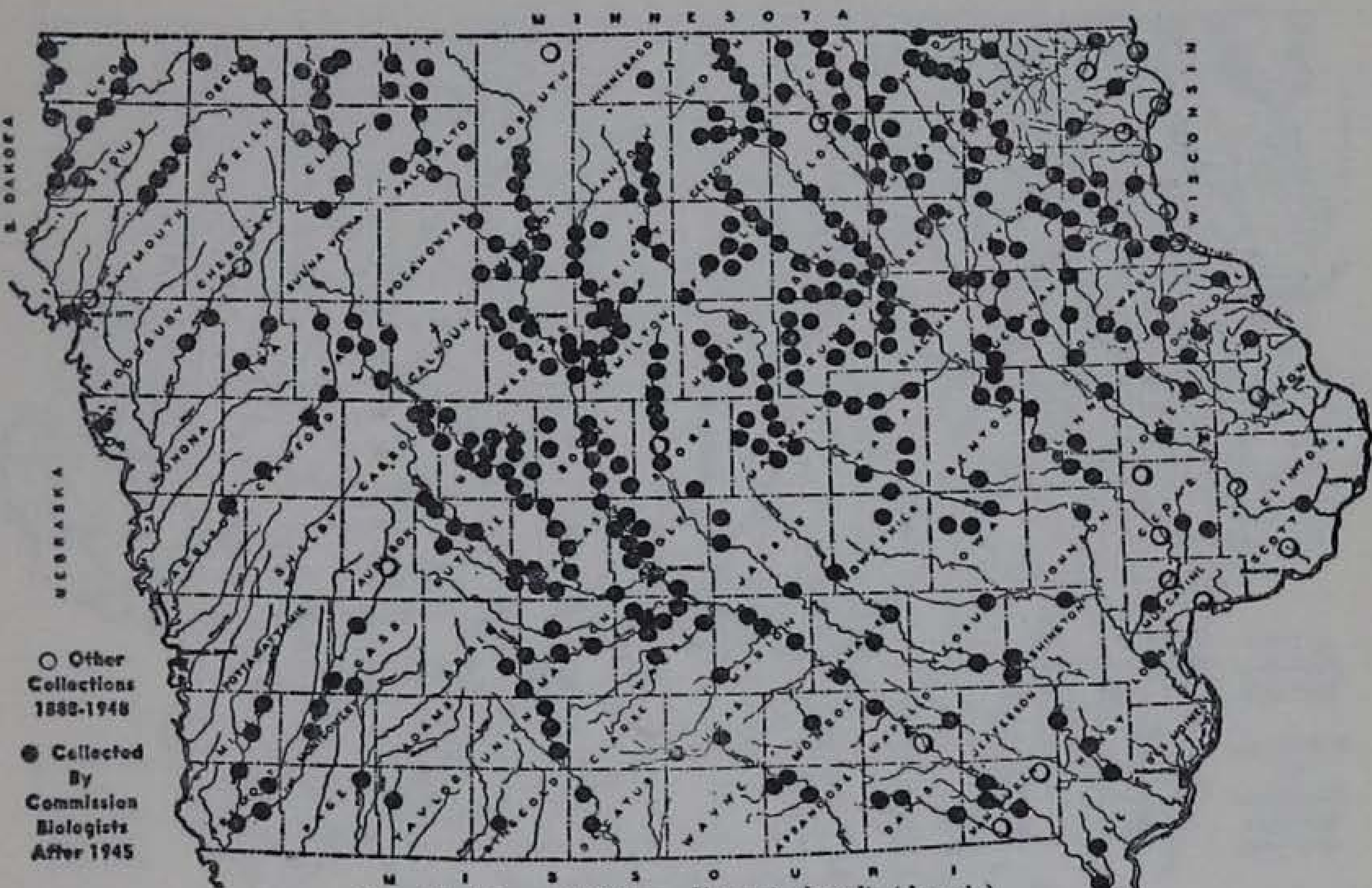
Map 44. Northern Common Shiner—*Notropis cornutus frontalis* (Agassiz)



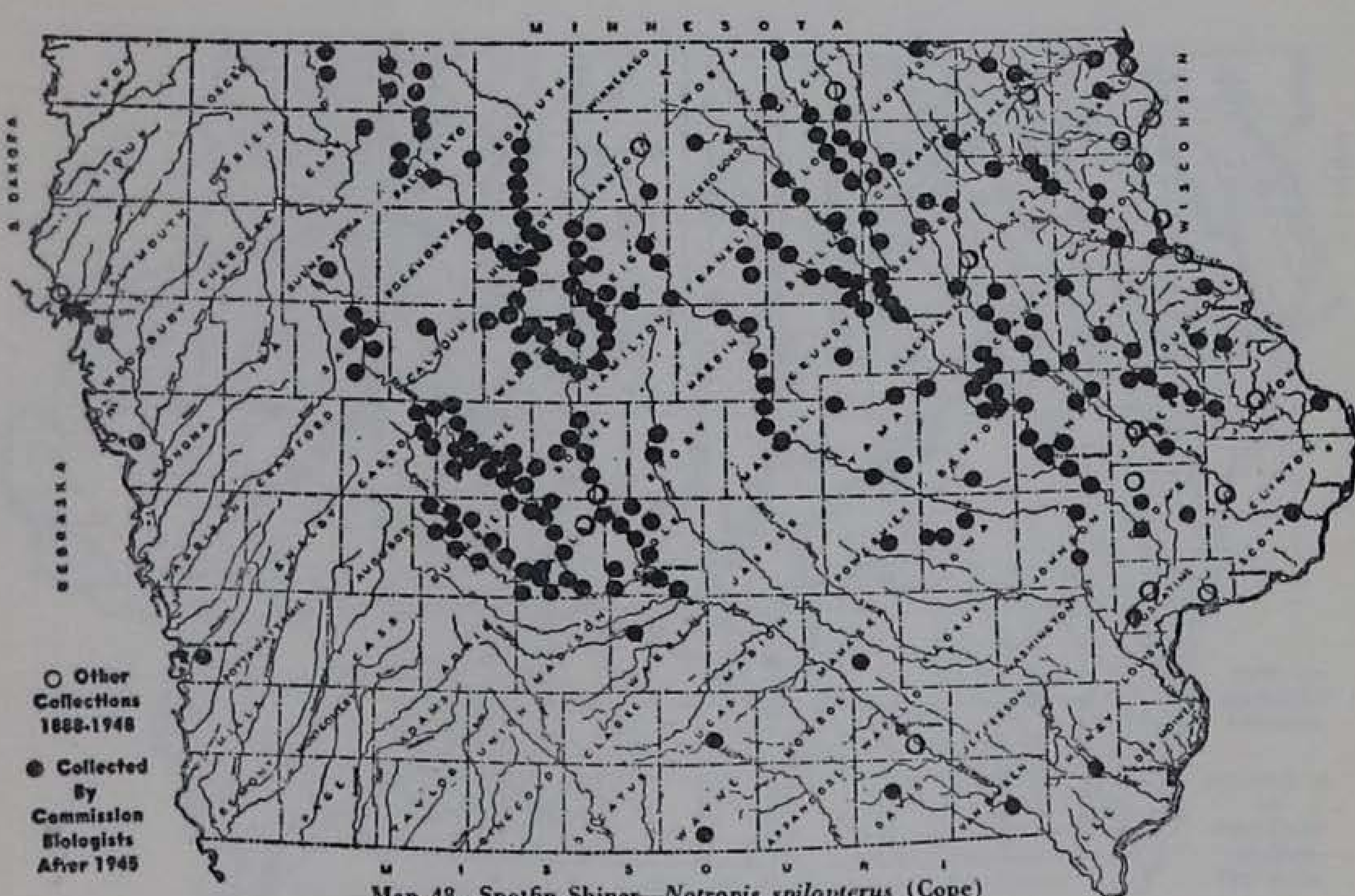
Map 45. Spottail Shiner—*Notropis hudsonius* (Clinton)



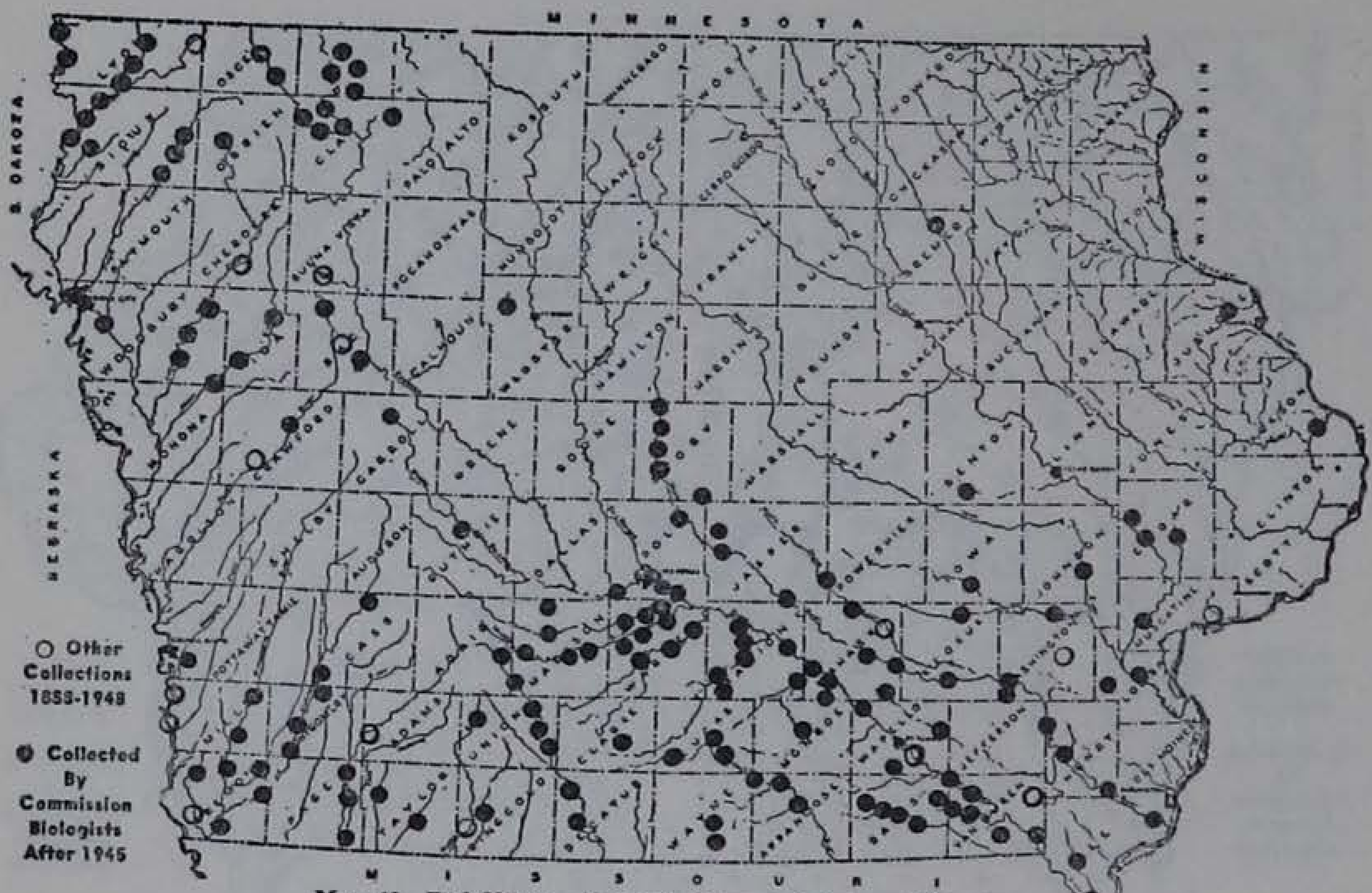
Map 46. River Shiner—*Notropis blennius* (Girard)



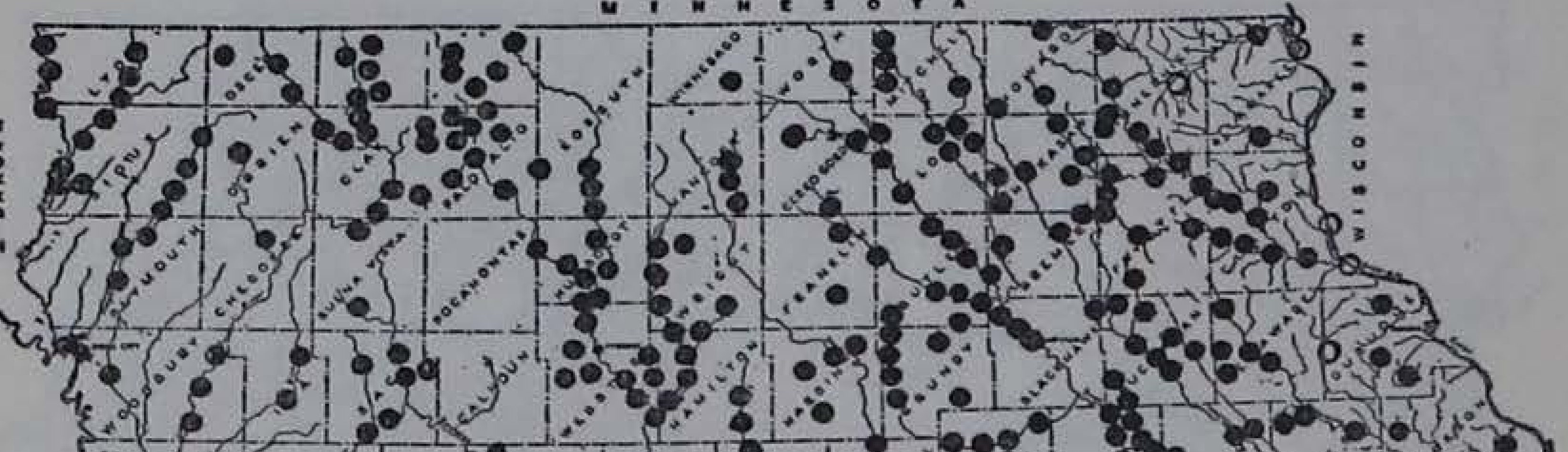
Map 47. Bigmouth Shiner—*Notropis dorsalis* (Agassiz)



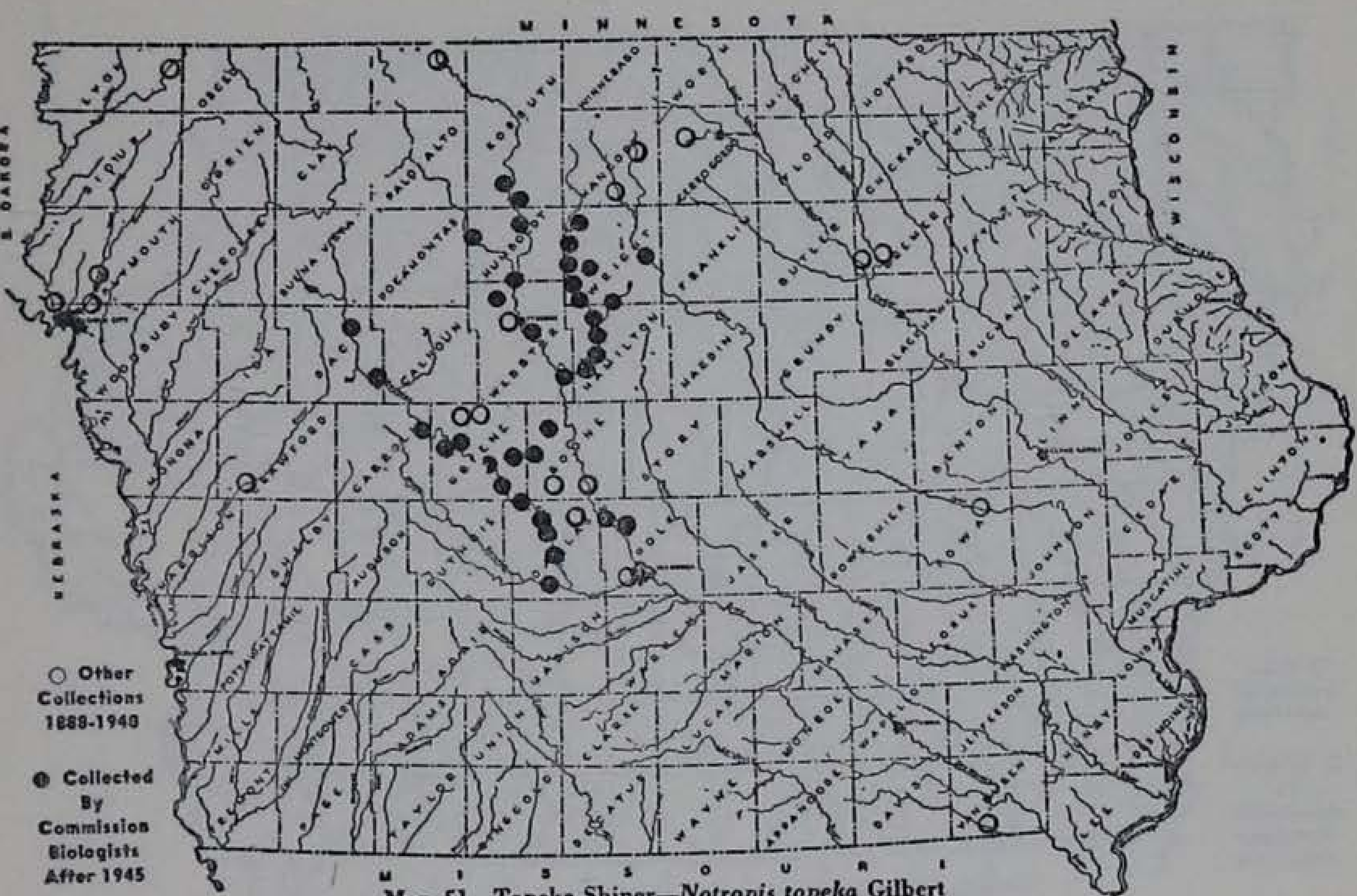
Map 48. Spotfin Shiner—*Notropis spilopterus* (Cope)



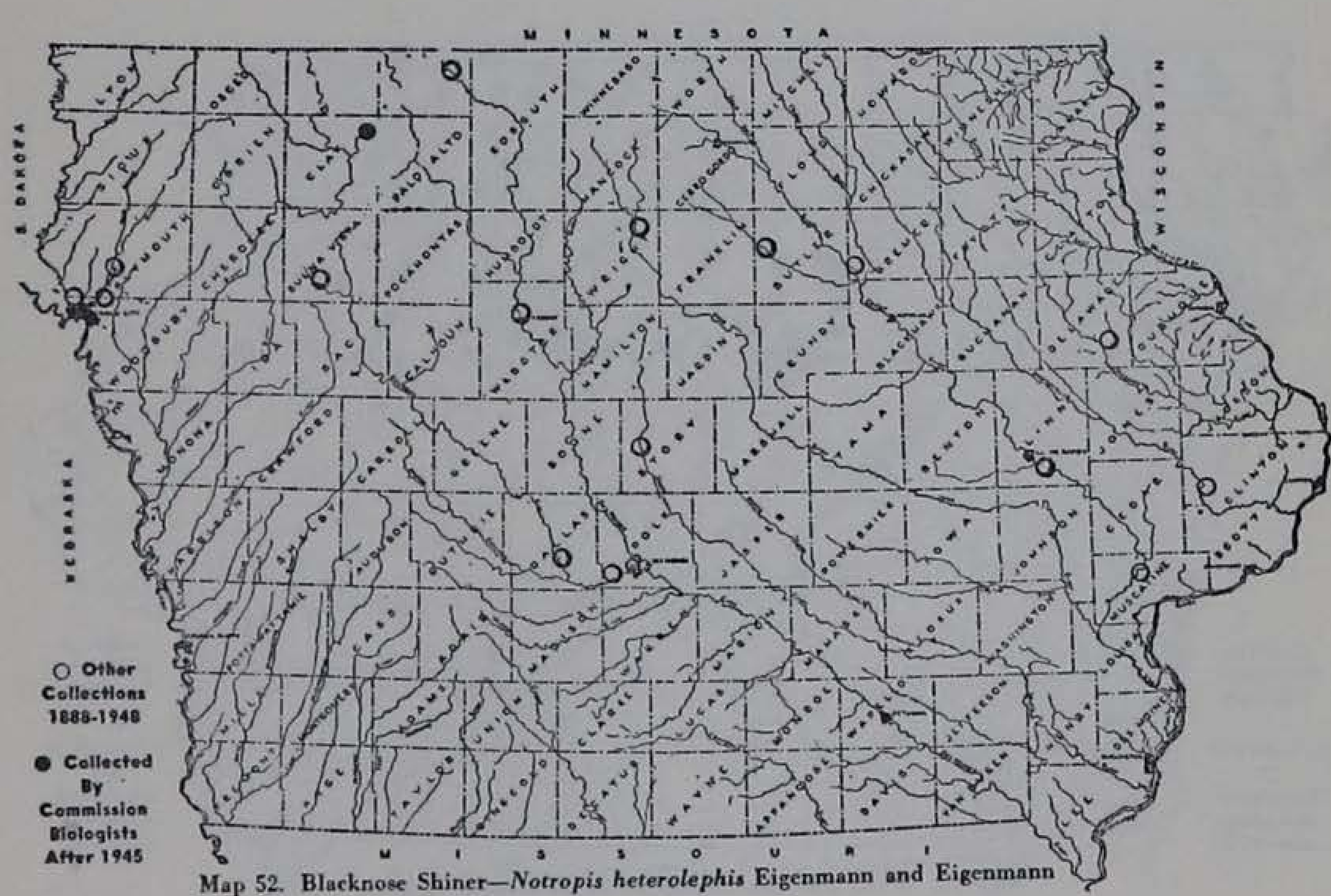
Map 49. Red Shiner—*Notropis lutrensis* Baird and Girard



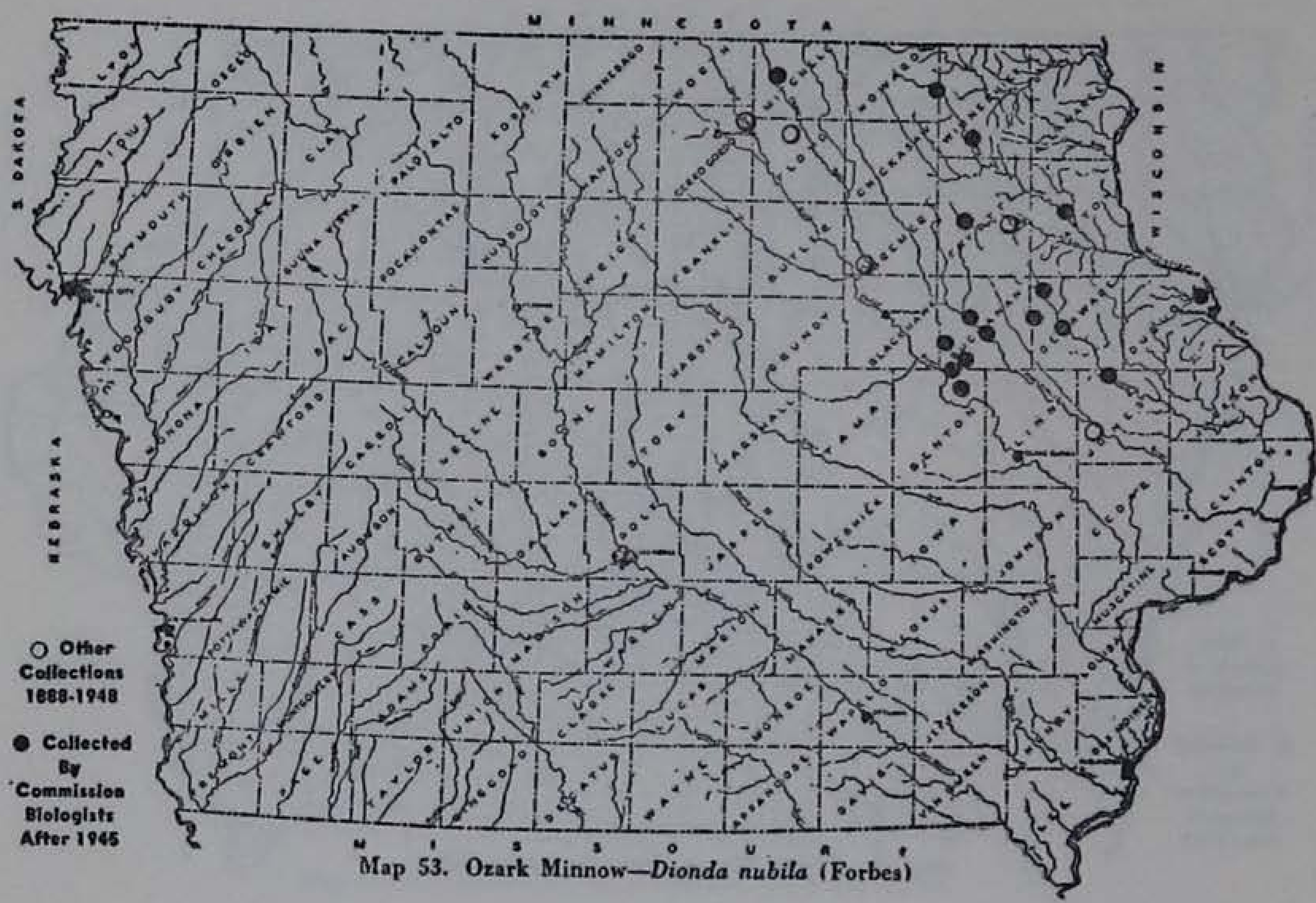
Map 50. Sand Shiner—*Notropis deliciosus ssp.*



Map 51. Topeka Shiner—*Notropis topeka* Gilbert

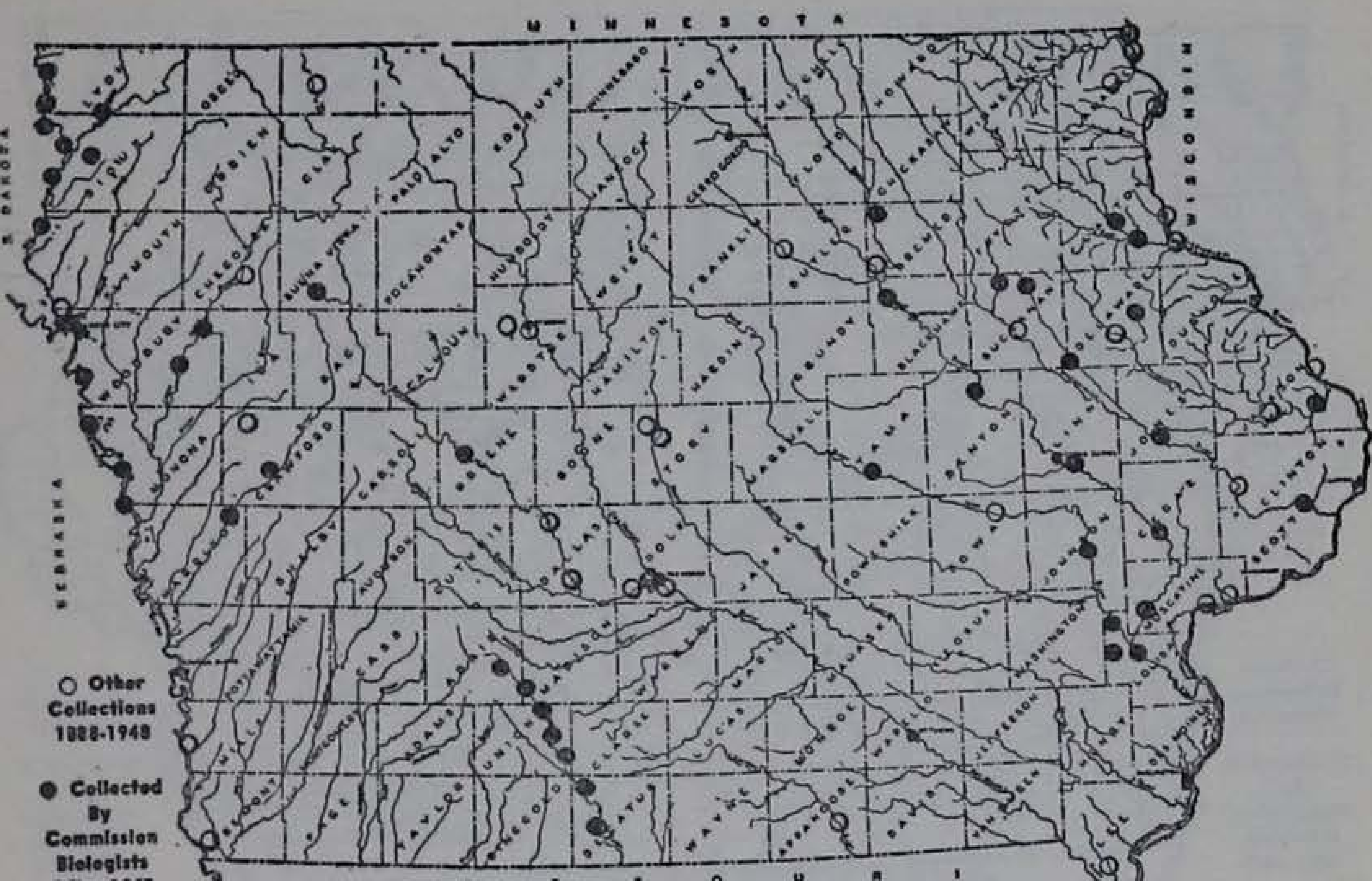


Map 52. Blacknose Shiner—*Notropis heterolephis* Eigenmann and Eigenmann

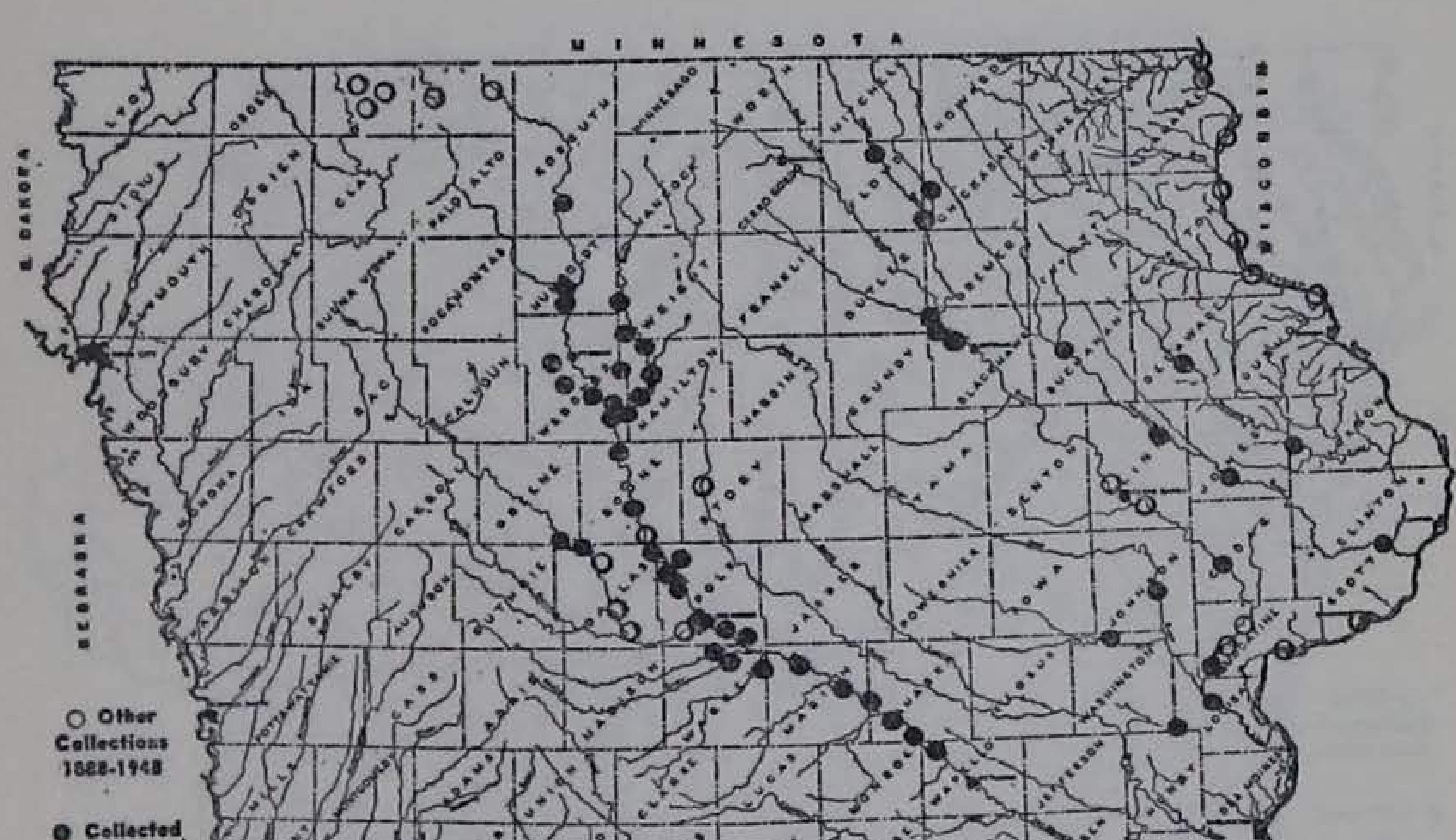


Map 53. Ozark Minnow—*Dionda nubila* (Forbes)

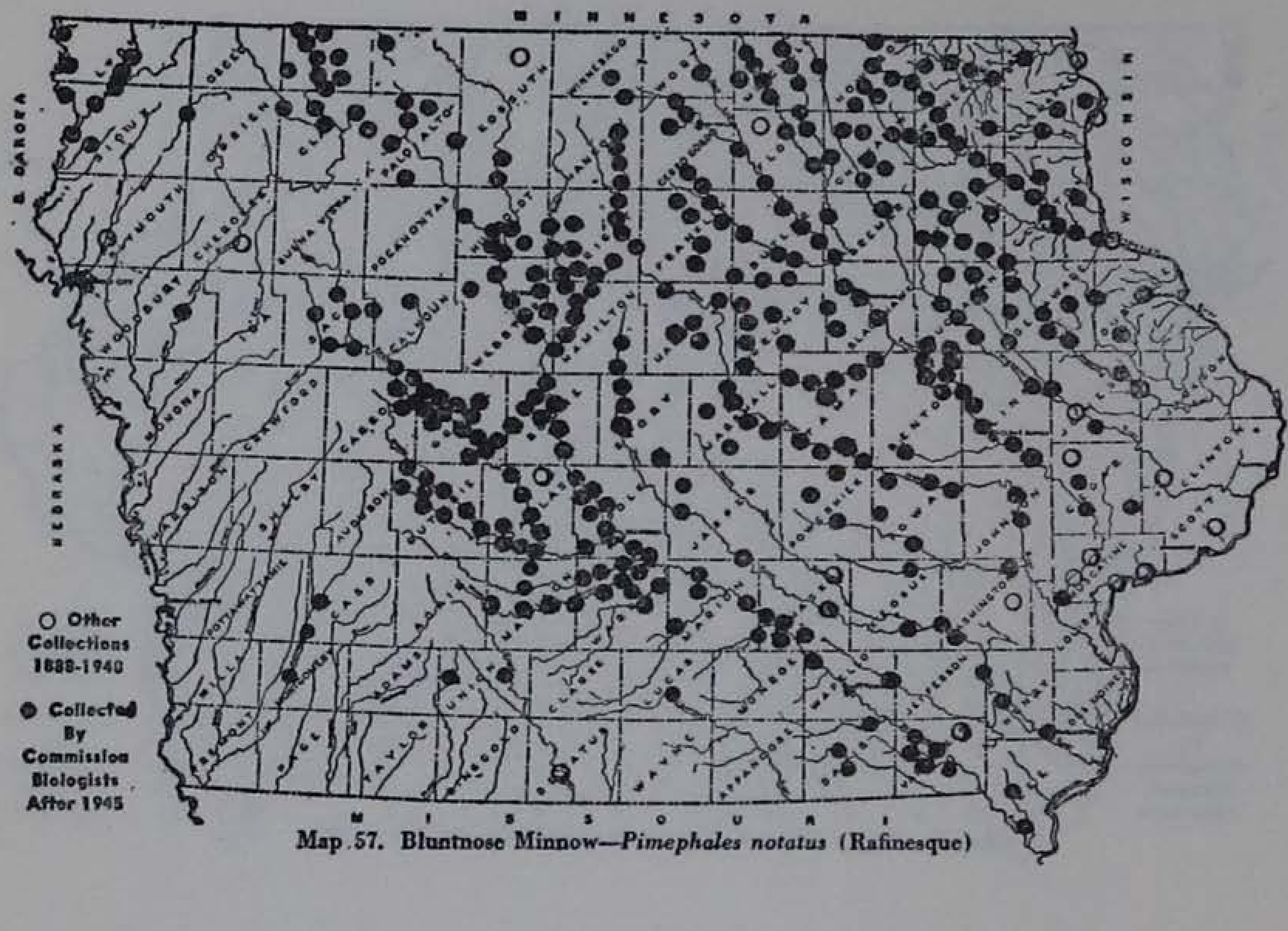
Map 54. Brassy Minnow—*Hybognathus hankinsoni* Hubbs



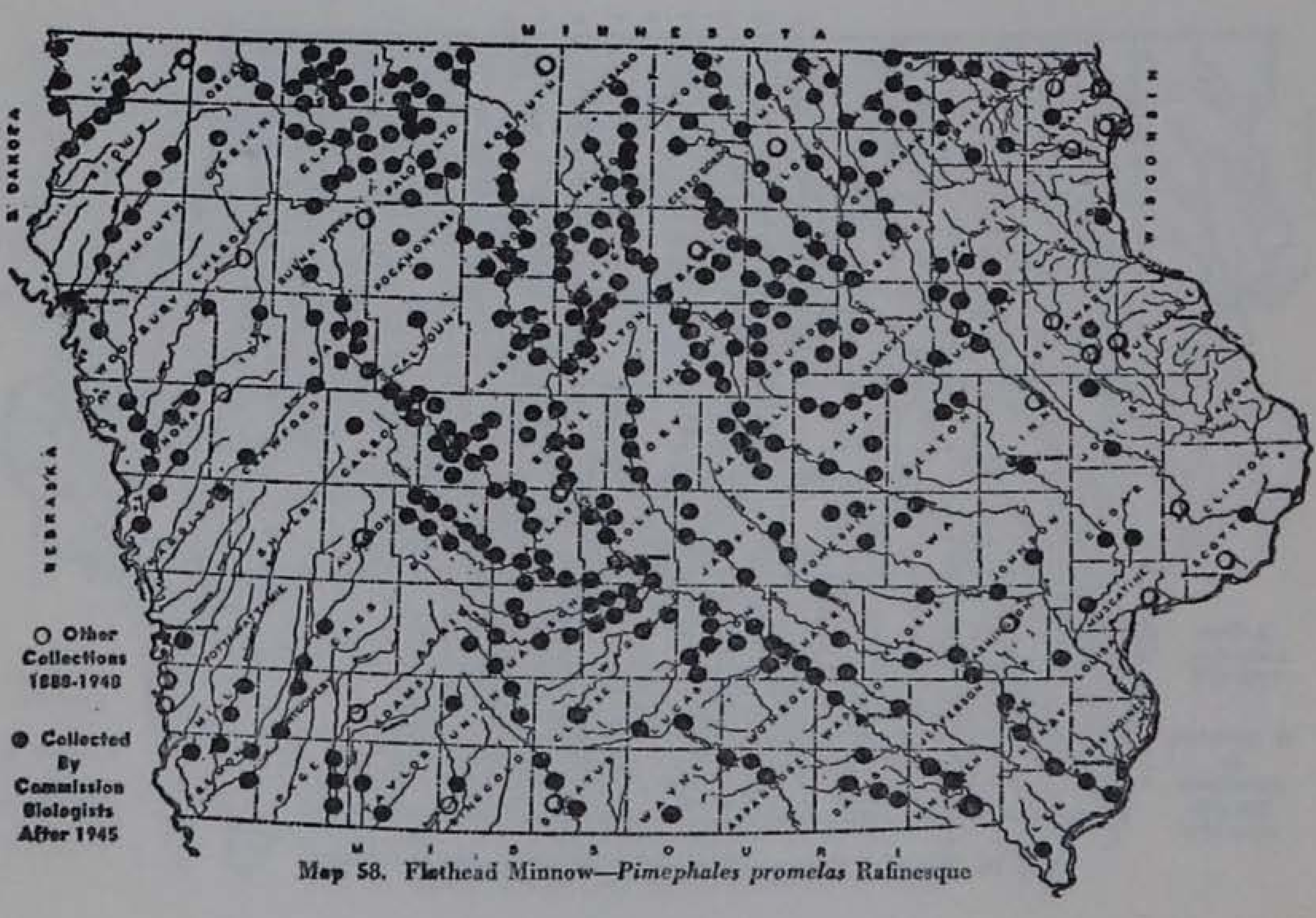
Map 55. Silvery Minnow—*Hybognathus nuchalis nuchalis* Agassiz



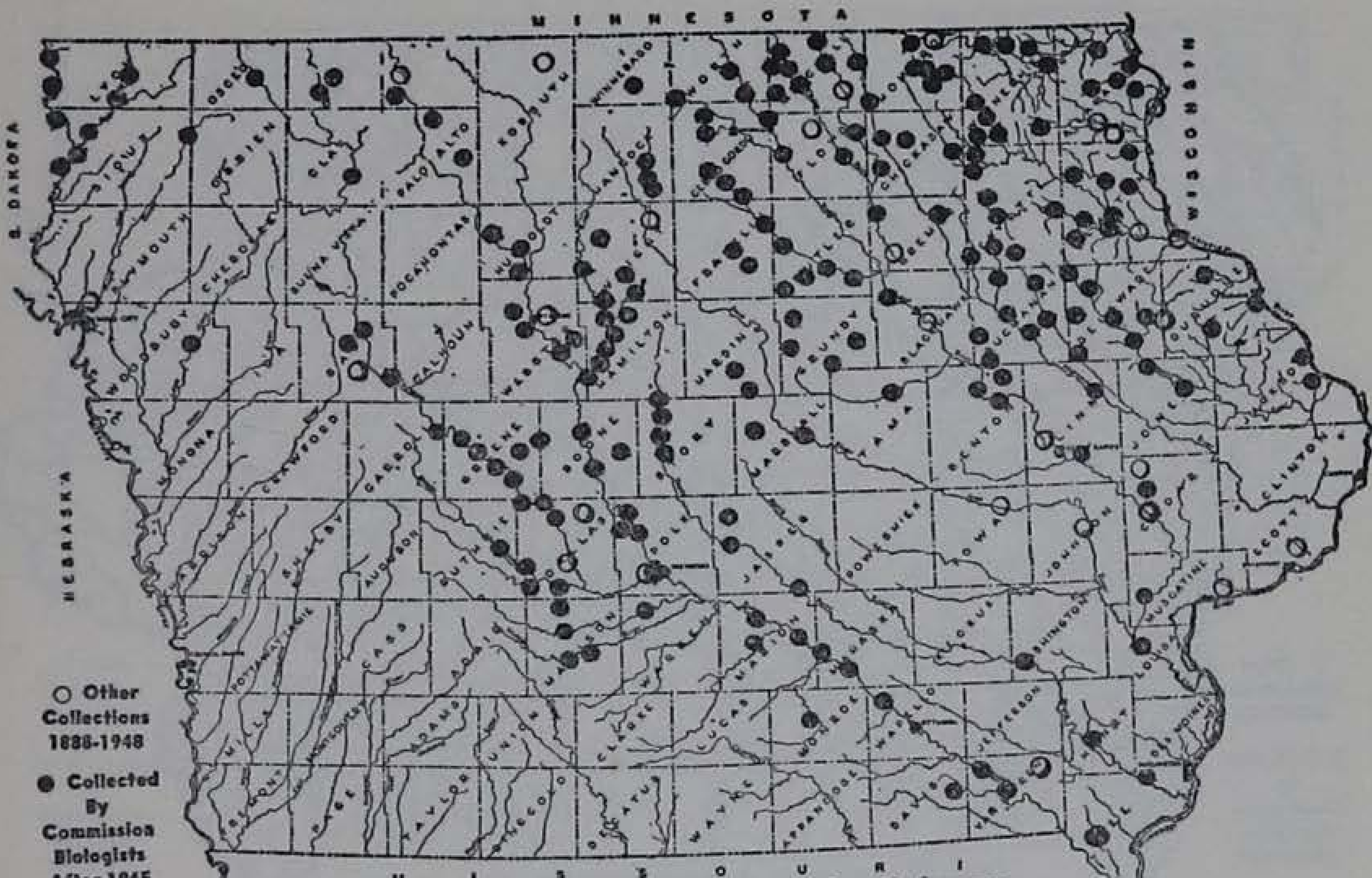
Map 56. Bullhead Minnow—*Pimephales vigilax perspicuus* (Girard)



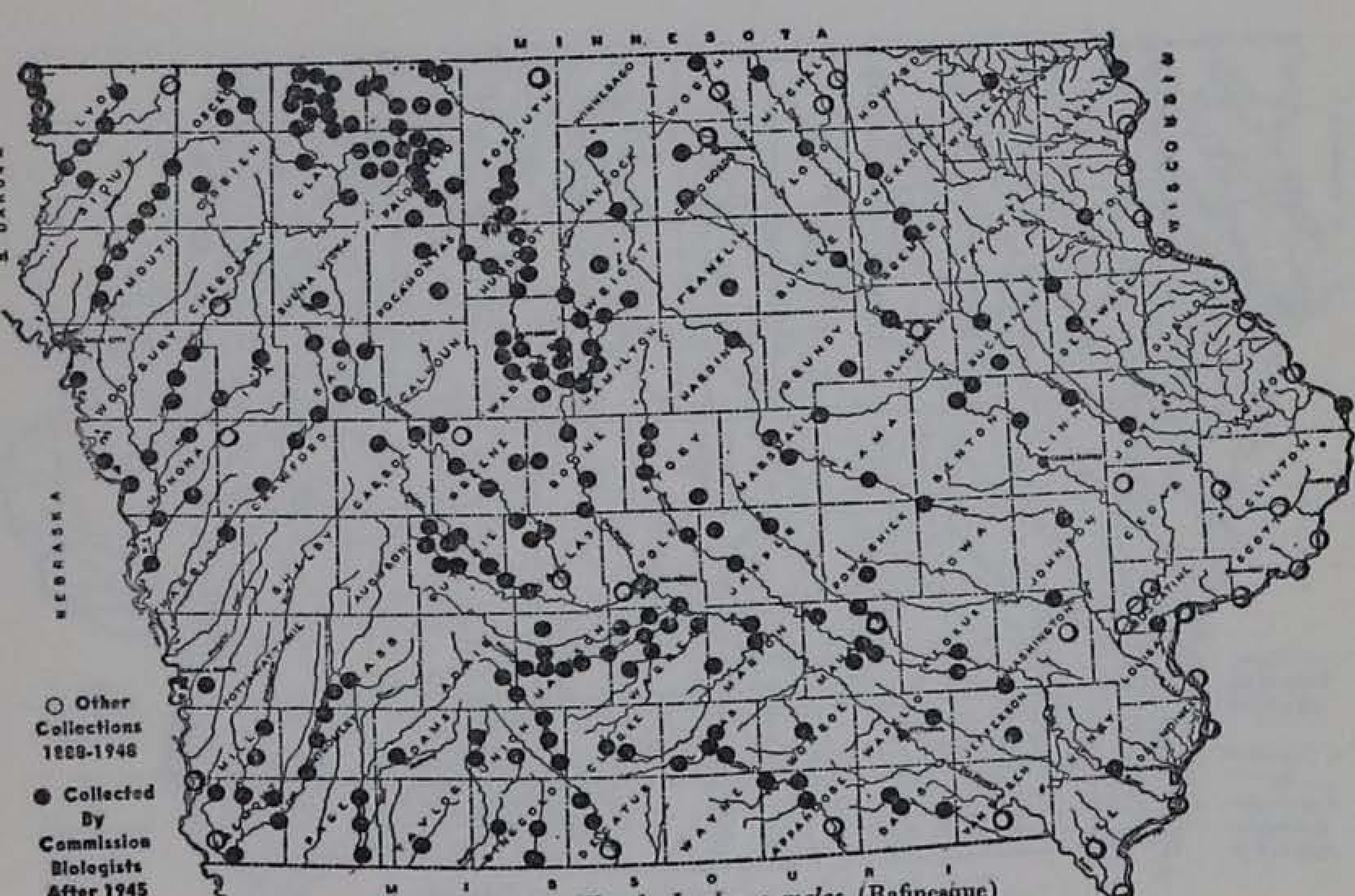
Map 57. Bluntnose Minnow—*Pimephales notatus* (Rafinesque)



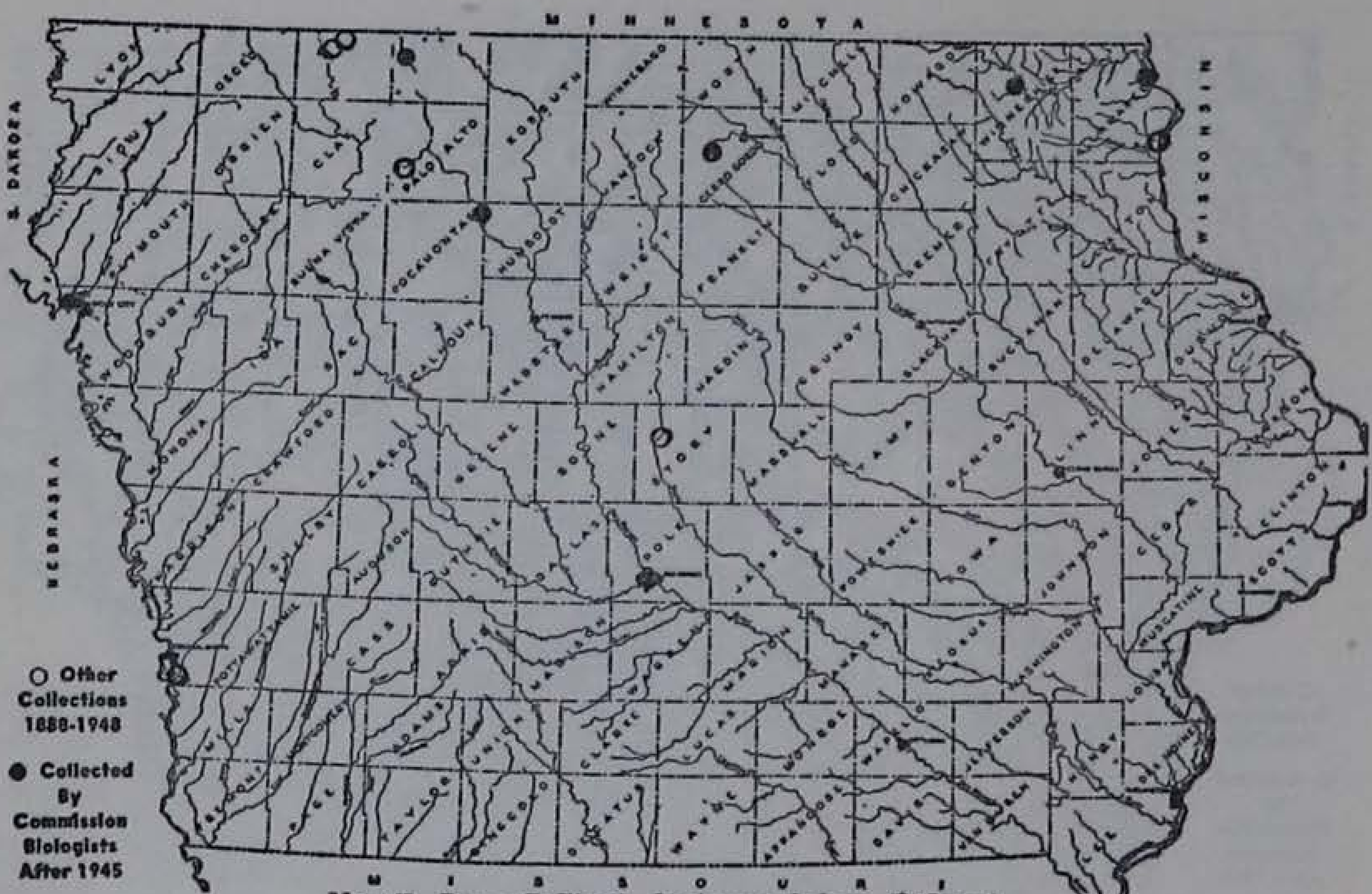
Map 58. Flathead Minnow—*Pimephales promelas* Rafinesque



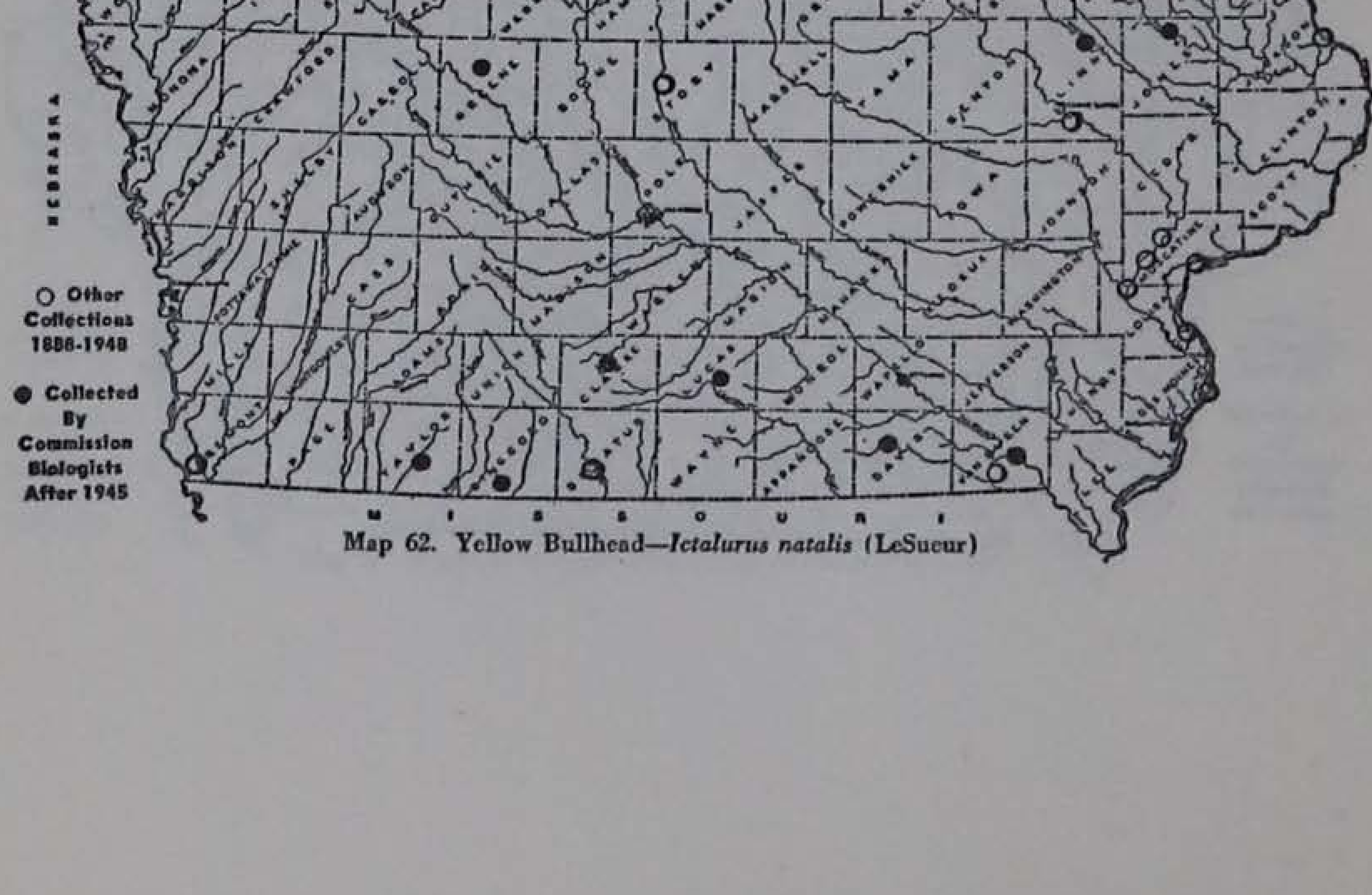
Map 59. Stoneroller—*Campostoma anomalum* Rafinesque



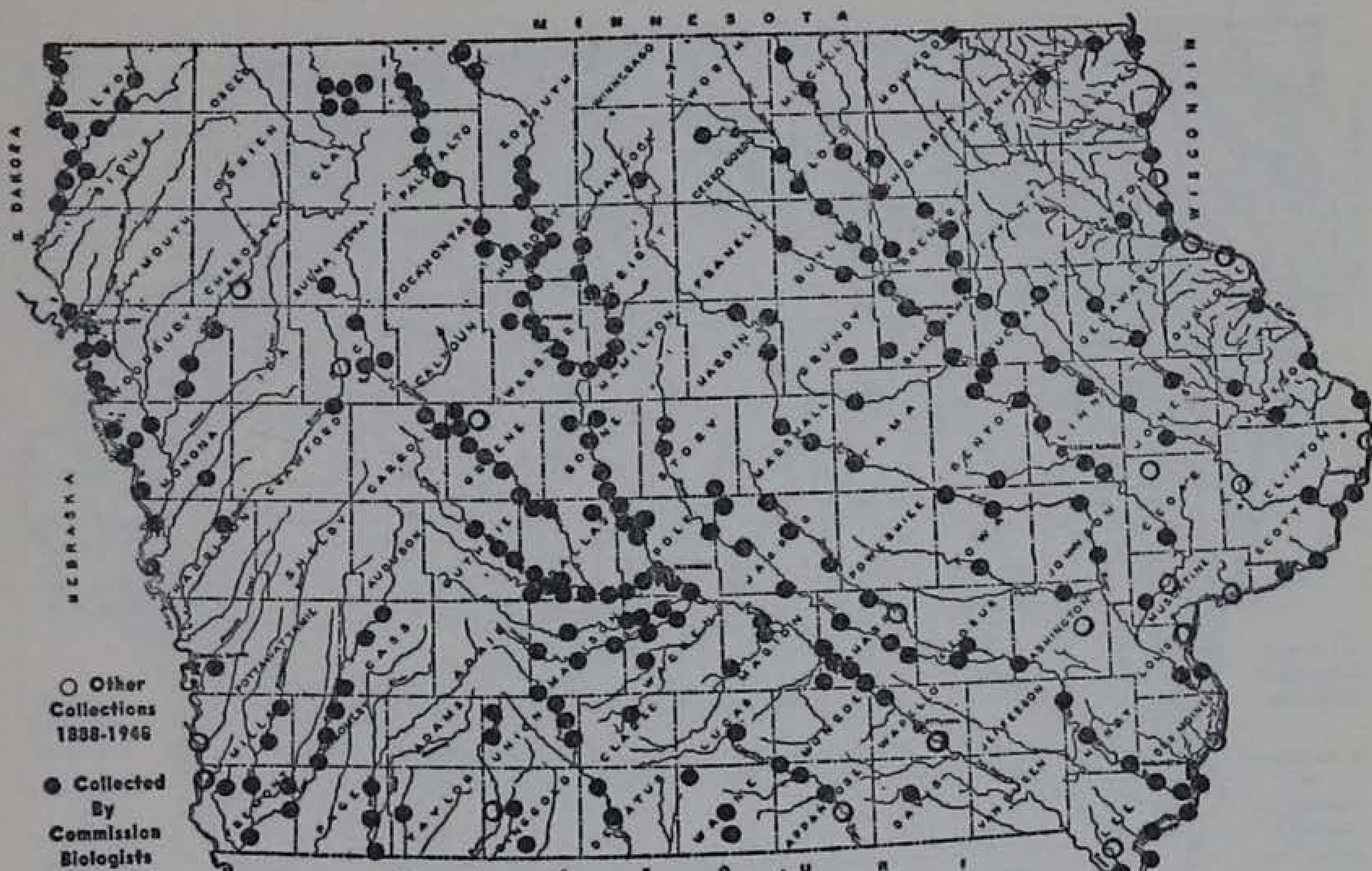
Map 60. Black Bullhead—*Ictalurus melas* (Rafinesque)



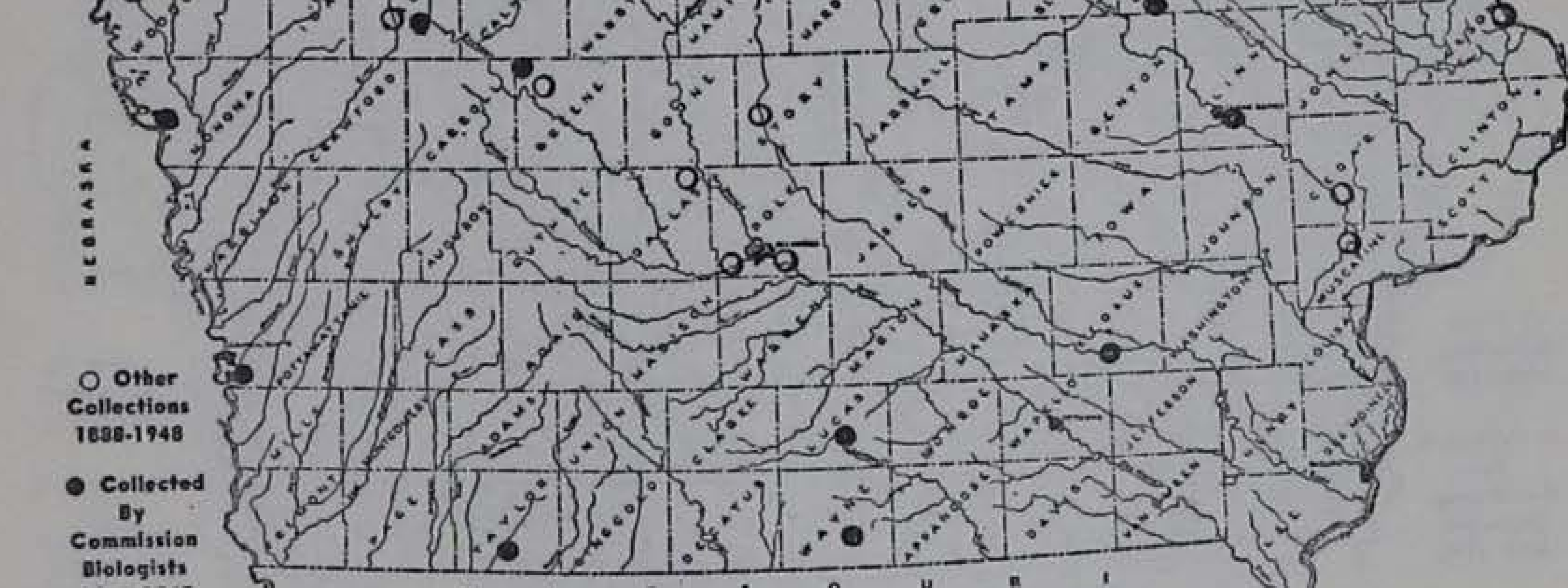
Map 61. Brown Bullhead—*Ictalurus nebulosus* (LeSueur)



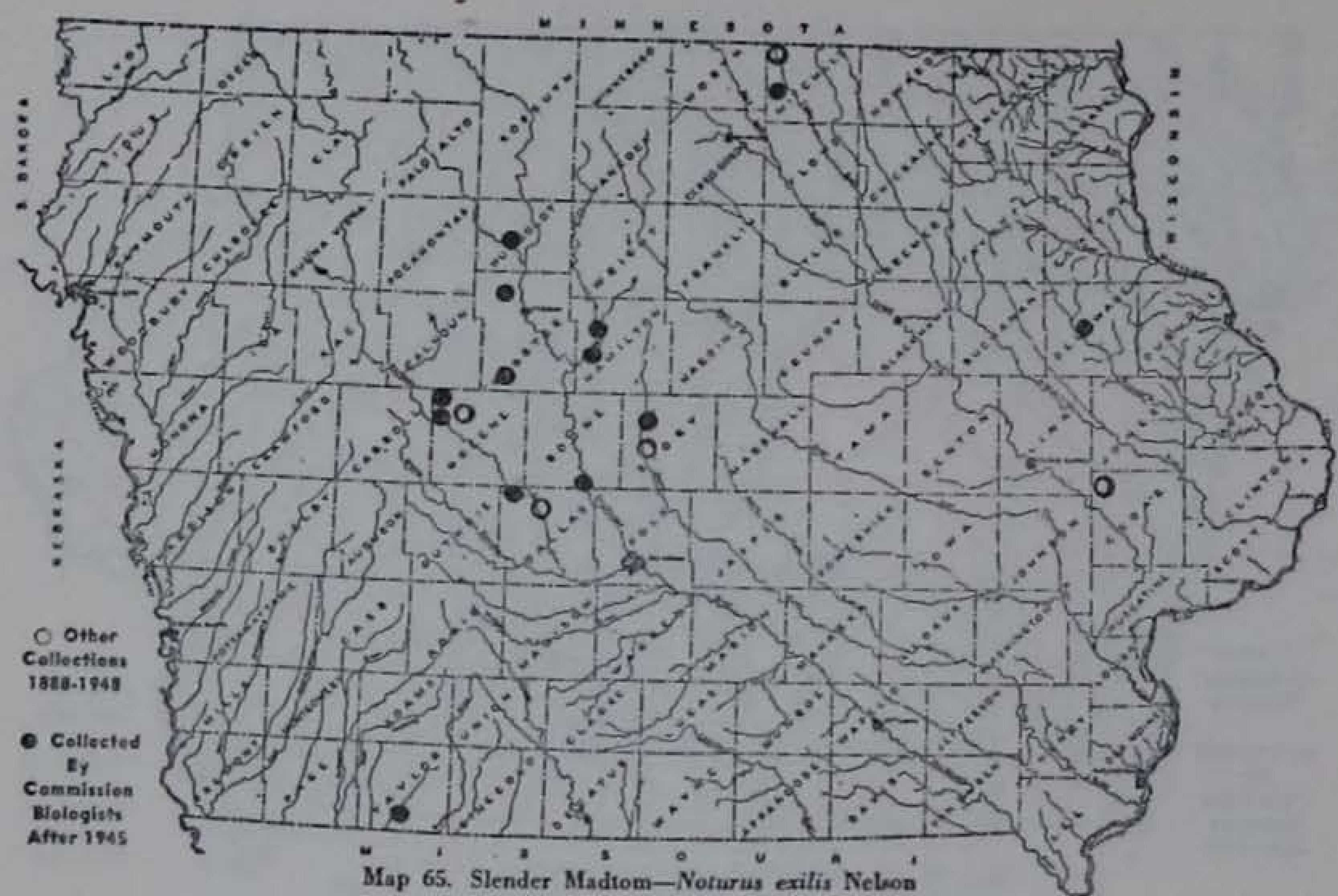
Map 62. Yellow Bullhead—*Ictalurus natalis* (LeSueur)



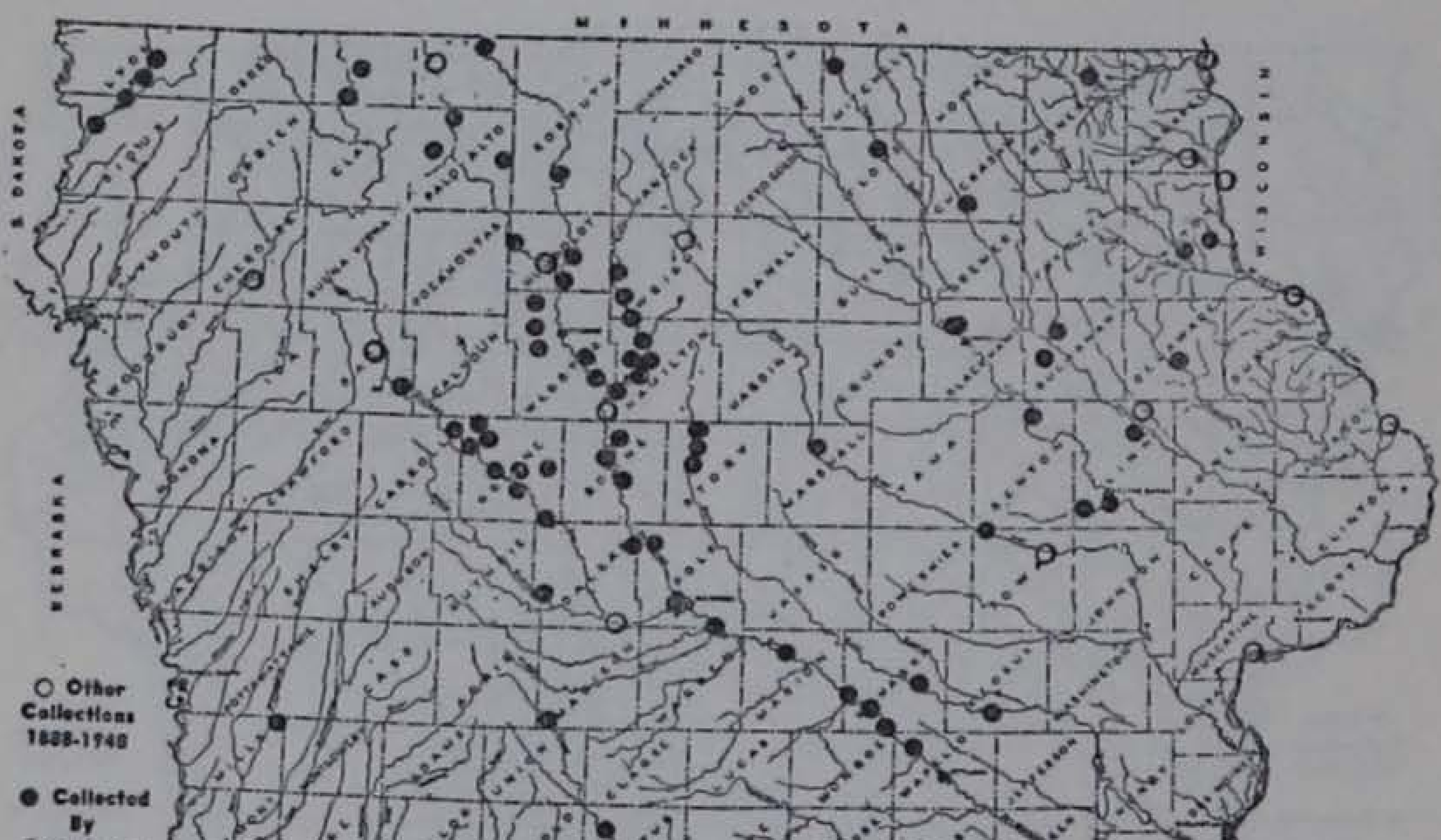
Map 63. Channel Catfish—*Ictalurus punctatus* Rafinesque



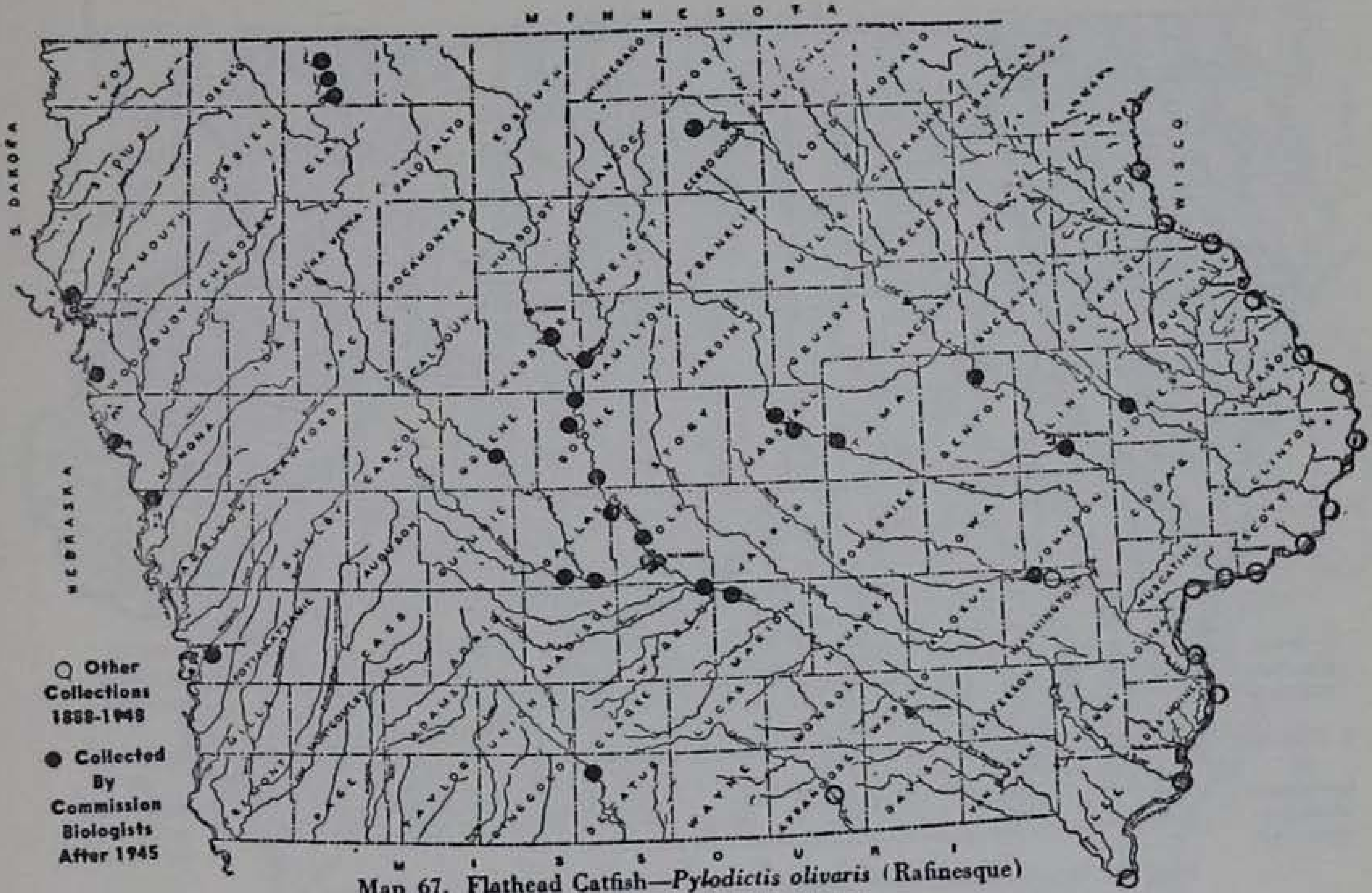
Map 64. Tadpole Madtom—*Noturus gyrinus* (Mitchill)



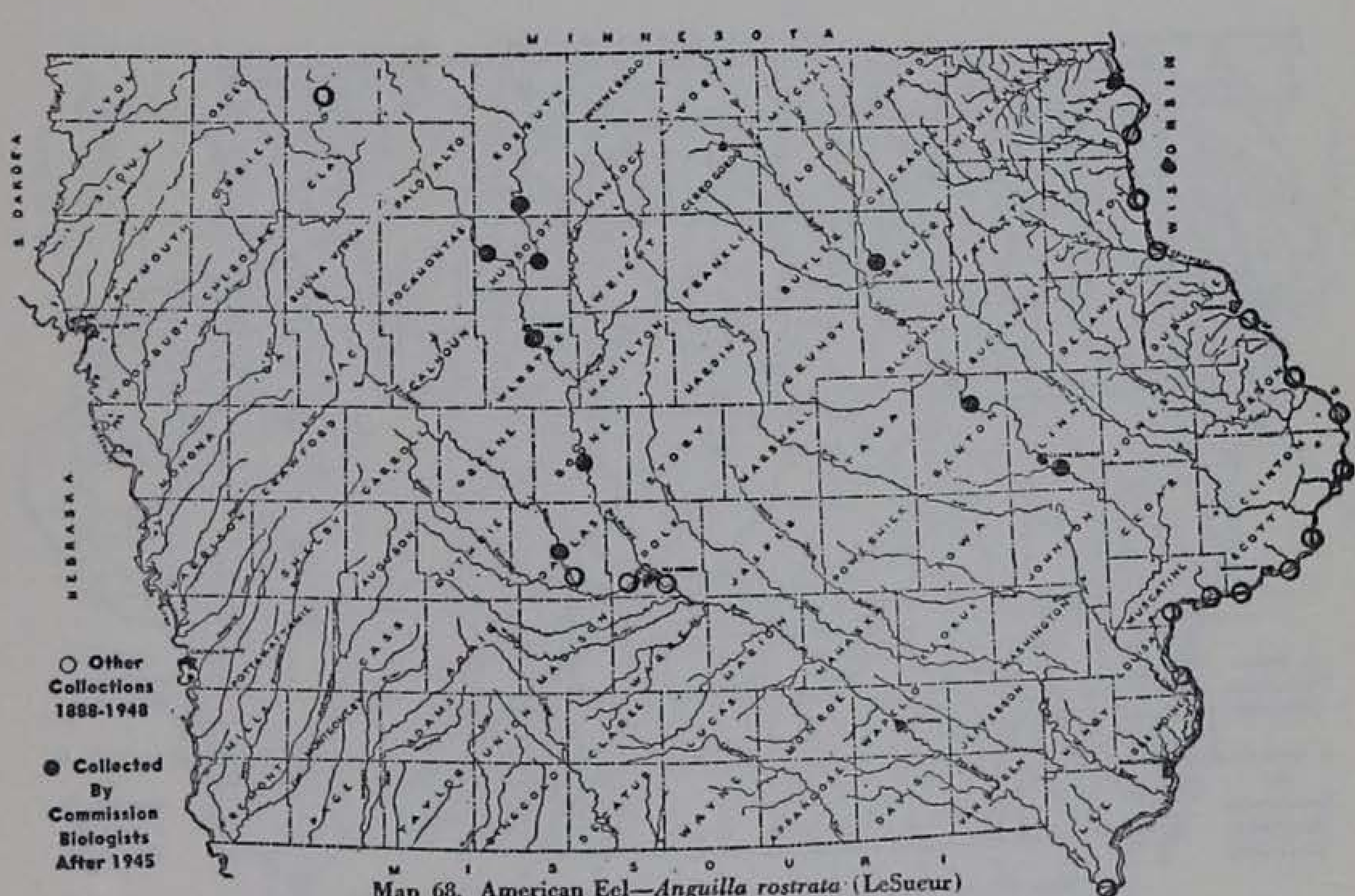
Map 65. Slender Madtom—*Noturus exilis* Nelson



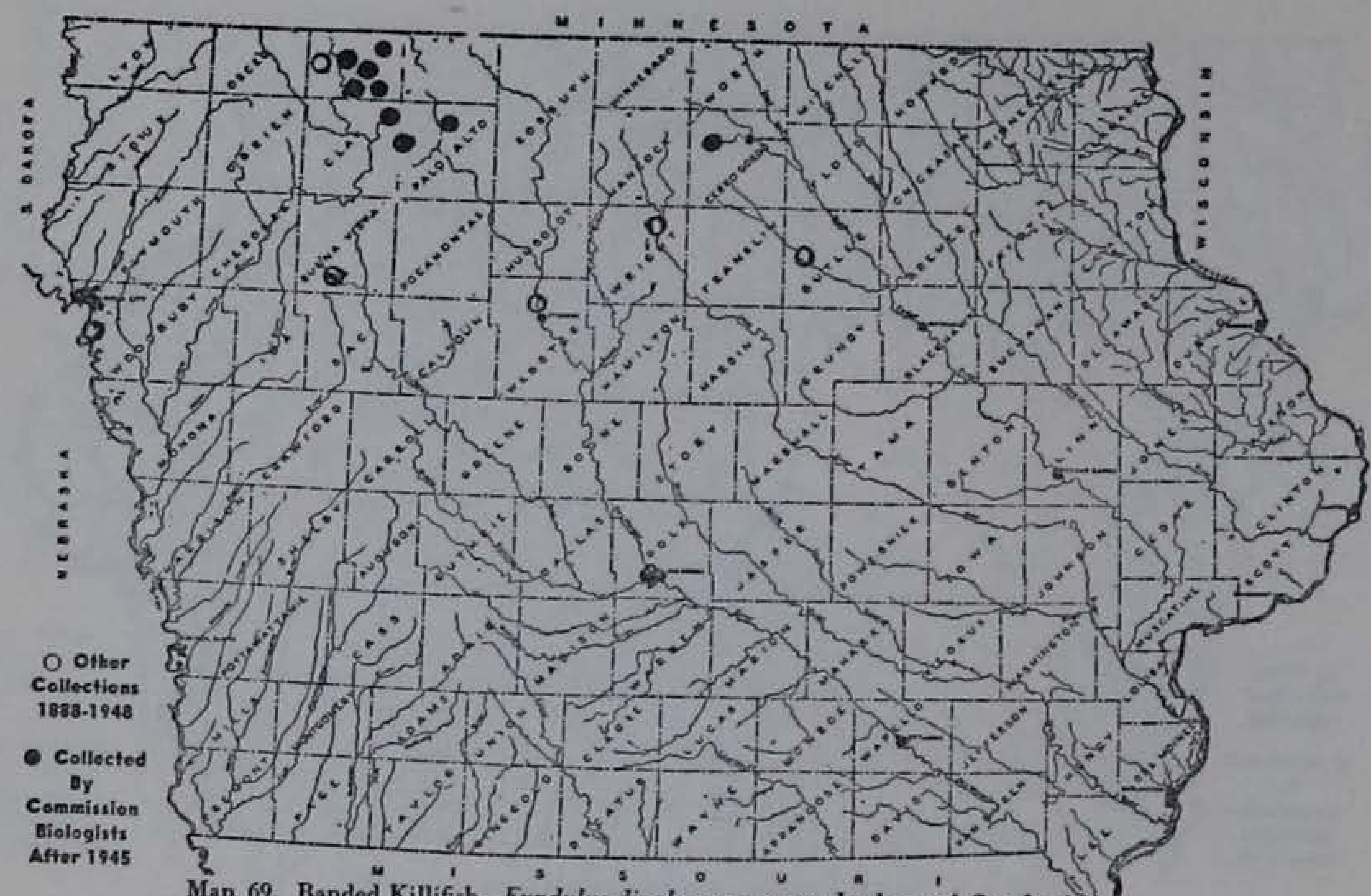
Map 66. Stonecat—*Noturus flavus* Rafinesque



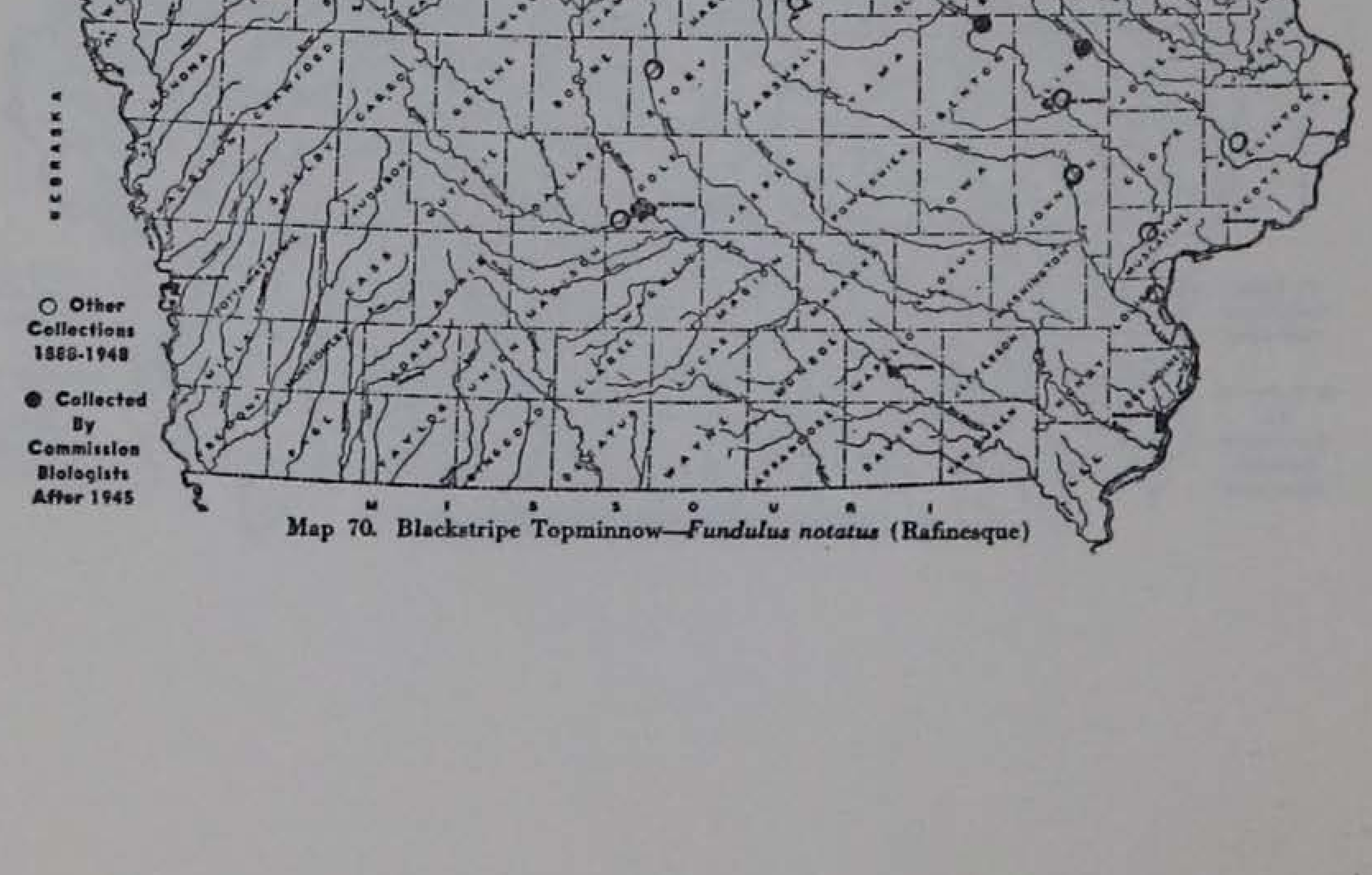
Map 67. Flathead Catfish—*Pylodictis olivaris* (Rafinesque)



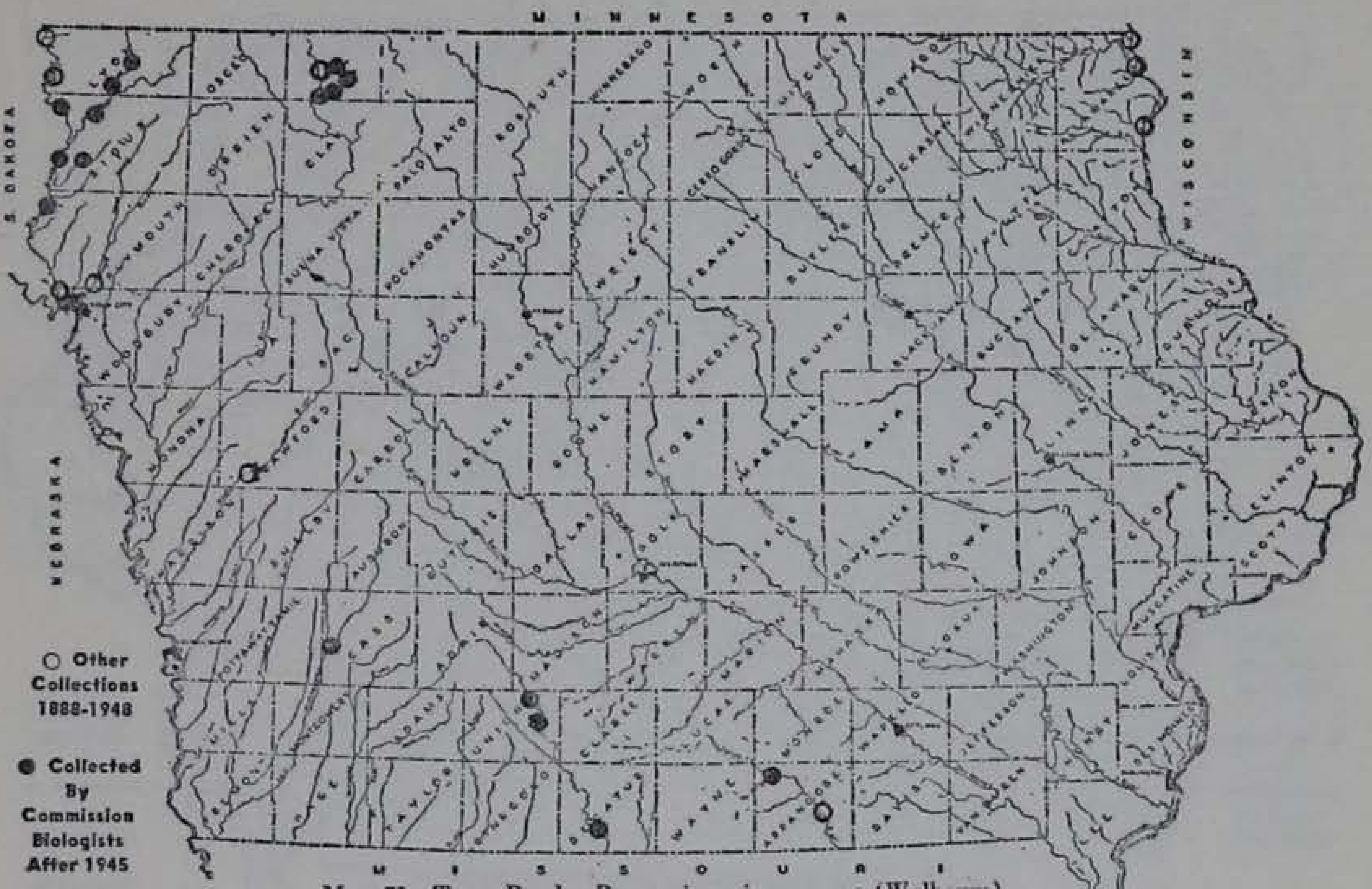
Map 68. American Eel—*Anguilla rostrata* (LeSueur)



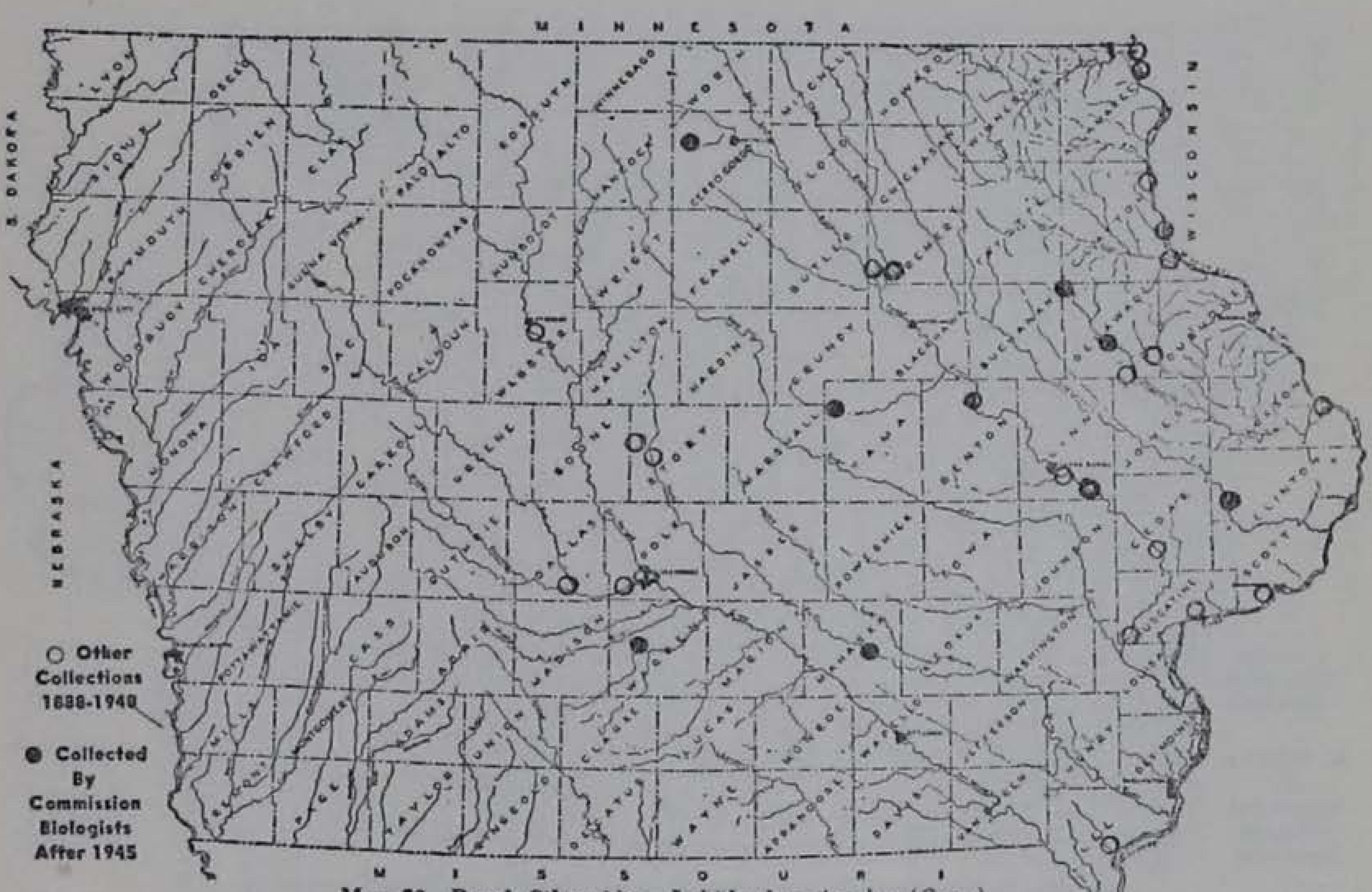
Map 69. Banded Killifish—*Fundulus diaphanus menona* Jordan and Copeland



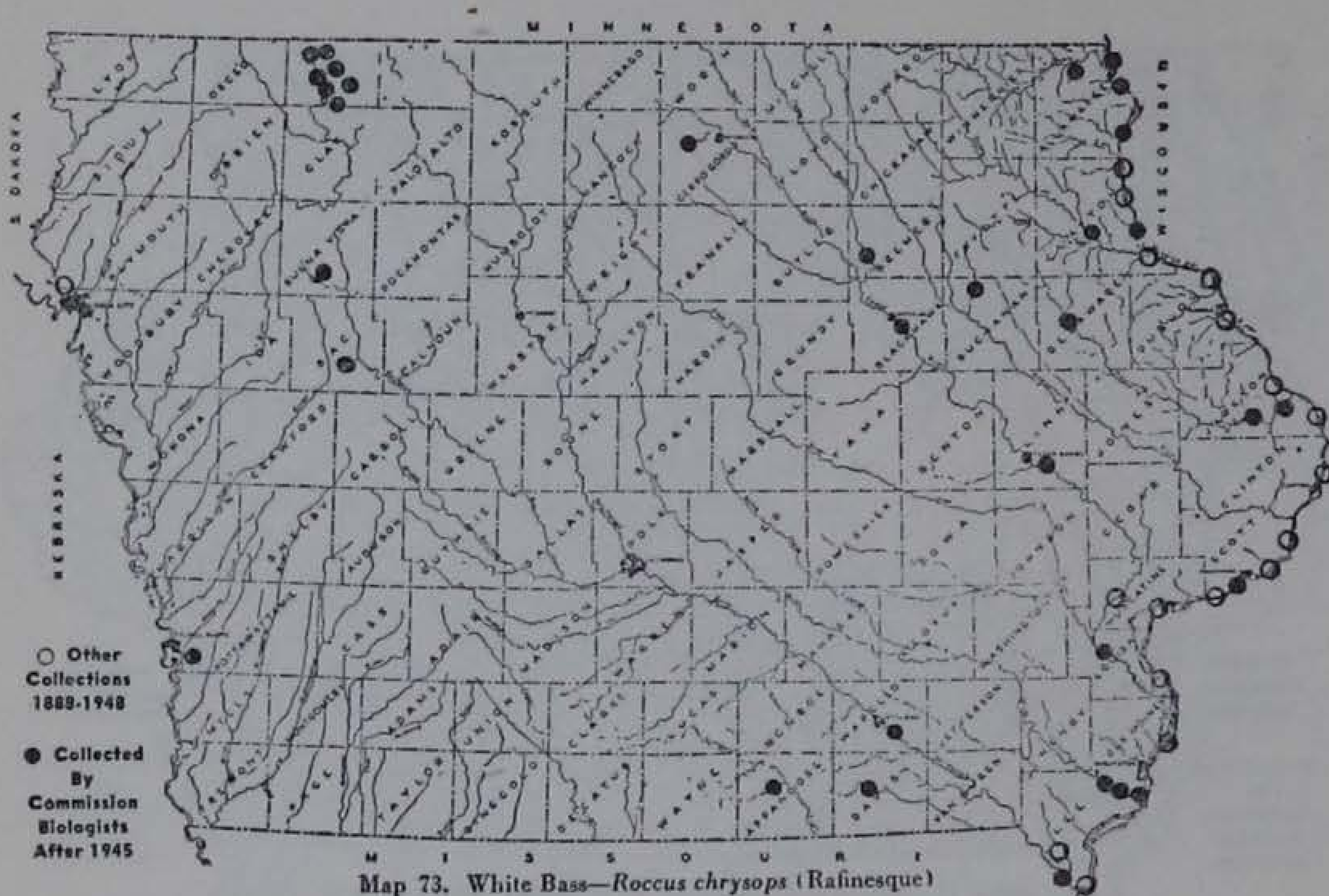
Map 70. Blackstripe Topminnow—*Fundulus notatus* (Rafinesque)



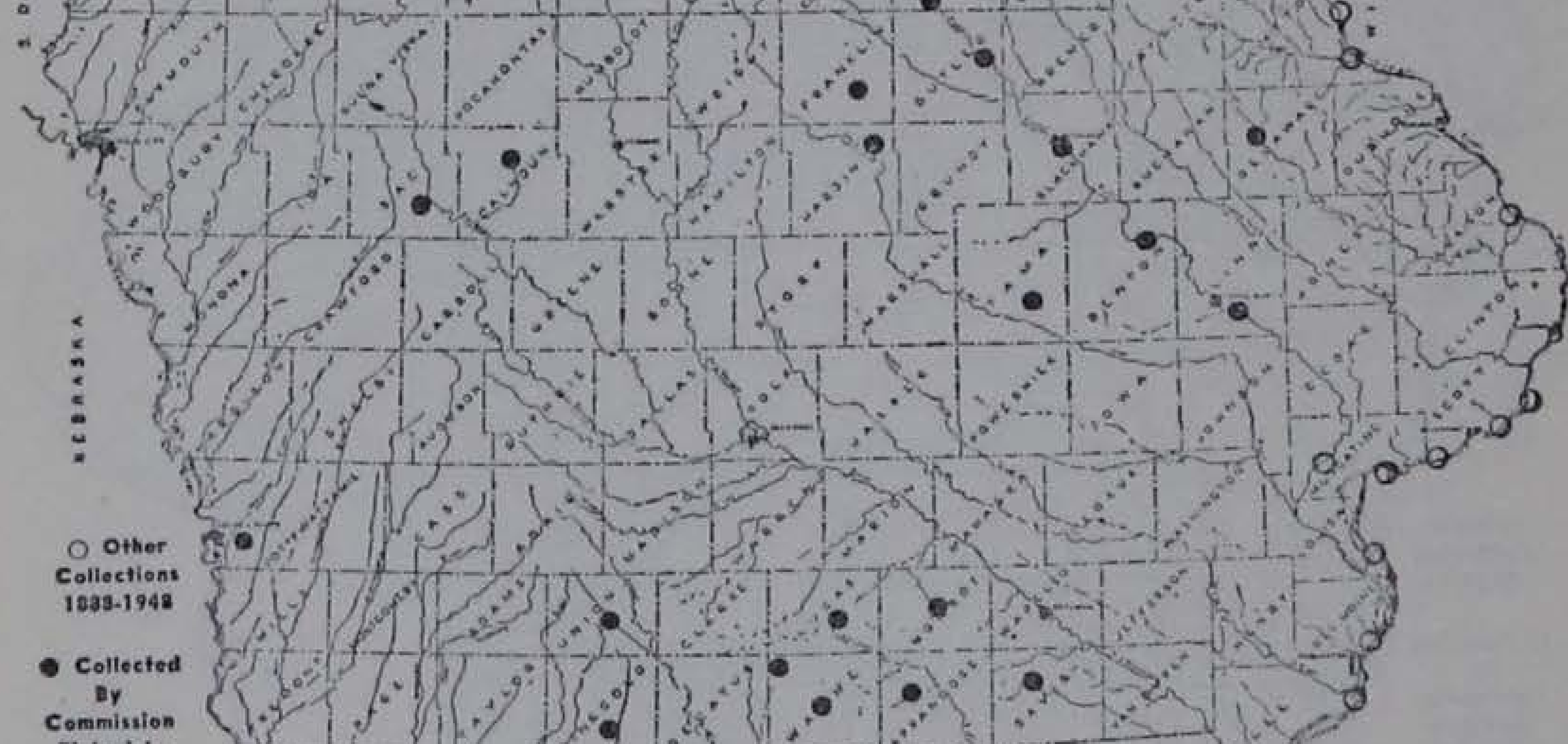
Map 71. Trout Perch—*Percopsis omiscomaycus* (Walbaum)



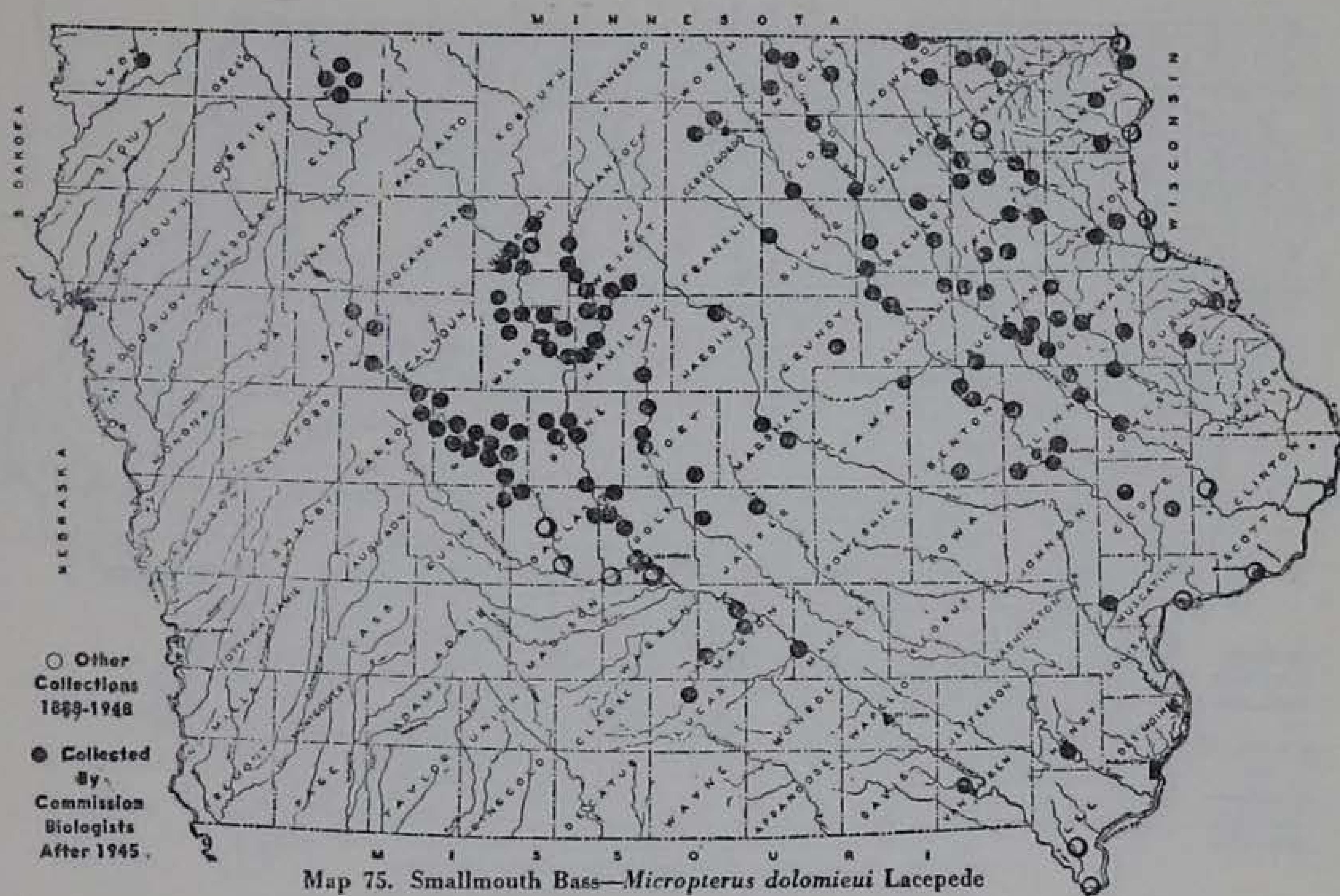
Map 72. Brook Silversides—*Labidesthes sicculus* (Cope)



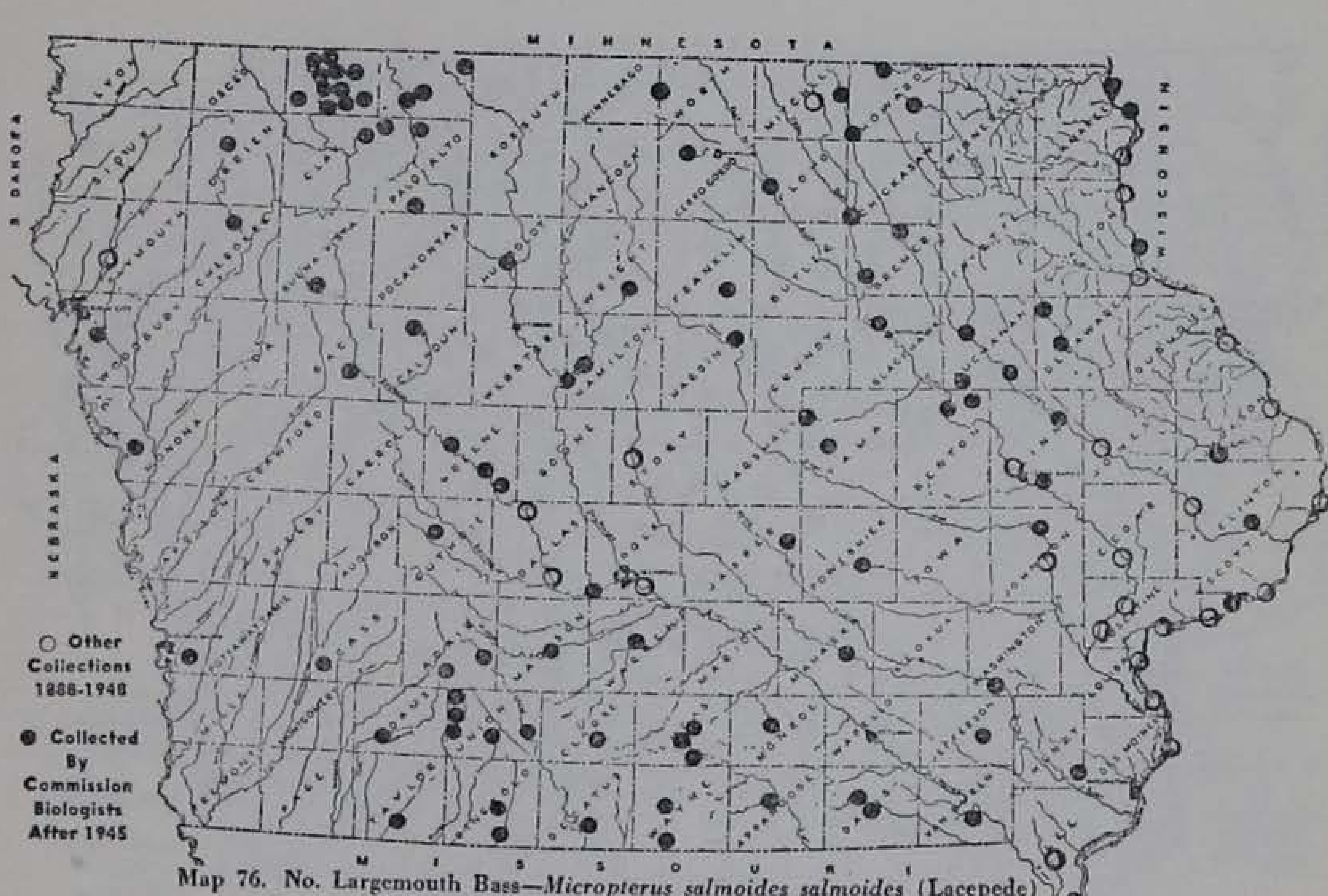
Map 73. White Bass—*Roccus chrysops* (Rafinesque)



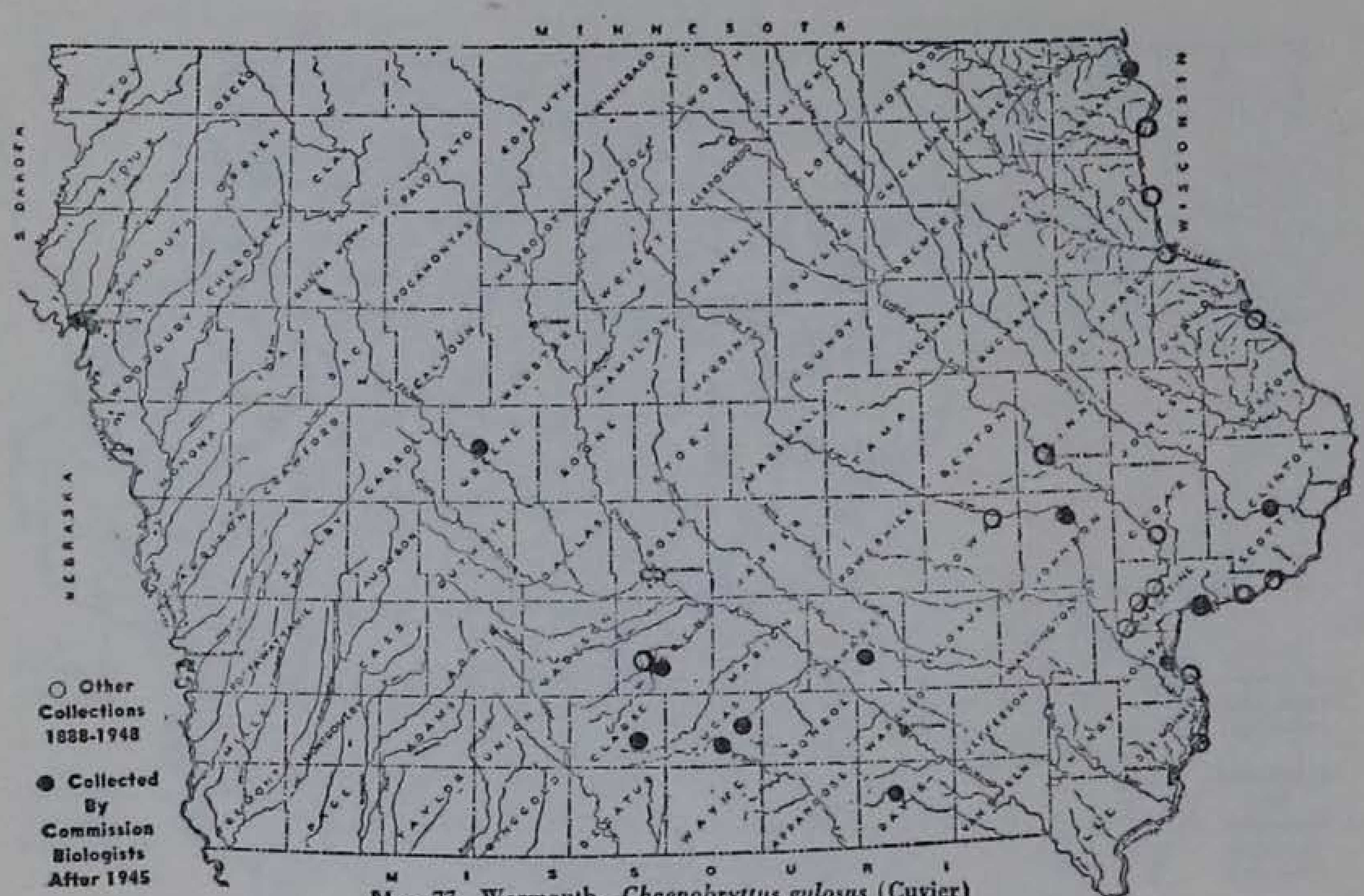
Map 74. Yellow Bass—*Roccus mississippiensis* (Jordan and Eigenmann)



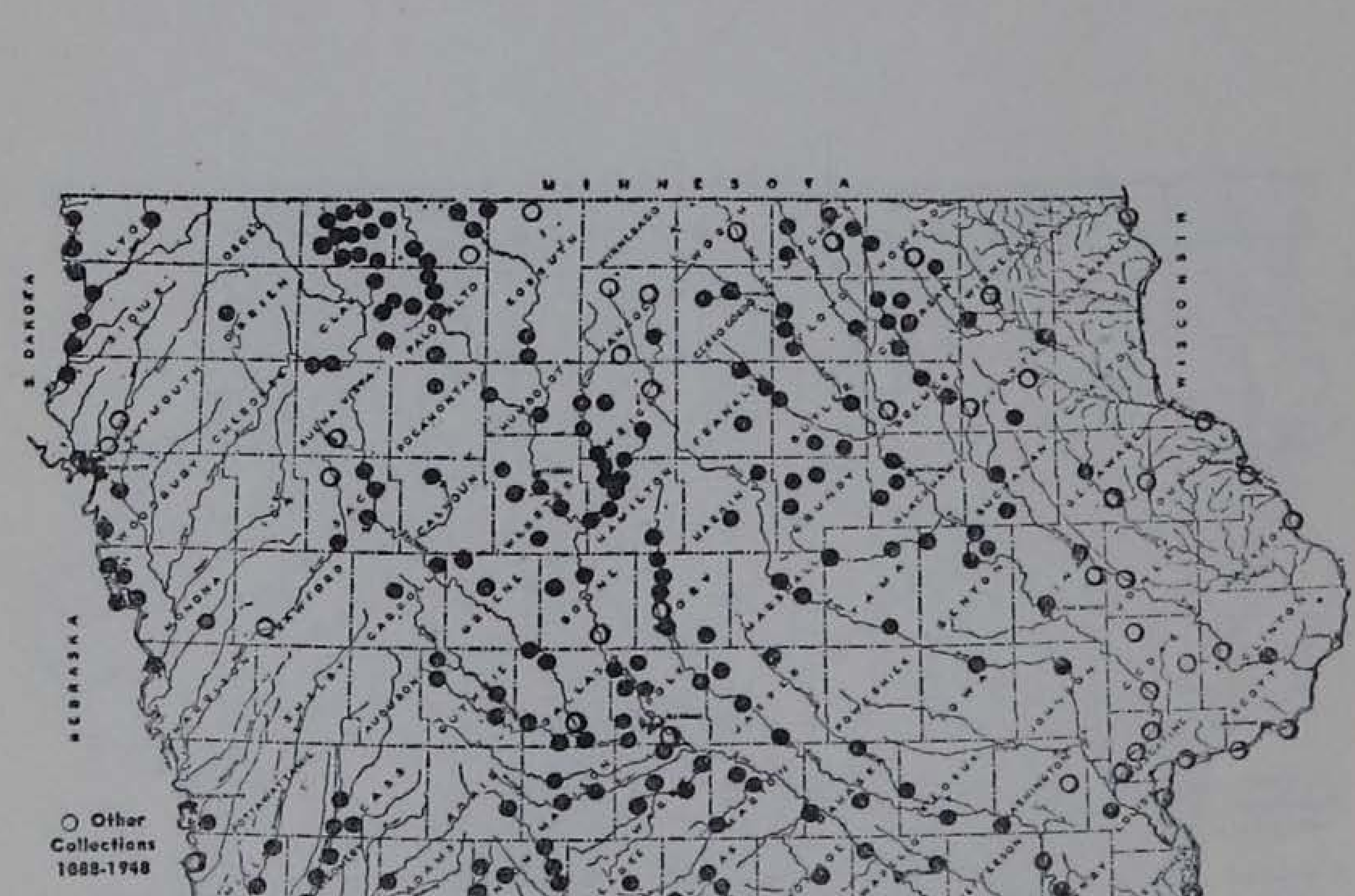
Map 75. Smallmouth Bass—*Micropterus dolomieui* Lacepede



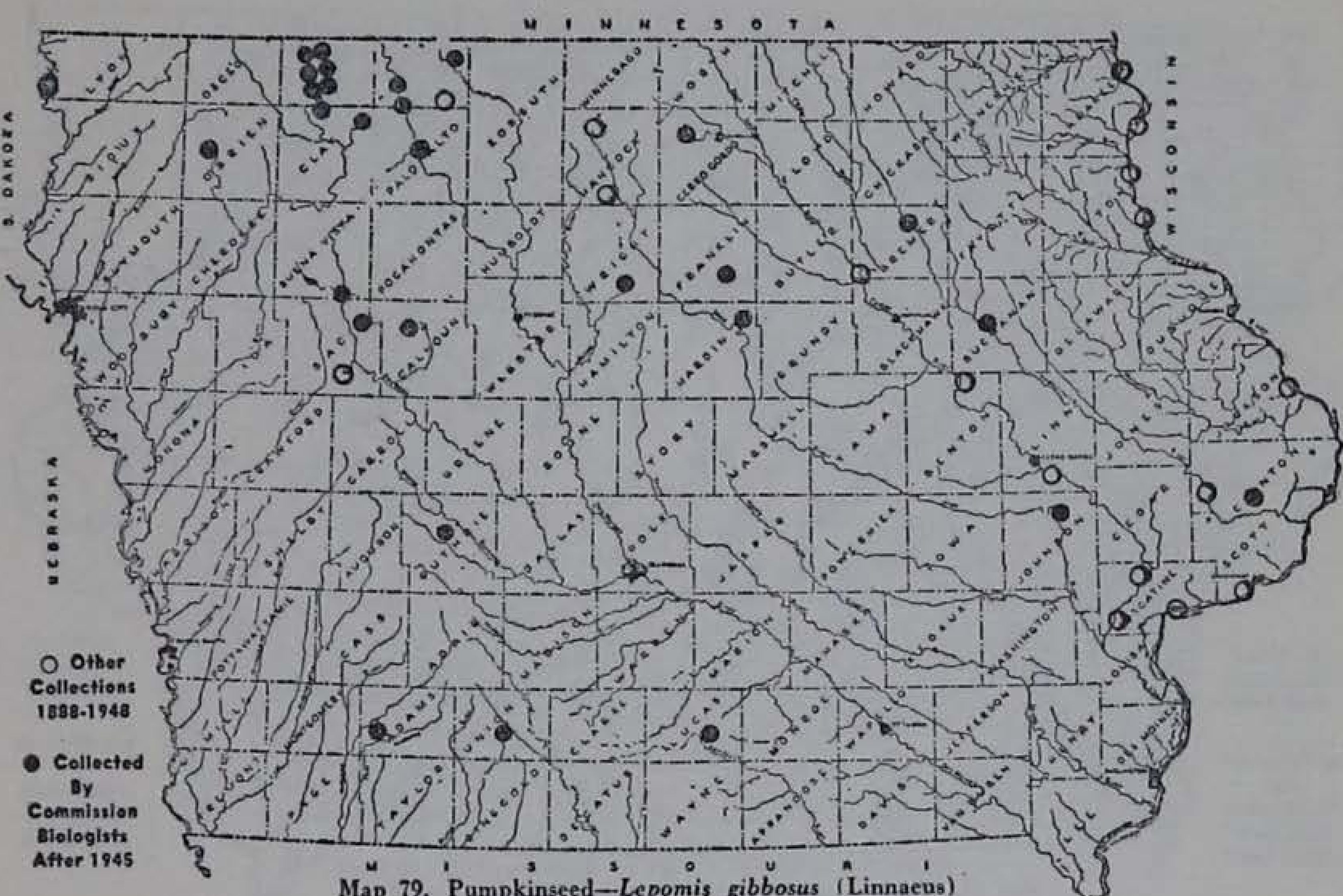
Map 76. No. Largemouth Bass—*Micropterus salmoides salmoides* (Lacepede)



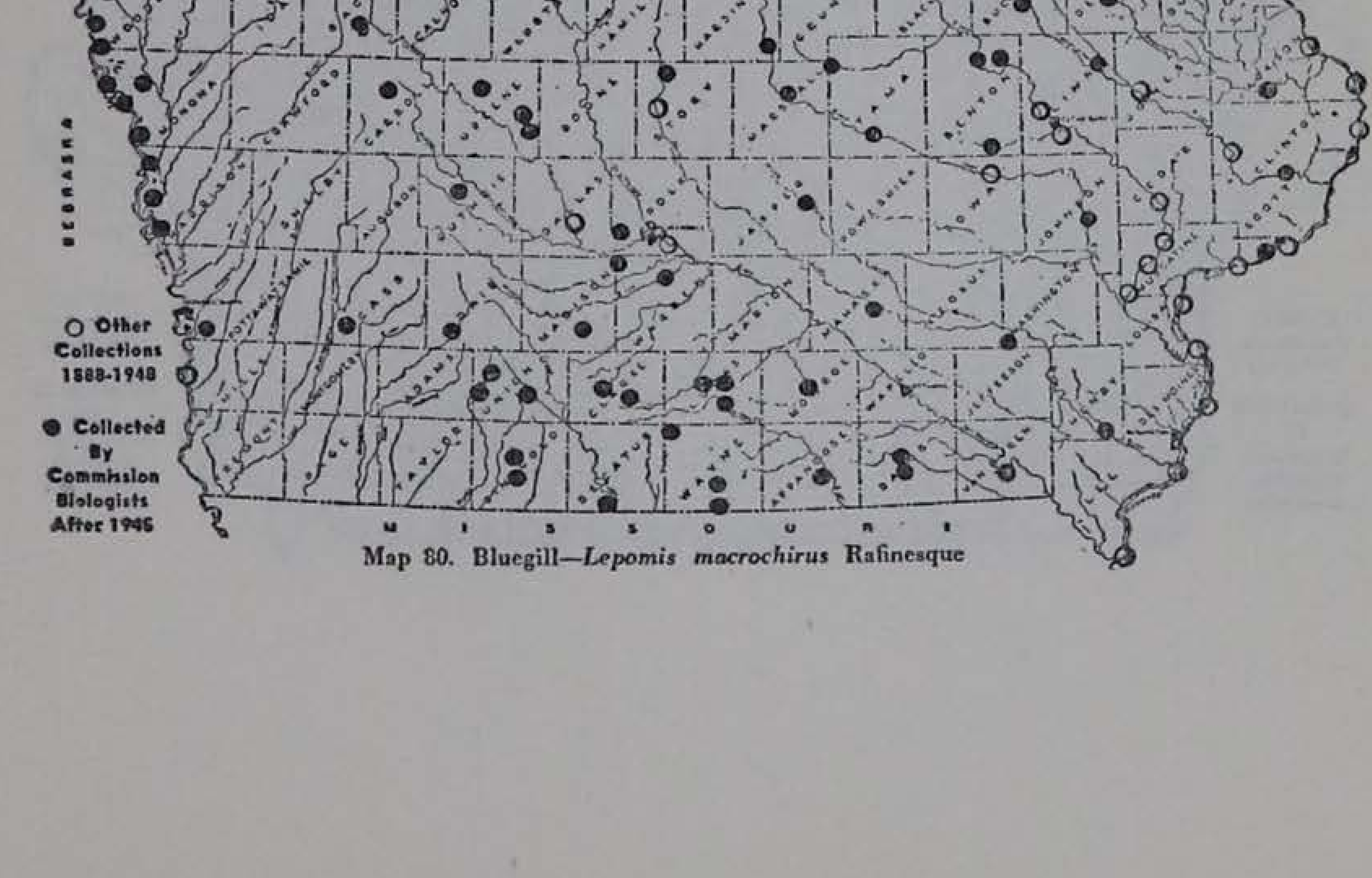
Map 77. Warmouth—*Chaenobryttus gulosus* (Cuvier)



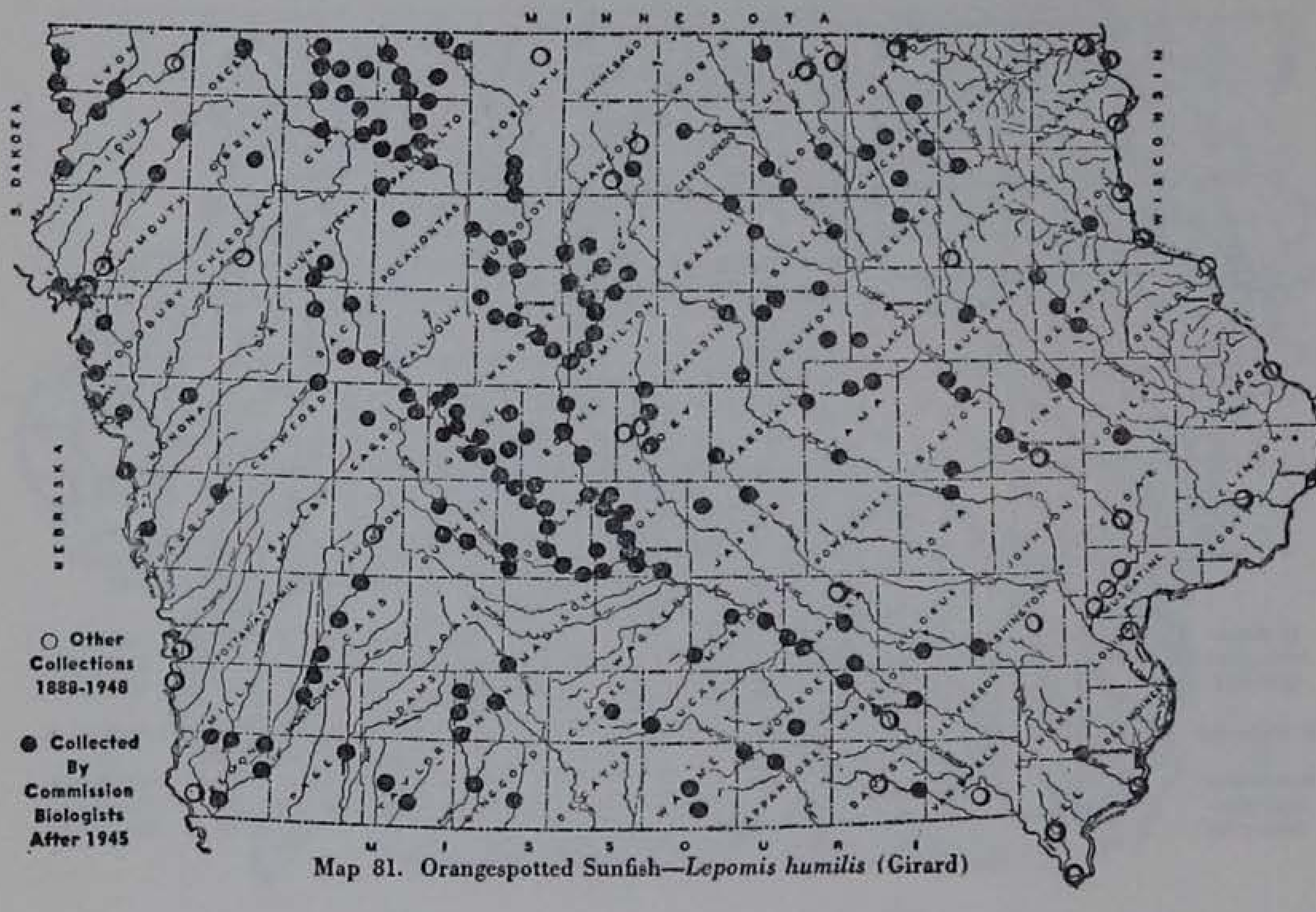
Map 78. Green Sunfish—*Lepomis cyanellus* Rafinesque



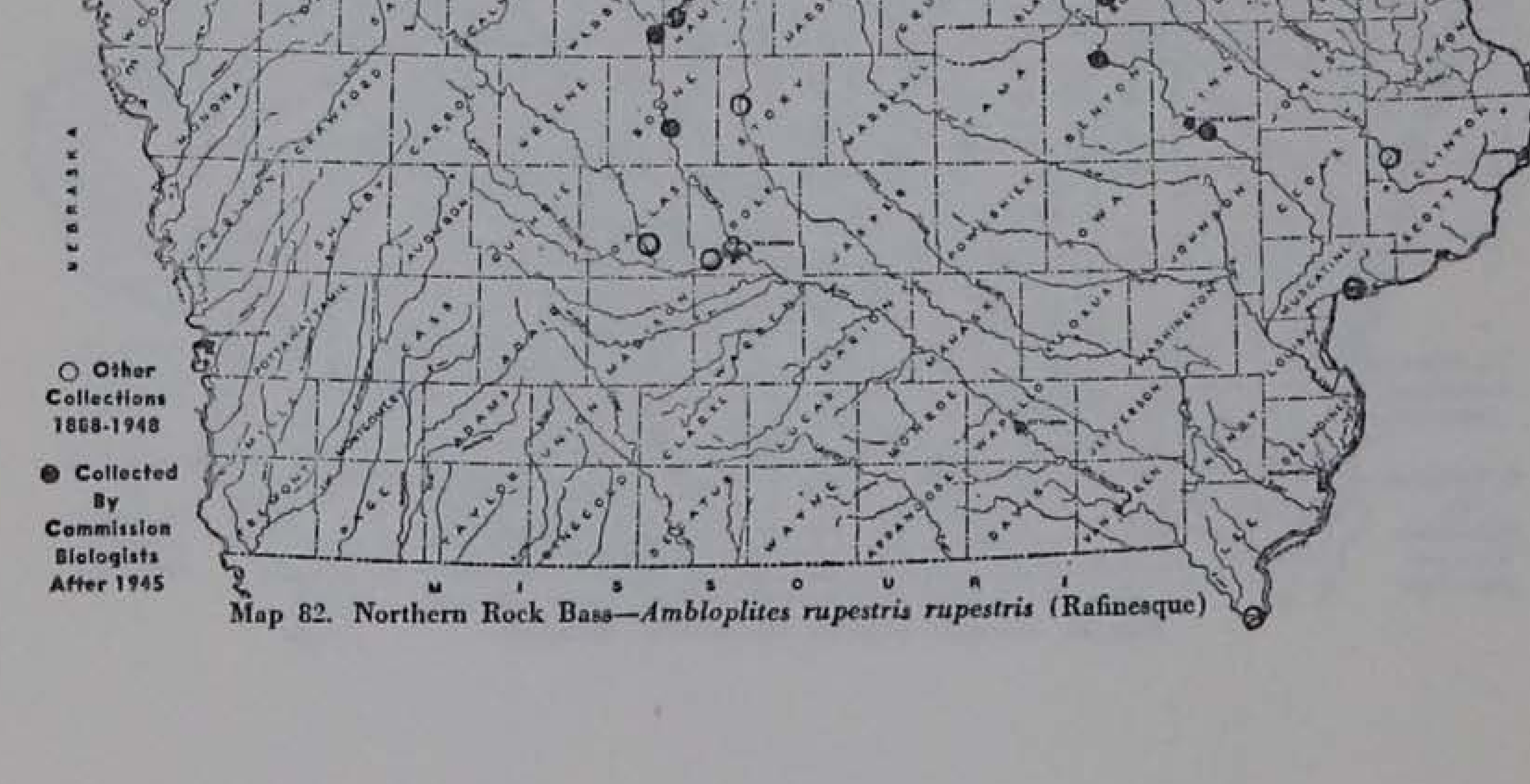
Map 79. Pumpkinseed—*Lepomis gibbosus* (Linnaeus)



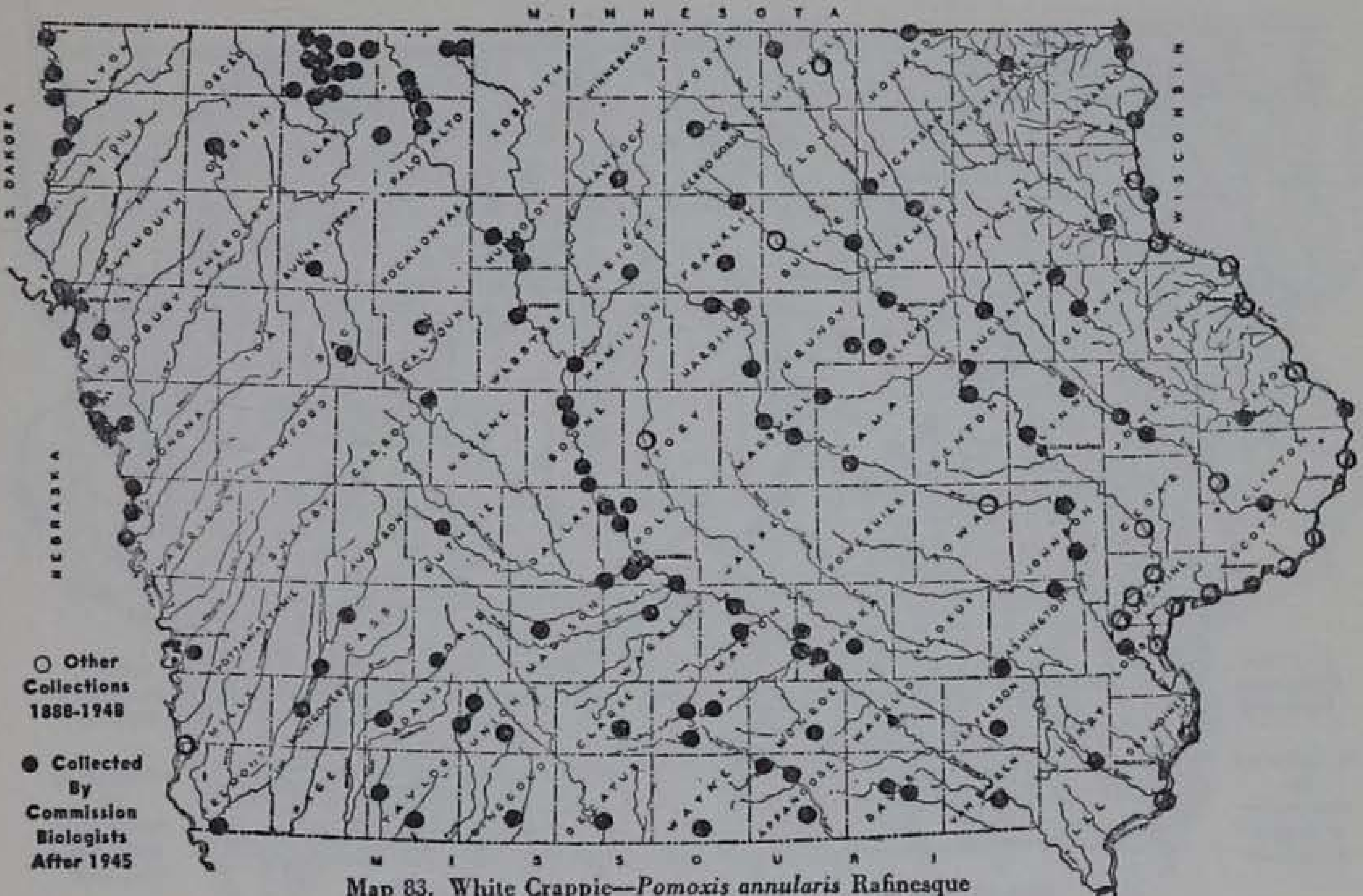
Map 80. Bluegill—*Lepomis macrochirus* Rafinesque



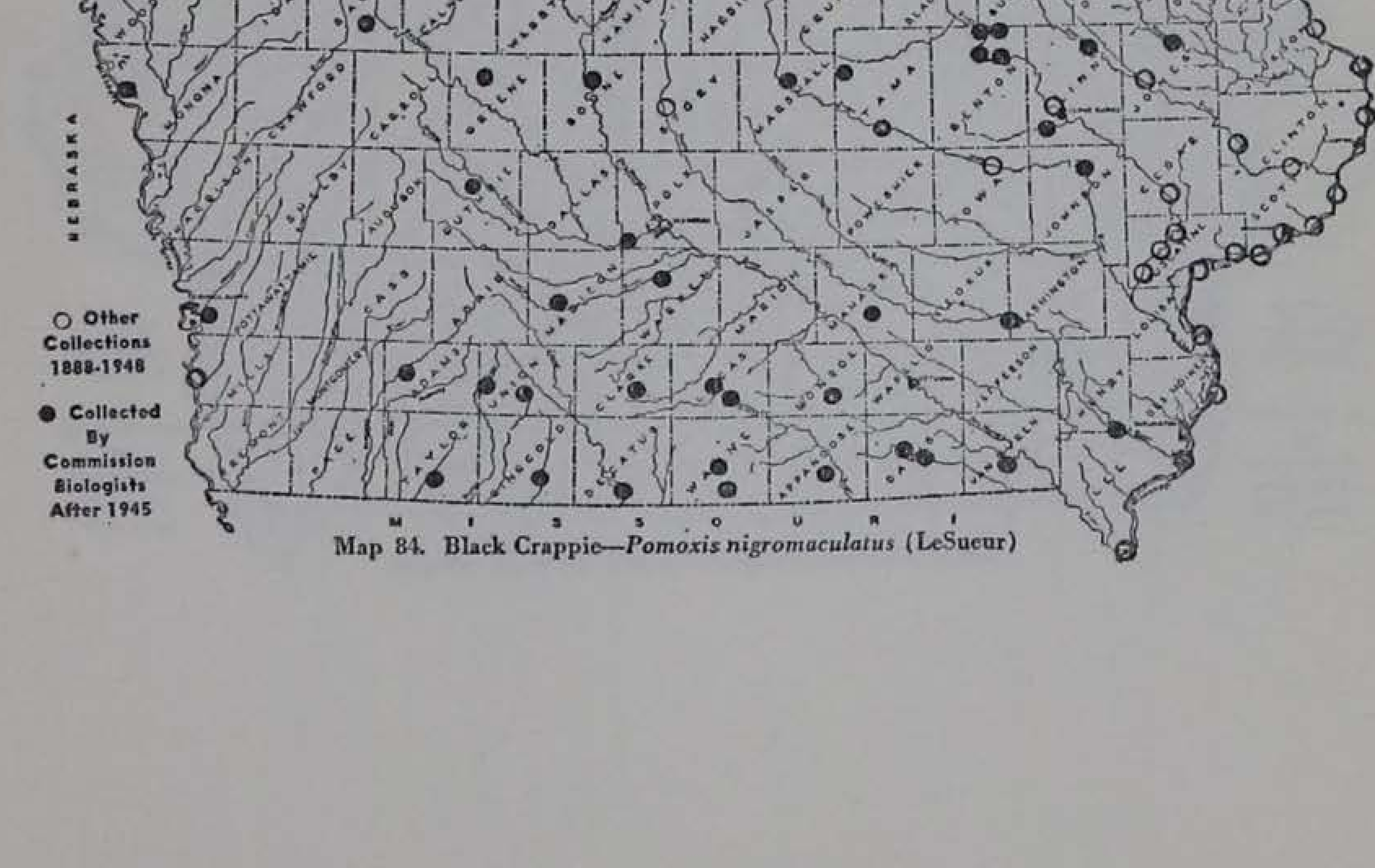
Map 81. Orangespotted Sunfish—*Lepomis humilis* (Girard)



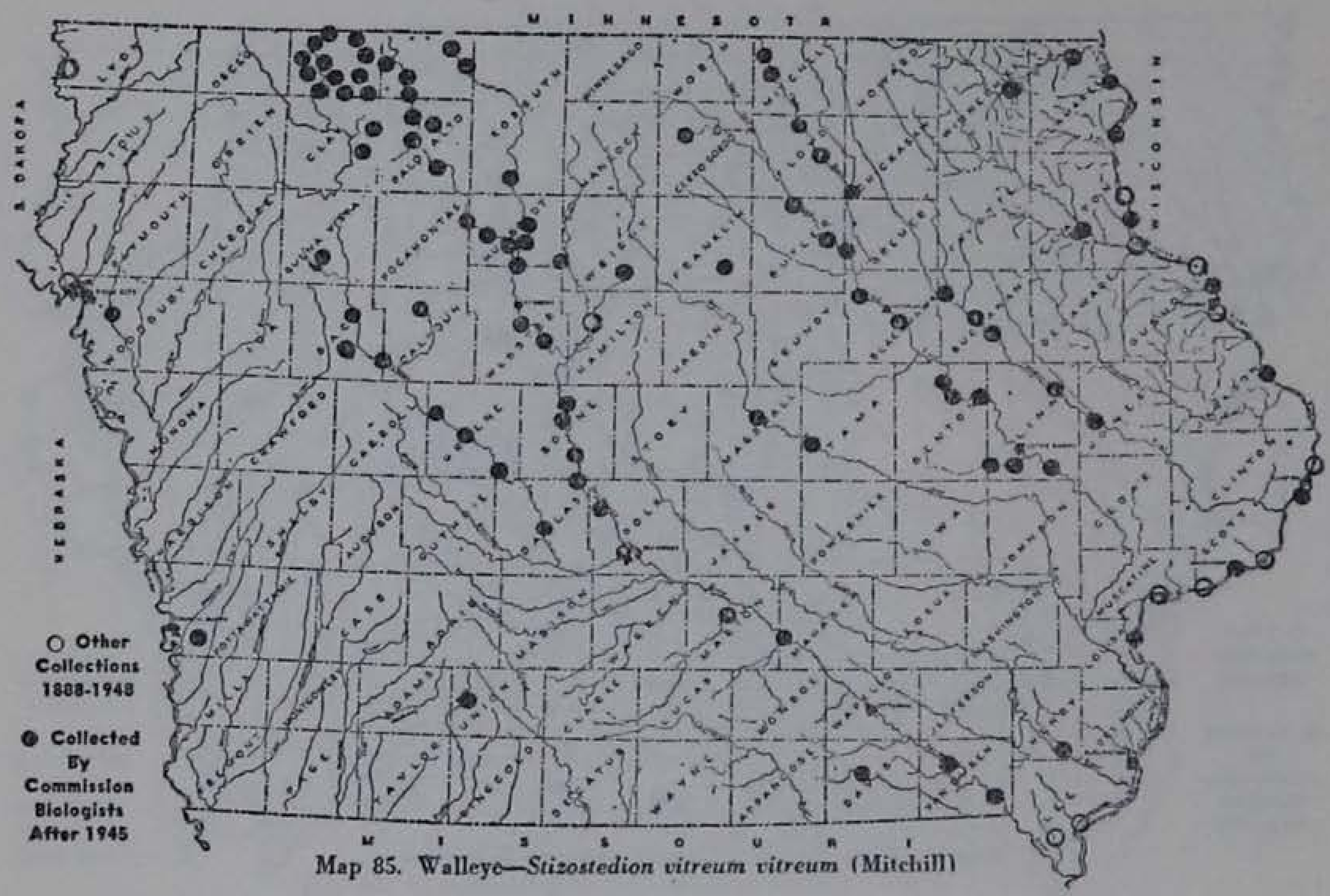
Map 82. Northern Rock Bass—*Ambloplites rupestris rupestris* (Rafinesque)



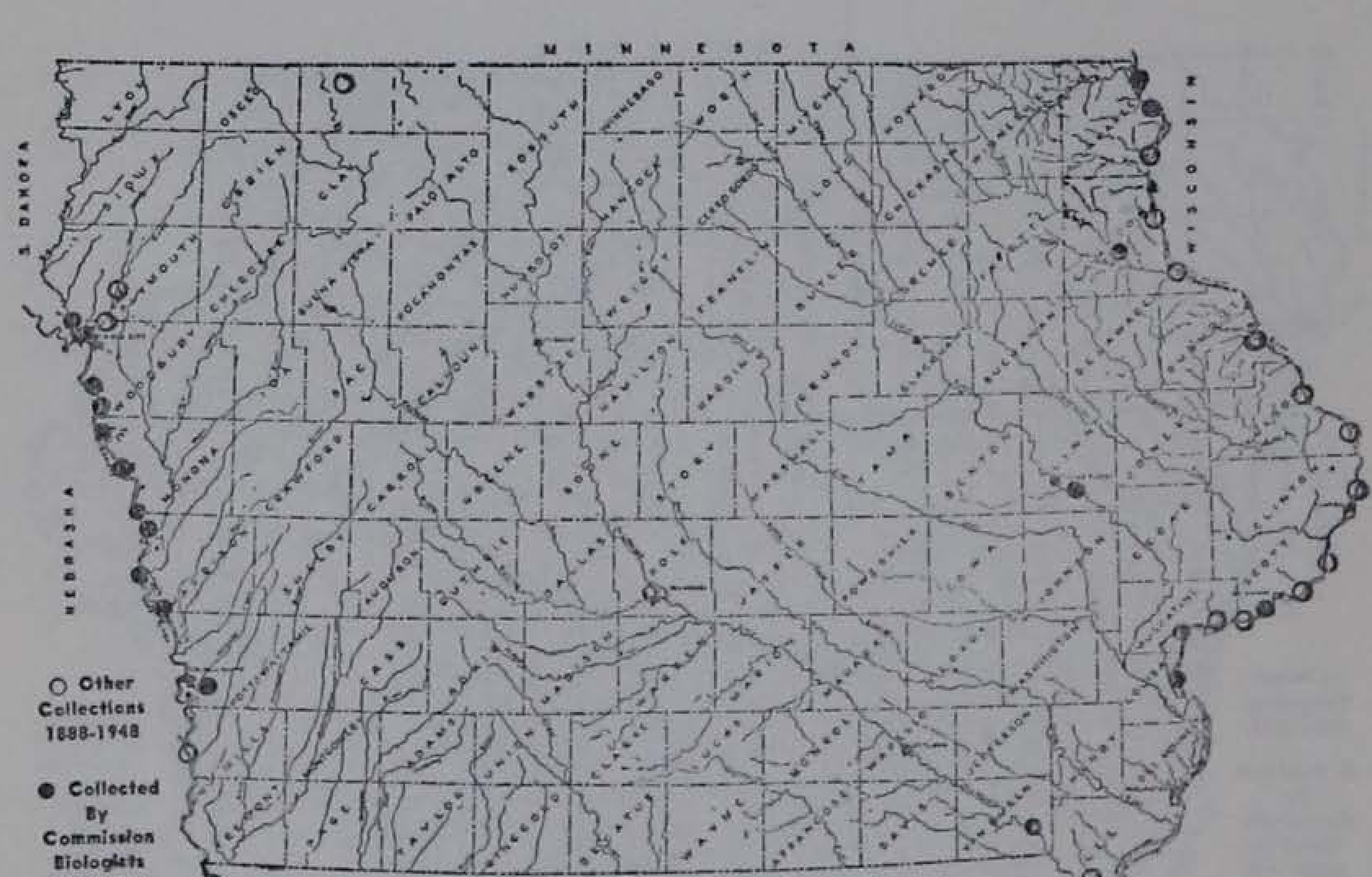
Map 83. White Crappie—*Pomoxis annularis* Rafinesque



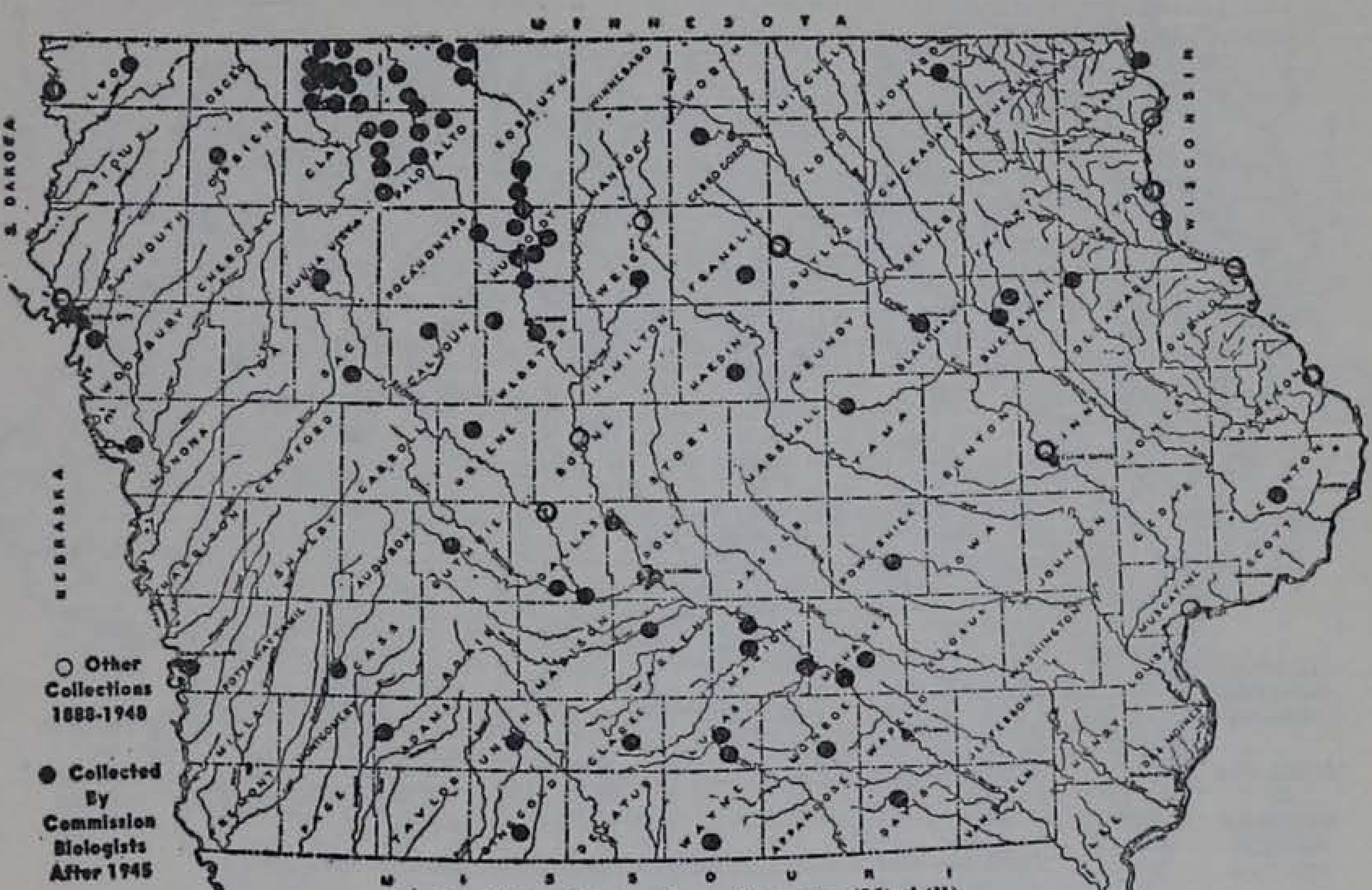
Map 84. Black Crappie—*Pomoxis nigromaculatus* (LeSueur)



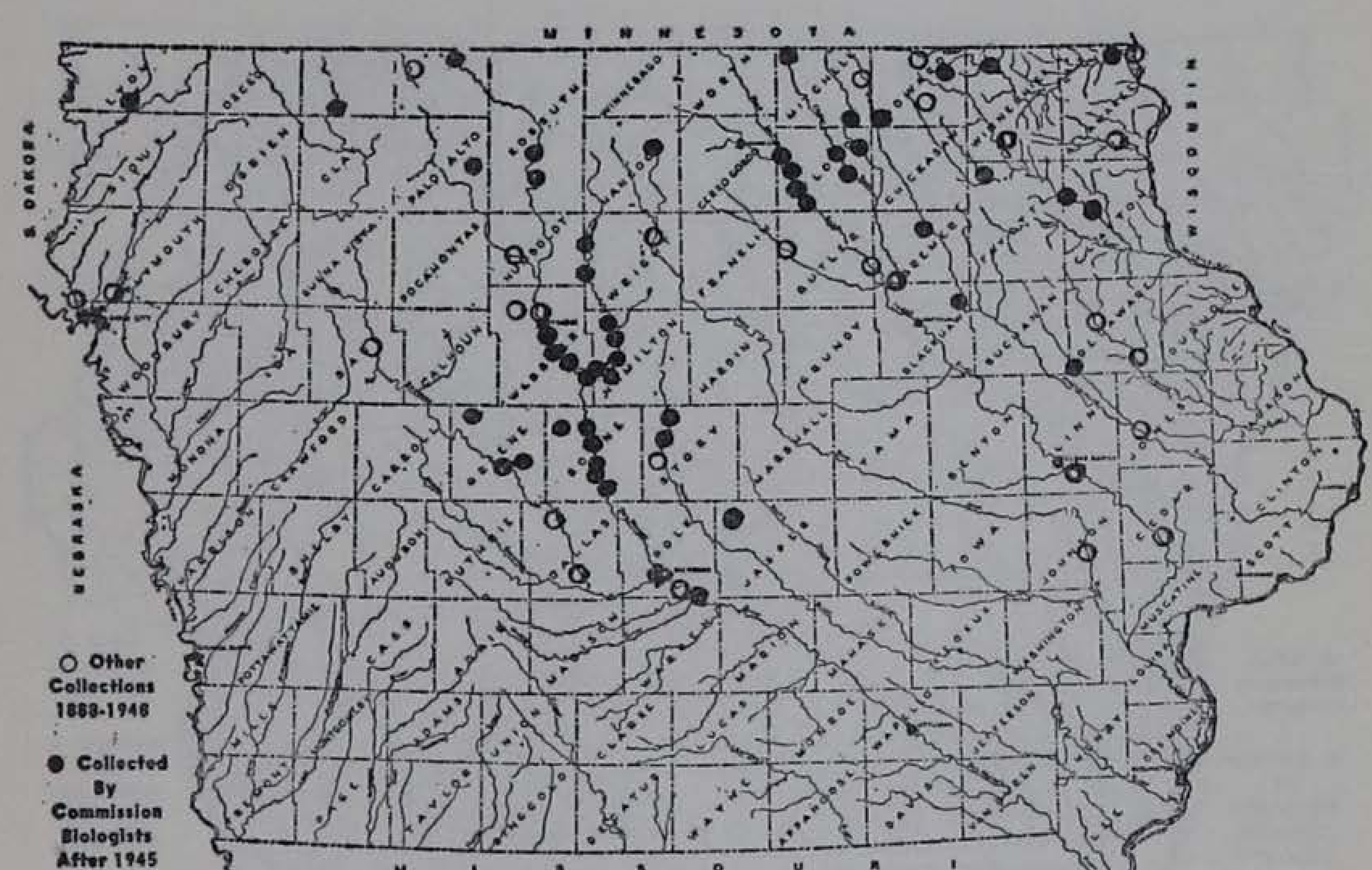
Map 85. Walleye—*Stizostedion vitreum vitreum* (Mitchill)



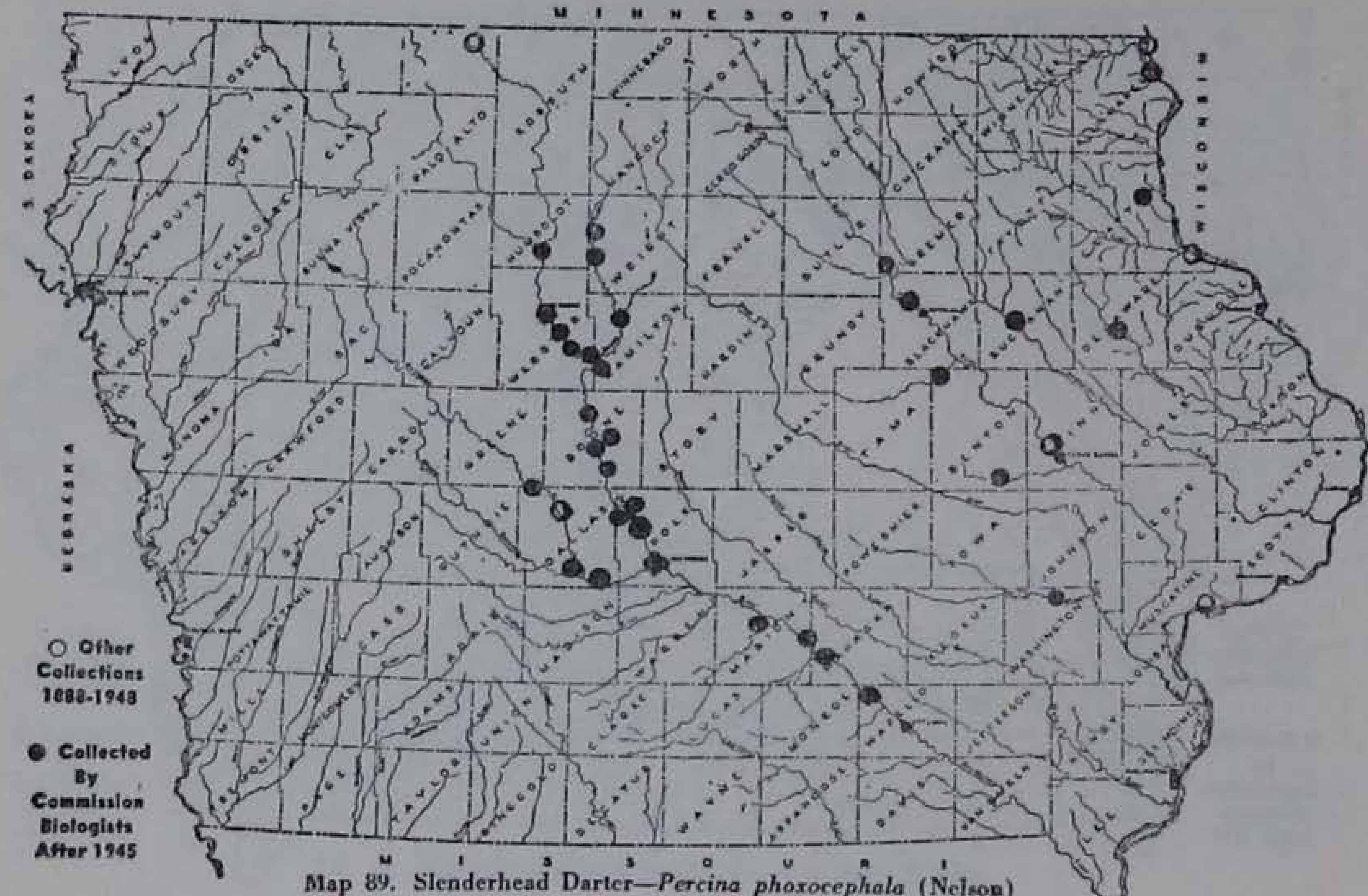
Map 86. Sauger—*Stizostedion canadense* (Smith)



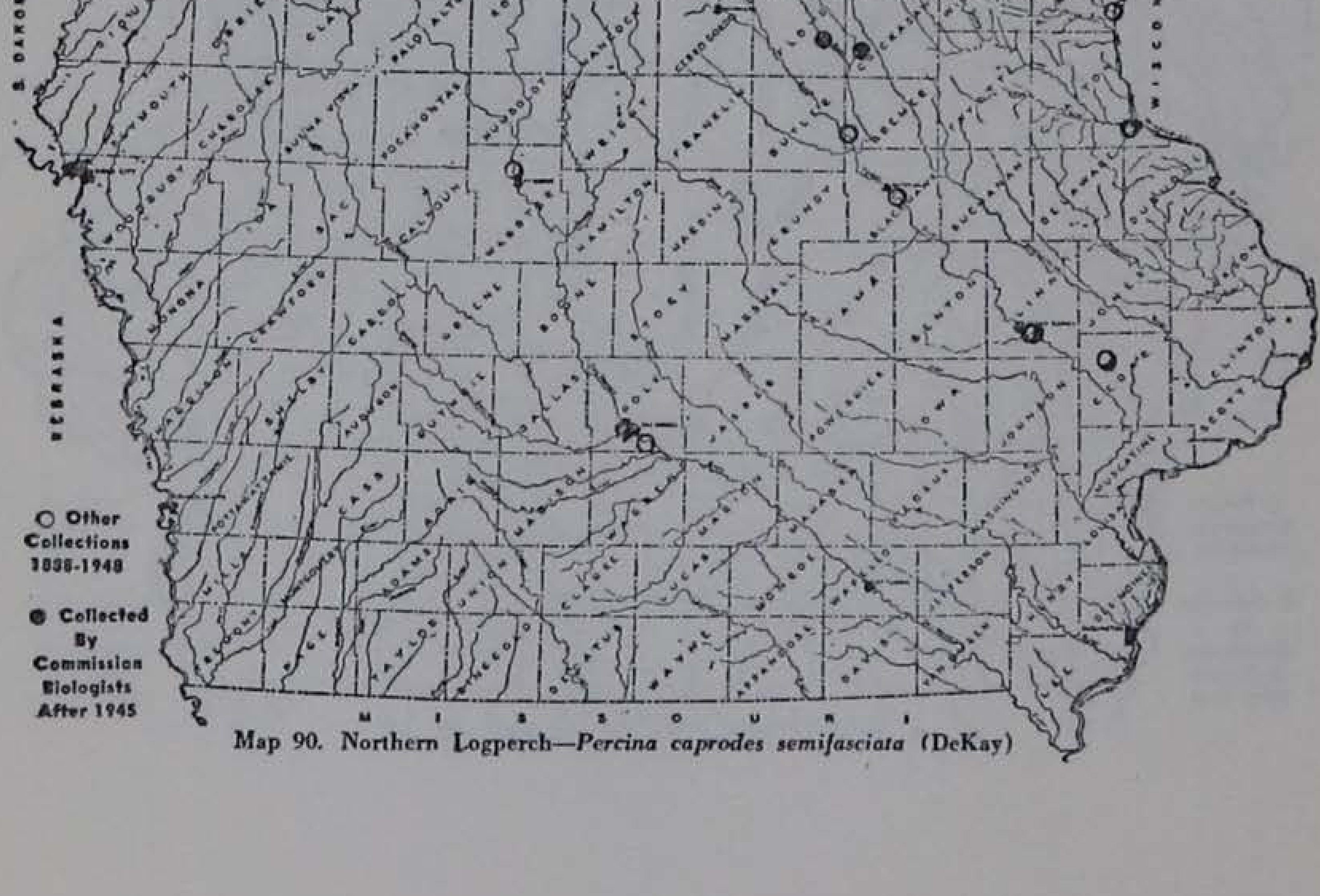
Map 87. Yellow Perch—*Perca flavescens* (Mitchill)



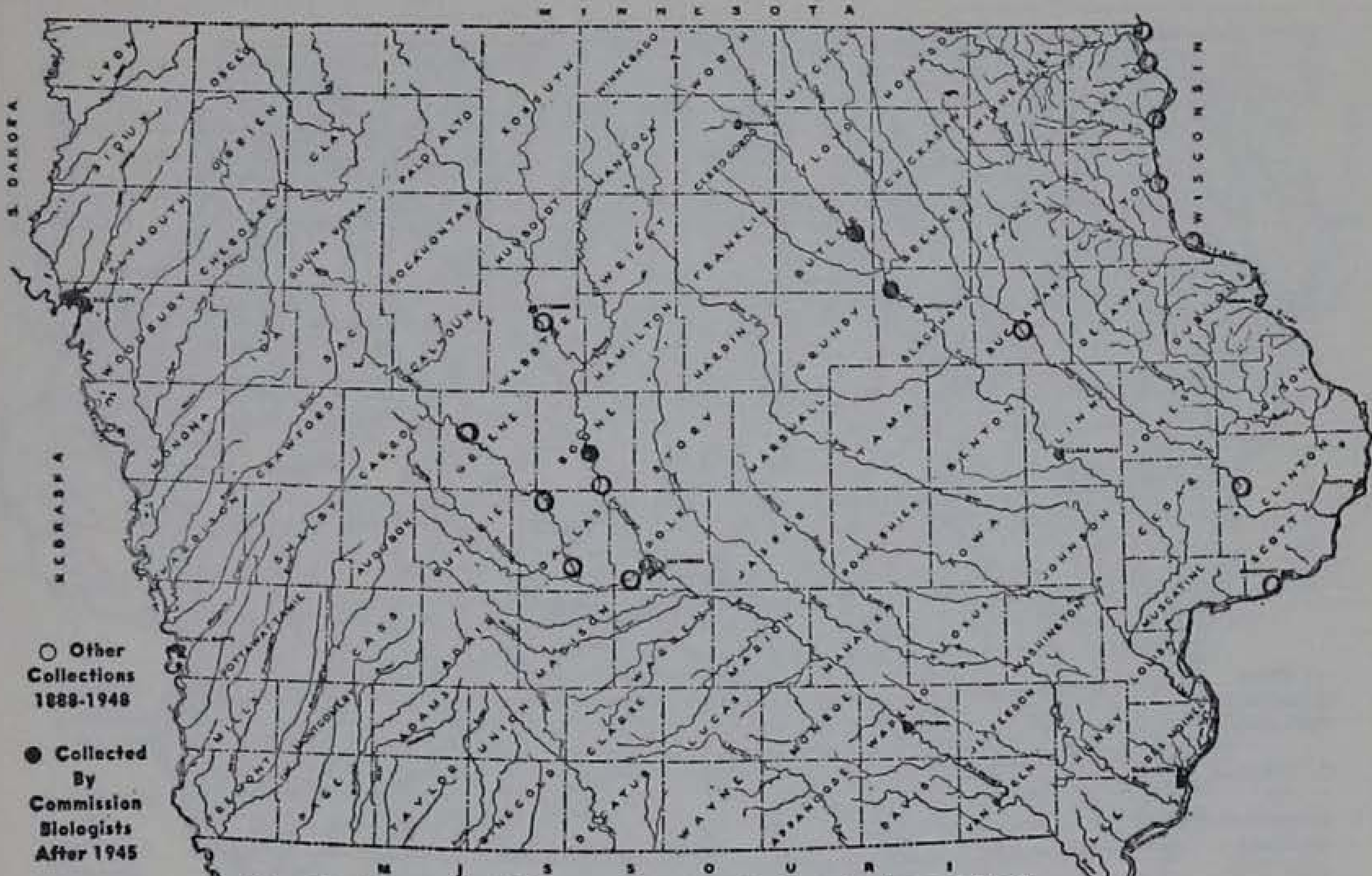
Map 88. Blackside Darter—*Percina maculata* (Girard)



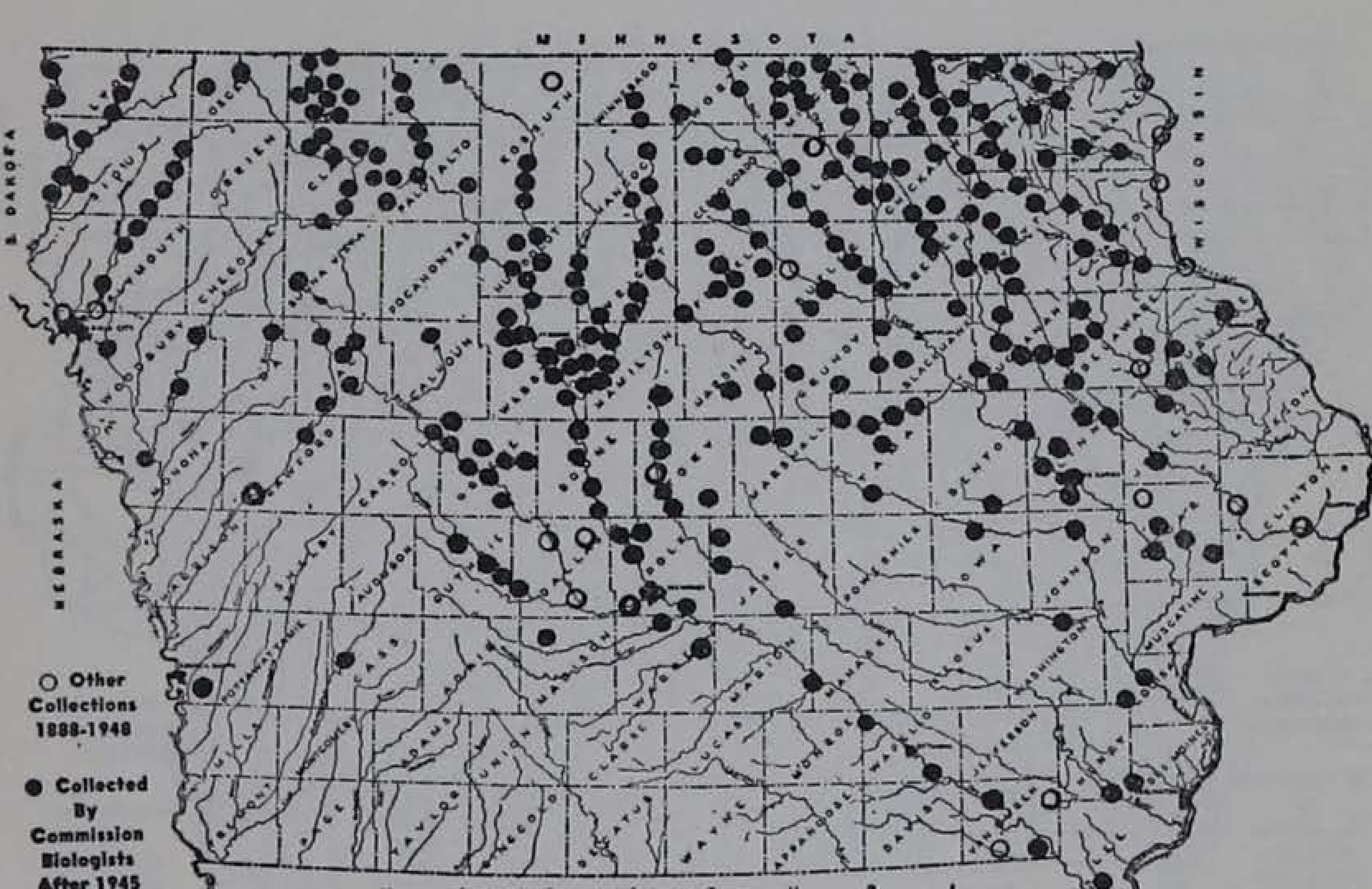
Map 89. Slenderhead Darter—*Percina phoxocephala* (Nelson)



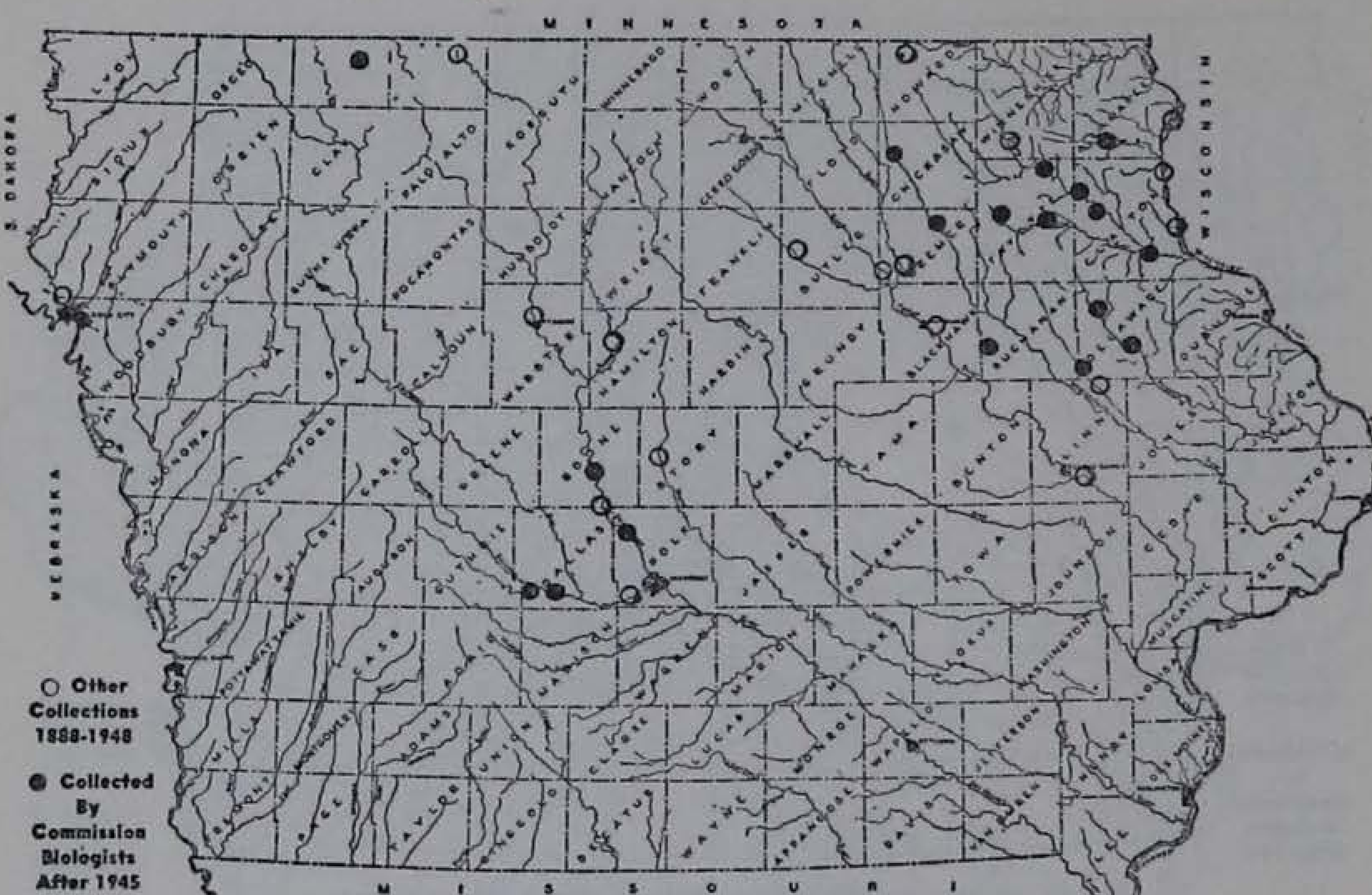
Map 90. Northern Logperch—*Percina caprodes semifasciata* (DeKay)



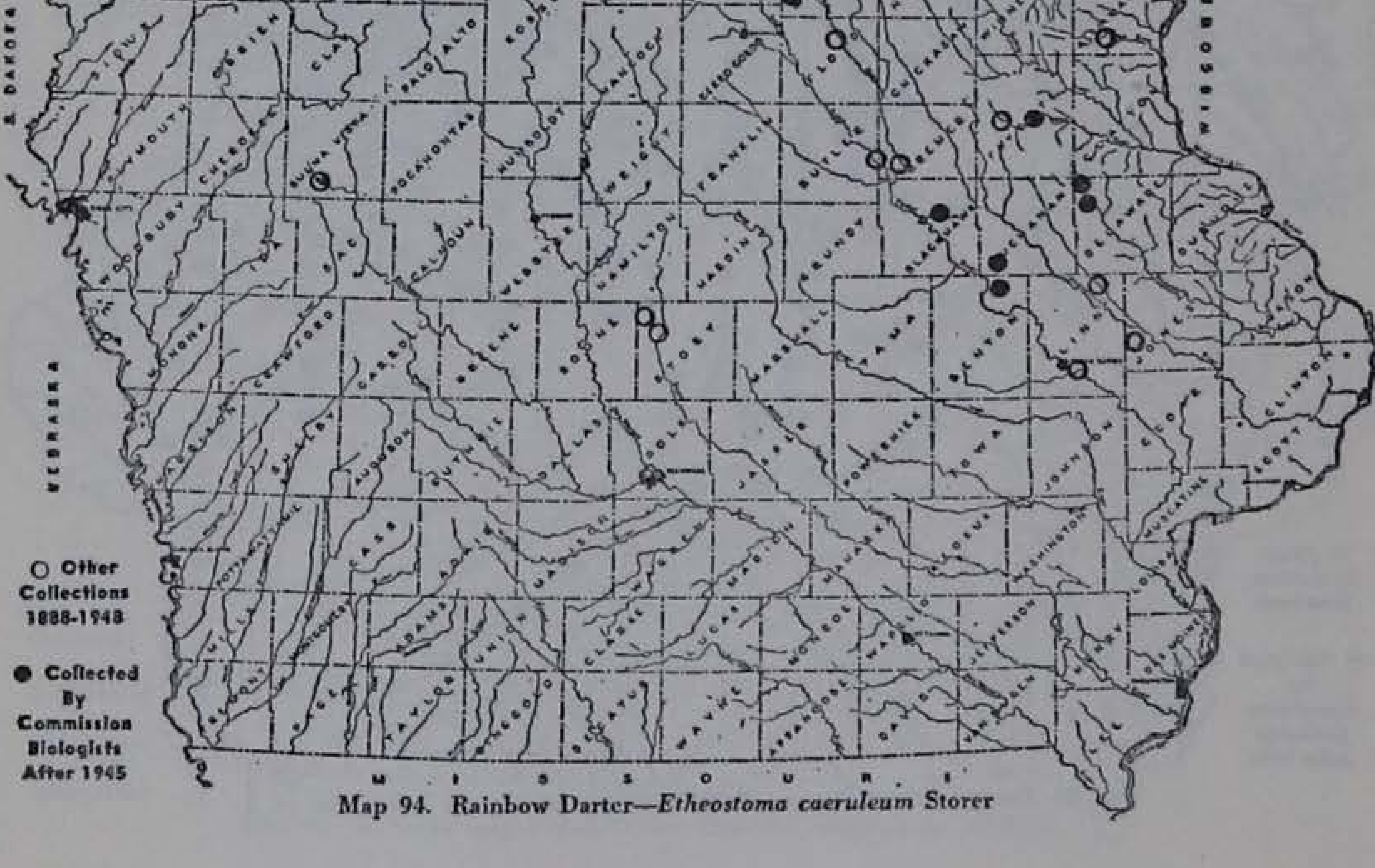
Map 91. Western Sand Darter—*Ammocrypta clara* Jordan and Meek



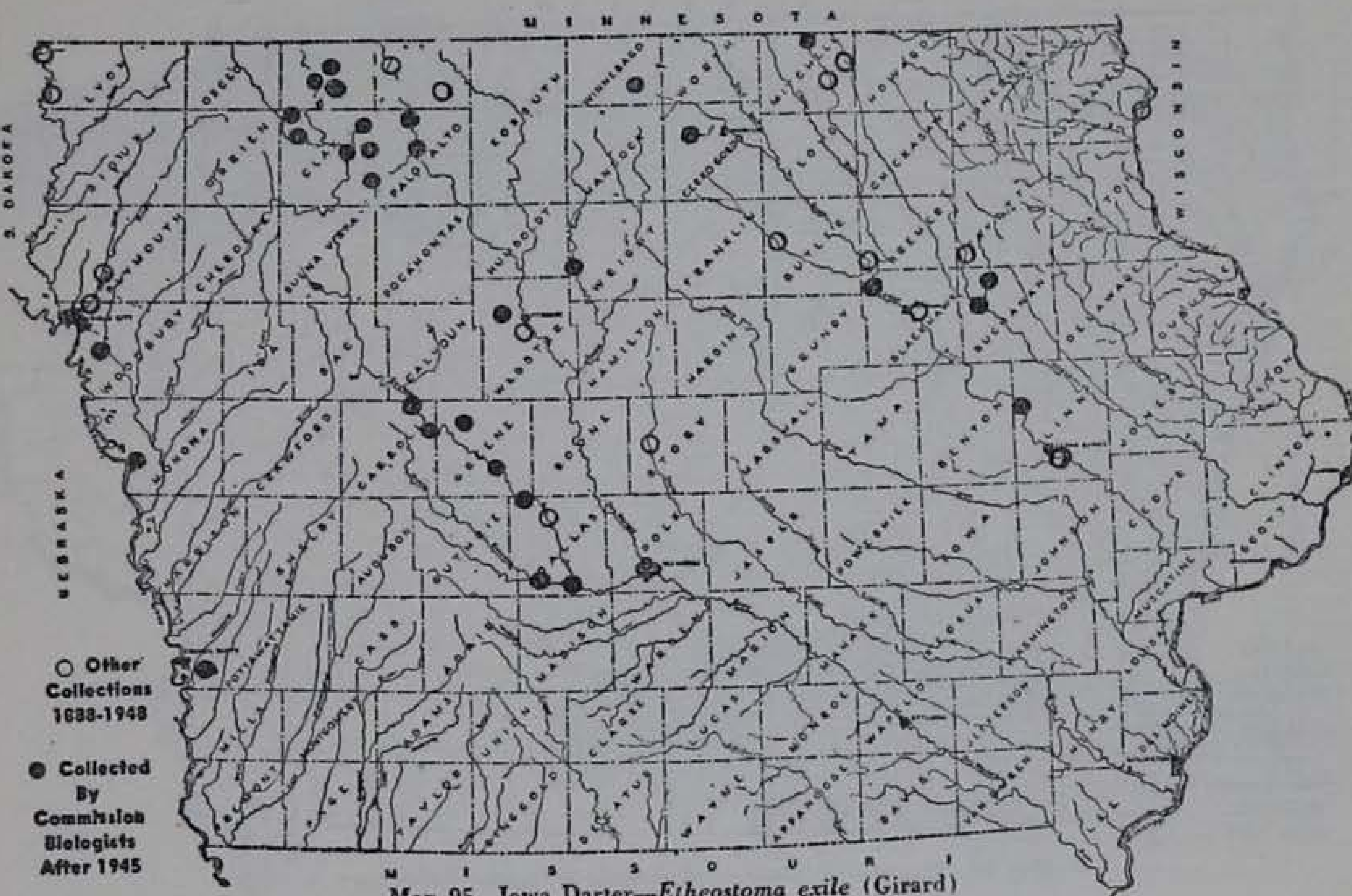
Map 92. Central Johnny Darter—*Etheostoma nigrum nigrum* Rafinesque



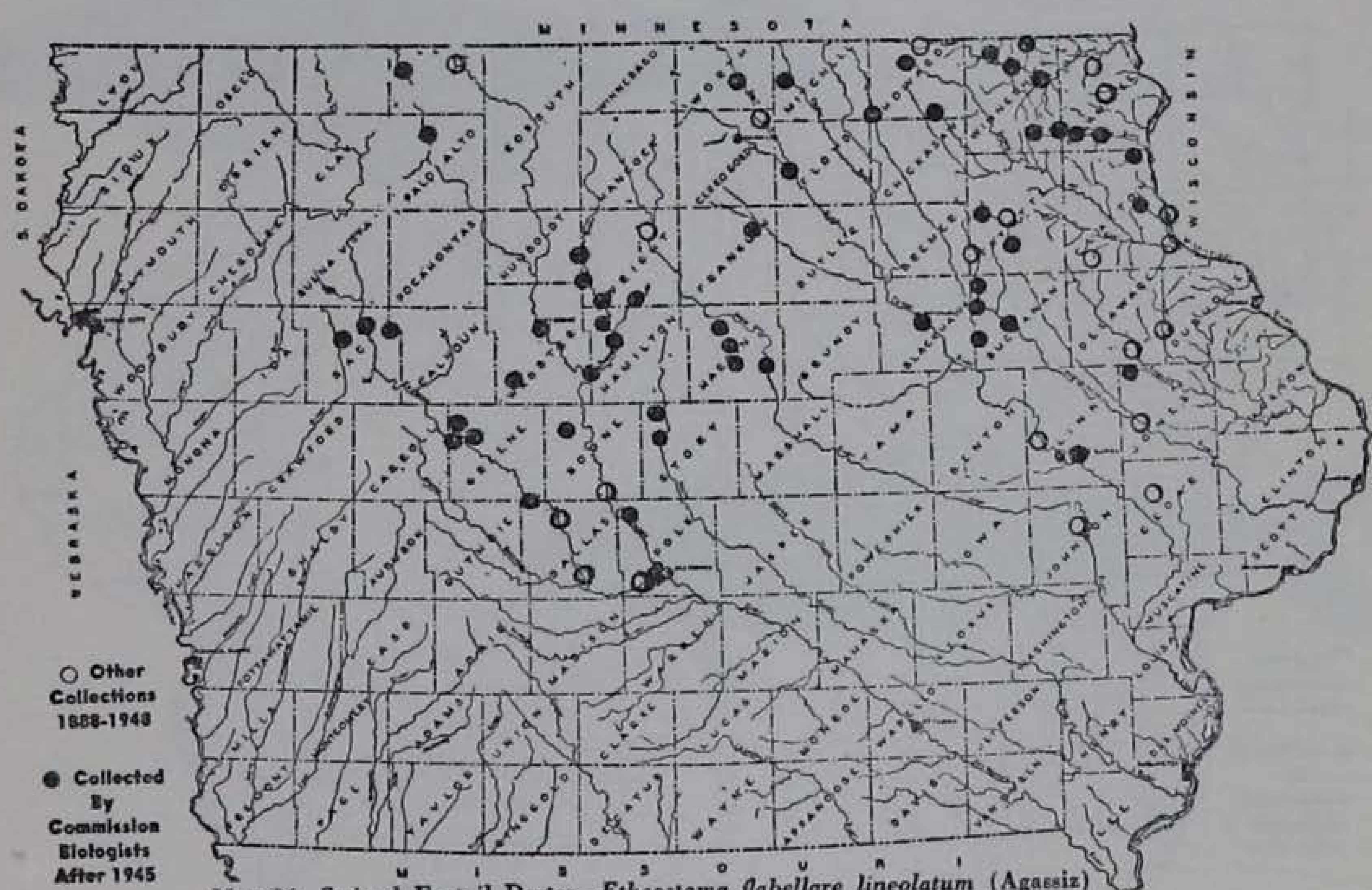
Map 93. Banded Darter—*Etheostoma zonale* (Cope)



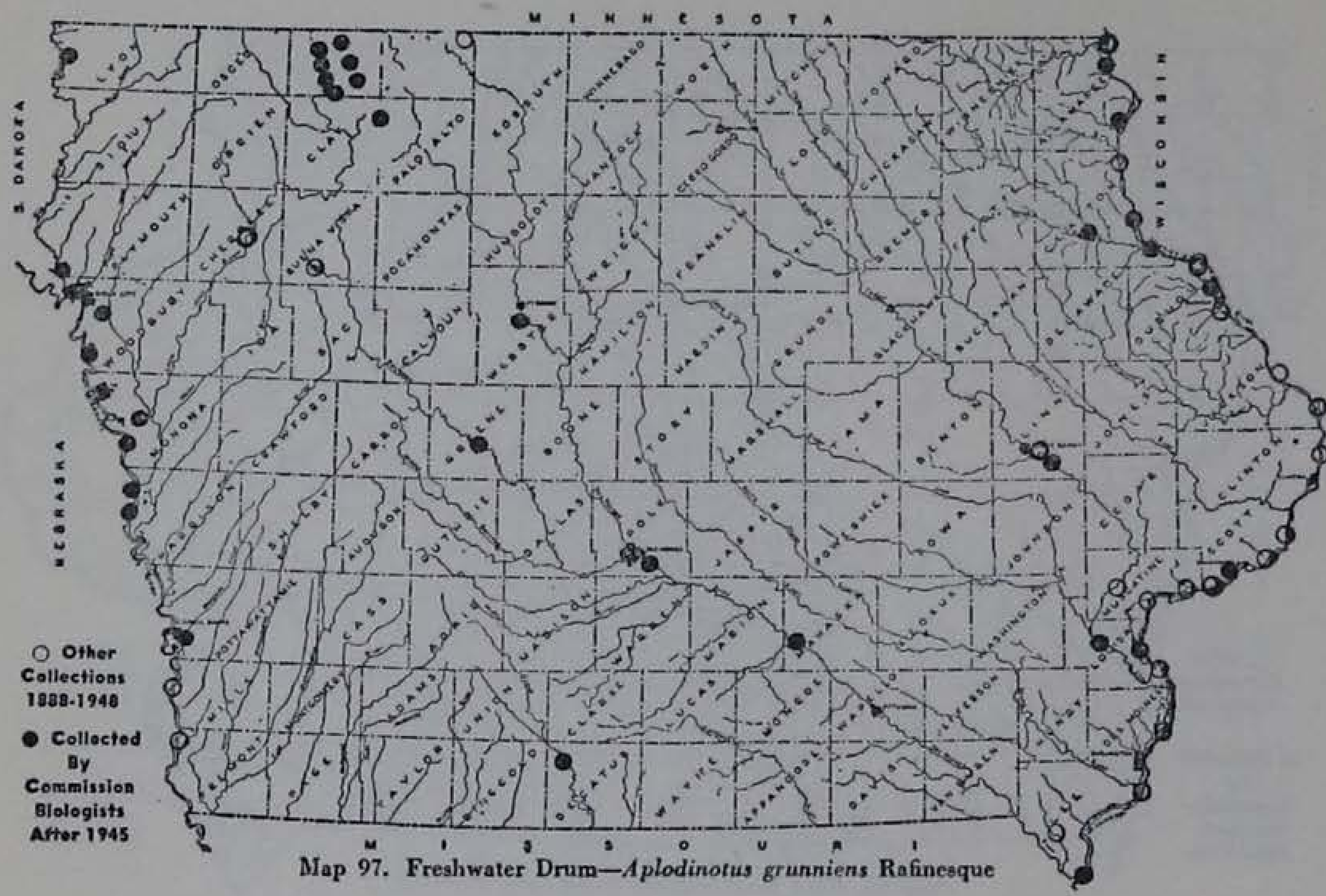
Map 94. Rainbow Darter—*Etheostoma caeruleum* Storer



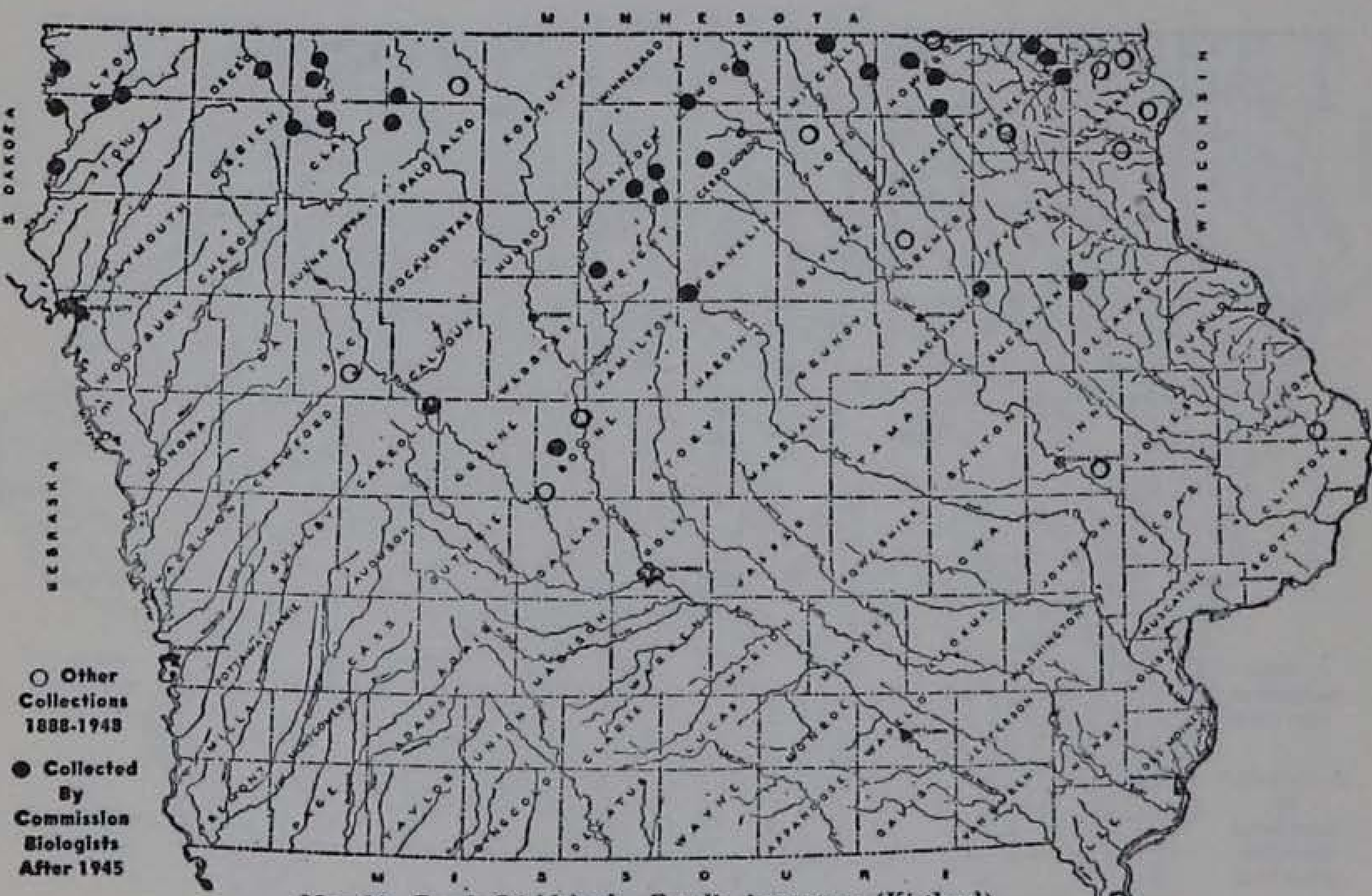
Map 95. Iowa Darter—*Etheostoma exile* (Girard)



Map 96. Striped Fantail Darter—*Etheostoma flabellare lineolatum* (Agassiz)



Map 97. Freshwater Drum—*Aplodinotus grunniens* Rafinesque

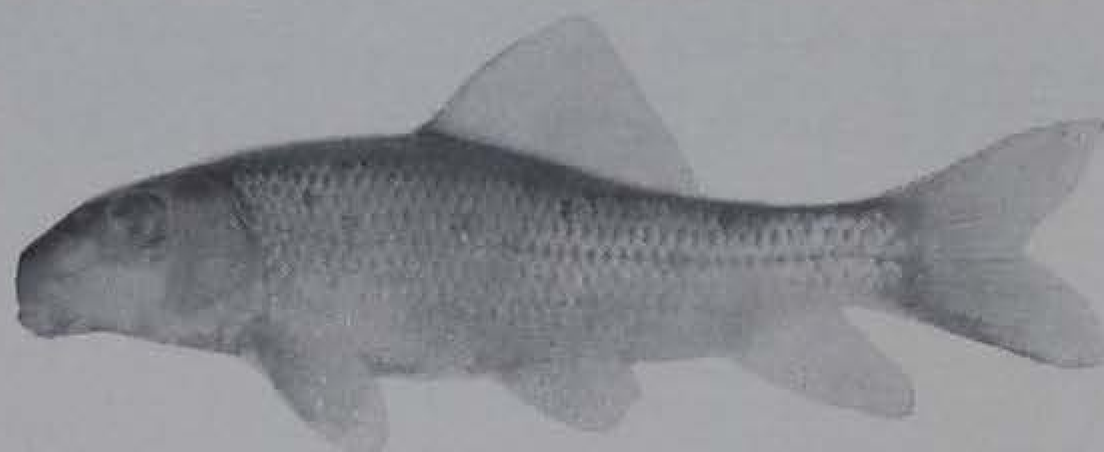


Map 98. Brook Stickleback—*Euçalia inconstans* (Kirtland)

PLATE NO. 19

Silver Redhorse

Golden Redhorse



Longnose Dace

Silver Chub

Emerald Shiner

PLATE NO. 20

Spottail Shiner

Rosyface Shiner

Spotfin Shiner

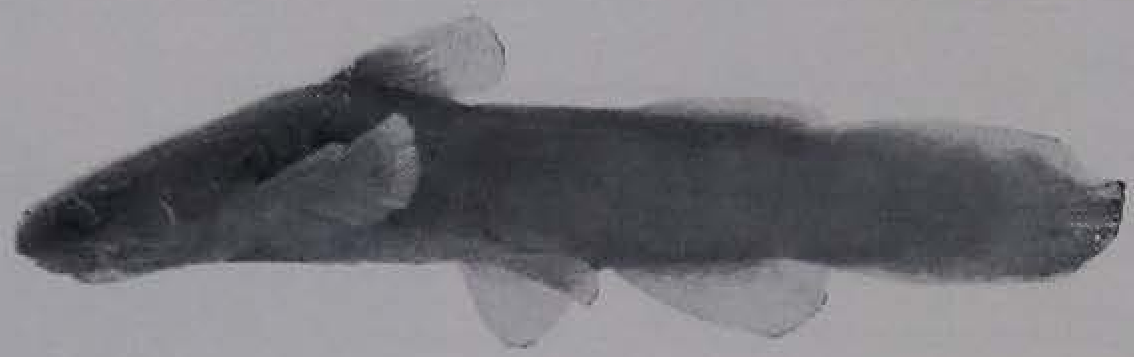
Silvery Minnow

Sand Shiner

PLATE NO. 21

Bullhead Minnow

Stonecat



Stoneroller

Tadpole Madtom

Slender Madtom

PLATE NO. 22

Blackside Darter

Yellow Bullhead

Central Mudminnow

Iowa Darter

Pirate-perch

A REVISED LIST OF THE FISHES OF IOWA, WITH KEYS FOR IDENTIFICATION

By Reeve M. Bailey

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A REVISED LIST OF THE FISHES OF IOWA, WITH KEYS FOR IDENTIFICATION[1]

By Reeve M. Bailey[2]

INTRODUCTION

In a series of prosaic, factual reports on the ichthyological surveys conducted by himself and his associates, Meek (1889-1894; Jordan and Meek, 1885; Call, 1892) wrote the opening chapter in the history of Iowa fishes. At the same time he laid the foundation on which future students might attempt to reconstruct the course of fish-population change in the waters of the North American prairie. That Meek's inquiry was not conducted before the prairie sod was broken prevents us for all time from knowing the condition of fish life when white settlers first arrived. As long ago as 1892 Meek wrote: "I have been informed that many streams, formerly deep and narrow, and abounding in pickerel, bass, and catfishes, have since grown wide and shallow, while the volume of water in them varies greatly in the different seasons, and they are now inhabited only by bullheads, suckers, and a few minnows. The breaking of the native sod for agricultural purposes has especially affected the smaller streams in this respect, while the construction of ditches and the practice of underdraining have had their effects upon the larger ones. Moreover the constant loosening of the soil, in farming, tends to reduce it to that condition in which it is readily transported by the heavy rains to produce muddy currents." Nevertheless, Meek found many fishes in abundance that are now rare, noted some to be widespread that are now of restricted or local occurrence, and caught nearly a score that are wholly extirpated from Iowa. It is doubtful whether any other state has experienced such extensive reduction in its original fish fauna.

Building on Meek's foundation, a number of studies of the Iowa ichthyofauna added materially to our knowledge of limited areas: Larrabee (1926) on the Okoboji Lake area, Coker (1930) on the Mississippi River near Keokuk, Bailey and Harrison (1945) on Clear Lake, and Starrett (1950) on Boone County. During 1932 numerous collections were assembled as part of a fishery survey for the Iowa 25-year Conservation Plan under the direction of Dr. Carl L. Hubbs (Crane and Olcott, 1933). From 1939 until 1944 the author and his associates at Iowa State College made collections throughout the state. Checklists of Iowa fishes appeared in 1928 (Potter and Jones), 1936 and 1941 (Aitken), and 1951 (Bailey).

Investigations of Iowa fishes were rapidly accelerated immediately after World War II. Dr. Kenneth D. Carlander and his students in the Iowa Fishery Research Unit at Iowa State College initiated a variety of biological projects in natural and impounded waters. The Upper Mississippi River Conservation Committee studied the fishes and the sport and commercial fisheries of that river (Barnickol and Starrett, 1951). The Biology Section of the State Conservation Commission was instituted under the supervision of Everett B. Speaker. In addition to studies concerned with the life histories, production, and populations of various fishes or on selected waters, many hundreds of fish collections were taken. The resultant reports by Harrison (1950), Cleary (1952 and 1954), and Harrison and Speaker (1954) provide excellent coverage for an understanding of fish distribution throughout most of the state. The available information has been synthesized into the report by Cleary which appears elsewhere in this volume.

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[1]Journal Paper No. J-2914 of the Iowa Agricultural Experiment Station, Ames, Iowa, Project No. 651, and the Industrial Science Research Institute (Project No. 651) of Iowa State College; in cooperation with the Iowa Conservation Commission.
[2]Museum of Zoology, University of Michigan, Ann Arbor, Michigan.

That the Iowa fish fauna is now rather well known is evident from the fact that since 1951, a period of active study, only one species has been added to the state list. Still deserving further investigation are the fishes of the Mississippi and Missouri rivers, the ox-bow lakes and overflow waters of the rivers in southeastern Iowa, and small or isolated spring flowage areas. Especially worthy of careful exploration are clear waters, other than the larger lakes, with an abundance of vegetation. Persistent pools of vegetated water with spring inflow, when discovered, may well yield remnant populations of some of the species not found in Iowa since Meek's time.

ACKNOWLEDGMENTS

By its nature a work such as this involves the compilation of material from many sources. Again I am grateful to all of those who contributed to the preparation of the 1951 version of this list and keys and who were mentioned in that report. In revising the keys I am especially obligated to William Ralph Taylor whose unpublished work on catfishes has been freely used. C. Richard Robins pointed out the utility of the character of the suborbital bones in distinguishing between *Moxostoma* and *Minytrema*. Royal D. Suttkus has called my attention to and loaned the specimens of *Hybopsis plumbea* which constitute the first authentic record for Iowa. William Brudon executed the drawings for the first edition and my wife, Marian K. Bailey, aided in their revision.

In redrafting the keys, copies of the earlier edition were distributed to a number of colleagues whose criticisms were enlisted. They were generous with suggestions and I regret my failure to incorporate all of these into the present draft. Any improvements in this version stem largely from the help of Kenneth D. Carlander, Robert E. Cleary, Shelby D. Gerking, Harry M. Harrison, Raymond E. Johnson, Robert R. Miller, George A. Moore, John B. Moyle, Edward C. Raney, Earl T. Rose, and E. B. Speaker.

SUBSPECIES

Since the appearance of the first edition of this list in 1951, the common taxonomic practice of dividing geographically variable species into named races, or subspecies, has been subjected to critical scrutiny. It has been noted that the pattern of geographic variation in some species takes the form of a rather gradual and progressive gradient, termed a cline. It is now agreed by many taxonomists that despite the high biological significance of this type of variation, it is undesirable to assign subspecific names on the basis of clinal gradients. Five species treated as subspecies in 1951 but herein regarded as binomials because of the clinal nature of the variation are: *Notemigonus crysoleucas*, golden shiner; *Semotilus atromaculatus*, creek chub; *Ictalurus punctatus*, channel catfish (Bailey, Winn, and Smith, 1954: 149); *Pimephales promelas*, fathead minnow (Taylor, 1954: 42); and *Ictalurus melas*, black bullhead.

Commonly the differences between geographic subspecies are slight and are best expressed as average conditions applying to a considerable fraction of individuals, but not to all. It is my revised opinion that acceptable subspecies should evidence high uniformity over their respective ranges and should differ one from another with high constancy. Zones of intergradation should be rather narrow. If they are wide the variation merges insensibly into a clinal gradient. Because of the small magnitude and the low constancy of the alleged differences among subspecies, the following species are here treated as binomials following Bailey, Winn, and Smith (1954: 150): *Lepisosteus osseus*, longnose gar; *Erimyzon sucetta*, lake chubsucker; and *Notropis roseus*, weed shiner. Additional species for which the available evidence appears not to justify the recognition of subspecies are: *Esox masquinongy*, muskellunge; *Catostomus commersoni*, white sucker; *Notropis atherinoides*, emerald shiner; *Notropis dorsalis*, bigmouth shiner; *Notropis lutrensis*, red shiner; *Lota lota*, burbot; and *Micropterus dolomieui*, smallmouth bass.

The ichthyologist, in studying material, often perceives differences among populations from various parts of the geographic range of a species. Such discoveries may presage the definition of validly recognizable subspecies. The premature use of such information without publication of the full data is disconcerting to other workers, who are unable to evaluate the basis for the action. The different stocks sometimes turn out to be fully distinct species. Bailey, Winn, and Smith (1954: 150) have indicated their reluctance to employ trinomials for the following pending presentation of supporting evidence: *Ictalurus nebulosus*, brown bullhead; *Aphredoderus sayanus*, pirate perch; *Labidesthes sicculus*, brook silverside; *Lepomis macrochirus*, bluegill. To these may be added *Hybopsis gracilis*, flathead chub, and *Cottus cognatus*, slimy sculpin.

Four species present special problems with respect to subspecies that are discussed briefly in the list of Iowa fishes: *Notropis volucellus*, mimic shiner; *Hybognathus nuchalis*, silvery minnow; *Campostoma anomalum*, stoneroller; and *Etheostoma nigrum*, Johnny darter.

The subspecific partition of 17 species of Iowa fishes is regarded as resting on a relatively secure body of evidence. It should be cautioned, however, that such status is provisional. In an area where ideas have not fully crystallized and new evidence is constantly being amassed it should be anticipated that changes in subspecific nomenclature will continue. Three species are regarded as having Iowa representatives of two subspecies each. Of these, the races of the sand shiner, *Notropis deliciosus*, are geographic replacements of one another, whereas those of the mimic shiner, *Notropis volucellus*, are classed as ecological rather than as geographic subspecies. The subspecies of the Johnny darter, *Etheostoma nigrum*, are strictly neither geographic nor ecological.

REVISED LIST OF IOWA FISHES

This list comprises 25 families, 56 genera, 133 species, and 136 total kinds, including subspecies, of native fishes. In addition four exotic species (brown trout, rainbow trout, carp, and goldfish) have become established and are included in the list, where they are designated by asterisks. Since 1951 one species (lake chub) has been added to the list and one (plains minnow) has been removed.

Some comments pertaining to nomenclature and occurrence were included in the check-list in the 1951 edition. These have been omitted in this list, but other remarks, dealing especially with changes in names and the status of subspecies, have been inserted. Although not of general interest this material is supplied for fishery workers or others concerned with the technical reasons for modifications in fish names.

Petromyzontidae

Ichthyomyzon unicuspis Hubbs and Trautman—silver lamprey

Ichthyomyzon castaneus Girard—chestnut lamprey

Lampetra lamottei (LeSueur)—American brook lamprey

Polyodontidae

Polyodon spathula (Walbaum)—paddlefish

Acipenseridae

Acipenser fulvescens Rafinesque—lake sturgeon

Scaphirhynchus platorynchus (Rafinesque)—shovelnose sturgeon

Scaphirhynchus album (Forbes and Richardson)—pallid sturgeon. In a recent study of the species of *Scaphirhynchus* (Bailey and Cross, 1954), the validity of the only Iowa record for the pallid sturgeon (Coker, 1930) was questioned. In the same publication, however, it was shown that the pallid sturgeon is generally distributed in the Missouri River from Montana to its mouth. Despite the absence of records it is obvious that the species occurs in Iowa; thorough collecting in the Missouri River would be rewarded not only by the finding of this fish, but of several other species rare or absent elsewhere in the state.

Lepisosteidae

Lepisosteus platostomus Rafinesque—shortnose gar

Lepisosteus osseus (Linnaeus)—longnose gar. Present knowledge of geographic variation in this species is too imperfect to justify the recognition of subspecies (see Bailey, Winn, and Smith, 1954: 117).

Amiidae

Amia calva Linnaeus—bowfin

Salmonidae

**Salmo trutta* Linnaeus—brown trout

**Salmo gairdneri* Richardson—rainbow trout

Salvelinus fontinalis (Mitchill)—brook trout

Clupeidae

Alosa chrysochloris (Rafinesque)—skipjack herring
Alosa ohiensis Evermann—Ohio shad
Dorosoma cepedianum (LeSueur)—gizzard shad

Hiodontidae

Hiodon alosoides (Rafinesque)—goldeye
Hiodon tergisus LeSueur—mooneye

Umbridae

Umbra limi (Kirtland)—central mudminnow

Esocidae

Esox americanus vermiculatus LeSueur—grass pickerel. I follow Legendre (1952: 21) in regarding the grass pickerel of the Mississippi basin and Great Lakes as a subspecies of the redfin pickerel of the Atlantic coast. The subspecific indentification of Gulf-coastal material is not yet on a firm basis (Bailey, Winn, and Smith, 1954: 121).

Esox lucius Linnaeus—northern pike

Esox masquinongy Mitchill—muskellunge. The recent study of geographic variation of the muskellunge in Canada (Hourston, 1955) indicates that the two subspecies thought to inhabit that country are not well founded. The evidence presented to date to substantiate the subspecific separation of the Ohio valley population is equally unconvincing. Until impelling new evidence is presented it seems unnecessary to recognize subspecies in the muskellunge.

Catostomidae

Cycleptus elongatus LeSueur—blue sucker

Ictiobus cyprinellus (Valenciennes)—bigmouth buffalo

Ictiobus niger (Rafinesque)—black buffalo

Ictiobus bubalus (Rafinesque)—smallmouth buffalo

Carpiodes forbesi Hubbs—plains carpsucker

Carpiodes cyprinus (LeSueur)—quillback carpsucker

Carpiodes carpio carpio (Rafinesque)—river carpsucker

Carpiodes velifer (Rafinesque)—highfin carpsucker

Moxostoma duquesnei (LeSueur)—black redhorse

Moxostoma erythrurum (Rafinesque)—golden redhorse

Moxostoma anisurum (Rafinesque)—silver redhorse

Moxostoma aureolum aureolum (LeSueur)—northern redhorse. This species is treated as a complex of two subspecies on the authority of Trautman and Martin (1951).

Moxostoma carinatum (Cope)—river redhorse

Hypentelium nigricans (LeSueur)—northern hog sucker

Catostomus commersoni (Lacépède)—white sucker

Minytrema melanops (Rafinesque)—spotted sucker

Erimyzon sucetta (Lacépède)—lake chubsucker

Cyprinidae

**Cyprinus carpio* Linnaeus—carp

**Carassius auratus* (Linnaeus)—goldfish

Notemigonus crysoleucas (Mitchill)—golden shiner

Semotilus atromaculatus (Mitchill)—creek chub

Gila elongata (Kirtland)—redside dace. In recognition of the close relationship of the eastern species customarily classified as *Clinostomus* Girard, with the western forms assigned to *Richardsonius* Girard, the redside dace was placed in the latter genus (Bailey, 1951: 191). This arrangement fails, however, to express the equally intimate relationship of the western species of *Richardsonius* with the species of *Gila* Girard. A simplified generic arrangement of the western species of the complex (Miller, 1945) removed much existing confusion. Both *Gila* and *Richardsonius* were ranked as genera, but no characters were presented by which they may be distinguished. Since *Gila*, *Richardsonius*, and *Clinostomus* agree in all those characters generally regarded as of primary (i. e., generic) importance in the classification of the Cyprinidae, and since their general appearance, ecology, and distribution support the inference derived from their morphology that they are, in fact, closely related, I think it best to unite them generically under the oldest name, *Gila* Girard.

The generic classification of the American cyprinids poses many extremely difficult problems. Almost all if not all of the species are closely interrelated, a situation that is masked by the excessive number of genera recognized in recent years. The grouping of *Gila*, *Richardsonius*, and *Clinostomus* as a single genus contributes to a more functional classification of the Cyprinidae.

Chrosomus erythrogaster (Rafinesque)—southern redbelly dace

Opsopoeodus emiliae Hay—pugnose minnow

Hybopsis plumbea (Agassiz)—lake chub. Recently (Bailey, 1951: 188) the lake chub was removed from the Iowa faunal list since it was shown that the only record was based on a misidentification. Now through the courtesy of Dr. Royal D. Suttkus of Tulane University, in loaning the specimens, it is possible to report an unquestionable record of occurrence of the species in Iowa. On September 8, 1954, Robert K. Chipman collected 7 specimens (41 to 70 mm. in standard length) in Twin Springs Creek, at Carter Road, northwest of Dubuque, Dubuque County. They are number 10208 in the Tulane University collection. Like *Cottus cognatus*, which lives in the area, the lake chubs occurrence in northeastern Iowa far south of the main body of the range of the species, is explainable as a glacial relict. There exists a strong likelihood that these species resided in the nearby Driftless Area during the Wisconsin glaciation. Persistence of these cool-water species is made possible by the presence of numerous springs in northeastern Iowa.

Hybopsis gracilis (Richardson)—flathead chub

Hybopsis storeriana (Kirtland)—silver chub

Hybopsis gelida (Girard)—sturgeon chub

Hybopsis meeki Jordan and Evermann—sicklefin chub

Hybopsis aestivalis (Girard)—speckled chub

Hybopsis sp.—gravel chub. This species, referred to as *Hybopsis* or *Erimystax dissimilis* and as *Erimystax* sp. in papers on Iowa fishes, is now rare in the state. It is apparently different from the true *H. dissimilis*, and has no available specific name.

Hybopsis biguttata (Kirtland)—hornyhead chub

Rhinichthys atratulus meleagris Agassiz—western blacknose dace

Rhinichthys cataractae (Valenciennes)—longnose dace

Phenacobius mirabilis (Girard)—plains suckermouth minnow

Notropis atherinoides Rafinesque—emerald shiner. After examining emerald shiners from various localities in the Great Lakes I am unable to confirm the existence of a pelagic form in Lake Michigan (Hubbs, 1945) that is so distinct as to merit subspecific separation from the typical form in Lake Erie.

Notropis percobromus (Cope)—plains shiner. The differences between this species and *Notropis atherinoides* are not great and perhaps do not have a genetic basis. Until the problem can be studied further I retain the *status quo*, as outlined by Hubbs (1945: 16). I cannot agree, however, to the inclusion of the upper Mississippi River in the range of *N. percobromus*. The two specimens from Minnesota assigned to *N. percobromus* in the Museum of Zoology collections are reidentified as *N. atherinoides*. The only Iowa specimens examined by me which I identify as *N. percobromus* are from the Missouri River (Bailey, 1951: 192).

Notropis rubellus (Agassiz)—rosyface shiner

Notropis umbratilis (Girard)—redfin shiner

Notropis illecebrosus (Girard)—silverstripe shiner. The failure of recent surveys to add to the single known Iowa specimen, from Sioux City (Bailey, 1951: 192), makes it increasingly doubtful that the fish really came from there. The species lives elsewhere in waters with excessively heavy silt loads so it seems doubtful that it has been eliminated from the Missouri River since 1890. If careful seining in the Missouri does not yield new material the silverstripe shiner should probably be removed from the state fish list. Until such collecting is done the entry may be retained on a provisional basis.

Notropis cornutus frontalis (Agassiz)—northern common shiner

Notropis chalybaeus (Cope)—ironcolor shiner

Notropis roseus (Jordan)—weed shiner

Notropis heterodon (Cope)—blackchin shiner

Notropis hudsonius (Clinton)—spottail shiner

Notropis blennius (Girard)—river shiner

Notropis dorsalis (Agassiz)—bigmouth shiner

Notropis amnis Hubbs and Greene—pallid shiner

Notropis spilopterus (Cope)—spotfin shiner

Notropis lutrensis Baird and Girard—red shiner

Notropis deliciosus (Girard)—sand shiner. A careful study of variation in the sand shiner throughout its range is needed. Until that is done the subspecies rest on an unfirm base. Sand shiners from the Great Plains have smaller scales, especially as counted around the body, than do those from the eastern and southern parts of the range. Whether or not this character is clinal is not established, nor is it known whether the difference in scale size is due to genetic or environmental factors. For the present it is convenient to maintain the *status quo* and recognize two subspecies. Study of the data presented by Gerking (1945: 63) makes it evident that the subspecies *stramineus*, irrespective of its possible validity, is not adequately defined.

N. d. deliciosus (Girard)—eastern sand shiner

N. d. missuriensis (Cope)—plains sand shiner

Notropis topeka Gilbert—Topeka shiner

Notropis heterolepis Eigenmann and Eigenmann—blacknose shiner

Notropis volucellus (Cope)—mimic shiner. Most subspecies are geographical races of the species; those of the mimic shiner are ecological. *N. v. volucellus* is a creek and lake fish; it is of extremely rare occurrence in northeastern Iowa. *N. v. wickliffi* Trautman inhabits large rivers; it is a common form in the Mississippi River where it lives together with the closely related N. *buchanani*. The complex is deserving of further study.

N. v. volucellus (Cope)—northern mimic shiner

N. v. wickliffi Trautman—channel mimic shiner

Notropis buchanani Meek—ghost shiner

Dionda nubila (Forbes)—Ozark minnow

Hybognathus hankinsoni Hubbs—brassy minnow

Hybognathus nuchalis nuchalis Agassiz—silvery minnow. *Hybognathus nuchalis* and *H. placita* have long been regarded as distinct species by most authors, including myself (Bailey, 1951: 193, 219). Although new data are strongly suggestive, it cannot now be affirmed categorically that the two are conspecific. Nevertheless, I feel sufficiently confident that they belong to one species for me to combine them under the older name, *H. nuchalis*. (The trinomial is employed on the presumption that the Atlantic coastal form *regia* is a distinct subspecies—see Bailey, 1954.) Plains fish customarily have smaller eyes and smaller scales, as counted around the body—especially below the lateral lines, than do those from the central or upper Mississippi valley (Bailey, 1951: 219). Intermediate populations are common, however, and what appear to be more or less typical populations of *nuchalis* are sometimes encountered on the Great Plains. Similarly, fish phenotypic of *placita* range far to the east in and adjacent to the turbid Missouri River, and they occur downstream (but not upstream) in the Mississippi below the mouth of the Missouri. Occasionally the two types occur together, leading to the assumption that two species are represented. This explanation is rendered questionable by the presence of intermediate, hence unidentifiable, populations.

The interpretation that the two forms are conspecific is based in large part on what appeared at first to be a mixture of two species in a collection from the Little Missouri River, at Camp Creek, Harding County, South Dakota, taken in August, 1952. Analysis of the collection shows that the small-eyed, small-scaled fish *(placita)* belong to the 1951 and 1952 year classes. The larger-eyed, larger-scaled fish (closely approaching typical *nuchalis*) belong to the 1950 year class. From these limited data it is inferred that environmental variations at the time of early development, probably chiefly in turbidity (Moore, 1950), are in some way translated into structural differences that can be perceived throughout the life of the fish. From prevailing conditions it may be conjectured that the usual high turbidity of the Missouri River and other plains streams results in small eyes and small scales; the lower turbidity of the Ohio and upper Mississippi basins produces large eyes and large scales. During drought or other local conditions plains streams, or their backwaters and oxbow lakes, may temporarily be relatively clear at the time the eggs and fry are developing. It is at such times, I conclude, that the phenotype "*nuchalis*" appears on the Great Plains (i. e. the 1950 year class in the Little Missouri River). High turbidities comparable to those of the Missouri River are rare and then temporary through the usual range of the "*nuchalis*" type. In this area the "*placita*" type is never encountered, to my knowledge, except in the Mississippi—Missouri River.

It is obvious that experimental study is needed to test the accuracy of this speculative explanation. It is of interest to note that where other Mississippi basin fishes have intimately related species or subspecies on the Great Plains, the same character differences are usually involved. For example, *Notropis percobromus* of the Great Plains differs from *N. atherinoides* chiefly in the smaller eye; *Notropis deliciosus missuriensis* of the plains contrasts with the eastern *N. d. deliciosus* in the more numerous body-circumference scales and the smaller eye.

Pimephales vigilax perspicuus (Girard)—bullhead minnow. The grouping of *Ceratichthys*, *Hyborhynchus*, and *Pimephales* under the latter name, proposed in the first edition of this list, has recently been discussed and supported by Cross (1953) in a paper which also demonstrates the need for the reduction of *perspicuus* to subspecific status under *P. vigilax*.

Pimephales notatus (Rafinesque)—bluntnose minnow

Pimephales promelas Rafinesque—fathead minnow

Campostoma anomalum Rafinesque—stoneroller. That subspecies of the species live in different geographic areas, rarely in diverse habitats in the same area, is widely accepted as a general rule. The reported occurrence of two subspecies of the stoneroller in the same waters in Wisconsin and Iowa (Hubbs and Greene, 1935; Greene, 1935) is therefore cause for suspicion. The association of two structural types of stonerollers, one with a larger mouth and larger scales, has been discovered also in many collections from southern Missouri. To add to the complexity, stonerollers from the eastern part of the range of the species, commonly assigned to the nominate subspecies, are more or less intermediate between these two. It is possible that the sympatric forms, *pullum* and *oligolepis*, are really fully distinct species. On the other hand, they may with greater plausibility merely represent environmental responses to differing conditions during early development. For example, streams emerging as large springs and with relatively uniform temperature may result in structurally different fish from those spawned in nearby waters that are fed by surface runoff and are subject to wider fluctuations in physical conditions. Subsequent movements of the fish would then explain the occurrence of the two types in the same waters. Many of the known localities of occurrence of *oligolepis* are in regions well known for the abundance of springs. Until the uncertainties are clarified it seems best to refer to Iowa specimens of the stoneroller in the binomial.

Ictaluridae

Largely as the result of the investigations by Dr. William Ralph Taylor on the North American catfishes, the classification and nomenclature of the group have been materially changed since the preceding edition. On the basis of his first summary comments (Taylor, 1954: 43-44) and his unpublished material the nomenclature, sequence of species, and the key (p. 363) have been fully revised. In anticipating some of his findings I accept responsibility for any errors that may be introduced. It is doubtful whether the name *Ameiurus* Rafinesque is available as a generic name because it was proposed neither as genus nor as subgenus, but as a section of a subgenus. It was ranked as a full genus, spelled *Amiurus*, by Gill in 1860 and is clearly available as of that date. As a result of the recommended amalgamation of *Amiurus* Gill (= *Ameiurus* Rafinesque) with *Ictalurus* Rafinesque (Taylor, 1954) the family name is changed from Ameiuridae to Ictaluridae. *Ictalurus* Rafinesque and *Ameiurus* Rafinesque are of identical date, but the latter was proposed as a division of the former. Therefore Rafinesque clearly qualifies under the rule of the first reviser. *Ictalurus* is adopted as the generic name not only of the larger, fork-tailed catfishes, but of all of the bullheads as well.

All of the madtoms are referred to *Noturus* in line with Taylor's recommendation.

Ictalurus melas (Rafinesque)—black bullhead
Ictalurus nebulosus (LeSueur)—brown bullhead
Ictalurus natalis (LeSueur)—yellow bullhead
Ictalurus punctatus (Rafinesque)—channel catfish. On the name of this species see Speirs (1952).
Ictalurus furcatus (LeSueur)—blue catfish
Noturus gyrinus (Mitchill)—tadpole madtom
Noturus exilis Nelson—slender madtom. Taylor (ms.) will present evidence to show that the name *insignis* should again be applied to the eastern madtom, necessitating a return to *exilis* as the specific name of the slender madtom.
Noturus flavus Rafinesque—stonecat
Pylodictis olivaris (Rafinesque)—flathead catfish. The generic name of the flathead catfish is corrected to agree with Rafinesque's original spelling.

Anguillidae

Anguilla rostrata (LeSueur)—American eel

Cyprinodontidae

Fundulus diaphanus menona Jordan and Copeland—banded killifish
Fundulus notti dispar (Agassiz)—starhead topminnow. I follow Brown (ms.) and Miller (1955) in applying the specific name *notti*. The names *notti* and *dispar* are of identical date but Garman (1895: 120), as first reviser, selected *notti*.
Fundulus notatus (Rafinesque)—blackstripe topminnow
Fundulus sciadicus Cope—plains topminnow

Gadidae

Lota lota (Linnaeus)—burbot. After an investigation of geographic variation in the burbot, Lindsey (in press) concluded that there are inadequate grounds for subspecific delimitation.

Percopsidae

Percopsis omiscomaycus (Walbaum)—trout-perch

Aphredoderidae

Aphredoderus sayanus (Gilliams)—pirate perch

Atherinidae

Labidesthes sicculus (Cope)—brook silverside

Serranidae

In the earlier edition of this work, Bailey (1951: 194) placed the white bass and the yellow bass in the genus *Morone*. This was an expression of the view, to which I still adhere, that the four species of serranids which commonly enter fresh waters of North America should be united into a single genus. In line with the then prevailing decision of the International Commission on Zoological Nomenclature, *Morone* Mitchill was adopted in preference to *Roccus* Mitchill because of page precedence, the names being of identical date. In 1954, Bailey, Winn, and Smith stated this opinion and referred the striped bass to *Morone*.

In doing so, however, they neglected to apply the reinstatement of the principle of choice of the first reviser, a reversal by the International Commission (1953: 66-67) in the procedure to be employed for the selection among names of identical date. Jordan and Gilbert (1883: 528-531) united *Roccus* and *Morone* under the single generic name *Roccus* and apparently qualify thereby as first revisers. For those who adhere to the generic merger it becomes necessary to assign the American species *saxatilis*, *chrysops*, *americanus*, *mississippiensis*, and the European species *labrax* and *punctatus* to the genus *Roccus* Mitchill.

Roccus chrysops (Rafinesque)—white bass
Roccus mississippiensis (Jordan and Eigenmann)—yellow bass. Unfortunately,

the above change in generic name necessitated by the Rules of Nomenclature makes the current specific name of the yellow bass, *interruptus* (Gill), a secondary homonym of *Perca mitchilli interruptus* Mitchill (a synonym of *Roccus saxatilis*) and thereby unavailable. The oldest available name is *Morone mississippiensis* Jordan and Eigenmann.

Centrarchidae

Micropterus dolomieui Lacépède—smallmouth bass. In line with my revised opinion regarding subspecies (p. 328, I no longer regard the form *M. dolomieui velox* Hubbs and Bailey (1940) as nameworthy.

Micropterus salmoides salmoides (Lacépède)—northern largemouth bass

Chaenobryttus gulosus (Cuvier)—warmouth. The Committee on Nomenclature of the American Society of Ichthyologists and Herpetologists has agreed unanimously that the name *Chaenobryttus coronarius* (Bartram) should be dropped because Bartram was not consistently binomial in the work in question, and on this judgment I reapply the long-familiar name *C. gulosus* even though final action is still pending.

Lepomis cyanellus Rafinesque—green sunfish

Lepomis gibbosus (Linnaeus)—pumpkinseed

Lepomis macrochirus Rafinesque—bluegill

Lepomis humilis (Girard)—orangespotted sunfish

Lepomis megalotis peltastes Cope—northern longear sunfish. Throughout most of the range of the longear sunfish the subspecies are not well understood. The form inhabiting the upper Mississippi valley and the Great Lakes, however, differs so sharply from the nominate form of the Ohio valley and south that the retention of the subspecific name *peltastes* seems justified.

Ambloplites rupestris rupestris (Rafinesque)—northern rock bass

Pomoxis annularis Rafinesque—white crappie

Pomoxis nigromaculatus (LeSueur)—black crappie

Percidae

The species placed in the genus *Hadropterus* in the preceding edition are here referred to *Percina* (Bailey, Winn, and Smith, 1954: 139-141).

Stizostedion vitreum vitreum (Mitchill)—walleye

Stizostedion canadense (Smith)—sauger

Perca flavescens (Mitchill)—yellow perch

Percina maculata (Girard)—blackside darter

Percina phoxocephala (Nelson)—slenderhead darter

Percina caprodes semifasciata (DeKay)— northern logperch. This subspecies occurs in northern Iowa. Specimens in the University of Michigan collection from Taylors Slough, adjacent to the Mississippi River near Fort Madison, Lee County, Iowa, are identified as intergrades *(P. caprodes: carbonaria* x *semifasciata)* between the southern and northern subspecies.

Percina evides (Jordan and Copeland)—gilt darter

Percina shumardi (Girard)—river darter

Ammocrypta asprella (Jordan)—crystal darter. The crystal darter is well separated structurally from the other sand darters, but its closest relationship lies in this group. On the premise that the primary function of generic classification is to facilitate the expression of relationship, the placement of *asprella* in *Ammocrypta* seems called for. *Crystallaria* may be retained as a subgenus for the sole inclusion of *asprella;* the species *vivax, pellucida, clara,* and *beani* may be referred to the nominate subgenus, as was done by Bailey and Gosline (1955).

Ammocrypta clara Jordan and Meek—western sand darter

Etheostoma nigrum Rafinesque—Johnny darter. Since the races of Johnny darters inhabiting the northcentral states have somewhat different habitats, they have been regarded as ecological rather than geographical subspecies.

Actually they are geographic forms but the distribution pattern is complex, both historically and at present, as demonstrated by Greene (1935: 174-181). The two forms do not live together although they intergrade freely in areas to which both types have free access. In Iowa relatively pure populations of *eulepis* occur only in Clear Lake and the Dickinson County lakes; intergrading populations are rather widespread in northern Iowa and all along the Mississippi River (an extension of the Wisconsin area noted and mapped by Greene); and typical *nigrum* occurs elsewhere in the state. Greene postulated a Pleistocene *refugium* for *eulepis* in the Driftless Area of Wisconsin, but this argument loses force now that it is known that typical populations of *eulepis* occur in central and southwestern Missouri.

E. n. nigrum Rafinesque—central Johnny darter
E. n. eulepis (Hubbs and Greene)—scaly Johnny darter

Etheostoma chlorosomum Hay—bluntnose darter
Etheostoma zonale (Cope)—banded darter
Etheostoma asprigene (Forbes)—mud darter
Etheostoma caeruleum Storer—rainbow darter
Etheostoma exile (Girard)—Iowa darter
Etheostoma spectabile spectabile (Agassiz)—northern orangethroat darter
Etheostoma flabellare lineolatum (Agassiz)—striped fantail darter
Etheostoma microperca Jordan and Gilbert—least darter

Sciaenidae

Aplodinotus grunniens Rafinesque—freshwater drum

Cottidae

Cottus cognatus Richardson—slimy sculpin

Gasterosteidae

Eucalia inconstans (Kirtland)—brook stickleback

ADDITIONAL FISHES WHICH MAY OCCUR IN IOWA

In the author's experience hypothetical lists have a poor record for accuracy in prediction. Nevertheless, knowledge of which among the undiscovered species in an area are most likely to be present is apt to stimulate search for them and to facilitate their capture. The list given here could be greatly lengthened but as presented it includes only those species which seem to have a reasonably good possibility of occurrence.

Ichthyomyzon fossor Reighard and Cummins—northern brook lamprey. Should be sought in eastern Iowa during the spring spawning period.

Lepisosteus spatula Lacépède—alligator gar. There is a good possibility that this species occurred in the Mississippi River near Keokuk long ago (it has been reported from above St. Louis), but it is doubtless extinct in Iowa now.

Lepisosteus productus (Cope)—spotted gar. Of possible occurrence in northern or eastern Iowa. This species resembles the shortnose gar but has larger scales (in fewer than 60 rows along body) and is boldly spotted.

Erimyzon oblongus claviformis (Girard)—creek chubsucker. This form should be looked for in quiet-water areas in eastern Iowa.

Moxostoma valenciennesi Jordan—greater redhorse. A potential addition to the Iowa list, this redhorse is apt to occur in the Mississippi River in northeastern Iowa.

Notropis cornutus chrysocephalus (Rafinesque)—central common shiner. This subspecies, which has larger predorsal scales than the northern common shiner, may replace that form near the Missouri border in southeastern or southwestern Iowa.

Notropis anogenus Forbes—pugnose shiner. This species probably occurred in the past in clear, weedy water in northern Iowa, and may yet be discovered there.

Noturus nocturnus Jordan and Gilbert—freckled madtom. Because it lives in northeastern Missouri, this species is of likely occurrence in southeastern Iowa.

Fundulus kansae (Garman)—plains killifish. This plains species has been taken in northwestern Missouri and should be looked for in southwestern Iowa.

Gambusia affinis affinis (Baird and Girard)—western gambusia. A species which is apt to be found in southeastern Iowa. It may turn up in Iowa as an introduction for the purpose of mosquito control.

Micropterus punctulatus punctulatus (Rafinesque)—spotted bass. A common species in Missouri and southern Illinois, the spotted bass may be present in southeastern Iowa.

Etheostoma spectabile pulchellum (Girard)—plains orangethroat darter. This inhabitant of the Great Plains may occur in southwestern Iowa.

Cottus bairdi Girard—mottled sculpin. One of the most likely species for addition to the state list, the mottled sculpin should be sought in trout streams in northeastern Iowa. It resembles the slimy sculpin but has palatine teeth, unlike *cognatus*, and usually has I, 4 pelvic rays instead of I, 3.

KEYS FOR THE IDENTIFICATION OF IOWA FISHES

The keys here presented are basically dichotomous; that is, the reader is confronted with two alternatives (*a* and *b*) at a time and makes a choice, then chooses again between two sets of opposed characters, and continues until the name of the species is reached. Item 8 in the family key involves decision from among 3 possible choices (*a*, *b*, or *c*). The contrasting characters in each couplet are always indicated by the same number (for example *3a* and *3b*), and it is emphatically urged that users of the keys read both of the opposed characters before making a decision and proceeding.

Those who have never used keys of this sort may at first experience difficulties, but practice in "running" the keys will improve speed and accuracy. Insofar as possible the characters emphasized are external structures; internal

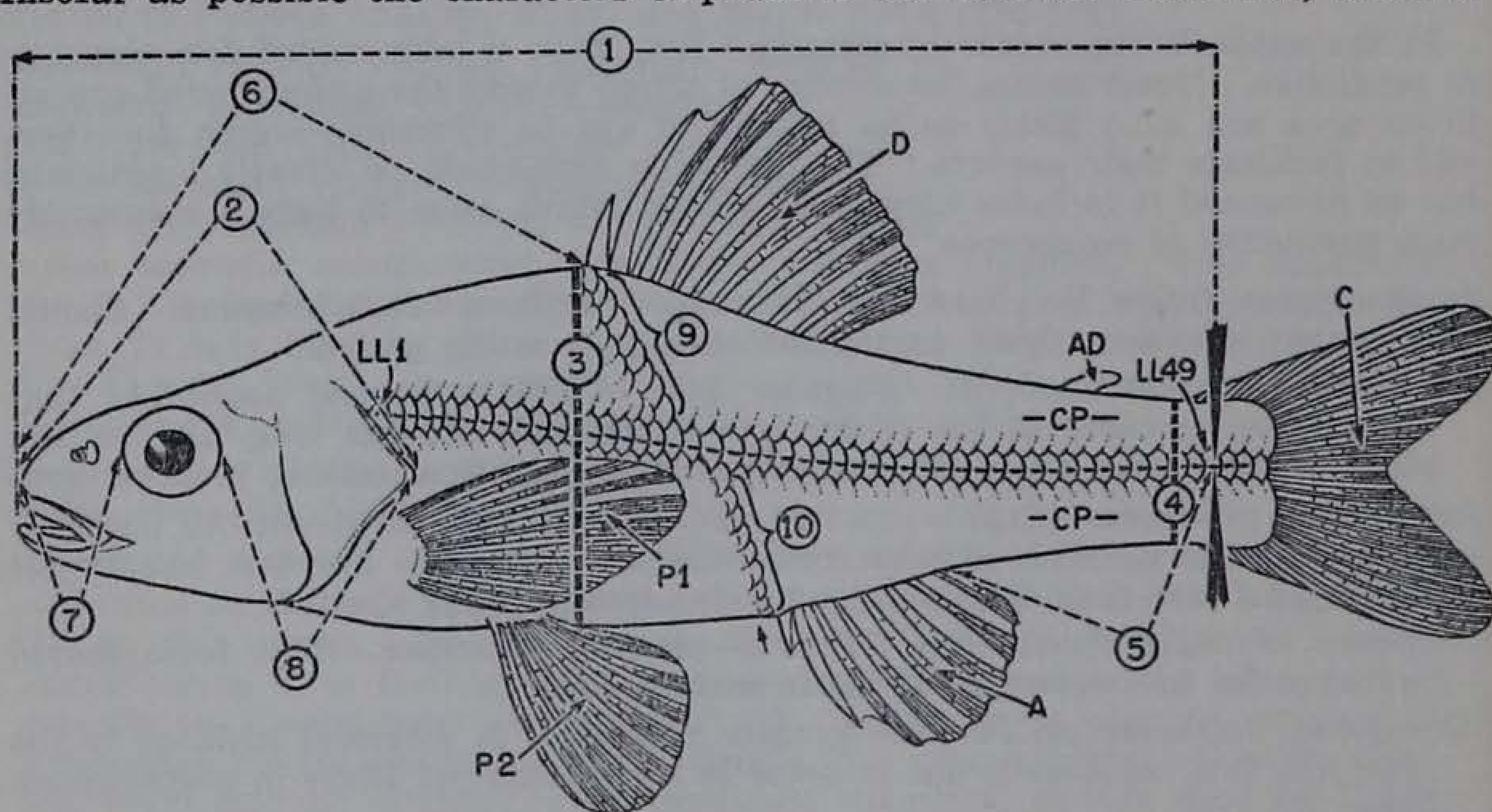


Fig. 1. Topography of a fish to show the location of structures and regions used in identification and how certain measurements are made.
A., anal fin; AD., adipose fin; C., caudal fin; CP., caudal peduncle; D., dorsal fin; LL1, first scale in lateral line; LL49, last scale in lateral line to be counted; P1, pectoral fin; P2, pelvic fin. 1, standard length; 2, head length (to tip of membrane); 3, body depth; 4, least depth of caudal peduncle; 5, length of caudal peduncle; 6, predorsal length; 7, snout length; 8, postorbital length of head; 9, scales above lateral line; 10, scales below lateral line.

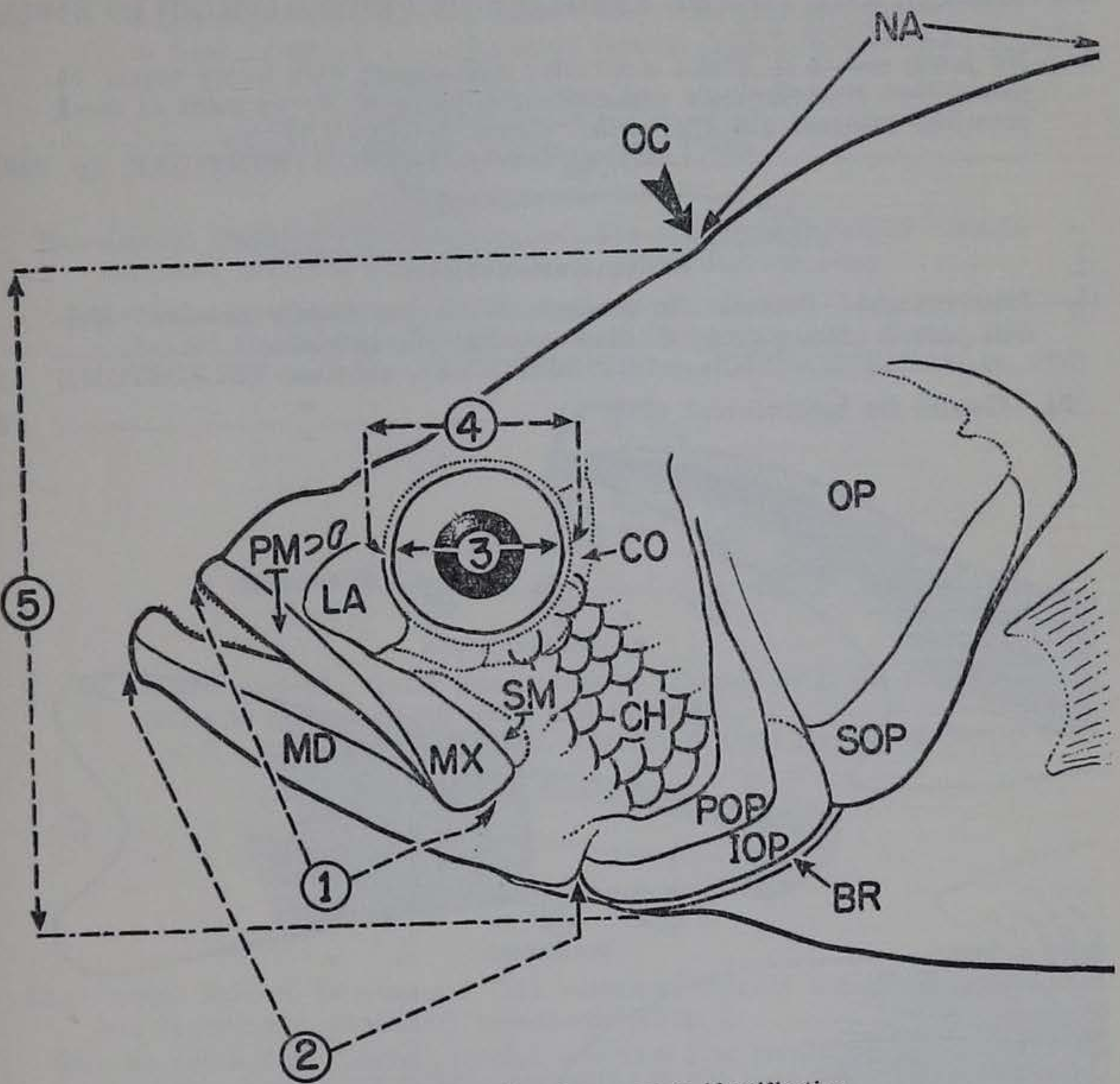


Fig. 2. Head of a fish to show structures and regions used in identification.
BR., branchiostegal ray; CH., cheek; CO., circumorbital; IOP., interopercle; LA., lacrymal (or preorbital): MD., mandible; MX., maxilla; NA., nape; OC., occiput; OP., opercle; PM., premaxilla; POP., preopercle; SM., supramaxilla; SOP., subopercle. 1, length of upper jaw; 2, length of mandible; 3, diameter of eye; 4, diameter of orbit; 5, depth of head.

features are subordinated. It appears impractical, however, to attempt identification of minnows without recourse to examination of pharyngeal teeth (see p. 373 and Fig. 5). For small fish the use of a good hand lens or a low-power dissecting microscope is almost indispensable.

The accompanying illustrations and glossary of terms (pp. 370 to 374) will aid greatly in gaining familiarity with the terminology and procedures involved in identifying fish with the keys. If two measurements are compared, one is "stepped" with dividers (calipers) into the other. For example, the expression "snout 2.1 to 2.5 in postorbital length of head" means that the length of the snout (7 in Fig. 1) if "stepped" with dividers is contained from 2.1 to 2.5 times in the distance from the back of the orbit to the back of the head (8 in Fig. 1).

An unknown fish is first run to the proper family in the initial key. If there is only a single species in that family the reader is directed to the proper page in the check-list for the species' name. If there are two or more species in a family a page reference to the next key is provided. After an identification has been made the reader should refer to the amplified account of that species given elsewhere in this volume.

ARTIFICIAL KEY TO THE FAMILIES OF FISHES FOUND IN IOWA[3]

1a.—No jaws; mouth in adults a circular disc armed with horny teeth. No paired fins. Nostril single and median in position. Seven pairs of small, pore-like external gill apertures. (Class AGNATHA)..Lamprey family, PETROMYZONTIDAE, (p. 348)

PETROMYZONTIDAE

1b.—Jaws present. Pectoral fin present; pelvic fin usually present. Nostrils paired. One pair of slit-like external gill apertures..(Class OSTEICHTHYES, subclass TELEOSTOMI) 2

2a.—Caudal fin heterocercal (Fig. 3).. 3

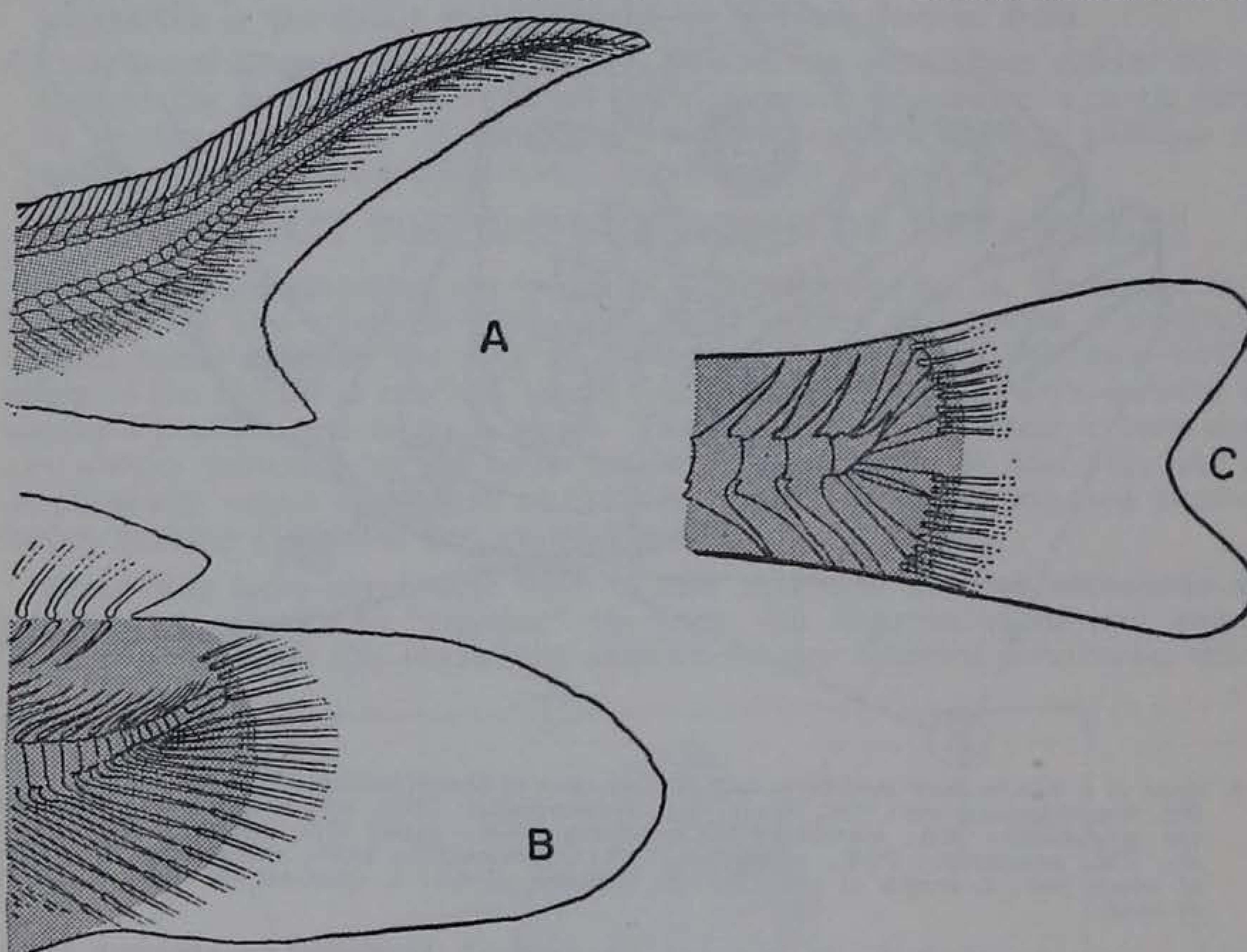
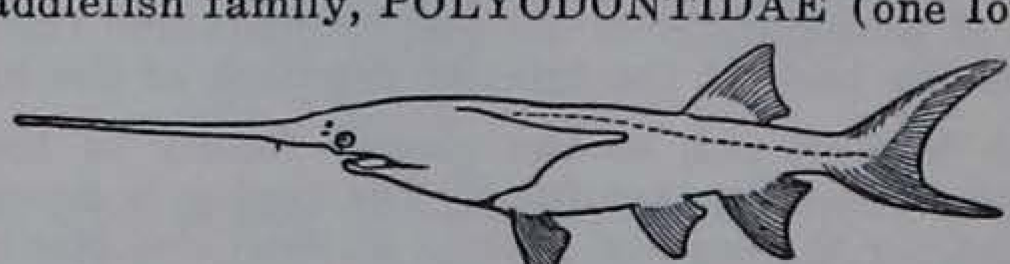


Fig. 3. Three types of caudal (tail) fins. A., typically heterocercal fin of sturgeon. B., abbreviate heterocercal fin of bowfin. C., homocercal fin typical of most bony fishes.

3a.—Caudal fin strongly heterocercal, emarginate, the lower lobe well developed. Mouth inferior, shark-like. Jaws almost or quite toothless. Endoskeleton largely cartilaginous... 4

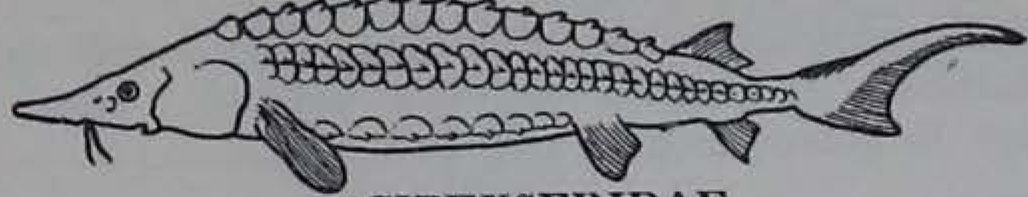
4a.—Body not armored. Snout greatly depressed and expanded laterally, paddle-like, with two tiny barbels on lower surface.........................Paddlefish family, POLYODONTIDAE (one Iowa species, p. 329)



POLYODONTIDAE

[3]The characters here ascribed to families are believed to be valid for all species living in Iowa but do not always hold for extralimital forms.

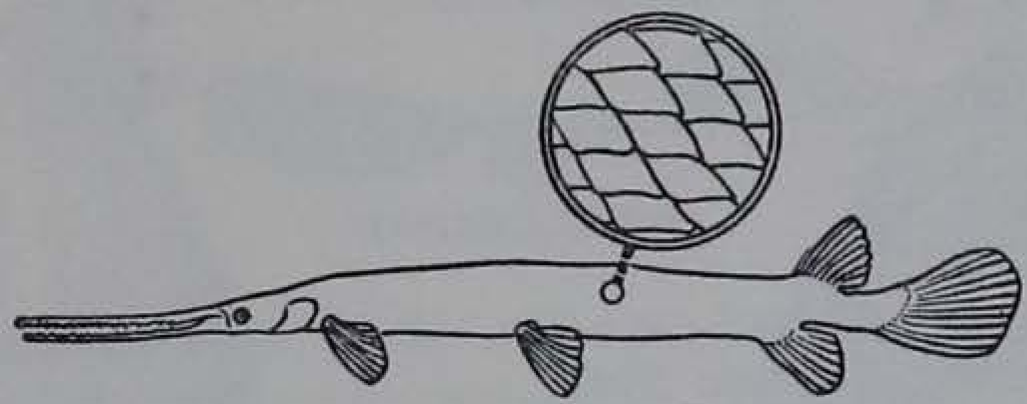
4b.—Body with several longitudinal series of strong bony plates. Snout relatively short, not paddle-like, with four elongate barbels in front of mouth............Sturgeon family, ACIPENSERIDAE (p. 348)



ACIPENSERIDAE

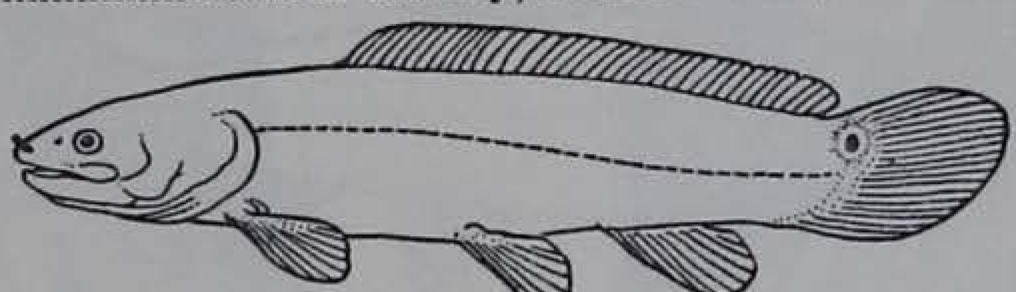
3b.—Caudal fin abbreviate-heterocercal, the fin rounded behind. Mouth terminal, the jaws strongly toothed. Endoskeleton bony.................... 5

5a.—**Scales ganoid (see cut). No gular plate. Dorsal short, it origin** behind that of anal. Snout produced into an elongate beak............ ....Gar family. LEPISOSTEIDAE (p. 350)



LEPISOSTEIDAE

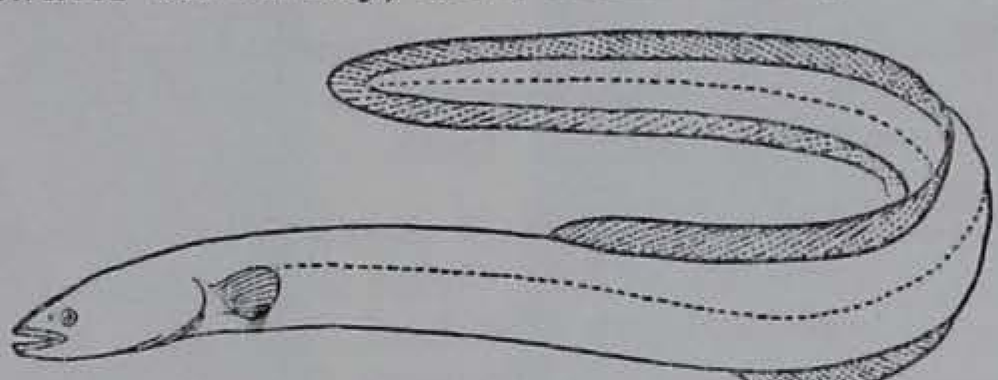
5b.—Scales cycloid. Gular plate present. Dorsal long, its origin anterior to pelvic. Snout blunt and rounded... ....Bowfin family, AMIIDAE (one Recent species, p 330)



AMIIDAE

2b.—Caudal fin not heterocercal (the vertebral column not bent upward into upper lobe), commonly homocercal (Fig. 3)...................................... 6

6a.—No pelvic fins. Dorsal, caudal, and anal fins continuous.................... ....Freshwater eel family, ANGUILLIDAE (one Iowa species, p. 335)



ANGUILLIDAE

6b.—Pelvic fin present (rarely absent in abnormal individuals). Dorsal, caudal, and anal fins separate.. 7

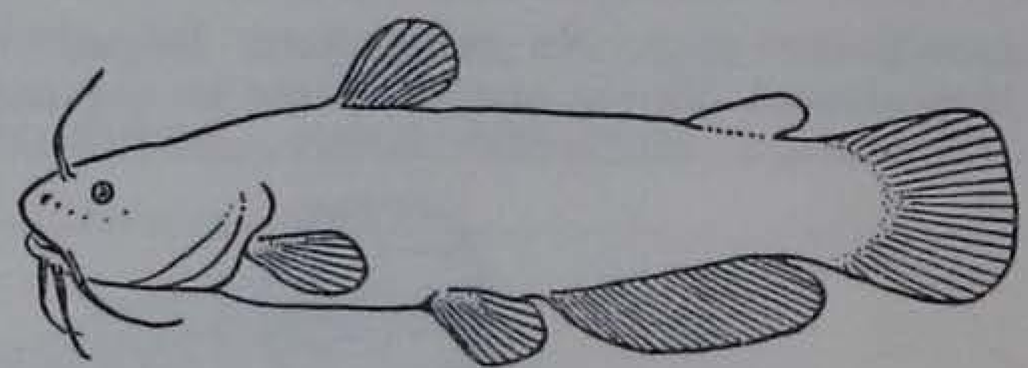
7a.—Pelvic fin jugular, placed in advance of pectoral fin, with 6 or 7 soft rays. A well-developed, median chin barbel. Two dorsal fins, each composed of soft rays.. ....Codfish family, GADIDAE (one Iowa species, p. 335)

GADIDAE

7b.—Pelvic fin thoracic or abdominal, placed below or behind pectoral fin. No single median chin barbel. Dorsal fin single or, if double, both parts not composed of soft rays........ 8

8a.[4]—Pelvic fin without spine, with more than 5 soft rays, abdominal in position. Scales, if present, cycloid. Anal fin spineless (except in introduced cyprinids)........ 9

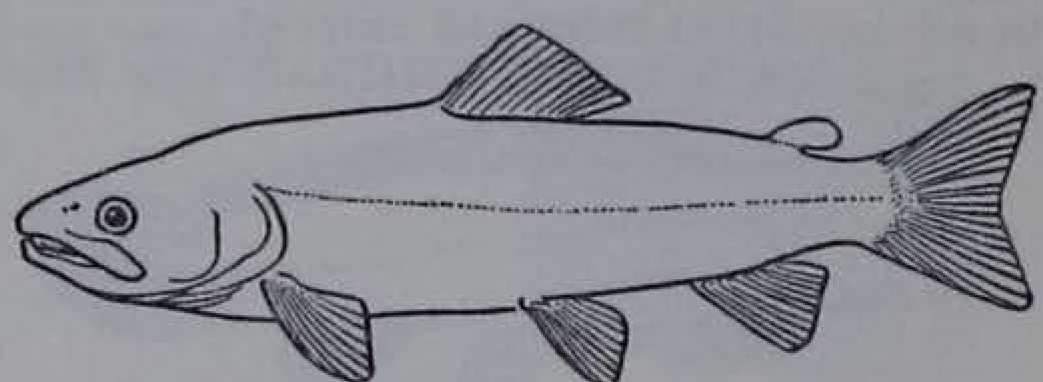
9a.—Pectoral fin with a spine. Body scaleless. Lower jaw with 4 long barbels........Catfish family, ICTALURIDAE (p. 363)



ICTALURIDAE

9b.—Pectoral fin without spine. Body normally with scales. No barbels on lower jaw........ 10

10a.—Adipose fin present........Trout family, SALMONIDAE (p. 351)



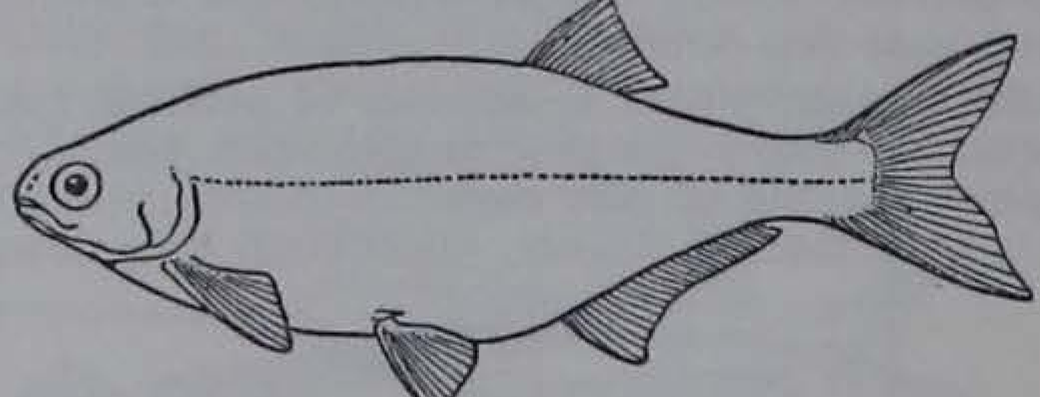
SALMONIDAE

10b.—No adipose fin........ 11

11a.—Head scaleless........ 12

12a.—Branchiostegal membranes free from isthmus; gill slit extended forward to below eye (Fig. 4). Jaws with or without teeth........ 13

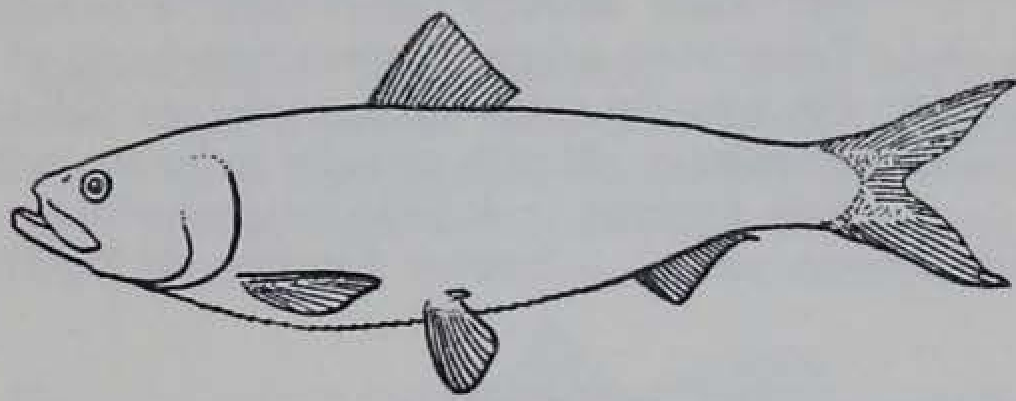
13a.—Lateral line well developed. Gillrakers few, short and knob-like. Gular fold present. Midline of belly without saw-like keel........
........Mooneye family, HIODONTIDAE (p. 351)



HIODONTIDAE

[4]Three alternatives are listed under item 8. Utilize *all* characters provided.

13b.—No lateral line. Gillrakers numerous, long and slender. No gular fold. Scales along midline of belly modified to form a saw-like keel...Herring family, CLUPEIDAE (p. 351)



CLUPEIDAE

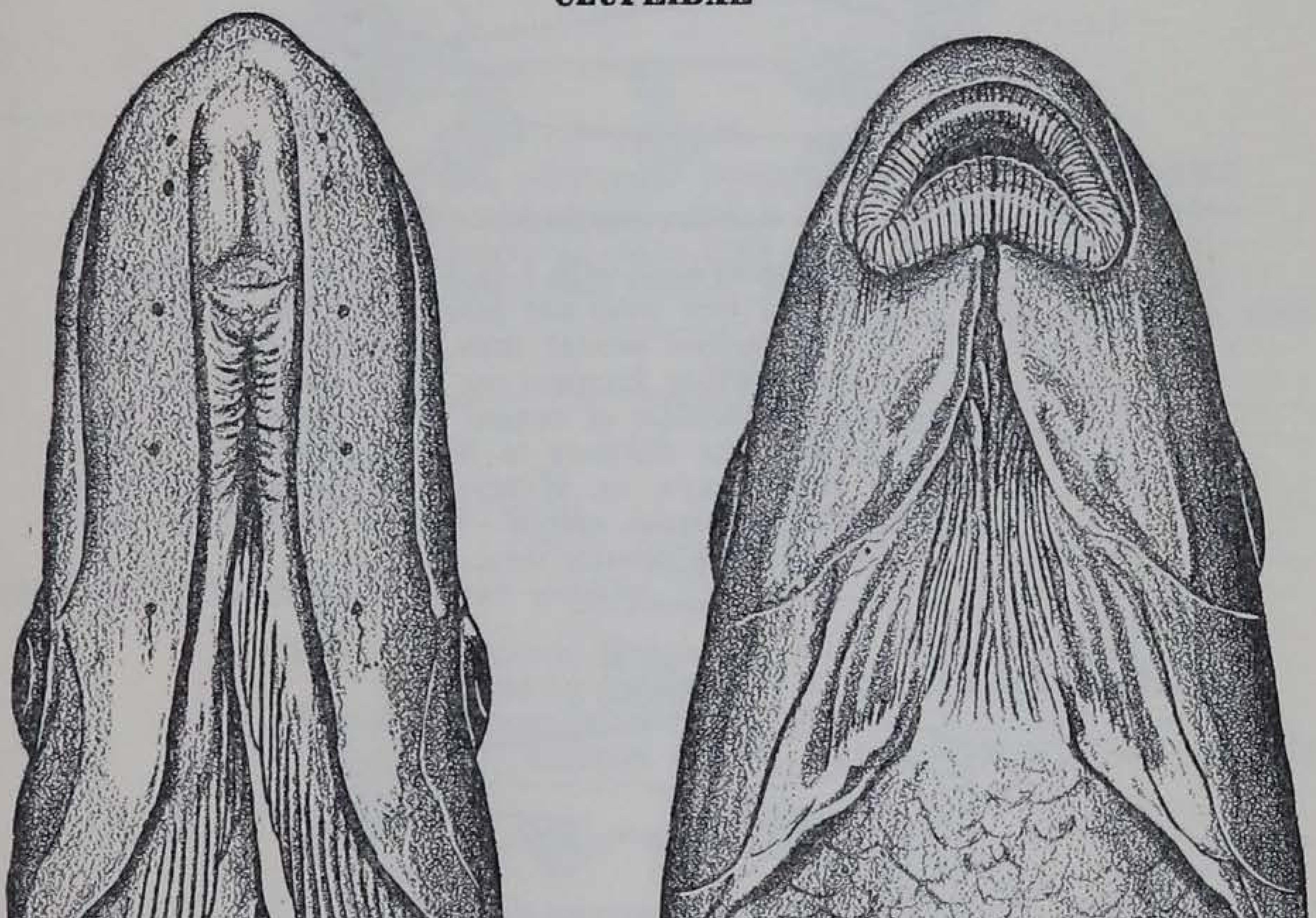
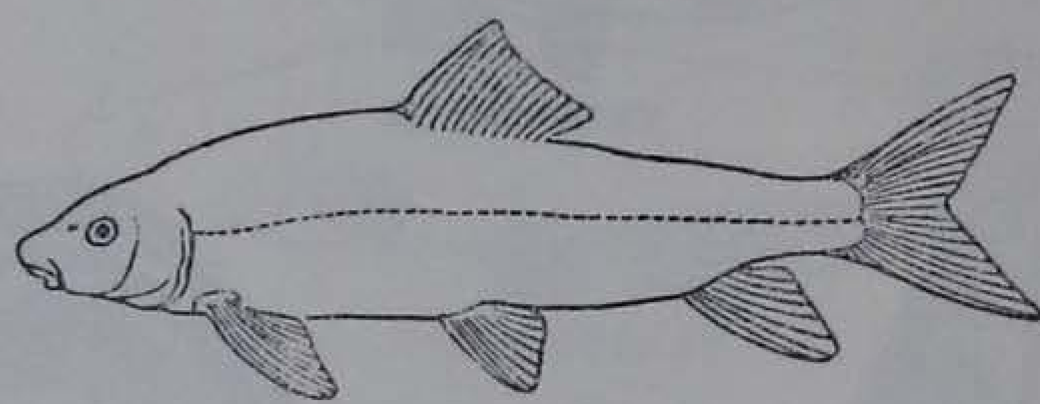


Fig. 4. Uudersurface of heads of northern pike, *Esox lucius* (left) and golden redhorse *Moxostoma erythrurum*. In the pike the branchiostegal membranes are separate and are not attached to the isthmus; in the sucker the membranes are attached to one another and are joined to the isthmus. Note also the series of five mandibular pores on each side in the pike, and the plicate lips of the redhorse.

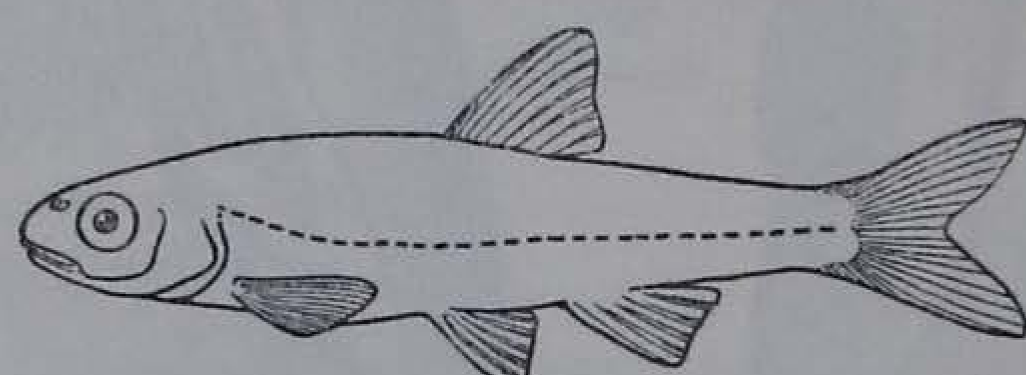
12b.—Branchiostegal membranes united to isthmus and broadly conjoined, the gill slit not extended forward beyond vertical arm of preopercle (Fig. 4). Jaws toothless **14**

14a.—Pharyngeal arch with a single, long, comb-like row of more than 20 teeth (Fig. 5, A and B). Principal caudăl rays typically 18. Anal fin placed well back on body, distance from its origin to middle of caudal base usually less than one-half the distance from anal origin forward to back of head. Dorsal fin usually with 10 or more principal rays, always spineless. Mouth usually inferior, with thick fleshy lips (except in *Ictiobus cyprinellus*) ....Sucker family, CATOSTOMIDAE (p. 352)



CATOSTOMIDAE

14b.—Pharyngeal arch with 1 to 3 short rows of teeth, the principal row with not more than 6 teeth (Fig. 5, C). Principal caudal rays typically 19. Anal fin placed farther forward on body, distance from its origin to middle of caudal base usually more than one-half the distance to head. Dorsal fin with 9 or fewer rays, or, if more numerous, with well-developed dorsal spines. Mouth variable in position, the lips usually thin..Minnow family, CYPRINIDAE (p. 355)



CYPRINIDAE

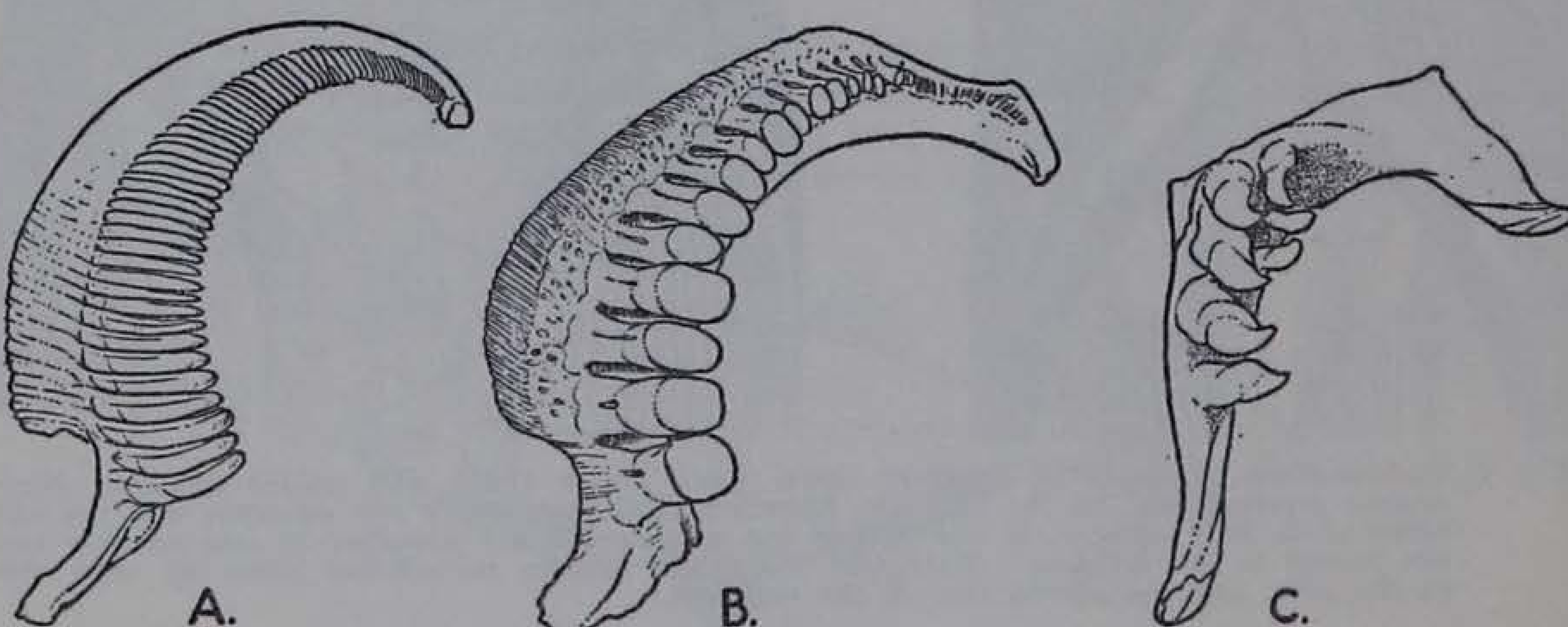
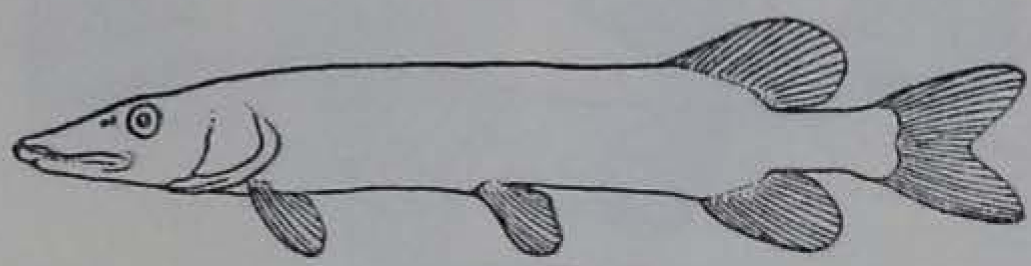


Fig 5. Left pharyngeal arches of two suckers and a minnow. A., golden redhorse, *Moxostoma erythrurum*, with many fragile teeth in a single row on a light arch. B., river redhorse, *Moxostoma carinatum*, with many molariform teeth in a single row on a heavy arch. C., creek chub, *Semotilus atromaculatus*, with hooked teeth in two rows, five in the main series and two in the lesser row.

11b.—Head partly scaled.. 15

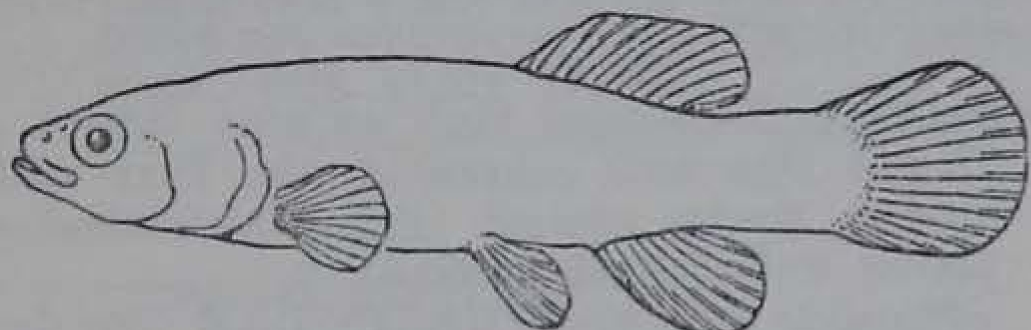
15a.—Premaxillae not protractile (the upper jaw bound to snout by a bridge of skin). Margin of upper jaw formed by premaxilla and maxilla.................................. 16

16a.—Canine teeth present. Jaws moderately produced into a broad, duck-like snout. Branchiostegal rays 11 to 19. Caudal fin forked. Transverse scale rows more than 100.. ....Pike family, ESOCIDAE (p. 352)



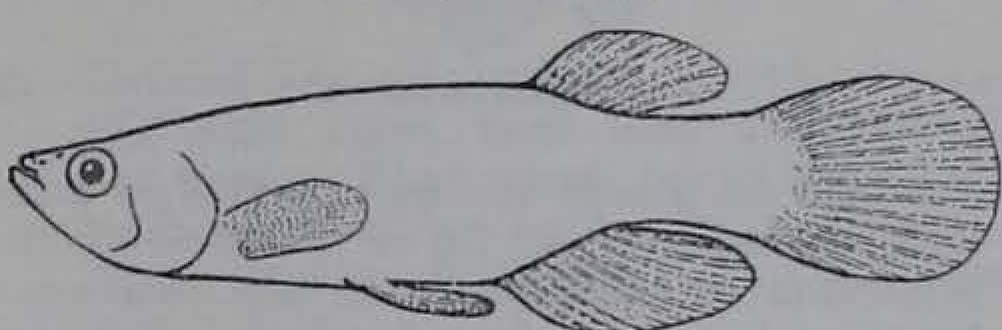
ESOCIDAE

16b.—Teeth villiform. Snout short and bluntly rounded. Branchiostegal rays 3 to 6. Caudal fin rounded. Transverse scale rows about 35.................................... Mudminnow family, UMBRIDAE ....(one Iowa species, p. 330)



UMBRIDAE

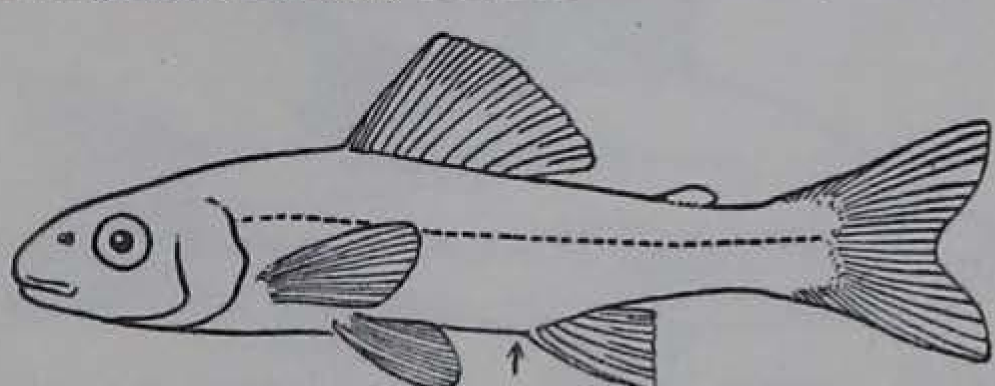
15b.—Premaxillae protractile (the upper jaw and snout separated by a groove). Margin of upper jaw formed by premaxilla only... ....Killifish family, CYPRINODONTIDAE (p. 365)



CYPRINODONTIDAE

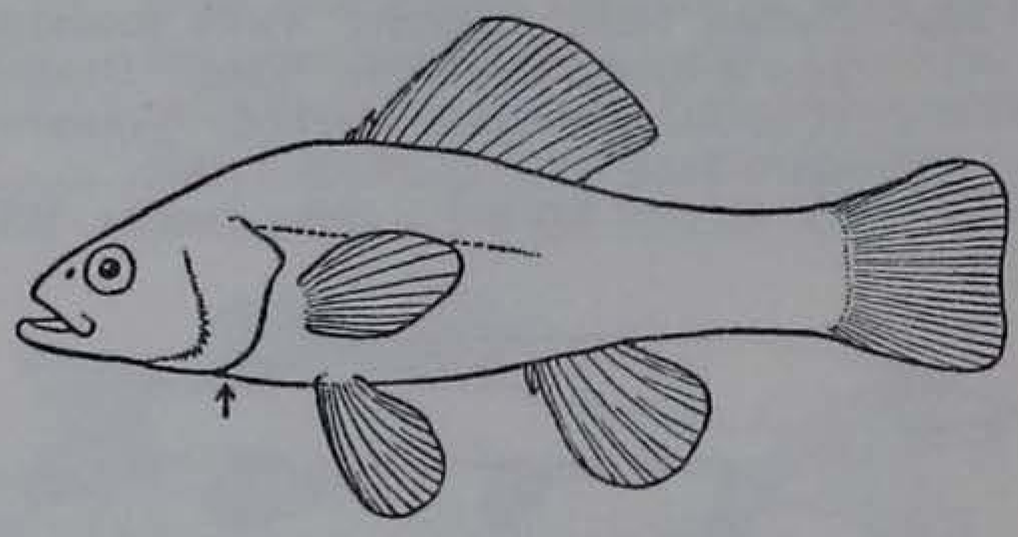
8b.'—Pelvic fin with a minute, splint-like spine and 7 or 8 soft rays; subabdominal or subthoracic in position. Scales strongly ctenoid. Anal fin with 1 to 3 spines... 17

17a.—Adipose fin present. Anus (arrow in cut) located just in front of anal fin. Preopercle and lachrymal almost entire. Trout-perch family, PERCOPSIDAE (one Iowa species, p. 335)



PERCOPSIDAE

17b.—No adipose fin. Anus (arrow in cut) in front of pelvic fin except in young. Preopercle and lachrymal strongly serrate ....Pirate perch family, APHREDODERIDAE ....(one Recent species, p. 335)

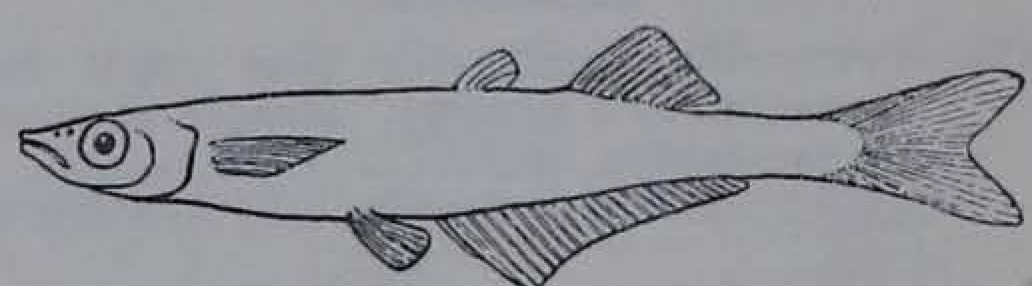


APHREDODERIDAE

8c.[4]—Pelvic fin with a well-developed spine (embedded in Cottidae) and 5 or fewer soft rays; usually thoracic in position (abdominal or subthoracic in Atherinidae). Scales, if present, usually ctenoid. Anal fin usually with 1 to 9 spines (none in Cottidae) 18

18a.—Pelvic fin with a spine and 5 soft rays. Body covered with scales 19

19a.—Pectoral fin placed high on side (above axis of body). Dorsal fins well separated, the first with only 4 or 5 spines. Scales cycloid. Pelvic abdominal or subthoracic, placed well behind pectoral.. Silverside family, ATHERINIDAE (one Iowa species, p. 335)

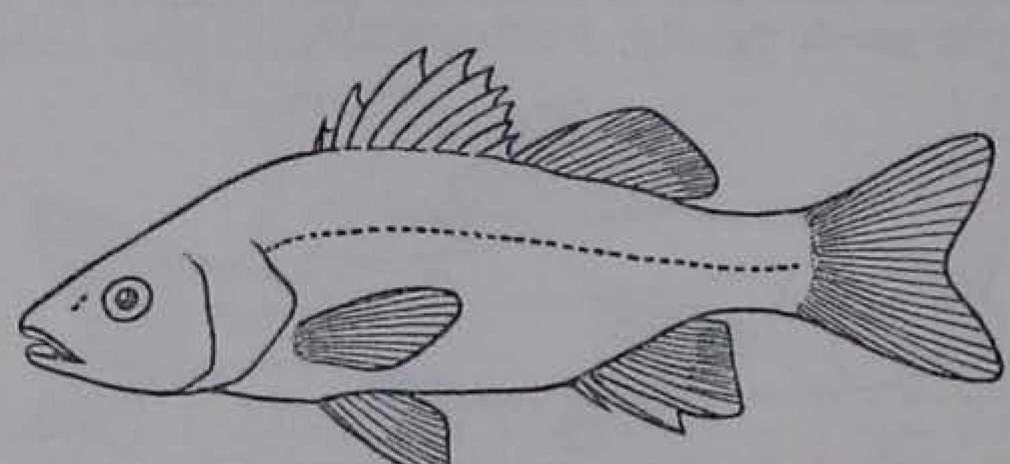


ATHERINIDAE

19b.—Pectoral fin placed low on side (below axis of body). Usually a single dorsal fin or two fins which are not widely separated at their bases; if the fins are well separated the first has more than 5 spines. Scales ctenoid. Pelvic thoracic, placed below or scarcely behind pectoral................ 20

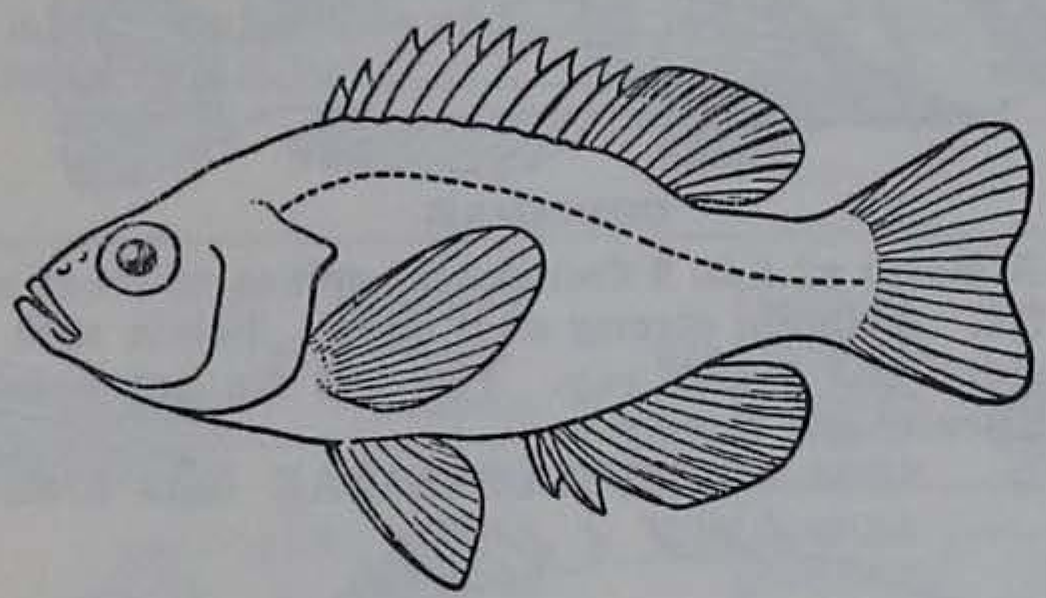
20a.—Anal spines 3 or more.. 21

21a.—Pseudobranchium well developed, exposed. Opercle with a spine. Anal spines 3.. ....Bass family, SERRANIDAE (p. 365)



SERRANIDAE

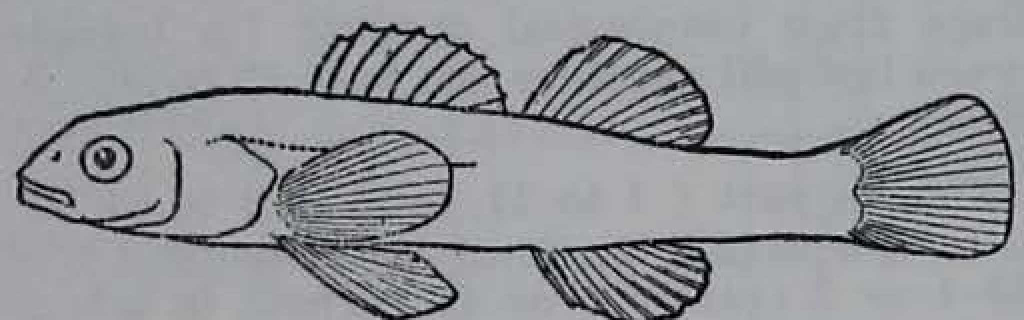
21b.—Pseudobranchium small and concealed by a membrane or wholly absent. Opercle without a developed spine, Anal spines 3 or more..Sunfish family, CENTRARCHIDAE (p. 365)



CENTRARCHIDAE

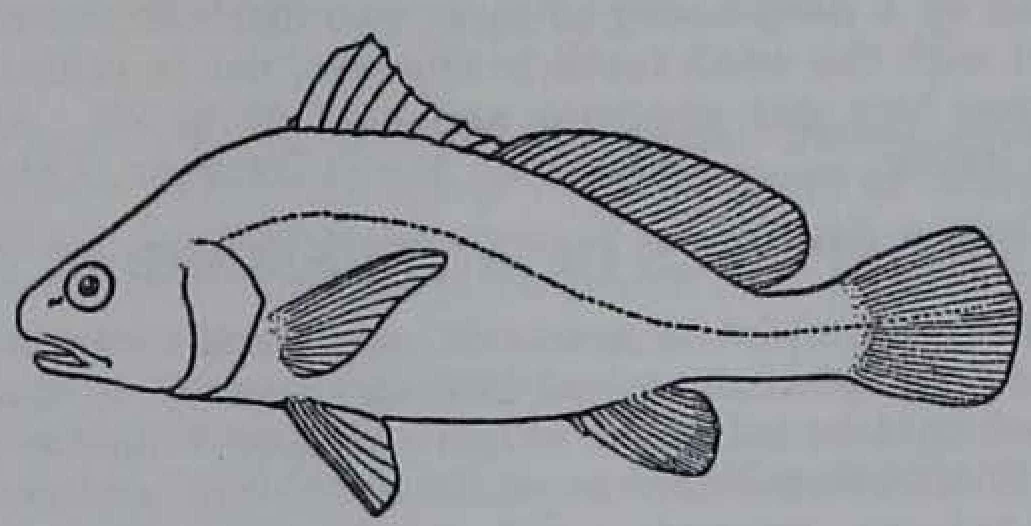
20b.—Anal spines 1 or 2.. 22

22a.—Lateral line not extending far onto caudal fin. Second anal spine, if present, slender, not very long. Head bones not cavernous. Pharyngeal bones slender, separate, with sharp teeth...Perch family, PERCIDAE (p. 367)



PERCIDAE

22b.—Lateral line extending well back onto caudal fin. Second anal spine very long and stout. Head bones cavernous. Pharyngeal bones broad and heavy, fused, with blunt molar teeth..Drum family, SCIAENIDAE (one Iowa species, p. 337)

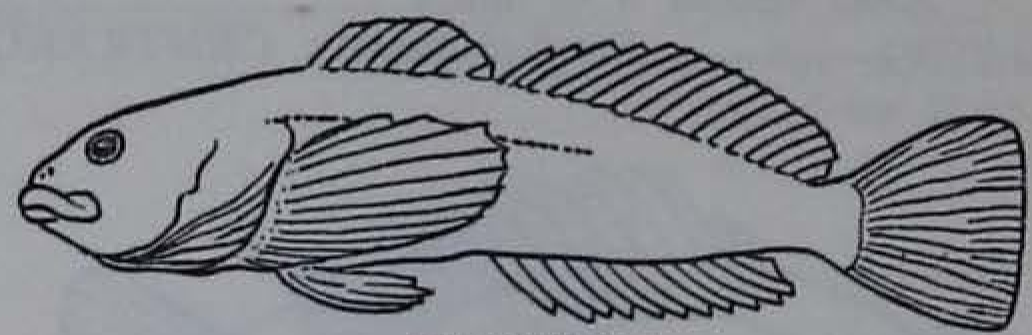


SCIAENIDAE

18b.—Pelvic fin with a spine and 1 to 4 soft rays. Body naked or with prickles 23

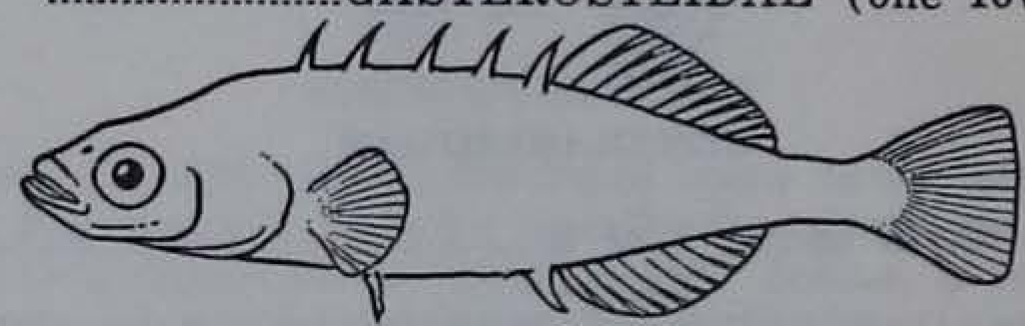
23a.—No free dorsal spines. No anal spine. Pelvic with an embedded spine and 3 or 4 soft rays. Pectoral fin large and

expansive ....
............Sculpin family, COTTIDAE (one Iowa species, p. 337)



COTTIDAE

23b.—A series of 4 to 6 free dorsal spines in front of soft dorsal fin. A single strong anal spine. Pelvic with a prominent spine and 1 soft ray. Pectoral fin not notably enlarged Stickleback family ....
........................GASTEROSTEIDAE (one Iowa species, p. 337)



GASTEROSTEIDAE

KEY TO THE SPECIES OF PETROMYZONTIDAE (Lampreys)

1a.—Dorsal fin single, sometimes emarginate but never divided into two distinct fins. Buccal funnel with rows of well-developed horny teeth radiating outward from esophageal opening (in transformed adults). Myomeres between last gill aperture and vent 47 to 56. Adults (in Iowa species) parasitic .... **Ichthyomyzon** **2**

2a.—Circumoral teeth in part (1 to 11, usually 6 to 8) bicuspid. Transverse lingual lamina usually moderately to strongly bilobed. Supraoral cusps usually 1 or 2 (rarely 3 or 4). Teeth in lateral rows 5 to 8 (usually 6 or 7). Teeth in anterior row 2 to 4 (usually 3).....................
....Silver lamprey, **Ichthyomyzon unicuspis**

2b.—Circumoral teeth (with rare exception) all unicuspid. Transverse lingual lamina usually linear or weakly bilobed. Supraoral cusps 2 or 3. Teeth in lateral rows 6 to 11 (usually 8 or 9). Teeth in anterior row 3 to 5 (usually 4 or 5)...
....Chestnut lamprey, **Ichthyomyzon castaneus**

1b.—Dorsal divided by a deep notch to form two distinct but contiguous fins. Buccal funnel with the weak teeth in clusters, not in radiating rows. Myomeres between last gill aperture and vent 63 to 70. Adults (in Iowa species) free living................American brook lamprey, **Lampetra lamottei**

KEY TO THE SPECIES OF ACIPENSERIDAE *(Sturgeons)*

1a.—Caudal peduncle incompletely armored, short and compressed, its length from posterior end of anal to last lateral scute much less than distance from origin of anal to insertion of pelvic. Snout narrower and deeper, more or less blunt and rounded in adults. Spiracle and pseudobranchium present. Accessory opercular gill enormously developed, extending along entire inner face of operculum. Gillrakers on outer face of first arch simple. Posterior nostril smaller than eye. Barbels not fringed. Lower lip with two non-papillose lobes. Caudal fin without filament......
....Lake sturgeon, **Acipenser fulvescens**

1b.—Caudal peduncle completely armored, long and much depressed, its width about twice its depth and its length much more than distance from origin of anal to insertion of pelvic. Snout greatly expanded and depressed, "shovel-like." No spiracle or pseudobranchium. Accessory opercular gill small, with only about 20 filaments. Gillrakers on outer face of first arch fan-shaped, mostly bifid or multifid. Posterior nostril much larger than eye. Barbels coarsely fringed. Lower lip with four papillose lobes. Upper lobe of caudal produced into an elongate filament (often injured in adults).. **Scaphirhynchus** 2

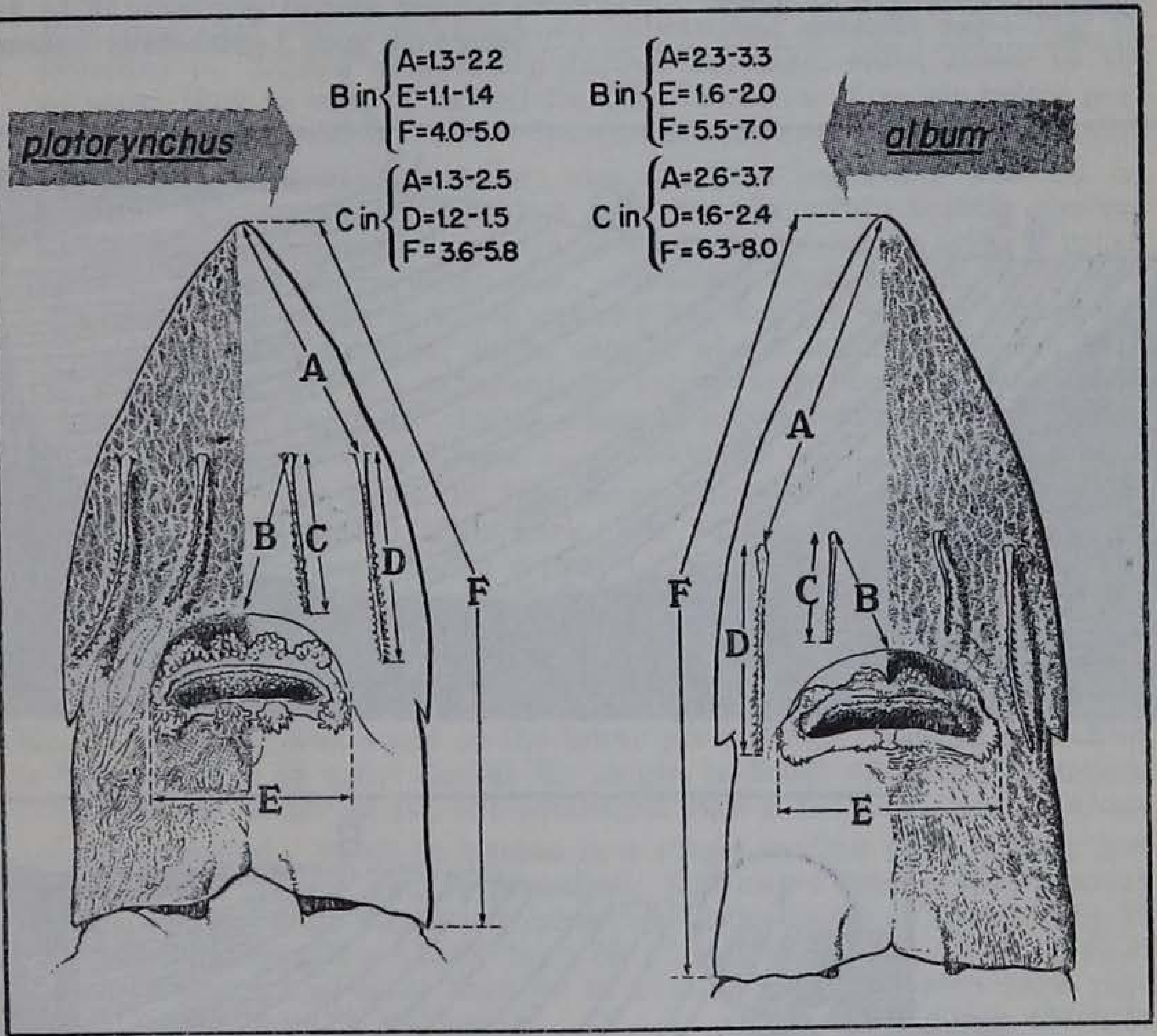


Fig. 6. Comparative diagrams of the lower surface of the head in the shovelnose (*Scaphirhynchus platorynchus*) and pallid (*S. album*) sturgeons, showing several measurement ratios of value for identification (from Bailey and Cross, 1954).

2a.—Belly covered with a mosaic of dermal plates (except in young). Bases of outer barbels in a line with or ahead of inner barbels. Inner barbel heavily fringed and longer (Fig. 6). All barbels placed farther forward on snout. Gillrakers on lower half of first arch mostly with 3 or 4 blunt points. Dorsal fin rays 30 to 36; anal fin rays 18 to 23. Lateral plates larger; eye larger; snout blunter; color darker. Size smaller, maximum weight about 5 pounds, usually much less..Shovelnose sturgeon, **Scaphirhynchus platorynchus**

2b.—Belly largely naked at all ages. Bases of outer barbels lying behind inner barbels. Inner barbel weakly fringed and short (Fig. 6). All barbels placed farther back on snout. Gillrakers on lower half of first arch more fanlike, mostly with 2 blunt tips. Dorsal rays 37 to 43; anal rays 24 to 28. Lateral plates smaller; eye smaller; snout sharper; color more pallid. Size larger, maximum weight over 30 pounds..Pallid sturgeon, **Scaphirhynchus album**

KEY TO THE SPECIES OF LEPISOSTEIDAE (Gars)

1a.—Snout short and broad, its least width contained about 5 to 7 times in its length (except in young). Interorbital width about 1.7 in postorbital length of head. Scale rows around caudal peduncle 26 to 30..Shortnose gar, **Lepisosteus platostomus**

1b.—Snout long and narrow, its least width contained about 12 to 20 times in its length (except in young). Interorbital width usually about 2.0 in postorbital length of head. Scale rows around caudal peduncle 19 to 24 ....Longnose gar, **Lepisosteus osseus**

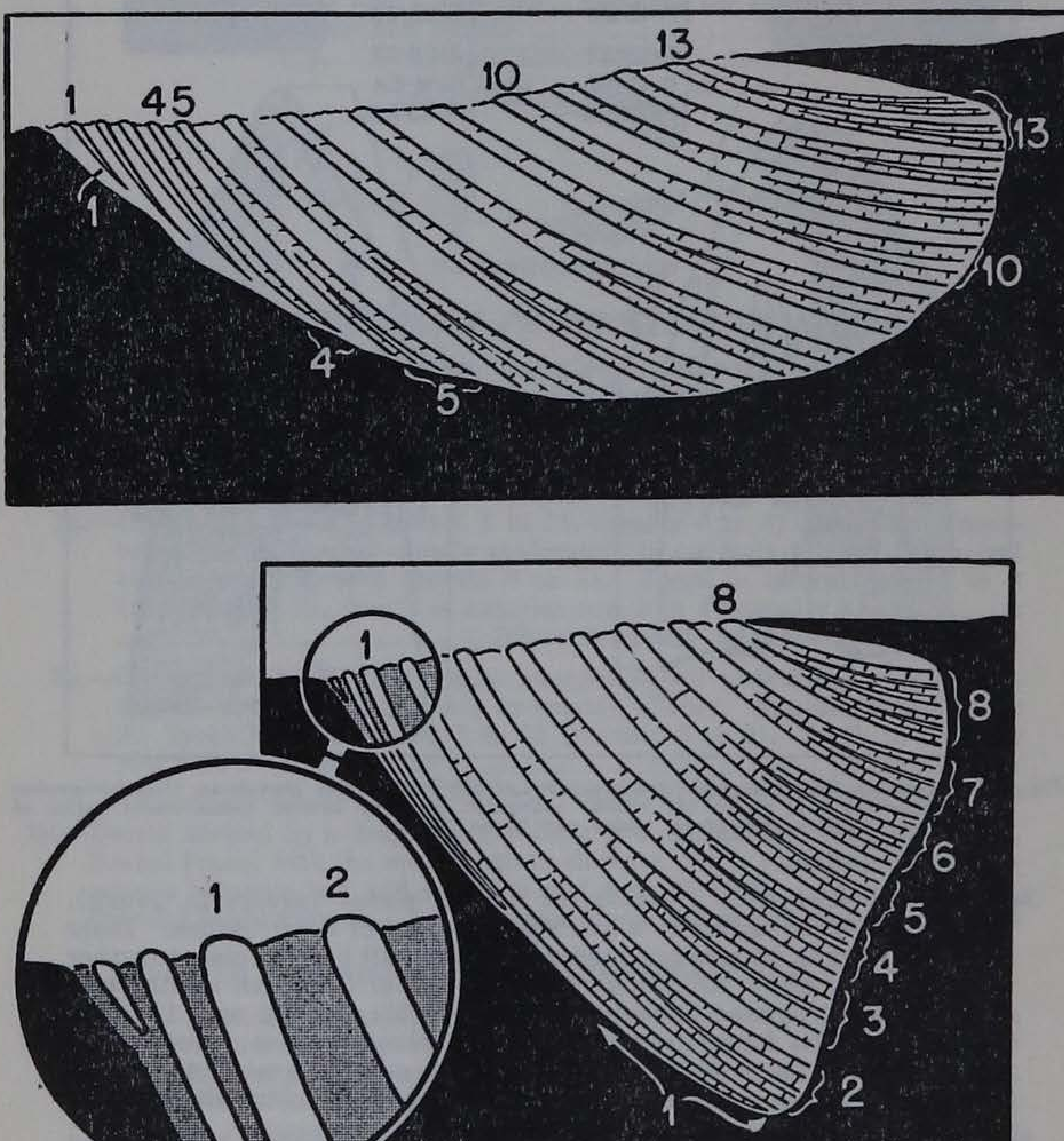


Fig. 7. Two methods of counting rays in the anal fin. Above, *total ray count*, including all rudiments, and often requiring a simple dissection at the front of the fin. Of the 13 rays the first four are simple, the remainder branched. The total ray count is employed in catfishes. Below, *principal ray count*, including all branched rays but only the third unbranched ray. The count is recorded as 8. The principal ray count is employed for both dorsal and anal fins in minnows and suckers.

KEY TO THE SPECIES OF SALMONIDAE (Trouts)

1a.—Scales larger, fewer than 140 just above lateral line. Body and fins with more or less definite dark spots. Vomer flattened, the shaft itself bearing 1 or 2 rows of teeth (these not on a free crest), the posterior teeth often lost with age. Parr-marks (when evident, especially in young) scarcely or not at all wider than interspaces..**Salmo** 2

2a.—Dark spots larger, fewer and more irregular; faint or absent on caudal. Adipose fin with a light margin, more or less orange in life (especially in young). Orange or reddish spots often present on body. Principal anal rays (including one unbranched anterior ray—Fig. 7) typically 9. Dorsal originating farther forward, much closer to tip of snout than to base of caudal fin (the insertion of pelvic below posterior half of dorsal fin base). **Introduced**....Brown trout, **Salmo trutta**

2b.—Dark spots numerous, smaller, and sharper; especially marked on caudal. Adipose fin light with a dark margin; often heavily spotted in adults. No orange or reddish spots on body; adults with a broad pink or reddish stripe along side. Principal anal rays 10 to 12 (occasionally 9 in young in which one ray has not yet become branched). Dorsal originating farther back, usually about equidistant from base of caudal fin and tip of snout in young and juveniles, somewhat closer to snout in adults (the insertion of pelvic below anterior half of dorsal fin base). **Introduced**................Rainbow trout, **Salmo gairdneri**

1b.—Scales smaller, more than 190 just above lateral line. Body frequently mottled or vermiculated with dark, but without definite small dark spots (red and blue spots often present). Vomer boat-shaped; the shaft depressed, toothless. Parr-marks (when evident) conspicuously broader than interspaces..Brook trout, **Salvelinus fontinalis**

KEY TO THE SPECIES OF CLUPEIDAE (Herrings)

1a.—Mouth terminal, jaws equal or the lower protruding. Maxilla extending to below center of eye. Dorsal fin origin in front of pelvic insertion. Posterior ray of dorsal fin not prolonged into a filament................**Alosa** 2

2a.—Jaws subequal. Teeth on tongue in a single median row. Lower jaw teeth weak, present only in juveniles. Gillrakers longer, that nearest angle of arch when depressed extending across bases of about 10 to 12 rakers of lower limb. More than 30 gillrakers on lower limb of first arch in young and more than 40 in adults. Mandible with dark pigment along most of its length........................Ohio shad, **Alosa ohiensis**

2b.—Lower jaw protruding well beyond upper. Teeth on tongue in 2 to 4 lengthwise rows. Lower jaw teeth present at all ages. Gillrakers shorter, that nearest angle when depressed extending across bases of 5 to 7 rakers of lower limb. About 22 gillrakers on lower limb of first arch. Mandible with dark pigment only anteriorly...Skipjack herring, **Alosa chrysochloris**

1b.—Mouth subterminal, the lower jaw included. Maxilla extending only to below front of eye. Dorsal origin behind pelvic insertion. Posterior ray of dorsal fin prolonged into a prominent filament (except in tiny young)..Gizzard shad, **Dorosoma cepedianum**

KEY TO THE SPECIES OF HIODONTIDAE (Mooneyes)

1a.—Dorsal originating before anal; with 11 or 12 principal rays. Dorsal base about ½ anal base. Fleshy midventral keel not extending in front of pelvic base. Eye larger, the iris silvery........Mooneye, **Hiodon tergisus**

1b.—Dorsal originating behind anal; with 9 or 10 principal rays. Dorsal base about 1/3 anal base. A fleshy keel extending along midventral line from just behind pectorals to vent. Eye smaller, the iris golden ....Goldeye, **Hiodon alosoides**

KEY TO THE SPECIES OF ESOCIDAE (Pikes)

1a.—Lower half of opercle [as well as cheek] fully scaled. Mandibular pores (Fig. 4) 4. Branchiostegal rays 11 to 13. Scale rows along body fewer than 115. Maximum length about 13 inches..Grass pickerel, **Esox americanus vermiculatus**

1b.—Lower half of opercle naked. Mandibular pores 5 to 8. Branchiostegal rays 14 to 19. Scale rows along body more than 120. Maximum length more than 4 feet.. 2

2a.—Lower half of cheek scaled. Mandibular pores 5. Branchiostegal rays 14 to 16. Scale rows along body fewer than 135. Body without dark spot or cross bars....................................Northern pike, **Esox lucius**

2b.—Lower half of cheek naked. Mandibular pores 6 to 8. Branchiostegal rays 17 to 19. Scale rows along body more than 140. Body with dark spots or cross bands....................Muskellunge, **Esox masquinongy**

KEY TO THE SPECIES OF CATOSTOMIDAE (Suckers)

1a.—Dorsal fin longer, with more than 20 principal rays.. 2

2a.—Lateral-line scales more than 50. Lips papillose. Head small, abruptly more slender than body. Eye closer to back of head than to tip of snout..Blue sucker, **Cycleptus elongatus**

2b.—Lateral-line scales fewer than 50. Lips smooth or weakly plicate. Head larger and not abruptly more slender than body. Eye closer to tip of snout than to back of head.. 3

3a.—Cheek shallow and shortened (distance from eye to lower posterior angle of preopercle about three-fourths that to upper corner of gill-cleft). Subopercle broadest at middle, subsemicircular. Mouth terminal to inferior. Anterior fontanelle much reduced or obliterated .... **Ictiobus** 4

4a.—Mouth large and oblique; upper lip about level with lower margin of orbit; upper jaw about as long as snout. Lips thin, only faintly striate. Lower pharyngeal arch thin, more than twice as high as wide..Bigmouth buffalo, **Ictiobus cyprinellus**

4b.—Mouth smaller, little oblique; upper lip far below lower margin of orbit; upper jaw distinctly shorter than snout. Lips fuller, more or less coarsely striate. Lower pharyngeal arch heavy, about as wide as high.. 5

5a.—Body more slender but thicker, its depth 2.6 to 3.2 times in standard length. Back less elevated and less sharpened. Eye smaller. Mouth larger and less inferior. Greatest distance from mandibular symphysis to extreme end of maxilla greater than orbit in large young to small adults, and about twice orbit in large adults....................................Black buffalo, **Ictiobus niger**

5b.—Body deeper and narrower, its depth 2.2 to 2.8 in standard length. Back more elevated and sharpened. Eye larger. Mouth smaller and more inferior. Greatest distance from mandibular symphysis to extreme end of maxilla about two-thirds orbit in small young, less than or equal to orbit in half grown and small adults, and only slightly greater than orbit in large adults................Smallmouth buffalo, **Ictiobus bubalus**

3b.—Cheek relatively deep and long (eye about equidistant from upper corner of gill-cleft and posteroventral angle of preopercle). Subopercle broadest below its middle, subtriangular. Mouth inferior. Anterior fontanelle well developed..**Carpiodes** 6

6a.—Scales smaller, in 37 to 40 rows along body. Lower lip without trace of a median, nipple-like projection. Opercular striations weak in adults, scarcely evident in young. Snout produced. Tip of lower lip clearly in advance of anterior nostril; distance from tip of snout to anterior nostril equal to length of eye (much greater than eye in adults).. 7

7a.—Anterior rays of dorsal moderately produced, the longest extending little if any beyond middle of fin. Body broader and more slender, its depth 2.7 to 3.5 in standard length. Head longer, usually 3.1 to 3.5 in standard length..Plains carpsucker, **Carpiodes forbesi**

7b.—Anterior rays of dorsal greatly elevated, the longest extending nearly to or much beyond posterior end of fin. Body more compressed and deeper, its depth 2.5 to 3.0 in standard length. Head shorter, usually 3.4 to 3.7 in standard length..Quillback carpsucker, **Carpiodes cyprinus**

6b.—Scales larger, in 33 to 36 (occasionally 37) rows along body. Lower lip with an evident median, nipple-like projection. Opercle strongly striated in adults (weakly striate in young). Snout blunter. Tip of lower lip scarcely or not at all in advance of anterior nostril; distance from tip of snout to anterior nostril less than eye (equal in large adults).. 8

8a.—Anterior rays of dorsal little produced, the longest ray not more than two-thirds length of fin. Body more slender, its depth 2.7 (young) to 3.3 (adults) in standard length. Eye smaller. Distance from tip of snout to anterior nostril contained less than 3 times in postorbital length of head..River carpsucker, **Carpiodes carpio carpio**

8b.—Anterior rays of dorsal greatly elevated, the longest ray when depressed often reaching at least to posterior tip of fin (except in young). Body deep and markedly compressed, its depth 2.9 (young) to 2.4 (adults) in standard length. Eye larger. Distance from tip of snout to anterior nostril contained more than 3 times in postorbital length of head..Highfin carpsucker, **Carpiodes velifer**

1b.—Dorsal fin shorter, with 17 or fewer principal rays.. 9

9a.—Circumorbital bones 2 or 3 in addition to lachrymal, narrow or moderate in breadth, greatest width less than half diameter of eye. Lateral line complete and well developed.. 10

10a.—Lateral line with 50 or fewer scales.. 11

11a.—Head not depressed between eyes, the interorbital area flat or convex. Lips plicate (Fig. 4), or weakly papillose (in **anisurum**). Gas bladder with three chambers..................**Moxostoma** 12

12a.—Pharyngeal arch weak, the breadth much less than depth in cross section. All teeth fragile, strongly compressed, in a comb-like series (Fig. 5). No semicircular ring of melanophores at base of each lobe of caudal.. 13

13a.—Caudal fin olive or slate-colored. Mouth moderate to large, lower lips meeting at an obtuse or sharp angle. Head moderate to large, 3.7 to 4.7 (3.3 to 3.7 in young from 1 to 3 inches long) in standard length. Body scales without dark spots at base.. 14

14a.—Body more nearly terete; caudal peduncle more slender (its depth typically less than two-thirds its length). Lateral-line scales 42 to 49, usually 44 to 47. Pelvic rays usually 10 (often 9 or 11). Dorsal pointed in front, of 13 (12 to 14) rays..Black redhorse, **Moxostoma duquesnei**

14b.—Body less terete; caudal peduncle deeper and shorter (its least depth typically much more than two-thirds its length). Lateral-line scales 38 to 44, usually 39 to 42. Pelvic rays usually 9 (often 8, rarely 7 or 10). Dorsal ordinarily rounded in front.. 15

15a.—Plicae of lips not broken up by transverse creases into papilla-like elements. Dorsal rays 11 to 15, usually 13. Dorsal base less than distance from dorsal to occiput. Body of adults yellowish...Golden redhorse, **Moxostoma erythrurum**

15b.—Plicae of lips broken up by transverse creases into papilla-like elements. Dorsal rays 14 to 17, usually 15 or 16. Dorsal base about equal to distance from dorsal to occiput. Body of adults silvery...Silver redhorse, **Moxostoma anisurum**

13b.—Caudal fin bright red in life. Mouth small, the plicate lower lips meeting in a straight line posteriorly. Head small and subconical, 4.3 to 5.4 (3.5 to 3.8 in young from 1 to 3 inches long) in standard length. Body scales on upperparts each with a dark spot at base. Dorsal fin falcate and pointed in front. [Dorsal rays 12 to 14, usually 13; pelvic rays usually 9.]...Northern redhorse, **Moxostoma aureolum aureolum**

12b.—Pharyngeal arch heavy, the thickness greater than depth in cross section. Teeth on lower half of arch greatly enlarged, somewhat cylindrical, and few in number; the crowns worn flat, molar-like (Fig. 5). Each lobe of caudal with a semicircular row of melanophores (convex backward). [Body scales on upperparts each with a dark spot at base. Caudal fin red in life. Mouth large, the lips thick and coarsely plicate.]...............................River redhorse, **Moxostoma carinatum**

11b.—Head depressed between eyes, the interorbital area concave. Lips heavily papillose. Gas bladder with 2 chambers...Northern hog sucker, **Hypentelium nigricans**

10b.—Lateral line with more than 55 scales. [Lips heavily papillose. Gas bladder with 2 chambers.]...White sucker, **Catostomus commersoni**

9b.—Circumorbital bones 1 or 2 in addition to lachrymal, broad, greatest breadth more than half diameter of eye, usually two-thirds eye. Lateral line weakly developed or absent. Lips plicate. Gas bladder typically with 2 chambers.. 16

16a.—Lateral line weakly developed in adults. Mouth inferior, horizontal. Color pattern (not developed in young) consisting of rows of dark spots (one on each scale) along sides..Spotted sucker, **Minytrema melanops**

16b.—Lateral line wholly lacking at all ages. Mouth subterminal, somewhat oblique. Color pattern consisting of a broad lateral dark streak in young which is broken to form a series of vertical bars or blotches in adults....................Lake chubsucker, **Erimyzon sucetta**

KEY TO THE SPECIES OF CYPRINIDAE (Minnows)[5]

1a.—Dorsal and anal each with a strong serrated spine; dorsal fin long, with more than 15 soft rays. **Introduced species** 2

2a.—Upper jaw with 2 long, fleshy barbels on each side. Lateral-line scales 35 to 38 (body sometimes scaleless—the "leather carp", or partially scaled—the "mirror carp"). Gillrakers on anterior arch 21 to 27. Pharyngeal teeth in 3 rows, 1, 1, 3-3, 1, 1; those of the main row short and heavy..........Carp, **Cyprinus carpio**

2b.—Upper jaw without barbels. Lateral-line scales 26 to 29. Gillrakers on anterior arch 37 to 43. Pharyngeal teeth in a single row, 4-4, not molar-like ....Goldfish, **Carassius auratus**

1b.—No spinous rays in dorsal or anal fins; dorsal fin short, with fewer than 10 principal rays (Fig. 7). Native species.......... 3

3a.—Abdomen behind pelvic fins with a fleshy keel over which the scales do not pass. Anal rays 10 to 14, usually 11 to 13. Anal fin falcate. Lateral line greatly decurved. [Teeth usually 5-5.]..........Golden shiner, **Notemigonus crysoleucas**

3b.—Abdomen behind pelvic fins rounded over and scaled. Anal rays 13 or fewer (9 or fewer in most species). Anal fin infrequently falcate. Lateral line little decurved (except in **N. umbratilis**).......... 4

4a.—Pharyngeal teeth (for method of counting see p. 373) in main row typically 5-5 or 5-4 (4-4 only in rare variants). Mouth terminal or subterminal, never inferior.......... 5

5a.—Maxilla with a flap-like barbel (Fig. 8A) placed in groove above upper lip well in advance of angle of mouth (barbel small or obsolete in young; the mouth should be opened to expose the groove in searching for the barbel). [Pharyngeal teeth usually 2, 5-4, 2]..........Creek chub, **Semotilus atromaculatus**

5b.—No barbel 6

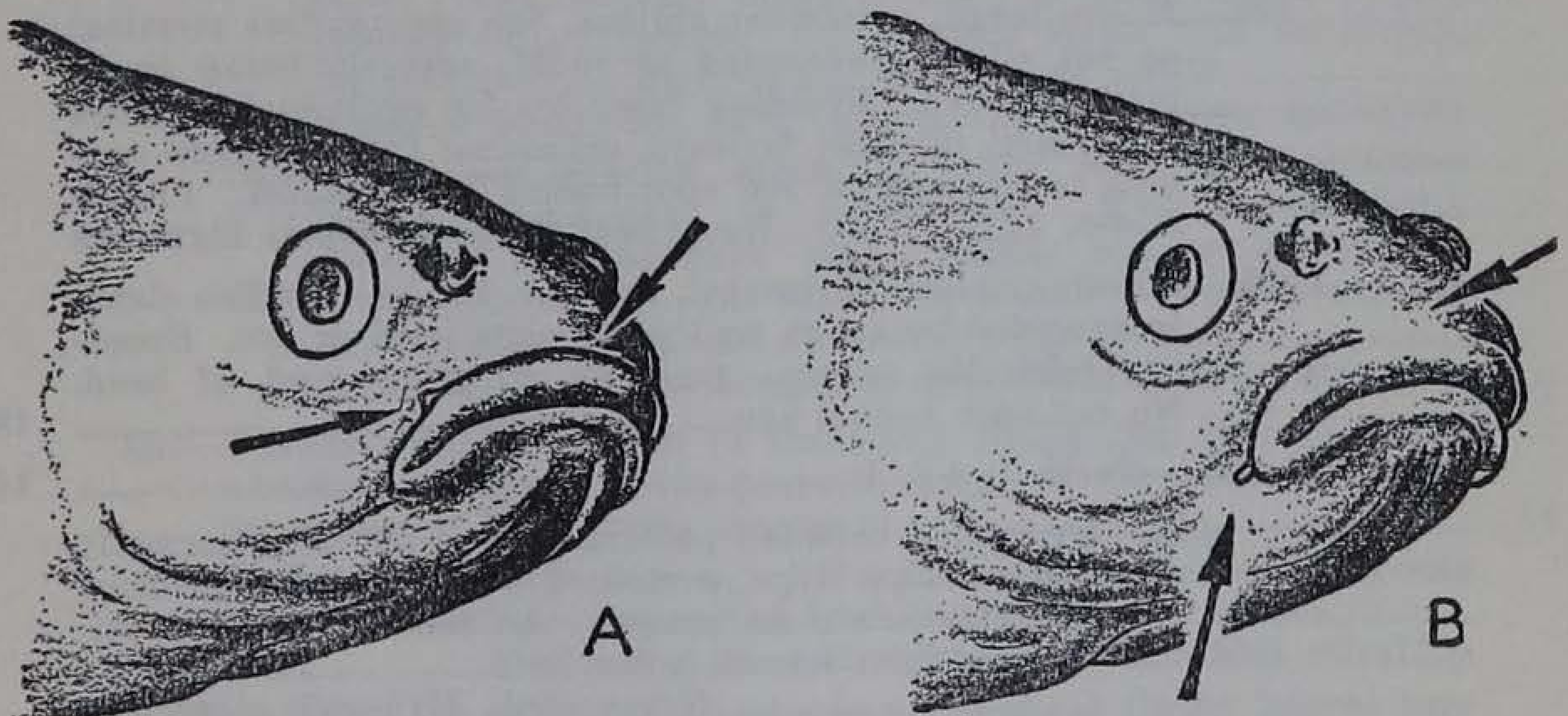


Fig. 8. Three-quarter views of the heads of two minnows to show barbels and relations of snout and lip. A. upper lip protractile (with groove, arrow, separating upper lip from snout); maxilla with a barbel (arrow), that is placed well in advance of its posterior end, as in *Semotilus*. B. upper lip not protractile (with a frenum, arrow); maxilla with a terminal barbel (arrow), as in *Rhinichthys*.

6a.—Lateral line complete. Peritoneum silvery. Intestine short, less than twice as long as body, with a single main loop. Body with a single, dusky lateral band. Mouth strongly oblique. Scale radii restricted to posterior (exposed) field.......... 7

[5]A key to the species and subspecies of *Notropis* appears on page 359.

7a.—Scales small, in about 65 to 70 rows along body. Pharyngeal teeth usually 2, 5-4, 2. Mouth very large, oblique. Dorsal rays typically 8................................Redside dace, **Gila elongata**

7b.—Scales large, in about 38 to 40 rows along body. Teeth usually 5-5, serrate. Mouth very small, almost vertical. Dorsal rays typically 9............Pugnose minnow, **Opsopoeodus emiliae**

6b.—Lateral line very incomplete. Peritoneum black. Intestine elongate, more than twice as long as body, with 2 crosswise coils in addition to the primary loop. Body with 2 black lateral bands. Mouth small, slightly oblique. Scales with radii in all fields. [Scales small, in more than 70 rows along body]............ ....Southern redbelly dace, **Chrosomus erythrogaster**

4b.—Pharyngeal teeth in main row 4-4. Mouth terminal to inferior........ 8

8a.—Maxilla with a slender barbel at its posterior end (Fig. 8 B)........ 9

9a.—Scale radii restricted to the posterior (exposed) field. Upper jaw protractile, separated from snout by a groove (Fig. 8 A). .... **Hybopsis** 10

10a.—Teeth usually 2, 4-4, 2. Lateral-line scales 48 or more.......... 11

11a.—Head moderately compressed, deeper than broad. Fins rounded, the pectoral not reaching insertion of pelvic. Scale rows above lateral lines in front of dorsal usually 25 to 27...................................Lake chub, **Hybopsis plumbea**

11b.—Head strongly depressed, broader than deep. Fins high and falcate, the pectoral exceeding pelvic insertion in adult. Scale rows above lateral lines in front of dorsal usually 13 to 15................Flathead chub, **Hybopsis gracilis**

10b.—Pharyngeal teeth 0 to 1, 4-4, 0 to 1. Lateral-line scales 50 or fewer 12

12a.—Mouth large, somewhat oblique, the premaxillae terminal or but slightly exceeded by snout, scarcely below lower border of eye. Breeding tubercles (in adult males) large and sharp, directed forward, extending from between nostrils to occiput. A red spot behind eye in adult. [Teeth 1, 4-4, 1]......................Hornyhead chub, **Hybopsis biguttata**

12b.—Mouth smaller, horizontal, inferior, the premaxillae clearly exceeded by snout, and well below level of eye. Breeding tubercles minute, granular, covering most of head. No red spot behind eye... 13

13a.—Teeth 1, 4-4, 1.. 14

14a.—Underside between pectoral and pelvic fins normally scaled. Eye large, contained 4 or less times in head. Gular area almost smooth, the sensory papillae minute. Adults 4 to 10 inches long.. ....Silver chub, **Hybopsis storeriana**

14b.—Ventral surface between pectoral and pelvic fins naked, or with scales only below pelvic bones. Eye small, contained 5 or more times in head. Gular area heavily papillose. Adults less than 4 inches long........ 15

15a.—Fins scarcely or not at all falcate; anterior dorsal rays exceeded by posterior rays in the depressed fin; pectoral fin not reaching insertion of pelvic (except in adult male). Body scales with prominent keels. Lateral-line scales 40 to 43. Belly naked. Head depressed and snout more projecting, its length about equal to postorbital length of head ....Sturgeon chub, **Hybopsis gelida**

15b.—Fins strongly falcate; anterior dorsal rays exceeding posterior rays in the depressed fin; pectoral fin reaching to or beyond insertion of pelvic. Scales without keels. Lateral-line scales 46 to 50. Belly with a few scales in pre-pelvic area. Head deeper and snout blunter, its length much less than postorbital length of head. Sicklefin chub, **Hybopsis meeki**

13b.—Teeth 4-4 16

16a.—Anal rays usually 8. Belly (in front of pelvics) naked. Snout projecting far beyond upper lip. Barbel long, about equal to pupil. Pharyngeal arch slender, the teeth without grinding surface. Peritoneum silvery. Intestine shorter than body, with a single, primary S-shaped loop. Body heavily dotted with black.......... ....Speckled chub, **Hybopsis aestivalis**

16b.—Anal rays usually 7. Belly scaled. Snout projecting little beyond upper lip. Barbel about half diameter of pupil. Pharyngeal arch moderately heavy, the teeth with grinding surface. Peritoneum dusky. Intestine elongate, about 1.5 times body length. Body not heavily dotted with black.............................. ....Gravel chub, **Hybopsis sp.**

9b.—Scales with radii in all fields. Upper jaw not protractile, not separated from snout by a groove (Fig. 8 B). [Lateral-line scales more than 56]..**Rhinichthys** **17**

17a.—Upper jaw little exceeding lower jaw; mouth somewhat oblique. Eye lateral, larger. Lateral dark stripe rather sharply defined below. Gas bladder fairly well developed, its posterior tip well behind insertion of pelvic...................... Western blacknose dace, **Rhinichthys atratulus meleagris**

17b.—Upper jaw greatly exceeding lower jaw; the horizontal mouth "shark-like" in appearance. Eye superolateral, smaller. Lateral dark stripe fading out gradually both above and below. Gas bladder (of adult) rudimentary, its posterior tip well ahead of insertion of pelvic.......................... ....Longnose dace, **Rhinichthys cataractae**

8b.—Maxilla without a barbel (a transitory fleshy flap that simulates a barbel projects from the posterior angle of the mouth in breeding males of **Pimephales notatus**).. **18**

18a.—Lower lip thick, rugose, with a fleshy projection on each side that is partially separated from mandible by a groove............. ....Plains suckermouth minnow, **Phenacobius mirabilis**

18b.—Lower lip rather thin and smooth, without fleshy lateral projections **19**

19a.—Cartilaginous ridge of lower jaw, if present, less prominent and not separated by a definite groove from lower lip. Intestine not spirally looped around the gas bladder. Gill-rakers on first arch fewer than 15, rather short....................... **20**

20a.—Predorsal scales usually neither greatly crowded nor conspicuously smaller than those on rest of body, in 21 or (usually) fewer rows (except in **N. cornutus** and **N. umbratilis which have 9 or more anal rays**). Second (rudimentary) ray of dorsal slender and closely adhering to first principal ray (Fig. 9). Nuptial organs not confined to a cluster of heavy tubercles on front of head.................... 21

21a.—Intestine short, much less than twice standard length, with a single S-shaped loop. Peritoneum usually silvery, often flecked with dark (occasionally or regularly black in a few species)............................**Notropis** (see p. 359)

21b.—Intestine elongate, more than twice standard length, with several loops. Peritoneum black. [Teeth 4-4. Anal rays typically 8]... 22

22a.—Mouth U-shaped. Pharyngeal teeth short, hooked. Suborbitals very narrow, little wider than infraorbital canal. Body with a dusky lateral band.................. ....Ozark minnow, **Dionda nubila**

22b.—Mouth gently curved, crescent-shaped. Pharyngeal teeth long, scarcely hooked. Suborbitals broad, extending half way across cheek. Body more or less silvery or yellowish.......................................**Hybognathus** 23

23a.—Body yellowish in life. Fins more rounded. Scales with the radii numerous (usually nearly 20 in adult) and weak; circuli smoothly curved at basal corners of scale. Head blunter. Size smaller, length to about 4 inches.. ....Brassy minnow, **Hybognathus hankinsoni**

23b.—Body silvery in life. Fins higher. Scales with the radii few (about 10) and strong; circuli sharply angulate (more or less squared) at basal corners of scale. Head more elongate. Size larger, length to about 6 inches.. ....Silvery minnow, **Hybognathus nuchalis nuchalis**

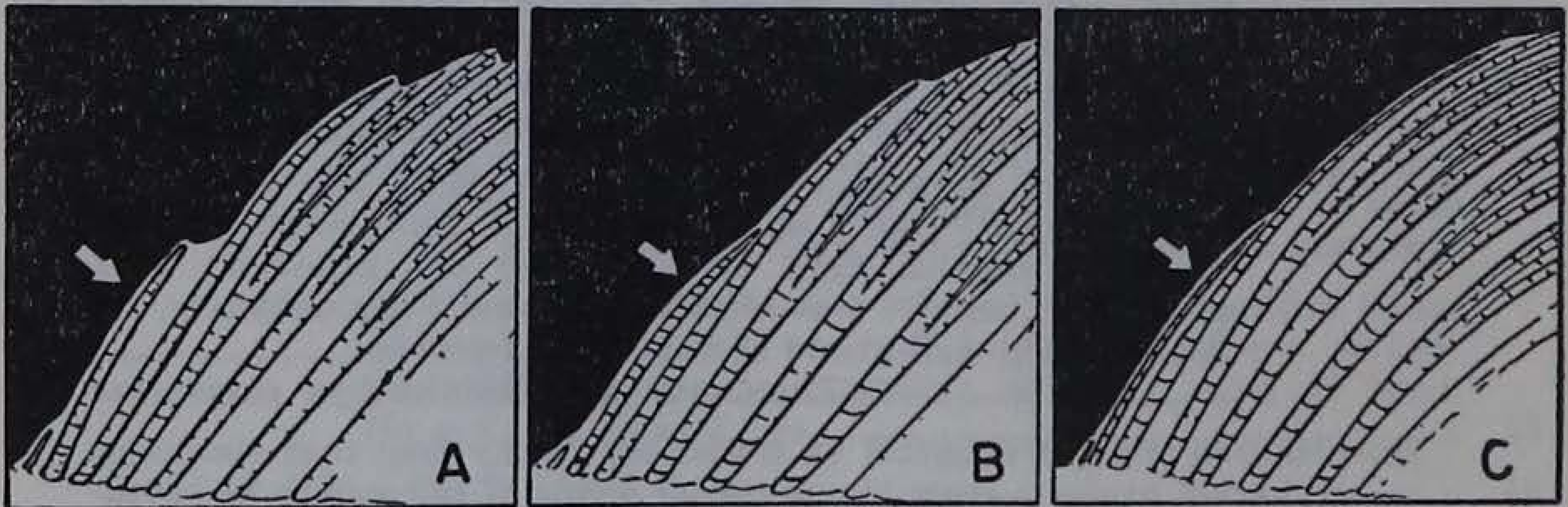


Fig. 9. Comparison of anterior rays of dorsal fin in bluntnose minnow, *Pimephales notatus*, adult male (A) and adult female (B) ; and common shiner, *Notropis cornutus* (C). The second unbranched dorsal ray is thickened and well separated from the third (first principal) dorsal ray in A, somewhat less marked in B, and in C the second unbranched ray is slender and closely adherent to the third ray. (The first ray is so small as to be overlooked without dissection.)

20b.—Predorsal scales crowded, much smaller than those on rest of body, in 21 or more rows. Anal rays 7. Second (rudimentary) ray of dorsal short and stout (Fig. 9), separated from first principal ray by a membrane (best developed in adult males). Nuptial tubercles large, those of head and body confined to a cluster on front of snout and (in **P. promelas**) chin. [Teeth 4-4]. **Pimephales** 24

24a.—Intestine short, forming a single S-shaped loop. Peritoneum silvery. Pharyngeal teeth rather strongly hooked. A dark spot in basal half of front of dorsal;

caudal spot conspicuous. Nuptial tubercles typically 9............Bullhead minnow, **Pimephales vigilax perspicuus**

24b.—Intestine elongate, with several loops. Peritoneum dusky or black. Pharyngeal teeth weakly or not at all hooked. No dark spot in dorsal fin; caudal spot well developed or faint. Nuptial tubercles on head usually 16 or more.. **25**

25a.—Lateral line complete. Mouth almost horizontal, subterminal. Body slender and terete. Caudal spot prominent. Nuptial tubercles lacking on mandible in breeding males, which have a barbel-like flap at angle of mouth.. ....Bluntnose minnow, **Pimephales notatus**

25b.—Lateral line incomplete. Mouth strongly oblique, terminal. Body compressed and deeper. Caudal spot faint. Nuptial tubercles present on mandible and snout in breeding males, which have no barbel-like flap of skin......Fathead minnow, **Pimephales promelas**

19b.—Cartilaginous ridge of lower jaw prominent, and separated by a groove from the fleshy lower lip. Intestine spirally looped about the gas bladder. Gillrakers on first arch 29 to 34, moderately long and slender. ....Stoneroller, **Campostoma anomalum**

KEY TO THE SPECIES AND SUBSPECIES OF *NOTROPIS* (Shiners)

1a.—Teeth in two rows, 1 or 2, 4-4, 1 or 2.. **2**

2a.—Principal anal rays 9 to 13 (occasionally 8 in **cornutus** and **illecebrosus**) **3**

3a.—Origin of dorsal well behind insertion of pelvic, nearer base of caudal than tip of snout. Anal rays usually 10 to 12............................ **4**

4a.—Dorsal fin without black spot at base of anterior rays. Lateral-line scales 40 or fewer. Predorsal scales fewer than 25. Scales not closely imbricated, the margins more rounded; anterior lateral line scales not much elevated. Body slender. Fins with little or no red **5**

5a.—Snout more blunt and shorter, its length usually contained more than 1.5 times in postorbital length of head. Eye larger, usually equal to or greater than snout. Body more compressed and deeper. Without rosy pigment.. **6**

6a.—Eye larger, contained about 3 times in body depth (measured over curve). Body more slender and thicker, its depth contained 1.9 to 2.5 times in distance from dorsal origin to occiput...................................Emerald shiner, **Notropis atherinoides**

6b.—Eye smaller, contained about 4 times in body depth (measured over curve). Body deeper and more compressed, its depth contained 1.4 to 2.0 times in distance from dorsal origin to occiput...........................Plains shiner, **Notropis percobromus**

5b.—Snout sharp and produced, its length typically contained less than 1.5 times in postorbital length of head. Eye smaller, less than snout. Body thicker and more slender. Breeding males rosy about head and base of pectoral fin... ....Rosyface shiner, **Notropis rubellus**

4b.—Dorsal fin with prominent black spot at base of anterior rays. Lateral-line scales 41 or more; predorsal scales more than 25.

Scales closely imbricated, the exposed portions more diamond-shaped; anterior lateral-line scales greatly elevated. Body compressed, deeper. Fins in breeding males bright red..Redfin shiner, **Notropis umbratilis**

3b.—Origin of dorsal ahead of to very slightly behind insertion of pelvic, nearer tip of snout than base of caudal. Anal rays usually 9............ **6**

6a.—Dorsal fin very high, the anterior rays much exceeding posterior rays in the depressed fin and about equal to length of head. Exposed portions of lateral scales not elevated, rounded behind. Predorsal scales about 15, not crowded or smaller than body scales.................................Silverstripe shiner, **Notropis illecebrosus**

6b.—Dorsal fin of moderate height, the anterior rays not or but slightly exceeding posterior rays in the depressed fin, much shorter than head. Exposed portions of lateral scales greatly elevated, diamond-shaped. Predorsal scales more than 20, crowded and much smaller than body scales...Northern common shiner, **Notropis cornutus frontalis**

2b.—Principal anal rays 7 or 8 (seldom 6 or 9; typically 9 and occasionally 10 in **lutrensis**, which never has 2, 4-4, 2 teeth).. **7**

7a.—Body with a pronounced, black lateral band which passes through eye, surrounds snout, and encroaches on mandible so that chin is black. Lateral line usually incomplete, sometimes complete in **N. roseus** **8**

8a.—Teeth usually 2, 4-4, 2 (often with 1 tooth in lesser row of one side). Breast naked below pectoral fin... **9**

9a.—Anal rays typically 8. Lateral line with more than 10 unpored scales. Nuptial tubercles well developed only on lower jaw, where a single or double series of outward-projecting tubercles borders lip; a few tubercles sometimes present on lachrymal, lower cheek, and above eye. Lateral stripe more sharply delimited; scales of row below lateral line unpigmented, or with few melanophores, not dark bordered. Dark pigment conspicuous on inner borders of jaws, floor and roof of mouth, and on oral valve.....................................Ironcolor shiner, **Notropis chalybaeus**

9b.—Anal rays typically 7. Lateral line with fewer than 10 unpored scales. Nuptial tubercles best developed on top of head; also present on nape, cheek, and lower jaw. Lateral stripe less sharply delimited; scale borders darkened on row below lateral line. Pigmentation on inside of mouth absent except for a few melanophores on oral valve............Weed shiner, **Notropis roseus**

8b.—Teeth typically 1, 4-4, 1. Breast scaled. [Anal rays usually 8. Mouth oblique, snout rather sharp]..Blackchin shiner, **Notropis heterodon**

7b.—Body without a pronounced, black lateral band; chin unpigmented. Lateral line complete.. **10**

10a.—Dorsal fin pointed, the anterior rays much exceeding posterior rays in the depressed fin. Eye larger, more than one-fourth head length. Upper jaw straight or gently curved (in lateral aspect). Scales usually not closely imbricated, the exposed surfaces not notably deeper than long... **11**

11a.—Mouth moderately oblique, upper jaw forming an angle of more than 20° with the horizontal. Front of upper lip on level with bottom of pupil. Eyes lateral. Teeth 1 or 2, 4-4, 2 or 1 (usually with 2 teeth on one or both sides)........................... **12**

12a.—Anal rays typically 8. A large, well-defined, circular black spot at base of caudal fin. Dorsal fin higher, its depressed length contained 1.1 to 1.3 times in distance forward to occiput................................Spottail shiner, **Notropis hudsonius**

12b.—Anal rays typically 7. No black spot at base of caudal fin. Dorsal fin lower, its depressed length contained 1.3 to 1.6 times in distance forward to occiput...River shiner, **Notropis blennius**

11b.—Mouth almost horizontal, upper jaw forming an angle of less than 15° with the horizontal. Front of upper lip on level with bottom of eye. Eyes superolateral. Teeth 1, 4-4, 1 (occasionally with tooth of minor row wanting on one side)............ **13**

13a.—Snout produced, but extending little in advance of upper lip. Mouth large, length of upper jaw 3.1 to 3.5 in head length. Lower lip attached to maxilla just in front of its posterior tip. Eye equal to (young) or less than length of snout. Origin of dorsal fin nearer caudal base than tip of snout. Dorsal lower, its depressed length 1.2 to 1.5 in distance forward to occiput...Bigmouth shiner, **Notropis dorsalis**[6]

13b.—Snout blunt, extending far beyond upper lip. Mouth smaller, length of upper jaw 3.9 to 4.5 in head length. Lower lip attached to maxilla far in front of its posterior tip. Eye greater than snout. Origin of dorsal fin nearer tip of snout than caudal base. Dorsal very high, its depressed length 0.9 to 1.0 in distance forward to occiput. [Aspect of **Hybopsis storeriana** but without a barbel]..Pallid shiner, **Notropis amnis**

10b.—Dorsal fin more or less rounded, the anterior rays much shorter than to slightly exceeding posterior rays (small juveniles) in the depressed fin. Eye smaller, less than one-fourth head length in adult. Upper jaw with a definite (obtuse) angle near middle of its length. Scales more or less closely imbricated, exposed surfaces notably deeper than long.. **14**

14a.—Anal rays typically 8 (rarely 7 or 9). Scales usually 36 to 38. Body more elongate, its depth 3.6 to 4.1 in standard length. Dorsal (especially in adults) with a black blotch on membranes between posterior rays. Anal yellow in breeding males. Teeth usually 1, 4-4, 1........Spotfin shiner, **Notropis spilopterus**

14b.—Anal rays usually 9 (often 8 or 10). Scales usually 34 or 35. Body deeper, its depth 2.7 (adults) to 3.7 (young) in standard length. Dorsal without black blotch. Anal red in breeding males. Teeth usually 4-4...Red shiner, **Notropis lutrensis**

1b.—Teeth in a single row, 4-4... **15**

15a.—Anal rays usually 9 (often 8 or 10). Body depth 2.7 to 3.7 in standard length. Scales closely imbricate. [Teeth occasionally 1, 4-4,

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[6]One of the most common problems for the student of Iowa fishes involves the separation of *Notropis dorsalis*, the bigmouth shiner, and *Notropis deliciosus*, the sand shiner. These species both live in abundance over a sand bottom and are frequent associates. *N. dorsalis* usually has the teeth in two rows, 1, 4-4, 1, whereas *N. deliciosus* has only a single row, 4-4. *N. dorsalis* differs from *N. deliciosus* further in that the eyes are superolateral (rather than lateral), the mouth is larger and more broadly U-shaped, the snout is more bluntly rounded (in dorsal aspect), the predorsal scales are smaller and less regularly arranged, the middorsal streak is broader and darker (especially evident behind the dorsal fin), the caudal peduncle is longer and more slender (its depth usually contained 2.4 to 2.8 times in its length rather than 2.0 to 2.4 times), and the anal rays are most often 8 (frequently 7, rarely 9) rather than typically 7 (rarely 6 or 8).

1 or 1, 4-4, 0]..........Red shiner, **Notropis lutrensis**

15b.—Anal rays 7 or 8 (rarely 9). Body usually slender, depth 3.5 to 5.5 in standard length. Scales not closely imbricate, more or less rounded behind and loosely attached.......... 16

16a.—Anal rays typically 7 (rarely 6 or 8).......... 17

17a.—Mouth nearly horizontal. Fins lower; length of depressed dorsal contained usually 2.2 to 2.3 times in predorsal length. Eye larger, greater than snout length, contained less than 3.5 times in head length. Lateral stripe weakly developed, with at most an indistinct dark spot at base of caudal. Nuptial tubercles granular. Body and fins without red..........**Notropis deliciosus**[6] 18

18a.—Scale rows around body just in advance of dorsal and pelvic fins 21 to 27, usually 22 to 25.......... ....Eastern sand shiner, **Notropis deliciosus deliciosus**

18b.—Scale rows around body 24 to 37, usually 26 to 29.......... ....Plains sand shiner, **Notropis deliciosus missuriensis**

17b.—Mouth oblique, upper jaw forming an angle of over 30° with the horizontal. Fins higher; length of depressed dorsal usually 1.8 to 1.9 times in predorsal length. Eye smaller, less than snout length, contained more than 3.5 times in head. A prominent, lateral dusky stripe terminating at base of caudal in a distinct, though small, dark spot. Nuptial tubercles on head coarse and sharp. Nuptial males with the fins and lower side bright red or orange..........Topeka shiner, **Notropis topeka**

16b.—Anal rays typically 8 (rarely 7 or 9).......... 19

19a.—Anterior lateral-line scales not greatly elevated, rounded behind. Dark lateral band conspicuous, marked with vertical black crescents. Infraorbital canal (Fig. 10) interrupted, usually in three sections..........Blacknose shiner, **Notropis heterolepis**

19b.—Anterior lateral-line scales greatly elevated, the exposed surface 2 to 5 times higher than long. Lateral band undeveloped or at most dusky, not marked with black crescents. Infraorbital canal (Fig. 10) complete or absent, not in three disconnected tubes.......... 20

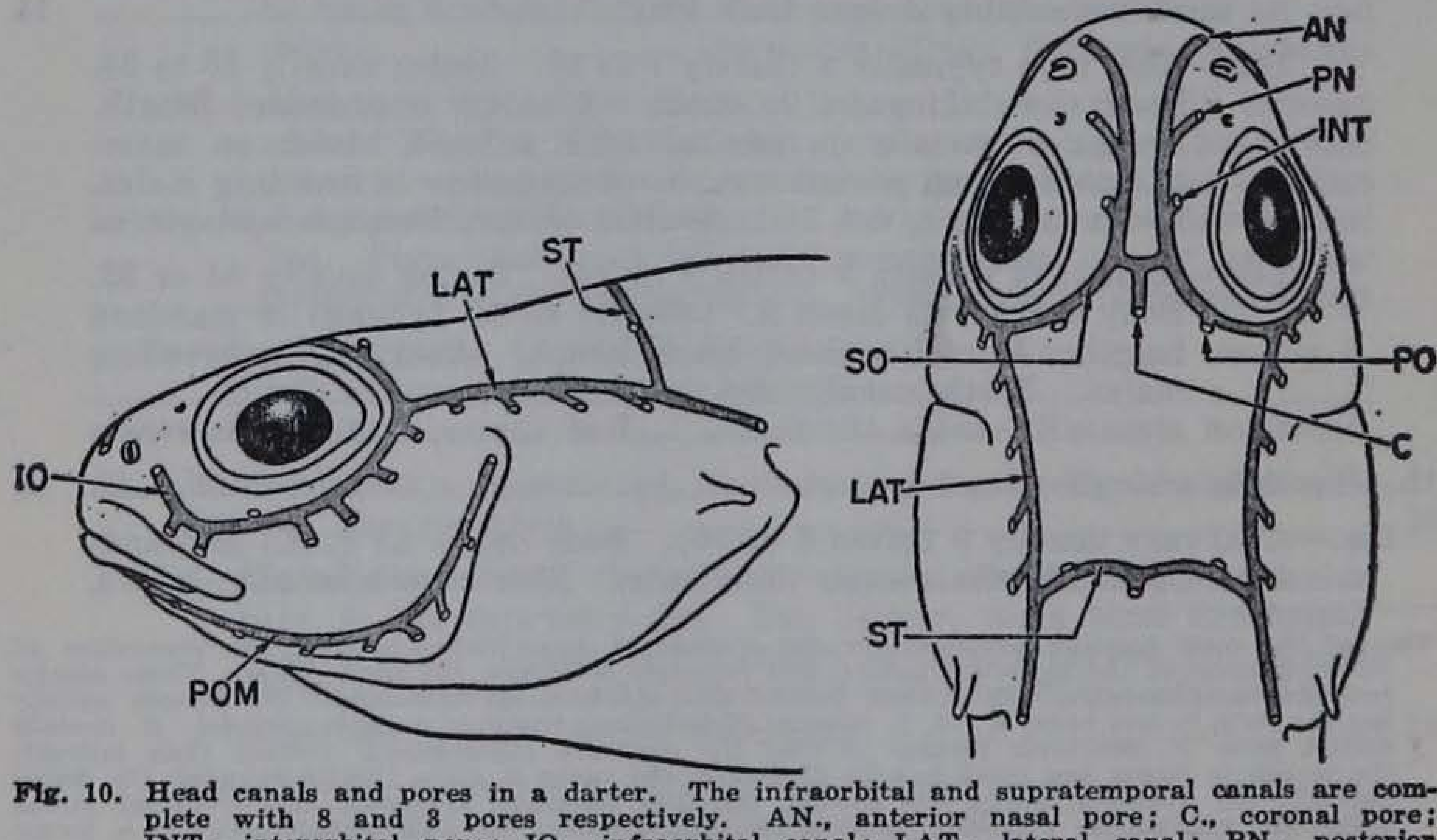

Fig. 10. Head canals and pores in a darter. The infraorbital and supratemporal canals are complete with 8 and 3 pores respectively. AN., anterior nasal pore; C., coronal pore; INT., interorbital pore; IO., infraorbital canal; LAT., lateral canal; PN., posterior nasal pore; PO., postorbital pore; POM., preoperculomandibular canal; SO., supraorbital canal; ST., supratemporal canal.

20a.—Infraorbital canal complete, extending from lateral canal, below eye, across lachrymal to a point in front of nostril. Fins lower and less notably falcate: length of the depressed dorsal 1.9 to 2.6 in predorsal length; pelvic not reaching origin of anal. Length of caudal peduncle 4.2 to 5.1 in standard length. Lateral-line scales less highly elevated. Pigmentation more profuse and more uniformly distributed over body........................ 21

21a.—Body more slender, greatest depth 4.7 to 5.1 in standard length, and least depth of caudal peduncle 2.7 to 3.1 in head length. Fins lower, height of dorsal 2.2 to 2.6 in predorsal length. Caudal peduncle length 4.2 to 4.7 in standard length. Chiefly an inhabitant of creeks and lakes.................. ....Northern mimic shiner, **Notropis volucellus volucellus**

21b.—Body more compressed and deeper, greatest depth 4.0 to 4.7 in standard length, and least depth of caudal peduncle 2.4 to 2.6 in head length. Fins higher, length of depressed dorsal 1.9 to 2.1 in predorsal length. Caudal peduncle length 4.7 to 5.1 in standard length. An inhabitant of large rivers. ....Channel mimic shiner, **Notropis volucellus wickliffi**

20b.—Infraorbital canal wholly undeveloped or (rarely) represented by a short section of the tube. Fins higher and more falcate: dorsal height 1.8 to 2.0 in predorsal length; pelvic reaching or exceeding origin of anal. Length of caudal peduncle 3.8 to 4.3 in standard length. Anterior lateral-line scales excessively elevated. Very pale, but with melanophores forming a dark spot just in front of dorsal origin, a dark vertical bar at base of caudal, a narrow axial streak on caudal peduncle, and a conspicuous dark peritroct.. ....Ghost shiner, **Notropis buchanani**

KEY TO THE SPECIES OF ICTALURIDAE (Catfishes)

1a.—Jaws equal or the upper protruding, mouth of moderate width. Pectoral spine various; never as in 1b. Preoperculomandibular canals (Fig. 10) separate, the pores 10 or 11. Anterior nasal pore located mediad to anterior nostril. Premaxillary tooth band usually a transverse bar (but see item 8b).. 2

2a.—Adipose fin with posterior margin free, not fused or continuous with caudal fin. Gillrakers 11 or more...**Ictalurus** 3

3a.—Caudal fin more or less truncate or rounded behind, not deeply forked. Anal rays (including all anterior rudiments—Fig. 7) 17 to 27. Jaws nearly equal. Supraoccipital bone produced backward but failing to join anterior process from dorsal fin................................ 4

4a.—Anal rays 17 to 24, usually 22 or fewer. Chin barbels dusky. Caudal fin slightly emarginate.. 5

5a.—Pectoral spine smooth or only weakly roughened posteriorly. Outer two-thirds of interradial membranes of anal fin uniformly pigmented, always darker than the rays, the fin not mottled, barred, or uniformly pigmented on both membranes and rays. Adults with the belly yellow......Black bullhead, **Ictalurus melas**

5b.—Pectoral spine with rather strong posterior serrations. Black pigment on anal fin typically densest on the membranes near their margin, or in spots that form an obscure longitudinal bar near base of fin, or in faint mottlings on both rays and membranes (in pale and unmottled specimens membranes and rays are about equally pigmented). Adults with the belly white..Brown bullhead, **Ictalurus nebulosus**

4b.—Anal rays 24 to 27, usually 25 or 26. Chin barbels white, rarely faintly dusky. Caudal fin rounded behind. [Black pigment on anal fin usually most pronounced in a narrower, marginal edging and in a wider bar just distal to base of fin. Fin neither mottled nor with dark dashes on interradial membranes.] ....Yellow bullhead, **Ictalurus natalis**

3b.—Caudal fin deeply forked. Anal rays 24 to 35. Upper jaw decidedly longer than lower. Supraoccipital bone produced backward to join with anterior process from dorsal fin.. 6

6a.—Anal shorter, its base about 3.4 to 3.7 in standard length, with 24 to 29 rays. Body silvery, the young immaculate, older fish more or less heavily spotted with dark (spots often obscure in adults, especially during the breeding season). Gas bladder with 2 chambers..............................Channel catfish, **Ictalurus punctatus**

6b.—Anal longer, its base about 2.9 to 3.1 in standard length, with 30 to 35 rays. Body silvery, nearly or quite immaculate. Gas bladder with 3 chambers........................Blue catfish, **Ictalurus furcatus**

2b.—Adipose fin a low, keel-like fleshy ridge which is fused or continuous with caudal fin. Gillrakers 3 to 10...**Noturus** 7

7a.—Head moderately deep. Pectoral-fin spine entire, with deep, long grooves that extend nearly to base. Distance from tip of caudal to adipose-fin notch, 0.8 to 1.5 in distance from that notch to dorsal origin. Caudal rays long, the fin broadly rounded. Pectoral soft rays usually 6 to 8; pelvic rays usually 8. [Jaws about equal; infraorbital and supraorbital canals separate anteriorly.] ....Tadpole madtom, **Noturus gyrinus**

7b.—Head notably depressed. Pectoral-fin spine entire or serrate behind, with rather shallow grooves in distal half. Distance from tip of caudal to adipose-fin notch, 1.6 to 2.5 in distance from that notch to dorsal origin. Caudal rays shorter, the fin more or less truncate. Pectoral soft rays usually 9 or 10; pelvic rays usually 9 or 10.......... 8

8a.—Vertical fins broadly margined with dusky. Jaws about equal. Pectoral spine with developed serrae along posterior edge. Infraorbital and supraorbital canals joined anteriorly (one internasal pore). Preoperculomandibular pores usually 10. Anal rays 17 to 22, usually 19 to 21. Premaxillary tooth band a transverse bar...Slender madtom, **Noturus exilis**

8b.—Vertical fins with white margins. Lower jaw included. Pectoral spine without developed serrae on posterior edge. Infraorbital and supraorbital canals separated anteriorly (2 internasal pores). Preoperculomandibular pores usually 11. Anal rays 15 to 19, usually 16 to 18. Premaxillary tooth band with a long, narrow backward projection on each side; the posterior border trapezoidal. ....Stonecat, **Noturus flavus**

1b.—Lower jaw projecting, the head markedly depressed and the mouth very wide. Pectoral spine strong, almost straight, anterior and posterior edges equally armed with well-developed serrae. Preoperculomandibular canals (Fig. 10) joined in a median pore on chin, the pores 12 on each side (including median pore). Anterior nasal pore located at edge of lip, well in front of anterior nostril. Premaxillary tooth band with a broad backward projection on each side, the posterior border smoothly curved. [Adipose fin large; free from caudal.] ....Flathead catfish, **Pylodictis olivaris**

KEY TO THE SPECIES OF CYPRINODONTIDAE (Killifishes)

1a.—Dorsal origin ahead of anal origin, its distance from caudal base 1.2 to 1.5 in predorsal length. Dorsal fin with 11 to 14 rays. Scale rows on body 38 to 49, usually 40 to 45. Body with vertical dark bars..Banded killifish, **Fundulus diaphanus menona**

1b.—Dorsal origin behind anal origin, its distance from caudal base 1.9 to 2.5 in predorsal length. Dorsal fin with 7 to 10 rays. Scale rows on body 33 to 36. Body without vertical dark bars except in males of **F. notti** 2

2a.—Pores along preopercular canal 7. Scale rows around body (before pelvic fins) 25 to 28. Anal fin rays 10 or 11 (rarely 12). Body pattern prominent 3

3a.—Body with many lengthwise streaks (females) or with slender vertical bars superimposed on horizontal streaks (males). Chin light. A broad, dark subocular bar. Fins immaculate..Starhead topminnow, **Fundulus notti dispar**

3b.—Body with a black lateral stripe, which is very regular (females) or with vertical projections (males). Chin black. No subocular dark bar. Dorsal, caudal, and anal fins more or less speckled with dark..Blackstripe topminnow, **Fundulus notatus**

2b.—Pores along preopercular canal 8. Scale rows around body 30 to 35. Anal fin rays typically 12 (rarely 11 or 13). Body pattern not prominent, with a faint dark lateral band on a uniform dusky body..Plains topminnow, **Fundulus sciadicus**

KEY TO THE SPECIES OF SERRANIDAE (Basses)

1a.—Anal rays III, 11 to 13; second spine much shorter than third. Dorsal fins entirely separate at their bases. Lower jaw projecting. Base of tongue with teeth. Color largely silvery, the lateral stripes narrower and not usually sharply broken or offset above origin of anal..White bass, **Roccus chrysops**

1b.—Anal rays III, 10; second and third spines subequal. Dorsal fins joined at their bases. Jaws nearly equal. Base of tongue toothless. Color largely yellowish or olive, the lower lateral stripes broader and usually sharply broken and offset above origin of anal..Yellow bass, **Roccus mississippiensis**

KEY TO THE SPECIES OF CENTRARCHIDAE (Sunfishes)

1a.—Anal spines 3 (very rarely 2 or 4). Dorsal spines usually 10.................... 2

2a.—Body elongate, depth 3 to 5 in standard length (somewhat deeper in large adults). Lateral-line scales more than 55. Precaudal vertebrae typically 15 ....**Micropterus** 3

3a.—Outline of spinous dorsal gently curving, the shortest spine at emargination more than half as long as the longest. Anal and soft dorsal with scales on membranes near base. Scales 68 to 81 along lateral line and 14 to 18 on cheek from eye to angle of preopercle. Pattern consisting principally of vertical dark bars, becoming obscured with age; young with base of caudal yellow succeeded by a marked dark band, the edge of fin clear white. Pyloric caeca typically unbranched................Smallmouth bass, **Micropterus dolomieui**

3b.—Outline of spinous dorsal angulate, the shortest spine at emargination less than half as long as longest. Anal and soft dorsal normally without scales on membranes near base. Scales 58 to 69 along lateral line and 9 to 12 on cheek from eye to angle of preopercle. Pattern consisting chiefly of a rather regular longitudinal dark stripe on side; young without marked band on caudal. Pyloric caeca typically branched at base..............Northern largemouth bass, **Micropterus salmoides salmoides**

2b.—Body compressed, oblong; depth usually 2.0 to 2.5 in standard length. Lateral-line scales fewer than 55. Precaudal vertebrae typically 12...... 4

4a.—Tongue, ectopterygoid, and entopterygoid toothed. Supramaxilla well developed, its length greater than breadth of maxilla..............Warmouth, **Chaenobryttus gulosus**

4b.—No teeth on tongue, ectopterygoid, or entopterygoid. Supramaxilla reduced or wanting, its length much less than breadth of maxilla. .... **Lepomis** 5

5a.—Opercle (not including membrane) stiff to its margin; not fimbriate along posterior edge.............. 6

6a.—Pectoral short and broadly rounded; about 4 in standard length. Gillrakers moderately long and slender, the longest if depressed extending to base of second (third in young) raker below. Opercle broadly margined with light, without scarlet in life. Supramaxilla about two-thirds breadth of maxilla. Inferior pharyngeal bone elongate, external margin straight, teeth rather sharp. Palatine teeth fairly well developed. ....Green sunfish, **Lepomis cyanellus**

6b.—Pectoral long and pointed; 3.0 to 3.3 in standard length. Gillrakers short and stout, the longest if depressed extending to base of first (second in young) raker below. Opercular margin dark, with a small semicircular scarlet spot. Supramaxilla about one-third breadth of maxilla. Inferior pharyngeal bone broad and heavy, the external margin a sigmoid curve, teeth blunt. Palatine teeth normally absent (often a single tooth developed)..............Pumpkinseed, **Lepomis gibbosus**

5b.—Opercle produced into a thin, flexible projection lying within the opercular membrane; often more or less fimbriate or ragged posteriorly 7

7a.—Gillrakers short and stout, knob-like; the longest when depressed not extending beyond first raker below (except in young). Longest anal spine usually 1.8 to 2.4 (1.4 or more in young) in distance from insertion of pelvic to origin of anal. Pectoral short, obovate. Caudal vertebrae typically 18..............Northern longear sunfish, **Lepomis megalotis peltastes**

7b.—Gillrakers rather long and slender, the longest when depressed extending to base of second raker below (third in young). Longest anal spine usually 1.0 to 1.8 in distance from insertion of pelvic to origin of anal (1.0 to 1.4 in young). Pectoral moderate to long. Caudal vertebrae typically 17.............. 8

8a.—Opercle extending little into membranous flap, its margin entire; opercular membrane broadly margined with light. Anal III, 7 to 9. No dark blotch on posterior dorsal rays. Palatine teeth present. Sensory cavities of head well developed, the supraorbital canals wider than interspace..............Orangespotted sunfish, **Lepomis humilis**

8b.—Opercle extending almost to membranous margin, edge of opercle fimbriate; opercular membrane dark to its margin. Anal III, 10 to 12. A dark blotch on median portion of posterior dorsal rays. Palatine teeth absent. Sensory cavities of head not enlarged, the supraorbital canals much narrower than interspace............................Bluegill, **Lepomis macrochirus**

1b.—Anal spines 5 to 7, usually 6. Dorsal spines not 10.. 9

9a.—Dorsal spines 11 or 12; base of anal contained 1.7 to 2.0 times in base of dorsal. Gillrakers moderate in length, fewer than 15. Branchiostegal rays 6. Preopercle nearly entire...Northern rock bass, **Ambloplites rupestris rupestris**

9b.—Dorsal spines 6 to 8; base of anal about equal to base of dorsal. Gillrakers long and slender, more than 30. Branchiostegal rays 7. Preopercle finely serrate...**Pomoxis** 10

10a.—Dorsal spines normally 6. Dorsal base much less than distance from origin of dorsal to posterior margin of eye (58 to 65 percent of distance from tip of snout to origin of dorsal). Caudal vertebrae typically 18. Mouth moderately oblique...White crappie, **Pomoxis annularis**

10b.—Dorsal spines normally 7 or 8. Dorsal base equal to or greater than distance from origin of dorsal to posterior margin of eye (73 to 81 percent of distance from tip of snout to origin of dorsal). Caudal vertebrae typically 19. Mouth strongly oblique..Black crappie, **Pomoxis nigromaculatus**

KEY TO THE SPECIES OF PERCIDAE (Perches and Darters)

1a.—Preopercle strongly serrate. Branchiostegal rays 7 (rarely 8). No distinct urogenital papilla. Top of skull ridged; supraoccipital crest high. Fishes of medium to large size.. 2

2a.—Strong canine teeth on jaws and palatine. Pelvic fins widely separated (interspace equal to breadth of fin base). Body slender and subterete. Anal II, 12 or 13. Pseudobranchium well developed.. **Stizostedion** 3

3a.—Lower lobe of caudal with a milk-white tip. Spinous dorsal without clearly defined black spots; a large black blotch near base of posterior spines. Dorsal soft rays 19 to 22 (rarely 19). Cheeks usually with few scales. Pyloric caeca 3, each about as long as stomach. Back crossed with about 6 or 7 narrow dark saddles...Yellow walleye, **Stizostedion vitreum vitreum**

3b.—Lower lobe of caudal not tipped with white. Spinous dorsal with clear-cut black spots (except in young), but without a large black blotch near base of posterior spines. Dorsal soft rays 17 to 20. Cheek usually well scaled. Pyloric caeca 5 to 9, each shorter than stomach. Back with 3 or 4 dark saddles, these expanded laterally to form 3 prominent oblong blotches—one below each dorsal fin and a smaller one on caudal peduncle........Sauger, **Stizostedion canadense**

2b.—No canine teeth. Pelvic fins close together. Body rather deep and compressed, crossed with about 7 prominent vertical dark bands. Anal II, 6 to 8. Pseudobranchium rudimentary..Yellow perch, **Perca flavescens**

1b.—Preopercle nearly or quite entire (in Iowa species). Branchiostegal rays 6 (rarely 5). Urogenital papilla prominent. Top of head nearly or quite smooth; supraoccipital crest weak or absent. Fishes of small size, the largest only 6 or 7 inches long, most much smaller. [Pseudobranchium rudimentary or absent]... 4

4a.—Interpelvic space and belly either naked (see **5b**) or with enlarged and modified median scales which are strongly ctenoid (modified scales sometimes much reduced in size and occasionally of normal size in females, but at least one enlarged interpelvic scale typically present). Anal fin large, about equal to or larger than soft dorsal (somewhat smaller in **P. caprodes**). Body usually more slender and more terete. [Pelvic fins widely separated, the interspace nearly or quite as great as base of fin. Caudal fin moderately to shallowly forked. Lateral line, infraorbital canal, and supratemporal canal always complete. Vertebrae 38 to 48]........ **5**

5a.—Anal spines 2, the first commonly stiff. Flesh opaque. Body less elongate, depth 4.9 to 6.7 in standard length. Dorsal fins closely approximated. Interpelvic space with one or more scales; midline of belly usually with scales, at least just in front of anus......**Percina** **6**

6a.—Interorbital space neither especially broad nor depressed. Snout not projecting beyond upper jaw. Lateral-line scales fewer than 78 .... **7**

7a.—Belly mostly scaled and with the scales of the midline strongly modified (at least in adult males). Premaxillary frenum broad, not hidden by a cross furrow. Anal fin of adult male not notably elevated, without tubercles (except in **evides**)........ **8**

8a.—Gill membranes separate; distance from junction to tip of mandible less than that to insertion of pelvic. Snout rather blunt, more or less decurved. No contrasting orange band on dorsal fin **9**

9a.—First dorsal with 13 to 16 spines; a prominent dark blotch anteriorly. Dark lateral blotches confined to side, more or less confluent and often forming a black longitudinal stripe; dorsal blotches, if present, more or less alternating with lateral blotches. Base of caudal fin without 2 large, cream-colored spots. Without bright colors. Cheek usually closely scaled; nape usually largely naked........ ....Blackside darter, **Percina maculata**

9b.—First dorsal with 10 to 13 spines; no prominent black blotch anteriorly. Dark lateral blotches vertically elongate, continuous over back to form about 8 saddles. Base of caudal with 2 large, cream-colored spots near base. Adults brightly colored with yellow, greenish-black, orange, and chocolate brown. Cheek almost or completely naked; nape closely scaled..........Gilt darter, **Percina evides**

8b.—Gill membranes broadly connected; distance from junction to tip of mandible greater than that to insertion of pelvic. Snout long and sharply pointed. Spinous dorsal with an orange submarginal band........ ....Slenderhead darter, **Percina phoxocephala**

7b.—Belly largely scaleless medially, but usually crossed before anus by a bridge of scales; scales of midline little modified. Premaxillary frenum very narrow or hidden by a furrow behind upper lip. Anal fin of adult male excessively elevated, the tips of the longest rays reaching approximately to base of caudal fin, with prominent tubercles during the breeding season.......... ....River darter, **Percina shumardi**

6b.—Interorbital space broad, more or less depressed. Snout forming a conical fleshy protuberance which projects beyond upper jaw. Lateral-line scales 78 to 103........ ....Northern logperch, **Percina caprodes semifasciata**

5b.—Anal with a single, thin flexible spine. Flesh pellucid in life. Body extremely elongate, depth 7.1 to 9.0 in standard length. Dorsal fins well separated. Interpelvic space and midline of belly naked.. **Ammocrypta 10**

10a.—Vomer and palatine with teeth. Vertebrae 45 to 48. Anal rays I, 12 to 14. Premaxillae bound to snout by a frenum. Lateral line with more than 80 scales to base of caudal and with 4 or more pored scales on caudal base..Crystal darter, **Ammocrypta asprella**

10b.—Vomer and palatine typically toothless, the vomer occasionally with a single tooth. Vertebrae 38 to 40. Anal rays I, 8 to 10. Premaxillae protractile. Lateral line with fewer than 80 scales to base of caudal, and with 1 or no pored scales on caudal base. ....Western sand darter, **Ammocrypta clara**

4b.—Breast, interpelvic space, and belly variously naked or covered with normal scales, but never with a median series of enlarged and modified scales. Anal fin usually smaller than soft dorsal. Body usually deeper and more compressed. [Pelvic fins separated by a space which varies from nearly as wide as the pelvic base to less than half that distance. Caudal fin forked, truncate, or rounded posteriorly. Lateral line, infraorbital canal, and supratemporal canal complete or incomplete. Vertebrae 32 to 41]..**Etheostoma 11**

11a.—Lateral line complete or incomplete, with more than 10 pored scales. Scale rows on body more than 40. Preoperculomandibular canal (Fig. 10) with 9 or more pores.. **12**

12a.—Anal spine single, thin and flexible. Premaxillae protractile. [Interpelvic space wide, at least three-fourths of fin base].......... **13**

13a.—Lateral line complete or nearly so. Infraorbital canal undeveloped only below eye; 2 or 3 pores open from that part of canal behind eye. Dark bridle on snout interrupted at midline **14**

14a.—Breast naked; cheek naked or with a few small scales behind eye; nape naked or with a few scales.................................Central Johnny darter, **Etheostoma nigrum nigrum**

14b.—Breast well scaled; cheek scaled except below front of eye; nape well scaled..Scaly Johnny darter, **Etheostoma nigrum eulepis**

13b.—Lateral line incomplete, terminating near middle of body. Infraorbital canal little developed behind eye; with 1 or no pores. Dark bridle continuous from eye to eye across front of snout above lip. Bluntnose darter, **Etheostoma chlorosomum**

12b.—Anal spines two, the first heavy and stiff. Premaxillae bound to snout by a frenum (rarely crossed by a groove in **zonale**)........ **15**

15a.—Pelvic fins widely spaced, the interspace about three-fourths of fin base. Lateral line complete. Pectoral fin longer than head. Snout very blunt. [Gill membranes broadly joined. Cheek scaled].......................Banded darter, **Etheostoma zonale**

15b.—Pelvic fins more closely approximated, the interspace less than two-thirds of fin base. Lateral line incomplete. Pectoral fin shorter than head. Snout more or less sharp, not steeply declivous **16**

16a.—Gill membranes separate or narrowly united. Dorsal spines usually 9 or more, their tips not thickened. Head with some scales. Supratemporal canal usually complete (interrupted in exile).......... 17

17a.—Cheek well scaled.......... 18

18a.—Lateral line extending at least to below middle of soft dorsal; 17 or fewer scales without pores. Supratemporal canal complete. Dorsal soft rays 12 to 14. Body more robust, greatest depth 4.0 to 5.0 in standard length..........Mud darter, **Etheostoma asprigene**

18b.—Lateral line not extending to below middle of soft dorsal; 27 to 42 scales without pores. Supratemporal canal widely interrupted. Dorsal soft rays 9 to 13, usually 10 to 12. Body slender, greatest depth 5.4 to 6.8 in standard length..........Iowa darter, **Etheostoma exile**

17b.—Cheek naked or with a few scales behind eye.......... 19

19a.—Infraorbital canal (Fig. 10) complete. Gill membranes narrowly united. Pectoral rays usually 13 or 14. Six dark bands on body from anus to base of caudal, these usually complete, separated (in adult males) by red-orange bands which are continuous across lower edge of peduncle. Adult males without orange stripe on ventrolateral surface; anal fin with much red-orange. ....Rainbow darter, **Etheostoma caeruleum**

19b.—Infraorbital canal widely interrupted below eye. Gill membranes separate. Pectoral rays usually 11 or 12. Five dark bands on body from anus to base of caudal, these usually interrupted ventrally, separated (in adult males) by red-orange bars which are interrupted ventrally. Adult males with orange stripe on ventrolateral surface; anal fin with little or no red-orange.......... Orangethroat darter, **Etheostoma spectabile spectabile**

16b.—Gill membranes broadly united across isthmus to form a gentle curve. Dorsal spines 7 to 9, often (in adults) with thickened fleshy tips. Head scaleless. Supratemporal canal usually incomplete.......... ....Striped fantail darter, **Etheostoma flabellare lineolatum**

11b.—Lateral line rudimentary, with 0 to 7 pored scales. Scale rows on body 34 to 37. Preoperculomandibular canal with 6 to 8 pores. ....Least darter, **Etheostoma microperca**

EXPLANATION OF TERMS USED IN THE KEYS

Adipose fin.—A fleshy, rayless fin on the mid-line of the back between the dorsal and tail fins (sometimes fused to the tail fin). (See Fig. 1.)

Anal fin (or anal).—The single or unpaired fin on the lower side of the fish between the anus and the tail fin (Fig. 1). In the count of soft rays the last ray is considered double at the base (counted as one). Where a well-developed anterior ray is present this is counted as the first (principal ray count, as in minnows), but where the rays become gradually shorter anteriorly all rudimentary rays are counted, as in catfishes. (See Fig. 7.)

Barbel.—A fleshy, thread-like, flap-like or conical process (Fig. 8); usually small if present in American minnows, but long in catfishes and carp.

Bicuspid.—Teeth with two points or cusps.

Branchiostegal rays.—The elongate, saber-like bones lying in a membrane (the branchiostegal membrane) just below the gill cover (Fig. 4).

Buccal.—Pertaining to the mouth; the buccal funnel of a lamprey is the cavity within the oral or mouth disc.

Canine teeth.—Strong and elongate conical teeth.

Caudal fin (or caudal).—The tail fin (Fig. 3).

Caudal peduncle.—The slender, posterior portion of the body (behind the anal fin) which bears the tail fin (Fig. 1). Its length is measured from the posterior base of the anal fin to the base of the tail fin (at its intersection with the lateral line).

Circuli.—Concentric ridges on fish scales.

Circumoral teeth.—Horny teeth in lampreys which surround the esophageal aperture.

Circumorbital.—One of a series of thin dermal bones which lie behind, below, and in front of eye (Fig. 2). The anterior bone, which lies in front of the eye is known as the preorbital or lachrymal, those below the eye are called suborbitals, and those behind the eye are termed postorbitals. The infraorbital canal commonly penetrates the circumorbitals.

Compressed.—Thin from side to side; deeper than broad.

Ctenoid.—Scales that bear a patch of spine-like prickles (ctenii) on the exposed or posterior field (for example, the yellow perch). The body feels rough when stroked from back to front.

Cycloid.—More or less rounded scales which bear no ctenii or prickles (for example, trout and minnows). The body feels smooth when stroked from back to front.

Depressed.—Thin from top to bottom; broader than deep.

Dorsal.—Pertaining to the back. Often used as an abbreviation for the dorsal fin.

Dorsal fin.—The single or double, ray-bearing, median fin of the back (Fig. 1). In our species it may be composed of spines anteriorly and soft rays posteriorly, two soft portions, or a single series of soft rays. The method of counting soft rays is the same as given for the anal fin.

Ectopterygoid.—A paired bone of the "inner-jaw" series, lying on the roof of the mouth behind the palatine bone.

Emarginate.—With a shallow notch, as in the moderately forked tail fin of a bass.

Entire.—Not bearing spines or denticulations; referring to an edge, as of a spine or bone, which is smooth; not serrated.

Entopterygoid.—A thin, flattened paired bone lying far back on the roof of the mouth between the ectopterygoids.

Falcate.—Shaped or curved like a sickle; with the margin markedly concave.

Fontanelle.—An aperture or opening in a bony surface.

Frenum.—A bridge of tissue which binds or restrains any part; as the tissue which binds the upper jaw to the snout (Fig. 8).

Ganoid.—Scales are said to be ganoid when rhombic (diamond-shaped); they are thick, strong interlocking structures.

Gas bladder.—A membranous, gas-filled sac lying in the upper part of the body cavity.

Gillrakers.—Slender rod-like to blunt knob-like projections from the anterior face of the first gill arch. A dissection is often necessary to obtain an accurate count (including all rudimentary rakers).

Gular fold.—A transverse fold of soft tissue across the throat.

Gular plate.—A large, median, dermal bone lying on the throat, as in the bowfin.

Head length.—The distance from the tip of the snout to the posterior margin of the opercular membrane (Fig. 1).

Heterocercal.—The tail is heterocercal if the vertebral column turns upward into the upper lobe (which is better developed than the lower—Fig. 3).

Homocercal.—The tail is homocercal if the posterior vertebra (the urostylar vertebra, which supports the hypural plate) is modified to support the entire tail fin; neither lobe of the tail fin is invaded by the vertebral column (Fig. 3).

Imbricate.—Overlapping, as the shingles on a roof.

Inferior.—Lower. The mouth is said to be inferior if located on the lower side of the head, the upper lip more or less overhung by the snout.

Infraorbital canal.—That portion of the lateral-line canal system which passes behind and below eye and onto snout (Fig. 10).

Insertion (of fins).—The positions at which the paired fins are joined to the body.

Interorbital width.—The distance across top of head between eyes. It is possible to measure either the bony interorbital width or the fleshy width.

Isthmus.—The narrow portion of the breast that projects forward between (and separating) the gill chambers (Fig. 4).

Jugular.—Pertaining to the throat.

Lachrymal.—The preorbital bone, or first circumorbital bone; it lies just before eye (Fig. 2).

Lateral.—Pertaining to the side.

Lateral line.—A series of tubes and pores, extending on the side of the body backward from the posterior margin of the head. The lateral line may be complete (reaching onto the base of the caudal fin); incomplete (not reaching to the base of the caudal fin); or entirely absent. The lateral line is a structure and should not be confused with pigment stripes or lines. The lateral-line system extends forward onto the head where it divides into several parts (Figs. 1 and 10).

Lateral-line scales.—These scales are counted from the head to the base of the caudal rays (the several scales sheathing the base of the tail fin are not included—Fig. 1). Where the lateral line is incomplete or absent, the transverse scale rows are counted along the line where the lateral line normally occurs.

Lingual lamina.—A transverse, horny ridge on the "tongue" of a lamprey.

Mandible.—The lower jaw.

Mandibular pores.—A series of small apertures along a tube (mandibular canal) on the lower side of each lower jaw. This is the anterior section of the preoperculomandibular canal (Figs. 4 and 10).

Mandibular symphysis.—The tip of the lower jaw.

Maxilla.—The bone of each upper jaw lying just above (or behind), and parallel to, the premaxilla (Fig. 2).

Melanophore.—A black pigment cell.

Myomere.—A muscle segment.

Nape.—The back of the neck; in a fish that area extending along the back from the occiput to or toward the dorsal fin (Fig. 2).

Nuptial tubercles.—Hardened calcareous concretions developed, especially in adult males, during the breeding season; breeding tubercles.

Occiput.—The posterior dorsal part of the head (often marked by the line separating scaly and scaleless portions of the skin).

Opercle.—The large bone of the gill cover; not including the fleshy membrane (Fig. 2).

Opercular gill.—A gill-like structure lying on the inner surface of the opercle near its edge, in sturgeons. Not to be confused with pseudobranchium.

Operculum.—The gill cover.

Oral valve.—Thin membranes, one near the front of each jaw, which function during respiration.

Origin (of fins).—The foremost point at which the dorsal and anal fins are in contact with the body.

Palatine teeth.—Teeth borne by the paired palatine bones which lie on the roof of the mouth behind the median vomer and inside the upper jaw.

Papilla.—A small, blunt fleshy projection.

Papillose.—Covered with papillae.

Parasitic.—Feeding upon (and at the expense of) another living organism.

Parr-marks.—Large dark blotches on the sides of the body (not continuous over the back or saddle-like as in the yellow perch), especially prominent in young trout.

Pectoral fin.—A paired fin on the side (or on the breast) just behind the head (Fig. 1).

Pelvic (or ventral) fin.—A paired fin inserted on the lower side of the fish (Fig. 1). Usually well behind the pectoral (abdominal in position) or beneath the pectoral (thoracic in position). In the pelvic ray count all rudimentary rays are included.

Peritoneum.—The lining of the body cavity.

Peritroct.—The area that surrounds the anus.

Pharyngeal teeth.—Teeth on the pharyngeal bones, located deep in the throat (Fig. 5). In suckers and minnows each pharyngeal arch bears 1 or 2 (3 in the introduced carp) rows of teeth. The formula gives the number of teeth in each of the rows from left to right, thus the formula 2, 5-4, 1 indicates that the pharyngeal bone on the left side has 2 teeth in the inner or minor row, 5 in the outer or main row, whereas that on the right side has 1 tooth in the inner row and 4 in the main row. A pharyngeal bone may be removed for study by lifting back the gill cover, passing a sharp scalpel between the shoulder girdle and the pharyngeal bone (which lies just in front of the pectoral girdle), and cutting free the muscles at each end of the bone. It may then be removed with the aid of a pair of forceps and should be cleaned of remaining muscles with the aid of a dissecting needle before examination. Considerable practice is necessary before this dissection can be performed without injuring the specimen or breaking the pharyngeal teeth.

Plicate.—With a series of parallel folds or soft ridges (plicae—Fig. 4).

Predorsal length.—The distance from the tip of the snout to the origin of the dorsal fin.

Predorsal scales.—The scales lying between the front end of the dorsal fin and the head; the number of rows is counted along the midline of the back.

Premaxilla.—The bone at the front of each upper jaw (Fig. 2). The premaxillae join to form part or all of the border of the jaw.

Preopercle.—The L-shaped bone (with the lower arm directed forward) which lies behind and below the eye (in front of the gill cover—Fig. 2).

Preopercular canal.—That portion of the preoperculomandibular canal that lies on the preopercle (Fig. 10).

Preoperculomandibular canal.—A branch of the lateral-line system that extends along the preopercle (preopercular canal) and the mandible (mandibular canal). (See Fig. 10.)

Preorbital.—The lachrymal, or first circumorbital bone; it lies just before eye.

Protractile.—The upper jaw is so termed when it can be protruded. This ability is indicated when a groove separates the margin of the upper jaw from the snout (Fig. 8). When the upper jaw is not protractile a fleshy connection (frenum) binds the premaxillae to the snout and no groove separates them along the midline.

Pseudobranchium.—A gill-like structure on the inner surface of the gill cover near its upper edge.

Pyloric caeca.—Finger-like appendages arising from the junction of the stomach and the intestine.

Radii.—Grooves on a fish scale which radiate outward from its central part, or focus.

Serrate.—Jagged or tooth-like; the denticulations are termed serrae.

Snout (length).—The distance from its anterior tip to the front margin of the orbit (Fig. 2).

Spiracle.—An opening from the pharyngeal cavity which emerges above and behind the eye in some species.

Standard length.—The straight-line distance from the anterior tip of the snout to the hidden base of the caudal-fin rays. The position of the base of the caudal rays is indicated by the sharp crease which is formed by bending the tail fin (Fig. 1).

Subopercle.—That bone of the opercular series (Fig. 2) which lies just below the opercle (the large bone of the series).

Suborbitals.—Those of the circumorbital bones which lie below the eye.

Superolateral.—Facing upward and outward.

Supramaxilla.—A small, movable bone adherent to the upper edge of the maxilla near its posterior tip (Fig. 2).

Supraoccipital.—The unpaired bone above the opening from which the spinal cord leaves the skull (the posterior bone on the top of the skull).

Supraoral cusps.—Projections or points on the large horny tooth or transverse plate that lies just in front of the mouth opening in lampreys.

Supraorbital canal.—A paired branch of the lateral-line system that extends along the top of the head between the eyes and forward onto snout (Fig. 10).

Supratemporal canal.—A branch of the lateral-line system which crosses the top of the head at the occiput, connecting the lateral canals (Fig. 10).

Terete.—Having a rounded body form, the body width and body depth about equal.

Terminal.—At the end of something. the mouth is spoken of as terminal when neither upper nor lower jaw projects beyond the other; it is subterminal when the upper jaw slightly exceeds the lower. A terminal barbel is placed at the posterior end of the maxilla.

Thoracic.—Pertaining to the chest; the pelvic fin is thoracic when inserted below the pectoral fin.

Total length.—The greatest overall length, measured from the anteriormost tip (whether upper or lower jaw) to the extremity of the tail fin.

Urogenital papilla.—A flap-like or finger-like projection between the anus and the anal fin.

Ventral.—The lower surface. The pelvic fins are referred to as ventral fins by some authors.

Vermiculate.—A pattern of fine, narrow or thread-like lines or vermiculations; worm tracks.

Vertebrae.—A dissection (or X-ray photograph) is necessary to count the number of vertebrae. The precaudal count includes those anterior vertebrae which do not have a well-developed haemal spine; that is, each appears as an inverted Y in cross section. The remaining vertebrae (including the modified last or urostylar vertebra, which with its attached hypural plate supports the tail fin) are listed as caudal vertebrae.

Vomer.—An unpaired bone lying near the front of the roof of the mouth, just behind the margin of the upper jaw.

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