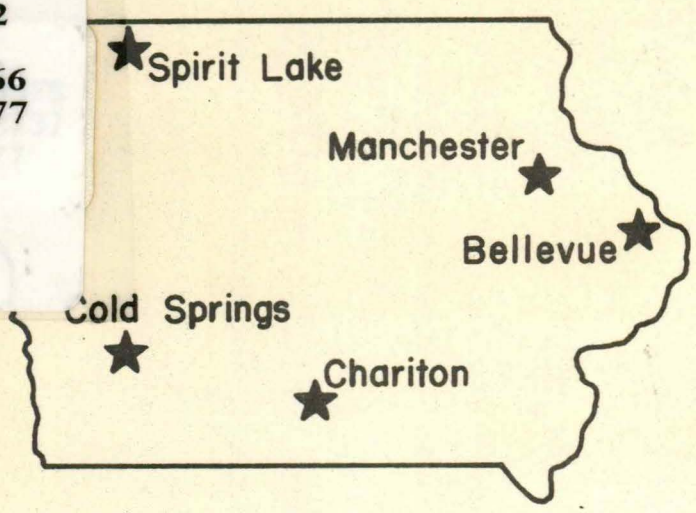
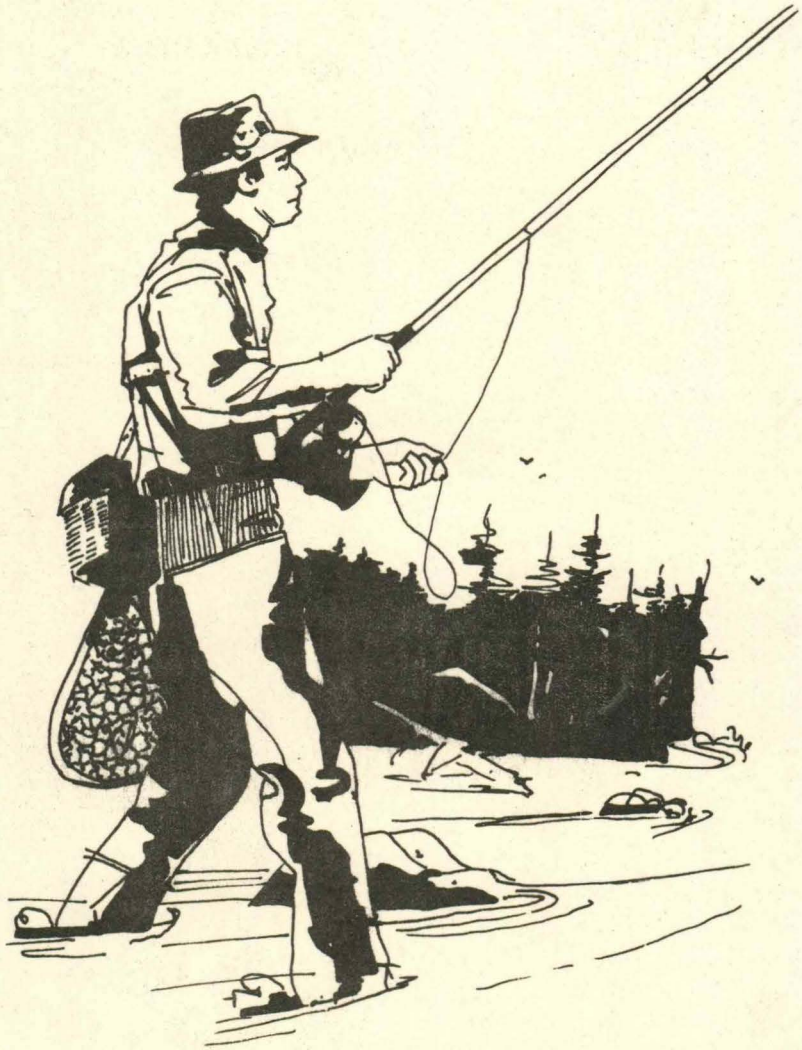


A COMPENDIUM OF FISHERY RESEARCH IN IOWA



FISHERIES SECTION
IOWA CONSERVATION COMMISSION

A COMPENDIUM OF FISHERY RESEARCH IN IOWA

April 1977

Fisheries Section
Iowa Conservation Commission

James Mayhew
Superintendent of Fisheries

FORWARD

A comprehensive review of fishery research projects in the Iowa Conservation Commission has been reported on alternate years for the past decade. The synopsis serves to update all research projects and assess the accomplishment and needs of each endeavor. Summarization of the entire program of the Research Branch under a single cover is also valuable in maintaining program continuity. Since publication of the last compendium, projects related to 0-age fish production and survival in Spirit Lake, population dynamics of sub-legal sized channel catfish in the Mississippi River, dynamics of the predator-prey relationship in DeSoto Bend Lake, the relationship of cage reared and released channel catfish and established fish and benthos populations were concluded and the findings presented in the Iowa Fisheries Research Technical Series or in Federal Aid (DJ) project completion reports. In this compendium additional projects concerning walleye behavioral characteristics, experimental smallmouth bass management in northeast Iowa streams, assessment of increasing the minimum size limit on a commercial fishery, alteration of the proportional stock density in a bass-bluegill population by mid-summer drawdown, and increasing forage utilization of a highly diverse predator population in a large reservoir replaced the completed projects.

Major research reassignments will be completed during this two year period by permanent establishment of a station at the Manchester District Office. Research personnel at the station will be assigned projects in northeast Iowa streams including trout waters. The immediate assignment shall be in some of the larger, cool water streams in this region of the state that have extra-ordinary potential for fishery resource development. Completion of this phase of reorganization establishes research stations in three of the four District Offices along with the Chariton Research Station where research is concentrated in large reservoirs and the Bellevue Station where studies in the Mississippi River are conducted.

All research projects continue to reflect long range, mission oriented emphasis which ultimately become part of the comprehensive management of this vast and valuable natural resource.

FISHERY RESEARCH STAFF MEMBERS AND ASSIGNMENTS

Des Moines — Don Bonneau - Fishery Research Supervisor

Chariton Research Station - Reservoir Investigations

Larry Mitzner - Fishery Research Biologist
Larry Squibb - Fishery Research Technician
Leo Schlunz - Fishery Research Technician
Cynthia Squibb - Fishery Research Worker
Kathy Schlutz - Secretary

Spirit Lake Research Station - Natural Lakes Investigations

Dick McWilliams - Fishery Research Biologist
Mike Cox - Fishery Research Technician

Cold Springs Research Station - Small Lakes Investigations

Kay Hill - Fishery Research Biologist
Dale Anderson - Fishery Research Technician

Bellevue Research Station - Mississippi River Investigations

Tom Gengerke - Fishery Research Biologist
Maurice Anderson - Fishery Research Technician
Dean Beck - Fishery Research Technician

Manchester Research Station - Stream Investigations

Vaughn Paragamian - Fishery Research Biologist
Ken Hyman - Fishery Research Technician

STUDY TITLE: Bullhead Population Dynamics and Production at Spirit Lake

STUDY NUMBER:	102.3	LOCATION:	Spirit Lake Dickinson County
PROJECT LEADER:	Dick McWilliams	DURATION:	March, 1975-February, 1978

STATEMENT OF THE PROBLEM:

Bullhead population abundance in Spirit Lake is subject to wide, nearly cyclic, fluctuations closely related to the progression of abundant or poor year classes through the fishery. Effects of the fluctuating bullhead abundance is vividly apparent in sport fishery harvest statistics, with catches of bullhead ranging from about 13,000 to nearly 383,000 fish with peak harvests in the last two decades occurring every 4 to 6 years. During years of high population abundance and harvest, the average size and weight of fish harvested is low, with subsequent increased size and weight with declining catches. The effects of high bullhead populations on cohabiting species is unknown. Factors influencing the development of bullhead year class abundance remain unknown, but year class development is suspected of being related to the suitability of small lakes and shallow slough areas connecting Spirit Lake for production. These waters contain habitat typical of that required for spawning, and may be the major spawning and nursery areas. Immigration of 0-age bullhead into Spirit Lake might also contribute substantially to total year class abundance. After assessment of these areas for their contributors to bullhead abundance, management designs can be developed to control bullhead population abundance.

STUDY OBJECTIVE:

To determine the magnitude and causes of cyclic fluctuations in the abundance of black bullhead in Spirit Lake by measuring numerical production, survival, growth and condition of bullhead in Spirit Lake and connecting small lakes and sloughes; and define the effects of fluctuating bullhead abundance upon cohabiting sport fish species.

STUDY BACKGROUND:

Black bullhead dominated the sport fishery at Spirit Lake in 22 of 27 years of creel survey data, comprising 8% to 85% of the total numerical harvest. Data collected during annual population surveys, in addition to the creel surveys, revealed the development of predominant year classes of bullhead to occur at about the same frequency as peak harvests. These data show the success of the bullhead fishery is wholly dependent upon year class abundance.

The relative abundance of bullhead in 1975 (26 bullhead per fyke net day; FND) revealed little or no change occurred in the population density since 1973 (23 FND). However, when compared to the high bullhead abundance in 1971 (329 FND) and 1972 (92 FND) the 1975 abundance was relatively low, indicating the lack of a predominant year class in the fishery. Individual year class abundance ranged from 5% to 50% in 1975 with two year classes comprising 83% of the total abundance of adult bullhead. Length-weight relationships did not differ significantly among years, indicating the relationship was independent of changes in population density. Condition factors for individual year classes in 1975 were similar. Ponderal indices for length groups varied widely, however there was no overall discernable annual trends. The average length of mature bullhead was 221 mm TL (8.7 inches), with a sex ratio in Spirit Lake of 1:1. Direct comparisons of annual abundances of bullhead, yellow perch and walleye for 1971-1973 and 1975 were not significant, indicating the overall abundance of each species was independent of each other.

The abundance index of 0-age bullhead in Spirit Lake and three connecting waters ranged from 331 FND to 1,325 FND. The seasonal abundance of young bullhead rose sharply during mid-summer, then decreased systematically through late summer and early autumn. Mortality of 0-age bullhead varied from 2% to 79%. Growth was most rapid between mid- and late summer, decreasing sharply in September and late autumn. Approximately 313,000 young bullhead immigrated into Spirit Lake from four connecting waters between mid-July and the first of November, with the period of peak immigration varying from late July and early August to late autumn.

APPROACH:

Job 1.

Title: Vital statistics of the black bullhead population in Spirit Lake

Objective:

To determine abundance, mortality, age-growth, length-weight relationships, condition factors, age at maturity and sex ratio of black bullhead in Spirit Lake.

Procedures:

1. Abundance indices and distribution of the bullhead population will be determined by fyke net sampling. Sampling will be conducted biweekly from June through August at 8 sites. Thirty-two fyke net days are required to achieve abundance indices with 95% precision and 80% accuracy.

2. Abundance indices will be computed directly from the transformed catch data by comparing catch statistics with the seasonal curve of availability.

3. Subsamples of bullhead will be weighed, measured, sexed and aged by conventional methods to provide statistics on age-growth, length-weight relationships, condition factors, age at maturity and sex ratio.

4. Relative strength of individual year classes will be determined from age data and abundance indices.

5. Mortality will be computed by a catch curve.

6. Past fish population surveys and other pertinent data including abundance of bullhead in 1971-73 will be reviewed, compiled and related to age and growth data to define previously recorded abundant year classes.

Job 2.

Title: 0-age black bullhead production in Spirit Lake and connecting waters

Objective:

To determine the numerical production and factors influencing production of bullhead in Spirit Lake and connecting waters.

Procedures:

1. Numerical density and production of 0-age bullhead populations in Spirit Lake and three connecting waters (East Hottes Lake, McClellands Slough, and Sanbar Slough) will be determined by fyke net sampling. Sampling will commence in June and continue biweekly through the first of September. If there are no water connections between the areas, sampling will be discontinued.

2. Catch data will be analyzed by factorial analysis of variance to determine the sources of variation in the catch data.

3. 0-age bullhead captured will be counted and released, with subsamples weighed and measured to determine the length-weight relationship and growth in each area.

4. Mortality will be computed directly from the catch data.

5. Water temperature, water level, turbidity, pH, alkalinity, and water hardness will be measured at each sampling interval in each area and correlated with the time of spawning and production.

6. Inlets of the connecting waters, including Little Spirit Lake, will be trapped from mid-summer thorugh autumn or until the water connection to Spirit Lake is broken, with modified hoop nets of 6.3 mm (1/4 inch) mesh to measure the number, size and time of 0-age bullhead immigrating into Spirit Lake.

7. Immigration counts will be used to derive the relative contributions from each area to the total bullhead year class abundance in Spirit Lake.

Job 3.

Title: Effects of fluctuating bullhead abundance on yellow perch and walleye populations

Objective:

To determine the effects of fluctuating bullhead abundance on yellow perch and walleye populations.

Procedures:

1. Relative abundance indices for yellow perch and walleye will be determined from the catch statistics in comparison with the seasonal curve of availability. Thirty-two fyke net days are required to achieve yellow perch indices with levels of 95% precision and 80% accuracy, with over 100 net days required to achieve similar levels of walleye abundance. Sampling will be conducted from June through August at biweekly intervals at 8 sites.

2. Subsamples of each species will be weighed and measured to compute the length-weight relationship and condition factors.

3. Growth will be determined by conventional measurements.

4. Relative year class strength will be determined from total abundance and age structure.

5. Total abundance and relative year class abundance of bullhead will be correlated with total and individual year class abundance of yellow perch and walleye.

6. Previous studies and other pertinent data including abundance of walleye and yellow perch from 1971-73 will be reviewed and compiled and related to similar bullhead to further define past relationships.

RESULTS OR BENEFITS EXPECTED:

Determination of life history parameters, abundance indices and the effects of fluctuating bullhead population abundance on other major sport fish species will provide necessary information to form a basis for defining management needs of the fishery resource. Knowledge about the bullhead production areas and their individual as well as combined contributions to the total year class abundance will supply one necessary key in effective management. With the development of a sampling method capable of accurately and precisely measuring year class abundance of young bullhead, the information will be available to effectively employ techniques for manipulating the abundance of 0-age bullhead and bullhead population abundance.

STUDY TITLE: Walleye Distribution, Movement and Seasonal Behavior in Spirit Lake

STUDY NUMBER:	103.1	LOCATION:	Spirit Lake Dickinson County
PROJECT LEADER:	Dick McWilliams	DURATION:	March, 1977-February, 1978

STATEMENT OF THE PROBLEM:

Angler exploitation of the Spirit Lake walleye fishery is intense, with the major portion of the harvest generally limited to spring, late autumn and winter. Annual exploitation of the fishery averaged nearly 29%, although exploitation of walleye > 20 inches total length averaged only up to 5%, with most of the larger walleye caught during the night time hours. These data revealed changes in walleye vulnerability to angling occurred, both diurnally and by size, although the causative factors, and whether directly related to changes in walleye movement and behavior are unknown. Studies of the walleye populations in Spirit Lake over the past two decades have defined the characteristics of most life history parameters, and has also revealed stocking of walleye sac-fry as a major factor in determining larval walleye density. However, the seasonal distribution and activity, and waht factors, both environmental and human, influence the distribution and activity patterns remain unknown.

STUDY OBJECTIVE:

To determine the seasonal distribution, movement and behavioral activity of mature walleye in Spirit Lake and relate these observations to walleye habitat selection, vulnerability to fishing, and factors that influence activity.

STUDY BACKGROUND:

Studies of walleye distribution and behavior in New York, Minnesota, Ohio and some Canadian provinces have documented the movement and behavior of walleye during the spawning season. Several studies have revealed a homing tendency during the spawning run, particularly in lakes and reservoirs where spawning occurs in tributary streams or rivers. Post-spawning movement and behavior is less understood. The eventual distribution of the spawning population was thought to mix throughout the lake or reservoir, but some evidence also indicated the spawning populations remained in discrete areas after spawning.

Preliminary results on walleye movement and behavior in Spirit Lake during 1976 revealed the establishment of a "home" area during late July, August and early September by a female walleye, with some movement during late autumn. However, seasonal activity and movement during late spring and early summer are unknown. Diel patterns indicated peak activity periods varied, but generally occurred between early evening and 2 AM, with a small secondary activity period about sunrise. Similarly, walleye in a Tennessee reservoir established home ranges, and returned to these areas even if physically displaced. Findings also revealed the extent of walleye movement and activity was negatively correlated with Secchi disc readings and positively correlated with water levels. Diel activity patterns revealed walleye were most active about 10 PM, with fish generally active between 6 PM and 6 AM. Contradictory movement and behavior patterns were reported for walleye in Minnesota, with tagged walleye in the Mississippi River and backwaters not establishing home ranges, but instead cruising over wide areas, seldom returning to the same areas. Walleye diel activity was bimodal, with peak activity occurring at sunrise and sunset. Findings indicate walleye movement and behavior may be different over a wide range of environmental conditions.

APPROACH:

Job 1.

Title: Walleye seasonal distribution, movement and behavioral activity

Objective:

To determine by ultrasonic tracking the seasonal distribution, behavioral activity, and movement of mature walleye in Spirit Lake.

Procedures:

1. Sun-Tronic Company ultrasonic transmitters with different frequencies and signal pulse rates will be surgically implanted into the abdominal cavity of eight, wild-trapped walleye. Both male and female walleye of different body sizes will be tagged.

2. Tracking will be conducted from ice breakup to November 1 or for as long as signal reception is maintained.

3. Daily and seasonal distribution and behavioral activity will be determined by locating and tracking individual fish for varied time intervals, with proportional time spent on each fish.

4. Location and movement of individual fish will be determined by triangulation and observation and plotted on a scaled map divided into locator grids, with each grid containing not less than 3 ha. Larger grid partitions will be developed if the behavioral pattern permits.

5. Selected fish will be continuously tracked at least once during a 24 hour period to determine diurnal activity.

6. Individual and composite behavioral activity will be defined directly from the ultrasonic tracking data.

7. Literature pertaining to walleye distribution and behavioral activity will be reviewed.

Job 2.

Title: Walleye habitat selection and factors affecting walleye distribution and behavioral activity

Objective:

To define walleye habitat selection and identify factors influencing distribution and behavior.

Procedures:

1. Habitat types and the habitat composition of Spirit Lake will be determined by detailed examination of hydrographic maps and direct field observations and sample collections.

2. Physical parameters; water temperature, water clarity using a Secchi disc, wind direction and velocity, and barometric pressure will be recorded daily in conjunction with the tracking of tagged fish.

3. Data on seasonal distribution and behavioral activity of walleye will be used to define the influence of the physical parameters, and also to determine the influence of major lake structures, both natural and man-made, and boating activity on walleye behavioral activity.

4. Pertinent literature on factors influencing walleye behavioral activity and distribution will be reviewed.

RESULTS AND BENEFITS EXPECTED:

Anglers will be one of the direct beneficiaries of findings from this study. Information on walleye daily and seasonal distribution and behavioral activity should provide anglers with additional opportunities in seeking this elusive sport fish species, particularly large sized fish. Findings will also be applicable to spring hatchery operations. Presently, brood fish are captured in traditional fishing areas. Information from this study will provide knowledge about the movement and activity of spawning walleyes in Spirit Lake, and will help increase the efficiency of the brood fish captured. Results will also expand the life history knowledge of this important sport fish and provide information applicable to future management programs in areas such as harvest or season regulations and habitat manipulations.

STUDY TITLE: Northern Pike Investigations - Mississippi River (NMFS Project 2-225-R)

STUDY NUMBER: 303.3

LOCATION: Mississippi River with special reference to Pools 9, 10, 13 and 14

PROJECT LEADER: Tom Gengerke

DURATION: 1 April, 1974-30 June, 1977

STATEMENT OF THE PROBLEM:

Northern pike were commercially harvested until 1959, when pressure from sport angler groups and discussion through the Upper Mississippi River Conservation Committee (UMRCC) toward regulation uniformity resulted in closing the fishery. Spring trap net catches in Pool 9 by the Lansing Fish Hatchery from 1955-59 compared with 1964-70 showed no significant difference in catch effort. There was no discernable difference in length frequency or age distribution of northern pike between Pools 7 and 9. Pool 7 is located between Minnesota and Wisconsin and was not subjected to commercial exploitation. Sport fishing surveys indicated few northern pike are caught by anglers. A vast segment of mortality in northern pike populations is attributable to natural causes. The harvest and market potenital of this fish species and its life history in the river are needed to determine the feasability for permitting commercial utilization.

STUDY OBJECTIVE:

To determine the commercial harvest and marketing potential of northern pike in the upper Mississippi River bordering Iowa and determine the vital biological statistics of this species in selected pools of the river.

STUDY BACKGROUND:

Substantially large populations of northern pike are known to exist in the Mississippi River bordering Iowa, particularly in the upper pools. The Iowa Conservation Commission took 2-3,000 northern pike for spawning each spring in the vicinity of Lansing in Pool 9. Surveys and fish distribution records by Cleary, Nord and others in annual reports of the UMRCC indicated northern pike are indigenous to all pools of the Mississippi River along this state. Relative abundance diminishes in a downstream direction and high populations are rare south of Dubuque, Iowa.

APPROACH:

Job 1.

Title: Life history investigation of northern pike

Objective:

To determine natural and fishing mortality, growth in length and weight, age and size at maturity, fecundity, age structure, seasonal movement and behavioral activity of northern pike in Pools 9, 10, 13 and 14 of the Mississippi River.

Procedures:

1. Fish collections will be accomplished in several periods of the open water season with trap nets and supplemented by electrofishing and trammel net samples.

2. Northern pike will be marked and tagged with numbered Floy anchor tags in the spring spawning season at the minimum rate of 300 in Pool 9 and 100 each in Pools 10, 13 and 14. In the event the number of tagged fish is below the minimum value, the entire number captured will be tagged in each pool.

3. Fish tagged in Pool 9 will be further identified by excision of various fin combinations to determine mortality from tagging and tag retention in the following manner: (a) mortality from tagging will be determined from the ratio of right fins clipped to left fins clipped in recaptured fish; (b) tag retention will be established from the ratio of fish recovered with and without tags which have left fins clipped; (c) pelvic fins will be clipped in 1974 and pectoral fins will be clipped in 1975.

4. Mortality attributed to the sport fishery will be determined from tags returned by anglers.

5. Total annual mortality will be determined from age structure and recaptured tagged fish.

6. Body length and weight along with scale samples will be collected from all tagged fish prior to release. Age of individual fish will be determined by microprojection procedures using plastic scale impressions.

7. Growth in length and weight, length-weight relationship and coefficient of condition will be determined for each sex.

8. Age and size at maturity will be determined by external visual examination of fish captured during the spawning season.

9. Fecundity will be determined by volumetric measurement of ova samples collected from female northern pike at 25 mm size range intervals. Fecundity by body size and age will be established by regression analysis.

10. Direction and extent of seasonal movement will be determined directly from tags returned by fishermen and in net surveys.

Job 2.

Title: Marketing potential of northern pike

Objective:

To determine the commercial market potential of northern pike for food fish by evaluation of market demand and determination of the monetary value; examination of processing procedures including the loss of weight through processing and change in value to processing; and analysis of flesh for mercury and pesticide concentrations to discern the suitability of northern pike for marketing as a wholesome food product.

Procedures:

1. Major food fish markets along the upper Mississippi River in Iowa will be contacted to inquire about the wholesale and retail demand for northern pike and determine seasonal values of this fish species.

2. Licensed commercial fishermen in Iowa will be contacted to evaluate interest in returning this species to the commercial food fish list.

3. A literature search will be made to document known concentrations of heavy metals, especially mercury and chlorinated hydrocarbon pesticides in northern pike from the Mississippi River. In the absence of applicable literature, fresh samples will be collected and analyzed for mercury and pesticides in Pool 9.

4. Weight loss and the change in value associated with market processing will be determined for various sizes by applying commercial market value.

Job 3.

Title: Harvest potential of northern pike

Objective:

To review commercial fish harvest statistics from statutory commerical fishermen reports and compile a list of abundance and distribution of the commercial catch.

Procedures:

1. Commercial harvest statistics prior to 1959 will be summarized by pool and season for as far back as records are available.

2. Some commercial fishermen maintain daily logs of fishing activity. Efforts will be made to examine these documents prior to 1959 to ascertain northern pike harvest.

3. Catch rates will be analyzed to determine relative abundance of northern pike between pools and potential catch effort.

RESULTS OR BENEFITS EXPECTED:

The research findings will be used primarily to achieve the following three interrelated goals: evaluate the commercial fishing potential of northern pike and obtain legislative support for re-opening the fishery; estimate potential harvest and value of the fishery; and collect the population statistics necessary to regulate a sustained commercial harvest.

STUDY TITLE: Paddlefish Investigations - Mississippi River
(NMFS Project 2-255-R)

STUDY NUMBER: 304.3 LOCATION: Mississippi River

PROJECT LEADER: Tom Gengerke DURATION: 1 Jan, 1975-30 Sept, 1978

STATEMENT OF THE PROBLEM:

Iowa has allowed unregulated commercial harvest of paddlefish in the Mississippi River. Total harvest has approached 30,000 lbs during high catch years. In 1974, a snag fishery was legalized which increased exploitation significantly and utilization of paddelfish appeared to accelerate greatly after initiation of the fishery. Exploitation rate, harvest potential and the computability of this species to fit into both a sport and commercial fishery in the upper Mississippi River is unknown. A comprehensive assessment of the impact of increased harvest of paddlefish population is vital to implementation of suitable regulations.

STUDY OBJECTIVE:

To determine exploitation and harvest potential of paddlefish in the Mississippi River and collect basic life history infomration from which applicable regulations can be devised in all regions of the river.

STUDY BACKGROUND:

Paddlefish harvest in the Mississippi River has been low because of severe restrictions on capture methods. Pole and line snagging was illegal until 1974 and commercial fishermen took few with entrapment gear. In general, the supply as a commercial food fish has been far below the potential market demand. Illinois liberalized the method of capture in 1974 to include snagging and as a result harvest increased many times over previous levels. Some of the fish were kept by fishermen for personal consumption, but many were commercially marketed as food fish. Iowa established a snagging season in late autumn 1974 which will increase harvest of paddlefish. Most of the catch will probably be marketed as food fish when the initial novelty of the fishery has passed.

APPROACH:

Job 1.

Title: Paddlefish life history and harvest inventory

Objective:

To compile vital statistics of paddlefish with emphasis on fishing mortality, population size, seasonal movement, diel activity, growth, maturity, fecundity and age structure.

Procedure:

1. Paddlefish taken by conventional commercial harvest methods and by pole and line snagging will be examined at major Mississippi River commercial markets and landings bordering Iowa. A minimum goal of 500 fish during the three year study period will provide a statistically reliable sample size. In case this goal cannot be achieved the entire sample size will be used for evaluation.

2. The fish will be examined to determine sex, maturity, and fecundity; weighed, measured and the dentary bones removed.

3. Aging of individual specimens will be accomplished by the usual microprojection procedures using sectioned dentary bones.

4. Total annual mortality will be determined from age structure.

5. Body growth in length, weight and the length-weight relationship and coefficient of condition for each sex will be determined using standard procedures.

6. A minimum of 300 fish captured by snagging and large mesh gill nets will be tagged and released in the tailwaters of Lock and Dam 12 at a rate of 25-50 each month with numbered Floy-type dart tags attached in the rostrum. In the event the minimum goal is unattainable all fish captured will be tagged and released. Alternate paddlefish will be additionally marked by notching pectoral and pelvic fins to determine the occurrence of tag loss.

7. Returned tags will be used to calculate mortality from different sources; i.e., conventional commercial fishing gear or snag fishing, determine fish movement, and estimate the numerical population size.

8. Localized movement and diel activity will be determined by attaching small floats to a small number of individual fish and making direct observations of their activity.

9. Supplemental vital statistics, such as the incidence of lamprey scarring and attachment will also be noted.

Job 2.

Title: Commercial catch statistics and economic value of paddlefish

Objective:

To review and compile the commercial catch statistics of paddlefish in the upper Mississippi River basin and evaluate changes in the value of paddlefish during conventional processing for food.

Procedures:

1. Commercial catch statistics reported in Quarterly Biology Reports, Job Completion Reports of the Iowa Conservation Commission and Annual Reports of the UMRCC will be examined to inventory the harvest of paddlefish since inception of the reporting system. Wisconsin, Minnesota and Illinois will also be requested to provide catch statistics to ascertain total harvest from the upper river basin. Records for the past 20 years will be examined.

2. Changes in weight and value of paddlefish during market processing will be determined by weighing samples of fish during each step of the process and applying average monetary values.

RESULTS OR BENEFITS EXPECTED:

The findings of this study will provide the biological information needed to properly regulate the harvest of paddlefish. A pole and line snag-type fishery was initiated without much knowledge of abundance and distribution of paddlefish in the river. The study will also provide useful information in evaluating the impact of this fishery on paddlefish populations. Life history studies will provide the data necessary to predict the potential harvest of paddlefish.

STUDY TITLE: Assessment of Change in Commercial Size Limit of Channel Catfish (NMFS Project No. Unknown)

STUDY NUMBER: 305.1 LOCATION: Mississippi River

PROJECT LEADER: Tom Gengerke DURATION: 1 Oct, 1977-30 Sept, 1981

STATEMENT OF THE PROBLEM:

Periodic over-exploitation by commercial fishing of channel catfish has been documented in the Mississippi River. As a result of nearly total harvest of the population 13 inches in body length or greater many immature fish are lost via the fishery. The fishery is wholly dependent upon year class abundance and fluctuations in year class strength is reflected in the harvest during subsequent seasons. Enabling legislation to permit change in the minimum size limit from 13 inches to a larger size has been submitted. Catfish consistantly rank high in the commercial fishery in the Mississippi River and alteration in harvest regulations would have significant impact upon the fishery. The proposed minimum size limit is 15 inches to restrict the harvest to about 50% mature fish, but this size met opposition with most commercial fishermen because of the loss of marketable sized fish to restaurants that promote "individual serving" sized catfish. Previous catfish studies indicated a two inch increase in the minimum size limit would result in fewer but larger fish, but reflecting an increase in the weight harvested. Assessment of the effects of increasing the minimum size limit is important to regulating over-exploitation by the fishery.

STUDY OBJECTIVE:

To assess the effectiveness of increasing the 13-inch minimum size limit to 15 inches for commercial channel catfish to prevent over-exploitation and develop size regulations to obtain optimum harvest of this resource in the Mississippi River.

STUDY BACKGROUND:

Channel catfish are a very valuable product of the commercial food fishery along the Mississippi River. Commercial fishermen market 200-400 thousand pounds each year that have a wholesale value of $130,000-$260,000.

Catfish investigations during the 1960's documented periodic over-exploitation of this resource in sections of the river bordering Iowa. Catfish are harvested rapidly after attaining the 13-inch minimum size limit with over 70% of the commercial catch comprised of fish 15 inches or less on the average. In some years more than 90% of the fish marketed were 15 inches or less. The fishery is strongly dependent upon year class

abundance; age IV fish make up a large portion of the early season fishery and age III fish contribute significantly in autumn. Weak year classes result in wide harvest fluctuations.

Increasing the minimum size limit to 15 inches was recommended in 1969 throughout the upper Mississippi River. This size was selected mainly because it conformed closely with existing regulations in several contiguous states. Missouri, Minnesota and Wisconsin, bordering with Minnesota had a 15-inch size limit while the minimum legal size in Iowa, Illinois and Wisconsin, bordering Iowa was 13 inches.

Legislation was completed in Illinois during 1976, but enforcement of the statute continues impractical without uniform regulations between adjoining states. Legislation to enable Iowa to set a 15-inch minimum size limit is expected from the current General Assembly.

The projected effects of a 15-inch minimum size limit on the commercial harvest of channel catfish are a 10% decrease in the numerical catch and a 30% increase in harvest weight, after a brief transition period to allow for the two inches of additional growth. These values are adjusted for the natural mortality occurring during fish recruitment into larger size limit. Natural reproduction potential will increase significantly since few catfish mature before reaching 13 inches in all sections of the river and about 50% attain maturity at 15 inches.

APPROACH:

Job 1.

Title: Response of the commercial catfishery to an increased minimum size limit

Objective:

To compare the catch statistics, harvest, age composition, size structure and market value of the commercial channel catfish fishery following an increase from 13 to 15 inches in the minimum size limit.

Procedure:

1. Following implementation of a 15-inch size limit on commercial catfish catch statistics and harvest data will be compiled from the mandatory monthly licensed commercial fishermen reports to compare the harvest with previous years with a 13-inch size limit.

2. A minimum of 500 fish will be sampled from each pool twice each year during spawning (May-June) and late summer (August-September).

3. Randomly sampled catfish will be measured in total body length to determine length frequency and size structure of the marketed fish.

4. Sub-samples of 5 fish in each .5 inch interval will be weighed and a pectoral spine collected for aging and determination of the age structure.

5. Age and size distribution under the new size regulation will be determined by collecting statistics at commercial markets and landings in Pools 9, 11, 13 and 18.

6. Market value and sales distribution will be evaluated by personal interview with commercial fishermen landing more than 500 lbs of catfish each year and at wholesale markets.

7. Market value, sales volume and market demand for the larger catfish will be determined from the fish size and market condition for live, whole and dressed catfish.

Job 2.

Title: Response of catfish populations to change in the minimum size limit

Objective:

To determine changes in the abundance of young-of-the-year, stability in year class strength, growth and mortality rate in catfish populations following an increase from 13 to 15 inches in the minimum size limit of commercial catfish.

Procedures:

1. Production of young-of-the-year catfish will be assessed in Pools 9, 11 and 18 by standardized sampling methods using a 50 ft small mesh drag seine and a 16 ft semi-balloon otter trawl.

2. Sampling locations and the experimental design will conform with those in a previous commercial catfish study that sampled young-of-the-year populations and will consist of 25 seine hauls and 15 trawl tows at one month intervals from August through October in Pools 9, 13 and 18.

3. Relative abundance and size structure of young-of-the-year populations will be compared each year in Pools 9, 13 and 18.

4. Sub-adult catfish populations will be sampled with bait nets containing 3/4 inch mesh in Pools 9, 13 and 18 during May, July and September each month and will consist of 48 net days.

5. All captured catfish will be measured to the nearest .1 inch body length and a randomly selected subsample of 10 in each 1-inch interval individually weighed to the nearest .01 lbs and a pectoral spine removed for aging and growth determination.

6. Age distribution of the populations will be extrapolated from the subsample to compute mortality directly from the geometric change in age structure and compared with previous years.

Job 3.

Title: Potential Commercial Harvest of Catfish in Pool 13

Objective:

To determine the potential equilibrium harvest of channel catfish by commercial fishing in Pool 13 of the Mississippi River with a 15-inch minimum size limit.

Procedures:

1. Potential equilibrium harvest will be determined in Pool 13 of the Mississippi River by the Beverton and Holt yield model.

2. Age at exploitation at the 15-inch minimum size limit will be determined from the age structure of catfish sampled in commercial landings and markets.

3. Instantaneous total mortality will be computed from the geometric change in the age composition of catfish sampled.

4. Two thousand channel catfish 12-inches or longer will be marked by fin excision in Pool 13 to determine exploitation via the fishery and population density.

5. Mortality attributable to commercial fishing will be partitioned from total mortality directly from tag returns in the commercial catch.

6. A population estimate using a multiple census technique without replacement will be completed for channel catfish in Pool 13.

7. Instantaneous growth will be computed for the catfish population in Pool 13 by the Walford transformation procedure.

RESULTS AND BENEFITS EXPECTED:

Results of the study will form the basis for adjusting size regulations on commercial catfish in the Mississippi River to permit stable harvest without periodic over-exploitation. Total value of the fishery will increase since weight will increase by about 30%. Year class abundance will increase and stabilize because 50% of the female catfish captured will be mature compared to 10% at present. An estimate of potential yield in one pool will further serve to assess the regulation of the fishery by a minimum size limit.

STUDY TITLE: Evaluation of the Split Season Stocking Method in Iowa Farm Ponds (D-J Project F-88-R)

STUDY NUMBER: 403.3 LOCATION: Experimental ponds in Adair, Cass, & Guthrie Counties

PROJECT LEADER: Kay Hill DURATION: July, 1977-November, 1979

STATEMENT OF THE PROBLEM:

A split season stocking schedule of largemouth bass, channel catfish and bluegill was initiated four years ago in Iowa farm ponds. The two-fold purpose of the program was to prevent the missing year class of natural bass production in the second year that occurred with simultaneous stocking schedules and to more efficiently use hatchery produced fish by double production in rearing facilities. Successful reproduction of bass was found in only three of 28 ponds surveyed in the second year. The split stocking method coincided well with hatchery production scehdules.

Two alternatives to the probem are possible. First, reduce the stocking density of bass from 100/surface acre to 70/surface acre which would result in a numerical population density of 35/surface acre at age I following the expected 50% annual mortality. Accelerated growth resulting from the density reduction would result in increased maturity. Second, two successive plantings of fingerling bass; initially at a density of 75/surface acre wouuld be followed by 150/surface acre in the second year. Exact consequences of the failure of bass to reproduce at age I to the multispecies population is unknown and should be determined.

STUDY OBJECTIVE:

To provide for largemouth bass reproduction in farm ponds in the second year of life by altering stocking density to 70 bass/surface acre and continue to monitor two experimental ponds stocked at 100 bass/surface acre to determine age and size of bass at maturity.

STUDY BACKGROUND:

The split stocking schedule for Iowa farm ponds involves stocking bluegill in late autumn with a largemouth bass fingerling stocking the following June. With the stocking of bass fingerlings prior to the bluegill reproduction, a predator population is established to control the initial bluegill hatch and the established bass population would be less dependent on a single age class which is highly vulnerable to fishing mortality.

Previous investigation demonstrated the split stocking method does not work as expected and should be altered to attain two consecutive year classes of bass after initial stocking. The split stocking evaluation revealed bass spawned as age I fish in 1 of 9 study ponds but failed to establish a year class. Bluegill spawned in July as age I fish and in

late May and June as age II fish. Annual estimated mortality rate of initially stocked bluegill and bass was 60% and 53%, respectively. Largemouth bass did not grow sufficiently to achieve maturity as age I fish. Studies in Missouri have shown poor reproduction from age I bass if standing crops are over 40 bass/surface acre. Stocking 70 bass/surface acre subjected to 50% annual mortality would yield a standing crop of 35 age I bass/acre that would have grown sufficiently to be sexually mature.

APPROACH:

Job 1.

Title: Alteration of the split stocking method

Objective:

To develop a farm pond stocking strategy that will provide for two consecutive year classes of largemouth bass by reducing the intial stocking density to 70 bass/surface acre.

Procedures:

1. Five experimental ponds that meet the minimum physical requirement of the Iowa Conservation Commission will be stocked with fish at the following density and schedule: 1,000 bluegill fingerling and 100 channel catfish fingerling per surface acre in October, 1976; 70 largemouth bass fingerling/surface acre, June, 1977.

2. Fish populations will be sampled by electrofishing and small mesh seine hauls twice each month from April through November each year.

3. Captured bass 100 mm in length or larger will be individually measured and weighed. Smaller fish will be measured in length, but weighed in aggregate.

4. Mortality of stocked bass will be assessed by the geometric change in catch effort during the sampling schedule.

5. Bass reproduction success in the second year will be determined by sampling each pond twice each month with a .5 m tow net and small mesh seine.

6. Ovary samples will be collected from 4 female bass each month during the second year to determine maturity.

7. Ova counts will be made in three, .1 gm aliquots to establish fecundity of the age I bass.

8. Probit analysis will be used to determine the relationship between bass fecundity, sexual maturity, size, and age of female bass.

Job 2.

Title: Long-term development of the split stocking schedule

Objective:

To monitor fish populations in two experimental ponds split season stocked with 1,000 fingerling bluegill, 100 fingerling channel catfish and 100 fingerling bass/surface acre and determine the long-term effects of this schedule on relative abundance, size structure of bluegill and largemouth bass and fecundity and age of maturity of largemouth bass.

Procedures:

1. Two experimental ponds stocked in 1975 with a split season schedule will be sampled by electrofishing and small mesh seine hauls once each month from April through November each year.

2. All captured fish larger than 75 mm total length will be measured to determine length frequency distribution and size structure.

3. The percent of bluegill larger than 3 inches (total length) that are 6 inches or larger and the bass 8 inches in length or greater that are 12 inches or longer will be computed.

4. Relative abundance of bluegill and bass will be computed as catch per unit effort with both types of sampling gear.

5. Bass reproduction success will be determined by sampling each pond twice each month from April through June each year with a .5 m tow net and small mesh seine.

6. Ovary samples along with length and weights will be collected from 4 female bass each month from April through June to determine maturity.

7. Ova counts will be made in three .1 gr aliquots to determine fecundity of age II and III bass.

8. Only ova larger than .71 mm in diameter will be considered mature.

9. Probit analysis will be used to determine the relationship between fecundity, seasonal maturity, size, and age of female bass.

RESULTS AND BENEFITS EXPECTED:

The success of the farm pond split stocking method resulting in a better predator-prey relationship depends on sufficient largemouth bass growth to reach sexual maturity and establish an additional year class of bass in the second year following stocking. With the initial stocking of bass to control initial bluegill reproduction and bass reproduction to control bluegill reproduction in the second year, a better predator-prey relationship is established. In addition the bass population would be less dependent on a single age class which is highly vulnerable to angling mortality. The reduced stocking density of bass should result in better bass growth and sufficient sexual maturity of age I bass to establish an additional bass year class.

The monitoring of two study ponds stocked by the original split-stocking method will reveal the success or failure of age II bass in establishing an additional bass year class. Continued monitoring after populations have stablized will disclose the success of both population to reach desired bass and bluegill size structure.

Results from both jobs will result in the most efficient use of hatchery facilities in our farm pond program and enable fisheries managers to better manage farm ponds and small lakes stocked with bass and bluegill.

STUDY TITLE: Manipulation of Bass-Bluegill Populations By Summer Drawdown (D-J Project F-88-R)

STUDY NUMBER: 407.1 LOCATION: Meadow Lake, Adair County

PROJECT LEADER: Kay Hill DURATION: May, 1977-November, 1980

STATEMENT OF THE PROBLEM:

Bluegill do not achieve acceptable angling size in many Iowa man-made recreational lakes containing bass-bluegill populations due to high population density and inadequate forage. The minimum acceptable size structure is 20-35% of the bluegill population 3-inches or greater in length are 6-inches in length or longer and 45-65% of the bass population 8-inches in length or greater are 12-inches or longer. Population reduction is the common procedure used to improve size structure. Summer drawdown of the water level to concentrate forage sized bluegill into the reduced water volume, thereby increasing vulnerability to predation, has been explored briefly for population manipulation. However, the frequency and magnitude of water level drawdown needed to achieve the acceptable size structure, as well as the effect of summer drawdown on other fish population parameters including abundance, growth and mortality are unknown.

STUDY OBJECTIVE:

To manipulate the proportional stock density of a largemouth bass-bluegill population so 20-35% of the bluegill greater than 3-inches in length are 6-inches or longer and 45-65% of the bass 8-inches in length or greater are 12-inches or longer by reducing the water volume 50% in Meadow Lake in mid-summer.

STUDY BACKGROUND:

The summer drawdown consists of reducing the lake water volume in July and August to concentrate fish populations and increase mortality by predation and thus alter fish populations and size structures. Young-of-year bluegill and age I bluegill need predation to reduce their numbers sufficiently so adequate bluegill growth is achieved and they reach acceptable angler size (6-inches).

Meadow Lake is a 38-acre recreation lake located in Adair County, owned by the Iowa Conservation Commission. It was constructed in 1964 with Federal Aid funds. Meadow Lake was surveyed by fisheries managers in 1971, 1972, and 1974. The 1971 survey showed bluegill were not reaching 6-inches until age III. The 1972 survey revealed bluegill were not entering the creel until age IV and the 1974 survey supported the 1973 findings. With the slow bluegill growth in Meadow Lake most bluegill are age IV or V before they enter the creel (6-inches). The 1973 survey revealed 86% of the 3.0-inch and larger bluegill were 6-inches or larger, and bass over 12-inches scarce. This data shows an abundance of large bluegill, but most were age IV, V, and VI and it is unlikely they are still living at the

present time. Winter fishing creel surveys in 1976 indicate the bluegill population is largely composed of 3-to 4-inch bluegill.

A summer drawdown will concentrate the fish populations and make the 3-to 4-inch bluegill more vulnerable to bass predation, and result in increased bluegill growth rates, better bass growth and a more desirable bass and bluegill population size structure.

APPROACH:

Job 1.

Title: Bass-bluegill population characteristic prior to summer drawdown

Objective:

To determine the abundance, size structure, age composition and growth in bass-bluegill populations prior to a mid-summer reduction of 50% in the lake water volume.

Procedures:

1. Samples of largemouth bass and bluegill populations will be collected each month at Meadow Lake by electrofishing and pound nets from May through October, 1977.

2. All captured fish will be measured in total length to establish a length-frequency distribuiton and 20% of the sample weighed.

3. The percent of bluegill more than 3-inches in total length that are 6-inches or longer and the bass 8-inches in length or greater that are 12-inches or longer will be computed.

4. Scale samples will be collected from 35 bluegill and 20 bass each month for aging and determination of the age composition of each population.

5. Relative abundance of bluegill and bass will be computed as catch per unit effort with both types of sampling gear.

6. Growth of bluegill and bass will be determined from scale measurements using an age and growth computer program.

Job 2.

Title: Water level reduction in Meadow Lake

Objective:

To reduce the water volume by 50% during July and August to manipulate the size structure of bass-bluegill populations in Meadow Lake.

Procedures:

1. Obtain necessary permits from the Iowa Natural Resources Council for drainage.

2. Contact land owners downstream from Meadow Lake to advise them that increase flow will pass through their land.

3. Conduct public relations program informing interested public of project and objectives.

4. Remove stop-log structure by 5 ft to reduce the water volume by 50%.

Job 3.

Title: Assessment of summer drawdown of bass-bluegill populations

Objective:

To assess the impact of 50% water volume reduction in mid-summer on the abundance, size structure, age composition and growth of bass-bluegill populations.

Procedures:

1. Samples of the largemouth bass-bluegill populations in Meadow Lake will be collected each month by electrofishing and pound nets from May through October for two years following a 50% water volume reduction in mid-summer.

2. All captured fish will be measured in total length to establish a length-frequency distribution and 20% of the sample will be weighed.

3. The percent of bluegill 3-inches or greater in length that are 6-inches or longer and the bass 8-inches or greater in length that are 12-inches or longer will be computed.

4. The minimum values acceptable in the size structure of bass-bluegill populations will be 20-35% for bluegill and 45-65% for bass.

5. Scale samples will be collected each month from 35 bluegill and 20 bass for aging and determination of age composition of each populations.

6. Relative abundance of bluegill and bass will be measured as catch per unit effort from both types of sampling gear and directly compared with pre-drawdown values.

7. Growth of bluegill and bass will be determined from scale measurements using an age and growth computer program and directly compared with pre-drawdown values.

RESULTS AND BENEFITS EXPECTED:

Typically bluegill in small lakes of Iowa are too numerous for available food, resulting in slow growth and small sized fish. Attempts to change the size structure of bass and bluegill populations has consisted of total or partial renovations followed by fish stocking. The summer drawdown will concentrate fish populations and make small bluegill more vulnerable to bass predation resulting in accelerated bluegill and bass growth because of reduced bluegill numbers and more bass forage. The increased predation should change the size structure of bass and bluegill populations towards a more optimum relationship. Drawdowns, although not applicable to all lakes could be used as a management tool which would produce better fishing more economically than the previously used management practices in lakes with slow-growing bluegill.

STUDY TITLE: Biological Control of Nuisance Aquatic Vegetation by Grass Carp (D-J Project F-88-R)

STUDY NUMBER: 504.5 LOCATION: Red Haw Lake, Lucas County

PROJECT LEADER: Larry Mitzner DURATION: January, 1977-June, 1979

STATEMENT OF THE PROBLEM:

Grass carp have reduced nuisance aquatic vegetation by nearly 90% at Red Haw Lake since 1973. Long-term effects of biocontrol on water quality remain unresolved. Continued use of grass carp to control vegetation at levels of 80% or greater, particularly for extended periods, might have deleterious effects on water quality even more serious than the macrophyte problem. Additional information is needed to determine the magnitude and extent of change in water quality and phytoplankton associated with control of vegetation by grass carp.

STUDY OBJECTIVE:

To assess the long-term impact of biological vegetation control by grass carp on water quality and primary production of phytoplankton at Red Haw Lake.

STUDY BACKGROUND:

Mean annual biomass of aquatic macrophytes decreased from 1.6 kg/m^2 in July, 1973 when grass carp were introduced to .2 kg/m^2 in 1976. During the study period grass carp consumed *Potamogeton*, *Elodea*, *Ceratophyllum* and *Najas* accounting for 45-88 metric tons of vegetation annually. Vast quantities of egesta had no apparent detrimental effect on water quality or phytoplankton, but some fo the results appeared contradictory. Alkalinity increased significantly between 1974 and 1975, while primary production remained nearly constant. In 1976 mean annual primary production decreased 35% from 1975, but alkalinity remained at levels measured in 1975. Phosphates, nitrates, nitrites, biological oxygen demand and turbidity fluctuated between years, but annual means were not significantly different. The most important change at Red Haw Lake was the 90% reduction in vegetation which greatly benefited shore fishermen. Shore fishing effort increased nearly 2.5-fold from 1974-1975 while total catch by shore fishermen increased 15%.

APPROACH:

Job 1.

Title: Aquatic macrophyte standing crop, primary productivity and water quality at Red Haw Lake

Objective:

To measure the biomass of aquatic macrophytes, primary production of phytoplankton and water quality at Red Haw Lake.

Procedures:

1. Vegetation samples will be collected monthly from May-September at 10 sites. Samples will be collected by divers equipped with SCUBA using a frame enclosure 38 mm deep and .5 m on each side. Wet weights will be measured immediately and the entire sample preserved for sorting and identification.

2. Standing crop of each taxa will be estimated as the product of mean sample weight and total area of unsampled vegetation.

3. The plant community will be mapped monthly from May-September to determine the extent and area of plant growth along the shoreline. Depths at the outer perimeter of vegetation growth will be recorded at 50-200 mm intervals. Values will be transposed to a hydrographic mpa so the area of the plant community can be determined by planimetry.

4. Primary production will be determined monthly at 1 m intervals in a 5 m column by the light-dark bottle method.

5. Water samples at the surface, 4 m and 8 m strata will be analyzed each month to determine alkalinity, phosphates, nitrates, nitrites, turbidity, pH, biological oxygen demand, dissolved oxygen and temperature at a single location near the dam.

RESULTS OR BENEFITS EXPECTED:

Findings of this investigation will provide information required to develop a comprehensive management plan to use grass carp for vegetation control in a long-term program. The investigation since 1973 has shown many benefits with no detrimental effects; yet there have been subtle changes in some water quality parameters at Red Haw Lake that indicate long-term effects may be less beneficial. Continued investigation of vegetation control by grass carp will determine, first, if there are undesirable effects on water quality and second, what is the nature, extent and magnitude of these conditions compared to the benefits.

STUDY TITLE: Inter-Relationships of Forage Fish Species and Predator Populations at Lake Rathbun
(D-J Project F-88-R)

STUDY NUMBER: 506.1 LOCATION: Lake Rathbun

PROJECT LEADER: Larry Mitzner DURATION: April, 1977-Oct, 1979

STATEMENT OF THE PROBLEM:

The fish population in Lake Rathbun is characterized by a high diversity of predatory species and a low diversity of forage species. Factors related to floodwater control regimens that influece the production of forage fish have been identified and rationale developed for controlling forage abundance. The next step is to formulate a program that will ensure maximum utilization of the forage fish population by predatory fishes; yet there are certain elements required before initiation of an effective management program. These are: determination of forage fish density and size structure; determination of predator fish population abundance and size structure; and the relationship between these two groups of fish.

STUDY OBJECTIVE:

To increase utilization of forage fish by the predator population in Lake Rathbun by implementing fish management programs and water regimens that will control the diversity, abundance and size structure of forage fish.

STUDY BACKGROUND:

Preimpoundment investigations of the Chariton River in the vicinity of Rathbun Lake were conducted in 1964-1968 followed by chemical renovation of fish populations in the watershed prior to impoundment in November, 1969. Investigations were initiated in 1971 to identify physical and chemical factors that influence the abundance of age 0 fish.

Preliminary findings showed strongest year classes of shad, crappie and bluegill occurred in 1973 when flushing rate was lowest, and storage and discharge greatest. Storage volume was not directly related to production, but was indirectly associated with age 0 fish abundance. Reservoir flushing rate was the most important factor influencing the abundance of forage.

Stocking of predator fish at Rathbun has resulted in white bass establishing naturally sustained populations while other species such as walleye and largemouth bass continue to decrease in abundance. Walleye fry and striped bass fingerling are stocked annually and five-inch largemouth bass fingerlings will be stocked in 1977.

Compared with other reservoirs in Iowa, Rathbun has a larger percentage of predators. In 1972-1975 predator species accounted for 33-67% of the sample by weight compared to Red Rock Lake where 12-33% of the catch were predators and at Coralville 8-14% of the biomass were predators.

Forage populations at Rathbun are dominated by shad accounting for 85% of the abundance in meter net and seine haul samples. The remainder were centrarchids and cyprinids.

APPROACH:

Job 1.

Title: Abundance, distribution and size structure of forage populations at Lake Rathbun

Job Leader: Larry Squibb

Objective:

To determine the abundance, distribution and size structure of forage fish populations in Lake Rathbun.

Procedures:

1. Forage population abundance will be estimated each year during June-September by trawling and in August by cove rotenone samples.

2. Numerical catch of forage fish in trawl samples will be determined biweekly at five stations. Two stations will be located in Buck Creek embayment and three in the main pool. Embayment stations will be located at the connecting channel and adjacent to the public use area. Pool stations will be near the dam, in mid-reservoir and in the upper reservoir. Latter stations will be sampled at mid-depth and near the bottom.

3. Six coves will be sampled in August each year. Two stations will be located in the upper reservoir, two at mid-reservoir, one near the dam and one in Buck Creek embayment. The coves will be blocked by nets, rotenone applied at 3 ppm and the fish picked up and enumerated for three consecutive days.

4. Size distributions of fish by both sampling methods will be determined for each species by measuring the aggregate weight and lengths of 25 fish (or the whole sample if $N < 25$) during each period. Fish measurements from rotenone samples will be taken only on the first day of recovery.

5. Forage fish population abundance will be estimated for each period by volumetric extrapolation using the catch means from trawl samples and the fraction of the lake volume sampled. If the fish population is unevenly distributed the estimate will be adjusted by weighted volume fractions.

6. Forage abundance in the lake will be expanded from cove sample counts by applying correction factors already determined in other reservoirs.

7. Forage biomass will be estimated for both sampling methods as the product of mean weight and population abundance.

Job 2.

Title: Abundance of predator populations at Lake Rathbun

Job Leader: Leo Schlunz

Objective:

To determine population abundance and size structure of predatory fish in Lake Rathbun.

Procedures:

1. Abundance of walleye, largemouth bass, white bass, crappie and channel catfish will be estimated by the Schnabel mark and recapture technique in Buck Creek embayment and by cove rotenone sampling in the pool.

2. Fyke nets and electrofishing will be used to capture fish for mark-recapture; fish will be marked by fin excision. The estimate will commence at ice-off and continue through August or until 90% accuracy is attained.

3. Emigration of marked fish from the embayment will be estimated by differential marking of fish at .5 mile increments from the connecting channel to adjust for dilution of the marked population.

4. Population estimates of predatory species in the pool will be estimated by cove rotenone samples in August.

5. Length and weight measurements will be recorded each month for 25 fish of each species (or the whole sample if $N < 25$).

6. Predator biomass will be estimated for both sampling methods as the product of mean weight and population abundance.

Job 3.

Title: Utilization of the forage fish population by predators in Lake Rathbun

Objective:

To determine the quantity and size of forage fish species consumed by predatory fish in Lake Rathbun.

Procedures:

1. Stomach content samples from ten fish of each predatory species will be collected biweekly from May-September and preserved in 5% formalin for laboratory analysis.

2. Fish will be collected by electrofishing. Fyke nets will be used to capture channel catfish with nets checked at two hour intervals.

3. Fish will be selected to represent the size range in the population.

4. Stomach volume will be measured and food items identified, enumerated and measured volumetrically to determine the composition of the daily ration.

5. The aggregate weight of prey consumed by predators in each period will be computed as the product of biomass for each predator size group and the estimated daily ration. Estimated daily ration will be selected from published investigations where daily ration was computed at 2-4% of the body weight per day depending on the size and species of predator.

6. The quantity of each prey species and size group consumed by the predator population will be computed as the product of aggregate prey weight consumed and the composition of prey in the ration.

7. Electivity indices for each prey species and size group will be determined by comparing the percent composition of the prey in the environment and in the ration.

8. The magnitude and intensity of forage utilized by predators will be determined by comparing the quantity and size of each prey species consumed by each predator group to the abundance of prey in the lake.

RESULTS OR BENEFITS EXPECTED:

Findings of this investigation will be used to develop comprehensive management strategies at Lake Rathbun with emphasis on controlling the abundance, size structure and diversity of the forage population. Depending upon the outcome of this investigation management practices at Lake Rathbun could proceed in a variety of ways. Foremost of these is a fish stocking regimen. Control of forage diversity may simply require the introduction and management of additional forage species. Likewise, introduction and management of predator species that will prey on segments of the forage population which are now mainly unutilized is possible. Abundance of forage is influenced, to a great extent, by reservoir hydraulics allowing control of forage density within the operational confines of the reservoir water plan. Other management techniques, such

as habitat improvement and harvest regulation may be equally important to control forage populations. Regardless of the techniques selected to manage fish populations at Rathbun the most important application of this investigation is to provide information that will optimize use of the forage population thereby enhancing the sport fishery.

STUDY TITLE: Population Dynamics of Smallmouth Bass in the Maquoketa River and Other Iowa Streams
(D-J Project F-88-R)

STUDY NUMBER: 602.1 LOCATION: Maquoketa River, Delaware County

PROJECT LEADER: Vaughn L. Paragamian DURATION: 1 July, 1977-31 June, 1980

STATEMENT OF THE PROBLEM:

Smallmouth bass is an important sport fish in streams of northeast Iowa. Despite their prominence very little is known of the factors that control their abundance in this region. Even in view of a dearth of knowledge about this species liberal regulations prevail including no size limit, no closed season, and a daily catch limit of five bass. Important elements identified by fish management personnel for declining or low populations include overharvest, habitat deterioration, and wide variations in year class abundance. The importance of these elements is unresolved. Before management strategies can be designed the factors controlling smallmouth bass abundance must be identified.

STUDY OBJECTIVE:

To identify the physical, chemical and biological factors that influence smallmouth bass population abundance and structure in the Maquoketa River, and similar northeast Iowa streams and utilize these factors to develop strategies for experimental management of the smallmouth bass fishery.

STUDY BACKGROUND:

Smallmouth bass are native to streams in northeast Iowa. In a recent angler survey, fishermen of this region preferred to fish these waters over all others except the Mississippi River. Public sentiment in recent years concerning the smallmouth bass fishery has grown considerably.

Regard for the smallmouth bass fishery was demonstrated as early as the 1940's when food habits and growth of bass were studied. This early investigation revealed 99% of the bass in the study streams to be age IV or younger but it was stated a downstream drift was responsible for the lack of older fish. Other studies outlined the importance of tributary streams for smallmouth bass reproduction and the deleterious impact of heavy precipitation during post-spawning periods. General survey studies and creel census data were collected and importance of smallmouth bass in the angler's catch ranged from 2% in the Wapsipinicon River to about 11% in the Maquoketa River and 15% in the Iowa River. A recent life history study of smallmouth bass in the Turkey River revealed few age V and older bass, growth was similar to that of other

midwestern streams and bass comprised 6% of the total electrofishing and net gear catch while the remainder was non-sport species. A sport fishery survey was recommended to determine the quality of the smallmouth bass fishery. A voluntary sport fishery survey was completed in 1974 and proved to be a futile effort. Data returned voluntarily by anglers appeared to be that from good fishermen while unsuccessful trips were omitted. In 1975 another life history investigation of smallmouth bass was undertaken in the Upper Iowa River. Smallmouth bass fishermen were found to be a minority, but were very vocal about their sport; their catch success was reported to be similar to that of other midwestern streams. A population density of about 263 smallmouth bass per river mile was estimated for bass 76 to 483 mm.

The Maquoketa River was selected as the primary study stream for numerous reasons; it is considered a representative northeast Iowa stream containing attributes of good and poor smallmouth bass habitat, angling pressure similar to other streams, access, and close proximity to the Stream Research Station.

APPROACH:

Job 1.

Title: Population characteristics of smallmouth bass in the Maquoketa River

Objective:

To determine the numerical population size, production and reproductive success, mortality and angler exploitation of smallmouth bass from two separate study areas of the Maquoketa River in Delaware County.

Procedures:

1. Two study areas will be established, at the foot of Delhi Dam, Delaware County, extending downstream about one mile and at the foot of a low head dam in Pin Oak County Conservation Board Park, Delaware County, extending downstream about one-half mile. Each study area will be separated into several segments.

2. Sampling of bass populations will commence when the water temperature approaches 13°C and techinques are effective. Bass will be captured by electrofishing, measured in length, weighed, and scales collected from 200 fish or the entire sample. All captured bass will be marked by excising a portion of the left pectoral fin and released. A subsample of at least 25% of the bass 200 mm or greater will be tagged with sequentially numbered anchor tags to determine movement.

3. A spring and autumn population estimate will be made obtained by sampling with replacement for each segment and area. Sample size will be considered unbiased when $MC \geq 4P$ or estimates on several successive trials are similar.

4. Population weight in each study area will be calculated as the product of mean weight of bass and numerical population size in the study areas.

5. Exploitation will be calculated from the estimated catch of marked smallmouth bass by angler through a creel survey conducted by the Fisheries Management Branch.

6. Weight-length relationship, condition, growth, and age class composition will be determined by scale aging, scale measurements and weight-length measurements.

7. Annual mortality and age class composition will be determined from the sample age distribution.

8. Reproductive success will be determined by an autumn electrofishing population estimate of 0-age bass. Ten seine hauls will be made at biweekly intervals, from June to October, at established sites, in various types of habitat. These data will be used to determine seasonal growth and distribution of 0-age bass. Seine hauls will consist of a radial sweep with a 17 m bag seine, with 6 mm mesh, at established sites.

9. Critical size will be calculated and compared to the mean size of the angler catch and harvest.

10. Biomass production will be calculated from the two seasonal estimates, growth, and annual mortality.

Job 2.

Title: Effects of habitat variation on the stream biota

Objective:

To determine the effects of habitat variation and temporal change on the numerical density and distribution of benthos, zooplankton, and forage fish in two study areas of the Maquoketa River in Delaware County.

Procedures:

1. 0-age fish populations and small forage fish populations will be sampled to determine species composition, relative abundance and distribution.

2. All captured fish will be identified, enumerated and weighed in the field or preserved for laboratory processing.

3. Benthos populations will be sampled twice, in April and August, in different habitat types with a core sampler or Eckman grab and a D-frame aquatic net.

4. Two samples will be collected from each habitat and preserved in 70% ethanol and returned to the laboratory for identification, enumeration and wet weight. Species composition, abundance, distributin, temporal changes and diversity will be determined from these samples.

5. Zooplankton populations will be sampled twice in April and August at four locations in each stream study segment containing different habitat types. A known quantity of water will be sampled with a Kemmerer water sampler and strained through a plankton net.

6. Taxa will be identified and enumerated to determine species composition, diversity, temporal change and distribution.

7. Forage fish will be collected by electrofishing to determine relative abundance, distribution, and species composition.

Job 3.

Title: Physical and chemical characteristics of the Maquoketa River

Objective:

To measure the physical characteristics and chemical composition of two study areas of the Maquoketa River and associate these variables to the abundance of smallmouth bass.

Procedures:

1. Water samples will be collected monthly, April through October, to determine nitrate and nitrite nitrogen, inorganic and organic phosphate, turbidity, pH, and total alkalinity.

2. Stream flow will be measured once by a flow meter at various points of stream segments to determine relative differences within segments. Stream flow volume will be acquired from USGS gauging stations, located on the Maquoketa River near Maquoketa.

3. Study segments will be mapped to include gradient, width and depth, proportions and distribution of various types of substrate, % boulder, bedrock, coarse gravel, pea gravel, sand and silt. In addition, cover provided by windfalls, log jams or other structures will be noted.

4. Physical characteristics of stream segments will be correlated with smallmouth bass abundance to establish criteria in identifying the requirements of smallmouth bass habitat.

Job 4.

Title: Population characteristics of smallmouth bass in other northeast Iowa streams

Objective:

To assess the abundance, growth, condition, age structure, size structure, and mortality of smallmouth bass in study areas of Coffins Grove Creek, Upper Iowa, Volga, and Turkey Rivers and compare these statistics with those in the Maquoketa River study area.

Procedures:

1. Smallmouth bass populations will be sampled twice each year, in late spring and early autumn, at preselected stations.

2. Smallmouth bass captured by electrofishing will be measured in length, weighed, scale sample collected from 100 fish. In case sample size is less than 100, the entire sample shall be processed.

3. Weight-length relationship, condition, growth, and age class composition will be determined by scale aging, scale measurements and weight-length measurements.

4. Annual mortality and age class composition will be determined from the sample age distribution.

5. Relative abundance of smallmouth bass will be calculated as the catch per electrofishing hour.

6. Proportions of bottom type found in study areas will be estimated from visual observations and stream velocity described as slow, moderate or fast.

RESULTS OR BENEFITS EXPECTED:

Factors limiting smallmouth bass abundance in northeast Iowa streams will be identified and methods devised through experimental management to control their impact. Guidelines for a stream classification system will be established to increase the smallmouth bass fishery of this region. The classification system will be based on the biological and physical potential of various stream qualities to produce smallmouth bass and will be integrated with a management scheme.