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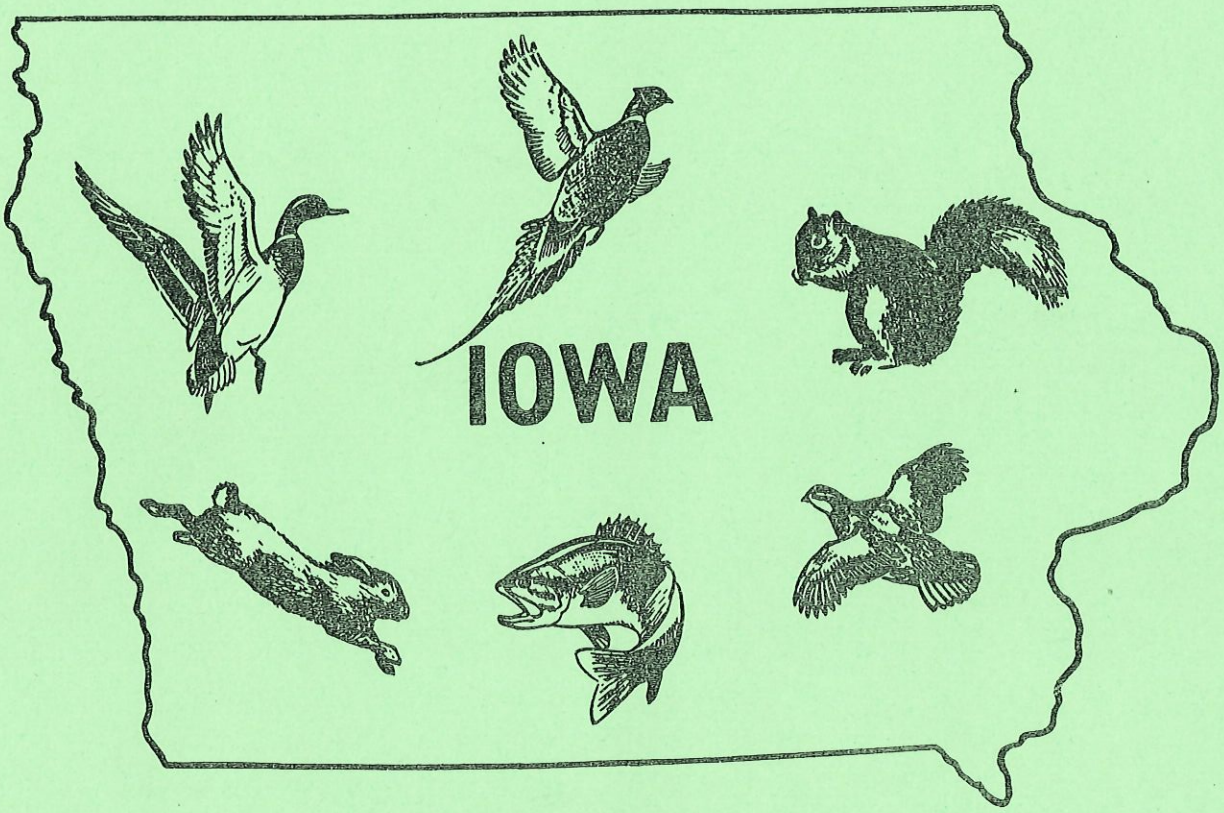
QUARTERLY BIOLOGY REPORTS



FISH AND GAME DIVISION — BIOLOGY SECTION

STATE CONSERVATION COMMISSION

QUARTERLY BIOLOGY REPORTS

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ABSTRACTS OF PAPERS

GAME

1969 WATERFOWL MIGRATION PHENOLOGY

Richard Bishop
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The migration of ducks and geese across Iowa in the spring of 1969 is documented in general terms. The fall migration pattern is discussed in similar fashion, plus a tabulation of weekly figures of numbers of the most important species on some of the major state areas throughout the fall season. A section on the fall goose migration and its effect on the 1969 season is also included. The Canada goose flight was later than normal, and contributed to only fair to poor shooting for the species. The duck migration pattern in 1969 was close to ideal for hunting purposes.

SPECIES COMPOSITION OF IOWA'S DUCK KILL

Richard Bishop
Game Biologist

The species of ducks most commonly shot by Iowa hunters are mallards, green-winged teal, blue-winged teal, wood ducks, and to a lesser extent, pintail, widgeon and gadwall. Iowa's duck kill usually includes 40% to 50% mallards. Species composition in the bag can be greatly altered by regulating season dates. This is well shown by the Iowa figures over the years. Selection of season dates can be an effective way of increasing or decreasing the harvest of certain duck species.

MISCELLANEOUS DEER MORTALITY, 1968 and 1969

Lee Gladfelter
Game Biologist

Reports of deer mortality other than legal hunting totaled 1,544 in 1968 and 1,800 in 1969. Traffic accidents accounted for most of the total with 1,364 killed in 1968 and 1,631 in 1969. This is an increase of 19.6% in traffic mortality in one year. Average damage to vehicles from each collison was $177.60 in 1968 and $94.40 in 1969 . The reports of miscellaneous deer kills do not give a complete picture of non-hunting mortality as there can be little doubt that many additional deer die from accidents, disease etc., but are not brought to the attention of officers who make these reports. It is believed the greatly increased number of deer killed on highways in recent years does reflect greater number of deer in Iowa. However, use of these data as an indicator of annual population changes is not wise as other variables are involved and cannot be accurately measured.

RESULTS OF THE 1969 PHEASANT HUNTER SURVEY

Richard C. Nomsen
Game Biologist

A sample of 10,000 hunters were contacted following the 1969 season to obtain information about their hunting success. The survey indicated that 80% (242,900) of the 303,637 resident licensees hunted pheasants during the 54-day season. They bagged a total of 1,508,400 pheasants in 1969. There were 134,400 ringnecks bagged by 16,100 non-resident hunters. The total take was 1,642,800 pheasants in 1969. Total harvest was up considerably in the southeast half of Iowa's pheasant range - down slightly in the northwest and north central regions. Hunters in northwest Iowa shot an estimated 20,900 Hungarian partridge during the season.

RESULTS OF FIVE YEARS OF POPULATION SURVEYS ON TWO QUAIL STUDY AREAS

M. E. Stempel and Gene Hlavka
Game Biologists

Quail counts on the two study areas in southern Iowa have continued for five years. The Wapello Area is located southwest of Ottumwa; the Decatur-Wayne Area about eight miles north of the Iowa-Missouri boundary in south central Iowa. Coveys are located with the aid of dogs and by "sign" in both autumn and winter. The standard roadside whistling cock counts are conducted from May through August. The brood stock for both study areas remained high with the greatest number of coveys at 44 in 1970. Good reproduction has followed the rather long calling periods which have exceeded ten weeks. The highest fall count on the two areas was 75 coveys in 1969. Farmers' estimates of the number of coveys have varied widely from actual findings, but are more reliable in the fall.

RESULTS OF POSTAL CARD SURVEY OF FOX, COYOTE, RACCOON AND WOODCHUCK HUNTERS FOR THE 1969-70 SEASON

Ron Andrews
Game Biologist

The results of the second phase of the 1969-70 postal card survey are presented in this report. Nearly 38% of the 10,000 hunters contacted responded. Eighteen percent hunted coyotes and foxes and 6% hunted raccoon. The expanded data reveals 142,100 foxes and coyotes and 300,630 raccoons were harvested during the 1969-70 season. An attempt to separate the fox and coyote kill was made. Hunter effort for each species is given. A discussion concerning the validity of questionnaire data in calculating the annual harvest of foxes, coyotes and raccoons is given.

RESULTS OF THE 1969 SQUIRREL SEASON

Robert Sheets
Game Biologist

The 1969 squirrel harvest for Iowa was 1,164,031 which is 149,000 more animals taken than the previous year. Of all hunters who bought a license, 42% hunted squirrels. To bag one squirrel required 1.9 hours last season compared to 2.1 hours in 1968. As in previous years, squirrels rank third in importance as an Iowa game animal, being exceeded only by rabbits and pheasants. The 1969 mast crop, or nut production, was considerably lower (1.6) than that of 1968 (2.1).

RECENT WILD TURKEY INTRODUCTIONS INTO IOWA*

Eugene D. Klonglan, Gene Hlavka and H. Lee Gladfelter
Game Biologists

Efforts by the Iowa Conservation Commission to reintroduce wild turkeys into their former range in Iowa have been expanded considerably in recent years. Since the initial release of Rio Grande wild turkeys in the Yellow River State Forest in northeastern Iowa in 1960-61, additional releases have been made at five other sites. Merriam's wild turkeys were liberated in the eastern part of Stephens State Forest in south central Iowa and in Monona County in western Iowa in early 1966. Eastern wild turkeys were stocked in Shimek State Forest in southeastern Iowa in 1965-66, in the western part of Stephens State Forest in early 1968, and along the Upper Iowa River, Allamakee County, in 1969. Results to date indicate that the Eastern sub-species is best suited to Iowa conditions, as evidenced by their good survival, production, and increase in numbers. The Rio Grande and Merriam's are not increasing their numbers to any significant degree, however.

NOTES ON THE BEHAVIOR OF RED FOXES IN A LARGE ENCLOSURE*

Robert L. Phillips
Game Biologist (former)

Information is presented on the general behavior of captive red foxes (Vulpes fulva) living in a 13-acre enclosure with a high cottontail rabbit (Sylvilagus floridanus) population. The high predator population rapidly reduced the prey population in a short period of time. Observations were made on feeding behavior of young fox pups and on their response to traps. There was evidence that territories were established by the foxes, even in this limited enclosure.

CURRENT STATUS OF THE WOODCOCK IN IOWA*

Eugene D. Klonglan, Gene Hlavka, and H. Lee Gladfelter
Game Biologists

Iowa is at the western edge of the continental range of woodcock. Because of their scarcity in the state, little interest has been shown in them. They are a prized game bird in many states in the eastern half of the country. In 1961 Iowa began cooperating in the U.S. Fish and Wildlife Service's annual spring woodcock census, and this has sparked efforts to learn more about this species in the state. The spring census of courting males on their singing grounds has revealed that a low population of breeding woodcock is to be found in limited suitable habitat, primarily in the eastern third of the state. Seven verified records of woodcock nesting in Iowa, most from brood sightings, were obtained during the 1960's. These bracketed the state from Lee to Pottawattamie Counties. Other sightings have been reported from various points in the state during the spring and fall migration periods. A composite of all types of information available shows that woodcock are not abundant in Iowa but are widely distributed over the state.

* Papers presented at 1970 meeting of Iowa Academy of Science held April 24-25 at Waverly; full paper will appear in Volume 77 of Proceedings of Iowa Academy of Science, with reprints available at later date.

FISH

SLIME DISTRIBUTION STUDIES ON THE MISSISSIPPI RIVER
(Progress Report No. 2)

Don R. Helms
Fisheries Biologist

Continued study of density and distribution of slime bacteria originating in the Dubuque area demonstrated a marked increase during the winter. In February, slime was detected 52 miles below the Dubuque sewage treatment plant. It probably extended much farther, but slime originating from Clinton would have masked any results had sampling continued downstream.

PROGRESS REPORT OF SPIRIT LAKE WALLEYE STUDIES, STATUS OF MARKED FINGERLING STOCKING STUDY

Terry Jennings
Fisheries Biologist

Stocking of fingerling walleye during September and October is part of the walleye management program in Spirit Lake. Except for fingerlings stocked during 1956, the validity of this program has not been evaluated. In 1964, a study was initiated to evaluate fingerling stocking. Between 1964 and 1969, nearly all fingerling walleye placed in Spirit Lake were marked. Marking was done by excising the right pectoral fin. Recapture data were collected by electro-fishing during the spawning "run" and by summer netting. Although the data are not complete, it seems only the 1965 marked fingerling stocking is approaching success. Marked fish comprise 16% of that year class. To date, marked fish total approximately 2% in each of the other year classes evaluated.

POPULATION ESTIMATES OF COMMERCIALLY VALUABLE FISH SPECIES IN CORALVILLE RESERVOIR

Larry R. Mitzner
Fisheries Biologist

Estimates of numerical abundance of carp, carpsucker, bigmouth buffalo and channel catfish were made on a study area to Coralville. Bigmouth buffalo contributed 366 fish per acre followed by carp, 232; carpsucker, 26; and channel catfish, 6. Confidence intervals were established for these species and discussion was given on possible sources of error.

POPULATION ESTIMATE AND GROWTH OF CARP IN RED ROCK RESERVOIR DURING THE FIRST YEAR OF IMPOUNDMENT

Gaige Wunder
Fisheries Biologist

Effort in the third quarter of the project was concerned primarily with the analysis of data taken in previous quarters. Cumulative population estimates of carp ranged from 34,839 to 2,854,436, the latter considered the most reliable estimate. Ninety-five percent confidence intervals were $\pm$ 228,004. Rapid increases in the population density of carp was attributed to recruitment of young-of-the-year fish into the population vulnerable to the pound nets.

The body-scale relationship in 1969 was expressed by $L = 0.4 + 2.7R$. Growth indices ranged from 79 in 1966 to 148 in 1958. Growth of age 0 carp ranged from 5.4 to 10.5 inches with a mean of 7.6 inches in 1969.

1969 WATERFOWL MIGRATION PHENOLOGY

Richard Bishop
Game Biologist

SPRING MIGRATION

The first influx of ducks and geese arrived at Odessa in southeast Iowa on February 19th. Birds continued to move into this area in small bunches and by February 28th, Louisa Refuge held 3,000 Canada geese and 1,500 mallards. The rest of Iowa reported little waterfowl activity in February. During mid-March, the first real movement of birds occurred across southern Iowa. By March 22nd, birds were numerous over most central and southern Iowa areas and some northern Iowa areas held a few thousand ducks. On March 22nd, Big Marsh reported 6,500 ducks; Otter Creek held about 10,000 ducks (mostly mallard and pintail); Louisa Refuge had 20,000 mallards and 5,000 other ducks plus 2,000 Canada geese; Red Rock had about 22,000 mallards and 3,000 geese; Sweet Marsh 6,000; Lakin Slough 3,500 ducks; southwest Iowa reported numerous ducks and Forney's and Riverton each held about 100,000 blue and snow geese. About March 20th was the start of the big flight of blues and snows in southwest Iowa. Canada's were migrating across the state from the middle of March until the middle of April. Cold temperatures in late March held back the duck and goose northward migration. Duck and goose numbers varied from day to day, but held generally steady from March 22nd to the end of the month.

The big push of blue and snow geese had passed Forney's Lake by the end of the first week in April. Most of the mallards and pintails had moved out of southwest Iowa and widgeon, scaup, gadwall, and shovelers were present in large numbers, with teal and wood ducks just starting to arrive. In northwest Iowa, ducks were just beginning to move in the first week of April. Most marsh areas were still frozen over. Birds were using flooded river bottoms and field ponds. Red Rock reported about 500,000 ducks (mainly divers) and 10,000 Canada geese on April 5th. By mid-April, most of the ducks and geese had left central and southern Iowa and the larger concentrations of birds were found in northern Iowa. These birds were using flooded fields and were widely scattered, which made assessment of populations very difficult. The blue-wing migration in northern Iowa was in full swing by April 20th.

For the most part, the spring waterfowl migration was over by the last of April. Most of the remaining blue-wings, wood ducks and mallards were probably nesting ducks. Shovelers, gadwall and a few other species still remained in fair numbers. Generally speaking, the spring of 1969 was a cold late spring which retarded large waterfowl buildups in northern Iowa. The birds went through quickly when water areas began opening up to the north of Iowa.

Water levels on northern Iowa marshes in 1969 were quite high. This was in contrast to conditions in 1968. Good shoreline vegetation was present in most cases

due to low water levels in 1968. Marshes in general were in good shape for nesting waterfowl and numerous field ponds attracted pairs of mallards and blue-wings.

Waterfowl populations were somewhat improved over 1967 and 1968. Mallards were present in fair numers corresponding to 1968 and the nesting blue-wing populations appeared to be up from 1968. Wood ducks were quite plentiful, equalling that of 1968 or maybe higher. The most noticeable increase was in the redhead population. Redheads were observed in the highest numbers seen in five years.

Production of mallards, wood ducks, and redheads was very good. Blue-wings experienced only fair production. All in all, it was considered a good waterfowl year in Iowa.

FALL MIGRATION

Duck Migrations:

The breeding habitat in northern United States and Canada was much improved in the spring of 1969 due to an exceptionally wet fall in 1968 and good winter snowfall. Waterfowl inventories indicated a large increase in nesting ducks on the breeding grounds, especially for mallards. Generally production was quite good.

Teal movements were similar to those of previous years with populations increasing about mid-August and peaking in early to mid-September. A nine-day teal season was held in 1969 and results were comparable with past years. Hunting was good across northern Iowa but was poor in southern Iowa. Success was excellent the first day, then dropped off for the rest of the season.

Pintails, widgeon, gadwall and wood ducks started moving into northern Iowa the middle of September. Another movement of these early migrating species occurred the first week of October. Pintails and widgeon built up to a peak in mid-October, then numbers started to decline. Mallards began building up on northern Iowa marshes the middle of October and by October 24th, most marshes held large numbers of ducks. An aerial survey on October 24th indicated that mallards and green-wing teal were most numerous with pintail and gadwall next. Widgeon and diving ducks made up the bulk of the rest of the ducks observed. Duck numbers were considered high for opening day, especially the number of mallards.

A large segment of ducks left Iowa during the week following the season opening on October 25th. Other migrators continued to move into the state to maintain populations and provide good shooting. Two major movements of mallards occurred after the season opening. A flight of mallards moved across Iowa the first of November and another large movement occurred from November 10th through the 14th. The last push was just ahead of a cold front which froze most northern Iowa marshes. Most hunting in northern Iowa, except field shooting, ended on November 14th due to

frozen marshes. Central and southern Iowa areas continued to hold large numbers of birds and shooting remained good.

By November 20th, the majority of mallards had migrated through northern Iowa. Certain areas held from several hundred to a few thousand birds through November and into December. Good field shooting resulted in the vicinity of these mallard concentrations.

High numbers of mallards were present in central and southern Iowa through November (check waterfowl build-up in Table 1). Approximately 750,000 mallards were reported in southwest Iowa in mid-November. Late flights of mallards continued to dribble across Iowa until early December, but for the most part, the duck migration was over by late November.

The duck season ran for 30-days from October 25th until November 23rd. A limit of four ducks, of which no more than two could be mallards or wood ducks and no more than one redhead or canvasback, was allowed. The season as a whole was very good. Opening day was quite good and ducks were present throughout the entire season. Shooting in southern Iowa and southwest Iowa was excellent until the end of the season. Northern Iowa had better duck hunting than has been experienced for the last three years.

To sum up the fall migration, one could say that teal and the early migrating species such as pintail, widgeon, gadwall and wood ducks were on schedule. They moved into Iowa in mid-September and continued to build-up until mid-October. After mid-October, the numbers of these species declined. Mallards, green-winged teal and the divers moved into Iowa in middle October in a general fashion until opening of the duck season on October 25th. Migration occurred as a general continuous movement of ducks from the first of October until the middle of November, with two major movements of mallards occurring the last of October and the first of November and again from November 10th to November 14th. This was an ideal migration pattern for hunting purposes. Ducks were present in good numbers on most refuges and some marshes throughout the season, which thus provided an excellent duck season across Iowa.

Goose Season and Migration:

The 1969 goose season was a 70-day season starting on October 4th and continuing through December 12th. Shooting hours and bag limit were the same as previous years.

The goose season opening was delayed a week to cut down on the kill of the early migrating segment of the Swan Lake flock of Canada geese. There are plans to increase this flock from 130,000 to 200,000 birds post-season to allow for the future increase in kill. This kill is expected to take place at Red Rock in Iowa, and in Iowa and Minnesota, due to increased hunting pressure on geese.

The migration of Canada geese was two weeks late. Birds did not come through as expected but started on October 10th, and continued through the first part of November. The migration took place in the form of a large push starting October 10th, lasting for a week, with a gradual migration of birds continuing through October and into November. The Canada goose migration coincided with the blue and snow goose migration, which lessened the kill on the Canadas. Many Canada geese went through without stopping, which also reduced the kill. It is believed that the kill of Canada geese was noticeably lower in 1969 than in 1968.

The blue and snow migration started on October 10th, as did the Canadas, and a large flight of geese continued across northern Iowa until October 22nd. After October 22nd, scattered flocks were observed migrating across northern Iowa, but the bulk of the birds had already passed.

In southwest Iowa, the migration was slightly different. The first blue and snow geese arrived at DeSoto Bend and Forney's Lake in the first part of October, but no significant build-up occurred until mid-October (Table 2). Blue and snow geese hit a peak in southwest Iowa about November 15th, with a reported concentration of 280,000 birds. Numbers declined from mid-November until December 13th, when all but a few thousand geese had left southwest Iowa. The blue and snow migration was a week to ten days late compared to previous years.

Goose hunting was fair to poor for Canadas across most of Iowa mainly due to the late flight. The lack of expected production could have been partly responsible also. Blue and snow geese on the other hand had excellent production, as was indicated by the number of young geese in the flocks and kill. Hunters had very good luck all across northern and central Iowa. Southwest Iowa had good shooting also, but the kill was not believed to be much higher than most years. The total kills of blues and snows is expected to be much higher than average.

Table 1. Duck Migration Figures - Fall Flight, 1969:

Area	Date	Mallards	Teal	Pintail	Wood Ducks	Others
Browns	9-27	50	200		150	
Slough	10-11	300	400	300	270	100
	10-18	250	100	150	250	100
	10-25	500	50	50	300	100
	11-1	3000	50	50	200	230
	11-8	200		50	20	100
	11-15	200		50	50	120
	11-22	200				200
	12-13	300				
Colyn	9-27	100	1150	50	100	50
Area	10-11	850	650	350	650	100
	10-18	500	125	200	400	100
	10-25	2200	100	520	500	100
	11-1	3500	50	75	200	400
	11-8	4200		350	120	470
	11-15	5200		420	70	330
	11-22	5200		100		350
	11-29	1000				30
	12-6	1500				10
	12-13	1500				
	12-2	2000				
Ingham-High	8-22	400	1500	50		350
Lakes	8-29	500	1625	150	500	300
	9-5	700	2000	200	500	300
	9-12	700	1500	200	500	350
	9-19	300	200	50	500	200
	9-26	Few	120	50	500	200
	10-3	Few	100	50	400	200
	10-10	300	100	100	400	500
	10-17	700	200	300	500	1900
	10-24	1730	50	200	300	2050
	10-31	3100	50	400	50	2400
	11-7	500		20	50	320
	11-14	40				40

Area	Date	Mallards	B.W. Teal	Pintail	Wood Ducks	Others
Odessa	9-6	350	800		550	
	9-15	600	200	25	600	100
	9-21	350	350	150	800	300
	9-27	550	350	100	800	200
	10-4	1400	150	300	1000	100
	10-11	3500		300	3100	450
	10-18	8000	100	600	8000	2500
	10-25	18000	100	250	12000	1900
	11-1	20000	100	300	7000	2500
	11-8	30000		300	3000	1100
	11-15	30000		200	200	1000
	11-22	35000		600	200	1100
	11-29	35000		400	100	750
	12-6	35000				
Otter Creek	9-8	400	1500		700	
	9-14	700	2000		1500	
	9-21	100	1500		2000	
	10-4	2000	1000	300	2500	1100
	10-12	2500	1700	1000	2500	1400
	10-18	3000	650	1800	1800	1550
	10-25	3400	350	2000	1500	1900
	11-1	2800		2100	950	1700
	11-8	3000		800	350	1040
	11-15	3500		600	150	900
	11-22	3000		200		875
	11-30	3000		100		
	12-6	2750				
	12-13	1750				
	12-20	2000				
	12-27	600				
Sweet Marsh	9-8	50	100		150	
	9-13	50	100	20	150	80
	9-20	50	400	20	200	230
	10-4	1000	1500	300	200	1400
	10-11	1500	1500	500	300	1650
	10-18	2000	1500	1000	300	3400
	10-25	3000	500	1000	200	2900
	11-1	3000	200	500	50	3300
	11-15	500				280
	11-22	50				

Area	Date	Mallards	B.W. Teal	Wood Ducks	Others
Rice Lake	9-22	75	300	200	75
	10-5	400	200	200	650
	10-10	400	300	250	1000
	10-17	200	75	50	200
	10-25	600	50	50	650
	10-31	200	15	25	300
	11-7	250	15	15	300
	11-14	2000			100
	11-20	5000			
East & West Twin Lakes	9-22	50	200	50	
	10-10	200	50	30	250
	10-17	450	50		1050
	10-25	650	50		400
	10-31	950	50		400
	11-7	525	25		400
	11-14	400			75

Area	Date	Mallards	Pintails	Others
Bays Branch	10-24	180	50	160
	11-8	500	50	380
	11-21	1500	200	450
	11-26	600	100	200
	12-20	1000	50	
Red Rock	10-25	5000	5000	2500
	11-1	15000	1500	3500
	11-8	10000	2000	3500
	11-15	10000	2000	2600
	11-22	8000	1000	1800
	11-29	8000	1000	
	12-6	10000		
Big Marsh	9-13	90		
	9-20	40		
	10-4	60		
	10-11	125	40	
	10-25	1700	900	950
	11-1	1500	800	800
	11-8	2500	1000	2500
	11-15	2000		300
	11-22	2000		
	11-29	2000		
	12-6	120		

Area	Date	Mallards	B.W. Teal	Wood Ducks
Green Island	10-4	200	200	400
	10-10	250	100	500
	10-17	800	100	1200
	10-24	1000	100	600
	10-31	500		
	11-8	500		
	11-15	500		

Area	Date	Mallards	Area	Date	Mallards
DeSoto Bend	10-11	1,000	Forney Lake	10-6	300
	10-18	5,500		10-25	2,300
	10-25	30,000		11-8	100,000
	11-8	196,000		11-15	95,000
	11-15	700,000		11-22	50,000
	11-22	250,000		11-29	50,000
	11-29	250,000		12-6	100,000
	12-6	175,000		12-13	25,000
	12-13	30,000		12-20	25,000
	12-20	30,000		12-27	15,000
	12-27	30,000			
Louisville Bend	10-6	300	Silver Lake	11-23	300
	10-11	1,000		11-30	750
	10-25	1,000		12-14	160
	11-8	75,000		12-27	200
	11-15	75,000			
	11-22	50,000	Five Island Lake	11-23	500
	11-29	50,000		11-30	1,000
	12-6	1,000		12-27	1,000
	12-13	5,000			
	12-20	3,000			
	12-27	5,000	Round Lake	10-22	200
				11-15	200
Riverton	10-25	3,000			
	11-8	20,000			
	11-15	100,000			
	11-22	50,000			
	11-29	50,000			
	12-6	30,000			
	12-13	30,000			
	12-20	15,000			
	12-27	5,000			

Table 2. Goose Migration Figures - Fall Flight, 1969:

Area	Date	Goose Numbers*	Area	Date	Goose Numbers*
Forney's Lake	10-6	600	Louisville Bend	10-6	
	10-11	1,100		10-11	50
	10-18	2,500		10-18	800
	10-25	10,000		10-25	1,500
	11-8	25,000		11-8	20,000
	11-15	50,000		11-15	10,000
	11-22	20,000		11-22	20,000
	11-29	10,000		11-29	10,000
	12-6	10,000		12-6	5,000
	12-13	3,000		12-13	
	12-20	3,000		12-20	
	12-27	5,000			
Riverton Area	10-6				
	10-11				
	10-18				
	10-25	6,000			
	11-8	15,000			
	11-15	30,000			
	11-22	10,000			
	11-29	5,000			
	12-6	20,000			
	12-13	5,000			
	12-20	3,000			
	12-27	2,000			
DeSoto	10-6	700			
	10-11	500			
	10-18	20,000			
	10-25	100,000			
	11-8	160,000			
	11-15	200,000			
	11-22	150,000			
	11-29	120,000			
	12-6	50,000			
	12-13	200			
	12-20	200			
	12-27	150			

* Blue and Snow Geese

Area	Date	Goose Numbers	Area	Date	Goose Numbers
Red Rock	10-4	200 C	Ingham High	9-26	450 C
	10-10	250 C 700 BS		10-17	720 C 30 BS
	10-17	1500 C 500 BS		10-24	985 C 95 BS
	10-27	2000 C 6000 BS		10-31	1050 C 85 BS
	11-1	1000 C 4000 BS		11-7	1030 C 125 BS
	11-8	1500 C 4000 BS		11-14	710 C
	11-15	1000 C 4000 BS		11-21	780 C
	11-22	1000 C 4000 BS		11-28	900 C
	11-29	1000 C 4000 BS		12-5	850 C
	12-6	1000 C 4000 BS		12-12	720 C
				12-19	438 C
				12-27	469 C
Otter Creek	9-13	50 C			
	10-4	100 C			
	10-11	200 C 100 BS			
	10-18	100 C 150 BS			
	10-25	75 C 125 BS			
	11-1	30 C 75 BS			
	11-8	40 C 100 BS			
	11-15	50 BS			
Odessa	9-7				
	9-15	350 C			
	9-21	300 C			
	9-27	600 C			
	10-4	800 C			
	10-11	1000 C 25 BS			
	10-18	1700 C 100 BS			
	10-25	1150 C 700 BS			
	11-1	1300 C 2500 BS			
	11-8	2000 C 4500 BS			
	11-15	2200 C 2900 BS			
	11-22	2500 C 5000 BS			
	11-29	2250 C 4500 BS			
	12-6	1700 C 1300 BS			
	12-13	150 C			

SPECIES COMPOSITION OF IOWA'S DUCK KILL

Richard Bishop
Game Biologist

The species of ducks that are most commonly shot by Iowa hunters are mallards, green-winged teal, blue-winged teal, wood ducks, and to a lesser extent, pintail, widgeon and gadwall. Table 1 gives data on species composition of Iowa's duck kill during the 60's. As indicated in Table 1, Iowa's duck kill usually includes 40% to 50% mallards. This is due to several different factors. The mallard has traditionally been the king of waterfowl in the Mississippi Flyway due to its numbers, hunting qualities, size and palatability. Hunters are biased in favor of the mallard and our season dates have been geared to harvest mallards. Other waterfowl species vary in importance due to season dates and regulations. Wood ducks, green-winged teal and blue-winged teal rival for second position behind mallards according to yearly regulations.

Species composition and total duck kill are generally determined by season length, bag limits, time of season and numbers of each species. Migration data collected for several years indicate that certain species pass through Iowa on fairly regular dates. The percent of their numbers represented in the bag largely depends on season dates. Thus the species composition of the total duck kill can be altered by regulating season dates.

Table 2 gives data on length of season, season dates, bag limits, duck stamp sales and total duck kill. Data indicate that season length and mallard bag limits, to some degree, regulate duck stamp sales and in turn total duck harvest. In years like 1961 and 1962, where only 30 and 25-day seasons were offered and bag limits were quite restrictive, the duck stamp sales dropped off as did the total duck kill. Thus by regulating seasons, we can regulate, to some degree, the number of hunters, the total duck kill and the species composition of the kill.

During the 1960's, waterfowl season regulations were established largely for the mallard and kill data reflect this. The years 1963 and 1964 are two exceptions to this. In these years, a split season was taken to harvest some of the early migrating species.

If season dates were shifted to an earlier time period, the species composition would also be shifted. The season would tend to fall within the time table of early migrating species and away from the late mallard flight. In 1963 and 1964, a split season was held and the kill of blue-winged teal and wood ducks increased significantly while the kill of other species like the gadwall, widgeon and pintail was not affected to any degree. The kill of these species should increase with earlier seasons; however, other factors such as migration conditions and populations can alter the outcome. The mallard harvest is noticeably affected with an earlier season, but green-winged teal make up a high percent of our kill regardless of season dates.

Selection of season dates could be an effective way of increasing or decreasing the harvest of certain species. The wood duck is a good example of how late season dates reduced harvest. A split season would have a more moderate affect on altering the species composition of the kill. This is primarily due to the fact that hunters are allowed a chance to take both early and late migrating species. Other factors such as hunter selection, species behavior, migration conditions and populations all tend to determine species composition.

Table I. Species Composition of Iowa's Duck Kill - 1960-1968

Species	1960*	1961*	1962*	1963	1964	1965	1966	1967	1968
Mallard	53.0	48.9	40.0	31.2	42.0	45.4	45.0	54.4	41.8
Black Duck	4.3	3.4	3.9	0.6	.9	.5	0.7	0.8	0.5
Gadwall	1.9	2.3	2.8	1.6	1.8	2.8	3.0	6.0	4.4
Widgeon	4.7	5.7	4.8	4.5	5.8	7.1	7.1	5.4	5.3
G.W. Teal	5.9	8.2	6.2	10.4	14.8	11.1	12.1	12.4	21.1
B.W. Teal	5.5	2.4	4.1	18.8	10.2	3.1	6.3	2.8	1.1
Shoveler	1.6	1.0	1.3	1.3	1.7	1.8	1.5	2.4	1.1
Pintail	4.2	4.6	4.8	5.0	4.0	4.3	2.1	2.3	2.2
Wood Duck	4.8	6.1	15.3	21.9	13.7	8.1	12.1	5.4	15.9
Redhead	0.2	0.1	0.2	0	.6	1.6	1.5	1.0	0.9
Canvasback	Tr.	Tr.	Tr.	0	.2	1.2	1.0	0.8	
G. Scaup	0.9	0.5	1.0	0.1	.2	0.1	0.1	0.2	0.4
L. Scaup	3.4	8.9	4.1	2.2	1.9	5.5	3.4	2.0	2.0
Ringneck	6.5	4.4	7.7	1.3	1.5	5.0	1.9	1.9	2.4
Other Ducks	3.1	3.5	3.8	1.1	0.7	2.4	2.2	2.2	0.9

* Flyway wide composition - not broken down by states.

Table 2. Waterfowl Season Regulations and Kill Data:

Year	Season Length	Season Dates	Daily Bag Limit	Mallard Bag Limit	No. Stamps Sold	Iowa's Duck Kill
1961	30	Oct 21-Nov 19	2	2	41,147	166,400
1962	25	Oct 27-Nov 20	2	1	30,602	67,700
1963	32	Oct 5-Oct 13 Oct 26-Nov 17	4	2	37,222	187,200
1964	36	Oct 3-Oct 4 Oct 24-Nov 26	4	2	37,668	258,400
1965	40	Oct 23-Dec 1	4	1	39,941	215,900
1966	45	Oct 15-Nov 28	4	2	47,438	359,200
1967	40	Oct 21-Nov 29	4	2	52,269	333,800
1968	30	Oct 26-Nov 24	3	1	45,501	132,000

MISCELLANEOUS DEER MORTALITY, 1968 AND 1969

Lee Gladfelter
Game Biologist

INTRODUCTION

A report of annual deer mortality other than legal hunting is a useful factor in determining the status of the Iowa deer herd. Results of this report are used to indicate a trend in the growth or decline of the deer population. The major cause of miscellaneous deer mortality is traffic accidents, but other forms of mortality are reported, such as illegal kill, disease, crippling loss, predation (mainly by dogs), and accidents. Reports on traffic accidents are detailed and includes sex of animal killed, amount of damage to vehicle, type of road on which the accidents occurred, and whether the accident took place in a marked deer crossing. This information is all compiled to keep us better informed on the type and extent of deer mortality in the state.

METHOD

Conservation officers are asked to submit a report on each deer killed, other than by legal hunting, in their respective territories. They are provided with postal cards which have the requested information printed on the back. These cards are mailed to the Wildlife Researsh Station at Boone where the information is compiled for each county in the state. Data in this report has been derived from the post cards submitted in 1968 and 1969 (Table 1).

Table 1. Miscellaneous Deer Kills - 1968 and 1969:

County	Number Reported Killed					
	1968			1969		
	Traffic	Other	TOTAL	Traffic	Other	TOTAL
Adair	5	1	6	7	-	7
Adams	4	-	4	10	1	11
Allamakee	20	7	27	18	2	20
Appanoose	9	8	17	17	-	17
Audubon	1	-	1	-	-	-
Benton	8	-	8	7	-	7
Black Hawk	15	1	16	16	4	20
Boone	22	2	24	19	-	19
Bremer	3	-	3	6	-	6
Buchanan	3	-	3	5	-	5
Buena Vista	10	2	12	8	-	8
Butler	16	3	19	19	2	21
Calhoun	6	-	6	5	-	5
Carroll	1	1	2	8	-	8
Cass	19	1	20	22	-	22
Cedar	10	3	13	15	6	21
Cerro Gordo	6	2	8	-	-	-
Cherokee	11	2	13	18	1	19
Chickasaw	7	-	7	10	2	12
Clarke	14	4	18	3	-	3
Clay	1	-	1	10	1	11
Clayton	17	-	17	23	2	25
Clinton	25	4	29	30	5	35
Crawford	19	1	20	12	1	13
Dallas	35	2	37	50	5	55
Davis	11	2	13	11	-	11
Decatur	3	6	9	2	-	2
Delaware	1	-	1	1	1	2
Des Moines	27	-	27	35	5	40
Dickinson	16	-	16	11	1	12
Dubuque	20	2	22	21	-	21
Emmet	-	-	-	10	3	13
Fayette	9	-	9	15	2	17
Floyd	5	-	5	12	-	12
Franklin	3	3	6	8	2	10
Fremont	30	3	33	44	1	45
Greene	13	6	19	13	1	14
Grundy	2	-	2	2	-	2

Table 1. (continued)

County	Number Reported Killed					
	1968			1969		
	Traffic	Other	TOTAL	Traffic	Other	TOTAL
Guthrie	2	1	3	14	11	25
Hamilton	15	-	15	4	2	6
Hancock	6	-	6	5	-	5
Hardin	15	3	18	21	7	28
Harrison	41	5	46	56	2	58
Henry	11	1	12	14	-	14
Howard	1	-	1	9	-	9
Humboldt	11	-	11	3	1	4
Ida	7	-	7	3	1	4
Iowa	18	3	21	28	2	30
Jackson	21	4	25	28	1	29
Jasper	12	2	14	13	-	13
Jefferson	5	-	5	11	-	11
Johnson	39	1	40	42	7	49
Jones	10	-	10	19	1	20
Keokuk	8	-	8	8	-	8
Kossuth	20	1	21	16	2	18
Lee	-	-	-	11	-	11
Linn	16	4	20	25	1	26
Louisa	7	-	7	10	-	10
Lucas	13	-	13	5	-	5
Lyon	8	-	8	8	1	9
Madison	11	1	12	18	5	23
Mahaska	8	-	8	13	-	13
Marion	2	-	2	2	-	2
Marshall	2	-	2	14	-	14
Mills	22	12	34	47	12	59
Mitchell	12	-	12	5	1	6
Monona	13	6	19	19	-	19
Monroe	6	15	21	12	1	13
Montgomery	10	5	15	13	3	16
Muscatine	2	-	2	6	-	6
O'Brien	2	4	6	-	-	-
Osceola	2	1	3	1	-	1
Page	15	1	16	20	-	20
Palo Alto	5	1	6	9	2	11
Plymouth	31	7	38	41	3	44
Pocahontas	1	1	2	2	-	2

Table 1 (continued)

County	Number Reported Killed					
	1968			1969		
	Traffic	Other	TOTAL	Traffic	Other	TOTAL
Polk	54	1	55	65	17	82
Pottawattamie	112	5	117	112	4	116
Poweshiek	10	-	10	12	-	12
Ringgold	9	1	10	10	1	11
Sac	6	3	9	7	2	9
Scott	12	3	15	17	1	18
Shelby	26	2	28	16	1	17
Sioux	14	1	15	8	3	11
Story	21	-	21	25	2	27
Tama	8	2	10	19	-	19
Taylor	2	-	2	12	-	12
Union	17	1	18	8	1	9
Van Buren	35	1	36	20	1	21
Wapello	29	-	29	31	4	35
Warren	29	-	29	34	1	35
Washington	6	2	8	13	1	14
Wayne	7	-	7	9	-	9
Webster	20	2	22	6	2	8
Winnebago	6	1	7	4	1	5
Winneshiek	28	4	32	29	4	33
Woodbury	38	6	44	58	9	67
Worth	12	-	12	4	-	4
Wright	6	-	6	14	-	14
TOTALS	1364	180	1544	1631	169	1800

RESULTS

Known mortality (other than legal hunting) totaled 1,544 deer in 1968 and increased to 1,800 in 1969. Traffic accidents accounted for most of the total with 1,364 deer killed in 1968 and 1,631 in 1969. This is an increase of 19.6% in traffic mortality in one year. The remainder were deer killed by poachers, dogs, disease, and accidents.

The county with the highest number of deer-vehicle collisions was Pottawattamie with 112 deer killed each of the two years. Polk County was second both years with 54 killed in 1968 and 65 in 1969, while third place went to Harrison County in 1968 (41) and Woodbury in 1969 (58).

Estimated damages resulting from these collisions in 1968 totaled $160,408.24, or an average of $117.60 per accident. In 1969, the total damage reported was $153,974.00, or an average of $94.40 per accident. This is a minimum figure as damages were not reported in some of the accidents.

Sex of deer killed by miscellaneous means was reported in 1392 instances in 1968 and in 1678 instances in 1969. This results for 1968 were 709 bucks to 683 does and for 1969, 835 bucks to 843 does. This gives a buck/doe ratio of 104/100 for 1968, but 99/100 for 1969. More bucks than does are killed in automobile accidents during the fall rutting season, but the does have the "advantage" during the spring.

The overall percentage of vehicle collisions occurring on state highways was 65.0% in 1968, 80.5% in 1969, as compared to 14.0% (1968) and 11.5% (1969) on hard surface county roads, with 21.0% (1968) and 8.0% (1969) on gravel roads. These data probably do not reflect amount of deer movement across the various types of roads, but more their vulnerability to speed and number of automobiles. Deer were killed in marked "Deer Crossing" areas 88 times for 6.8% of the reported highway mortality in 1968. In 1969, 179 deer were killed or 11.0% of the highway mortality took place in marked areas. The remainder of deer were killed in unmarked areas.

DISCUSSION

The winter deer population for 1967-68 was estimated at 22,770 early in 1968. A loss of 1,364 (6.0%) in vehicle accidents for 1968 is a significant mortality factor. The winter deer population for 1968-69 was estimated at 23,327, with the 1969 highway mortality eliminating 1,631 or 7.0% of the estimated population. It would appear that vehicle accidents are responsible for more deer mortality than any other cause except legal hunting. However, it must be remembered that each such accident involves people and probably property damages; therefore, it is likely to be reported. There can be little doubt that many deer fatalities occur, such as poaching, disease, and crippling loss, which are never known to the officers who file these reports.

The increase in highway mortality can be used as a trend indicator for the deer population. Extreme caution must be used in concluding however, that the population increases at the same rate as the increases in highway mortality. There are many variables which must be considered, such as increase in total highway traffic and the number of accidents which go unreported. The best viewpoint is that our highway mortality has been steadily increasing since 1951 (Table 2) and that this correlates to a steady increase, over the years, of our deer herd.

Table 2. A Comparison of Miscellaneous Deer Kills, 1951-1969

Year	Traffic Mortality	Total Miscellaneous Mortality
1951	120	192
1952	173	256
1953	273	393
1954	229	310
1955	216	306
1956	286	419
1957	261	345
1958	314	438
1959	379	508
1960	546	753
1961	683	839
1962	726	939
1963	900	1,138
1964	914	1,170
1965	1,022	1,224
1966	1,067	1,241
1967	1,273	1,451
1968	1,364	1,544
1969	1,631	1,800

RESULTS OF THE 1969 PHEASANT HUNTER SURVEY

Richard C. Nomsen
Game Biologist

A sample of 10,000 hunters was contacted immediately after the close of the 1969 season to obtain information about their hunting success. The names were obtained from the cards returned by license sellers - one from each book of hunting, combination, and non-resident hunting licenses. A record card and letter of instructions were mailed to each person.

The 54-day season opened on November 8 and closed December 31, 1969, with shooting permitted from 8:00 A.M. to 4:30 P.M. The daily bag limit was three cocks and the possession limit was six roosters.

There were 3,760 cards returned by resident hunters and 472 returns from non-residents for a total of 4,232 cards, about 42%. Total license sales for 1969 consisted of 166,867 hunting and 136,770 combination which was nearly the same as 1968. The sale of non-resident hunting licenses increased from 12,800 to 17,321 in 1969.

Results of the survey indicated that hunter success improved in 1969. Complete state-wide statistics are given in Table 1 for both residents and non-resident hunters. These figures include only licensed hunters. No figures are avilable for persons hunting on their own land without a license or those under 16 hunting with a licensed adult. It is believed that their omission would tend to balance any bias in the data obtained due to non-response and the possibility that hunting results were poorer for those that did not respond.

The total kill of cocks during the 1969 season was 1,642,800 which was 18% above the harvest in 1968. The 1969 August roadside count had indicated a decrease of 14% in the fall population although, production appeared to be excellent. The young per hen index was 5.0 which was the highest in recent years and was the second successive year of improved production. Records from previous years had shown that the population increased beyond expectations following two years of improved reproductive success. Apparently, census conditions were less favorable on the average in 1969 than in 1968, which resulted in the lower count. Hunting conditions can also be a factor in such yearly variations.

Heavy field cover favored the ringneck during the early weeks of the pheasant season, but hunting conditions improved considerably in early December. Less than half of Iowa's corn crop was harvested as the season opened, but harvest was nearly complete by the first of December except for a number of unpicked fields in northern Iowa. Snow fell over the entire state on December 6th and 7th and this snow cover remained during the rest of the season. Birds were clearly visible during this period, but sometimes were too wild and flushed out of range. Most

fields of unpicked corn were left standing during the winter because of the heavy snow and they provided extra protection for pheasants.

The survey showed a slight increase in the number of resident hunters and they made more trips in 1969 (Table 2). The number of non-resident hunters increased considerably and they too averaged more trips per hunter. Resident hunters averaged 6.2 birds for the 1969 season compared to 5.6 in 1968. The average season kill for non-resident hunters also increased - from 6.9 birds in 1968 to 8.4 ringnecks in 1969. Non-residents averaged a bird every 3.5 hours and residents hunted 3.8 hours for each rooster.

The distribution of hunting pressure and pheasant kill continued to shift in 1969 with the greatest change occurring in the eastern region. Eastern Iowa supported 26.8% of the pressure - an increase of 40%. Total kill in this region was high for the state and 89% higher than in 1968. Pressure and harvest also increased considerably in the southern regions. A reduction in hunting pressure was registered in all other regions. Total kill was up slightly in central and southwest Iowa, but down in north central and northwest regions. Production was apparently much better than expected in the southeast half of Iowa's pheasant range, and favorable hunting conditions encouraged hunters to make more trips.

Hunters reported that 95% of all pheasant hunts occurred on private land compared to 5% on state land. The greatest amount of hunting on state land was reported in the northwest region.

HUNS

Huns were reported shot in 21 northwest and north central counties. Estimates from these limited samples indicated that 20,900 Hungarian partridge were harvested in 1969 which was slightly lower than the estimated kill in 1968.

Table 1. State-wide Pheasant Hunting Statistics From the 1969 Postal Card Survey

	Resident	Non-Resident	TOTAL
State-wide Bag, Pheasants	1,508,400	134,400	1,642,800
Total Hunting Hours	5,795,600	472,100	6,267,700
Total Hunting Trips	1,518,100	87,300	1,605,400
Number Hunting Pheasants	242,900	16,100	259,000
Percent Hunting Pheasants	80.0%	93.0%	
Avg. No. Trips per Hunter	6.25	5.42	
Avg. No. Gun Hours per Hunter	23.86	29.32	
Avg. No. Bagged per Hunter per Season	6.21	8.35	
Avg. No. Bagged per Trip	0.99	1.54	
Avg. No. Bagged per Gun Hour	0.26	0.28	
Avg. No. Hours per Bird	3.8	3.5	
Avg. No. Hours per Trip	3.82	5.40	

Table 2. Summary of State-wide Hunting Success - Iowa, 1968 and 1969

	1968	1969
Resident Hunters		
Percent of Licensees Hunting Pheasants	81.8%	80.0%
Avg. No. of Hunting Trips	5.7	6.3
Avg. Season Kill per Hunter	5.6	6.2
Hours per Pheasant Killed	4.0	3.8
Estimated Total No. of Pheasant Hunters	235,250	242,900
Estimated Total No. of Hunting Trips	1,343,300	1,518,100
Estimated Total No. of Pheasants Killed	1,312,700	1,508,400
Non-Resident Hunters		
Percent of Licensees Hunting Pheasants	92.6%	93.0%
Avg. No. of Hunting Trips	4.3	5.4
Avg. Season Kill per Hunter	6.9	8.4
Hours per Pheasant Killed	3.4	3.5
Estimated Total No. of Pheasant Hunters	11,850	16,100
Estimated Total No. of Hunting Trips	51,000	87,300
Estimated Total No. of Pheasants Killed	81,200	134,400
Statistics For All Pheasant Hunters		
Estimated Total No. of Pheasants Killed	1,393,900	1,642,800
Estimated Total No. of Pheasant Hunters	247,100	259,000
Estimated Total No. of Hunting Trips	1,394,300	1,605,400
Estimated Total No. of Hunting Hours	5,595,800	6,267,700

Table 3. Distribution of Hunting Pressure and Pheasant Kill By Regions - Iowa, 1968 and 1969

Regions	Percentage of Trips		Birds Killed	
	1968	1969	1968	1969
1. Northwest	20.2%	16.6%	241,500	239,800
2. North Central	16.7	14.7	216,600	200,400
3. Southwest	15.7	14.5	224,500	266,200
4. Central	21.4	19.2	273,000	307,200
5. East	19.1	26.8	244,200	463,300
6. South	6.9	8.2	112,900	165,900

RESULTS OF FIVE YEARS OF POPULATION SURVEYS ON TWO QUAIL STUDY AREAS

M. E. Stempel
Game Biologist
and
Gene Hlavka
Game Biologist

Two quail study areas are located south of Highway 34 in Iowa's primary quail range (Stempel and Hlavka, 1966). The Wapello Area, of over 2,000 acres, is southwest of Ottumwa, Iowa, in Adams, Green and Center Townships of Wapello County. Little Soap Creek drains the area. Bottom lands and ridge tops are in grain or hay. Slopes are in brush or timber. Much of this is now being cut or otherwise destroyed. The Decatur-Wayne Area, of some 4,700 acres, comprises parts of Clay and Jefferson Townships in western Wayne County in addition to parts of High Point and Woodland Townships in eastern Decatur County. This former Iowa State University quail study area is located about eight miles north of the Iowa-Missouri boundary in south central Iowa. Steele's Creek ditch drains this area. Grain crops are raised in the flood plain. For the most part, the terrain in both areas is rolling to hilly. The soils are somewhat acid. Farm ponds are numerous. "Up and down-hill" farming continues; many gullies are caused by erosion. Tree and brush removal is occurring coupled with the shift in land husbandry toward livestock grazing.

On the study areas, late winter covey counts, summer roadside whistling cock counts, and early fall covey counts are conducted each year. A field record is also kept of the number of rabbits and pheasants sighted.

METHODS OF CENSUSING

Game Biologists conduct the late winter and early fall counts with the aid of dogs. The fall counts commence when most of the soybeans are harvested and some of the corn fields are opened up. Covey searches are limited primarily to grain field edges and adjoining travel lanes or cover patches. Abandoned farmstead grounds are also scouted. When snow cover is present, coveys can be located by their trails. Other quail signs (calling, roosts, feathers, droppings or tracks) and the actual walking time of the counts are recorded. Farmers are also asked for their estimates of the number of coveys on their farms.

From May through August, at two-week intervals, standard roadside whistle counts are conducted on each study area. The number of different cock quail heard calling at each of ten stops (listening points) on a pre-selected route is recorded. Quail sightings made while conducting the counts are also noted. After each month of the quail hunting season, five farmers on each study area are interviewed

about hunting activity on their farms. Questions are asked about the number and size of the hunting parties using the farms.

RESULTS

Both Areas: Winter Studies

The potential breeding stock is enumerated in late February and early March. In 1965 and 1968, there was some snow and this made locating quail easier. In 1969 and 1970, there was a little snow and in 1966 and 1967, there was no snow. Since 1965, there was an annual increase in numbers of late winter quail coveys (Figure 1). The number of quail coveys increased from 20 in 1965 to 44 in 1970.

Winter cover on the Wapello site decreased as is reported in Biology Reports for October-December, 1967, and remaining cover was severely trampled by cattle. The number of coveys remains high as winters have not been harsh. For the entire two areas, the late fall quail population is 33% higher than the average late winter population (Figure 1).

Spring and Summer Studies

Through the period 1965 to 1969, calling bobwhites were counted in spring and summer. Calling begins in March or April. Most is in June or July with calling sometimes high through portions of both months. This whistling (calling) is affected by weather; that is, the better the weather, the greater the amount of calling. Best rates for this activity were during 1967, 1968, and 1969 when Iowa Climatological Data rated the spring and summer seasons as being mostly favorable, early spring cloudy but with many nice days, respectively. The rating for 1965 was late spring; 1967 was cool with the wettest June in 95 years. Consistent calling patterns are established in June. Most of the whistling stops by the end of August. Ten weeks or more of calling with 20 or more birds calling per 10-stop routes indicates good reproduction activity since this is associated with calling by bobwhites (Table 1).

Changes in numbers of birds giving the "bobwhite" call during the peak indicates changes in numbers of males. Fifty-four was the least number whistling during a peak period (1965). Highest numbers (one route) were 66 in 1967 and 65 in 1969 (Figure 2).

Importance of weather and amount of calling are mentioned above. There is another indicator of good production activity - a high peak in June or in July with another smaller calling peak later. This occurred in each of the five years except in 1966.

Fall Studies

As for the number of fall coveys, in prime range the population remained at a

continued high with 53 coveys in 1965, 60 in 1966, 50 in 1967, 57 in 1968, and then increased to a high of 76 in 1969 (Figure 1). The comparatively low autumn population for 1967 was probably brought about because of the nearly continuous rainfall from late May through July 1.

HUNTING ACTIVITY

For the five year period, the earliest quail season opening was October 21, 1967 (Table 2); latest was November 6, 1965. Earliest ending was January 28, 1967 and latest was January 31 for the other years. About 20% of hunting reported on their places by cooperating farmers was in each of the months October and January, while the most (39%) was reported in November with 25% in December (Table 3). In the Decatur-Wayne Area, bird hunters also had pheasant shooting. Some hunting without permission was reported by the farmers on both areas.

OTHER INFORMATION

Quail Seen

The numbers of quail seen during the ten-stop quail census is not consistent with the numbers seen on other counts. Numbers seen on the roadside counts varied from nine to twenty birds per 100 miles. The sample size is too small to obtain precise results.

Pheasants

Very few pheasants are sighted on the Wapello County Area. In the Decatur-Wayne Area, there has been a gradual increase in the pheasants seen during the past five years of censusing.

Rabbits

In the Wapello County area, an average of five cottontails were seen per late winter count while in the fall the figure was six. For Decatur-Wyane, the late winter average per count was 27; the fall count average was 31.

COMPARISONS - FARMER ESTIMATES AND BIOLOGIST'S COUNTS

Winter Counts

Preceeding information, except the hunting data, is based on the field surveys by biologists. This section of this report sets forth information based on farmer's estimates as compared to biologists' findings.

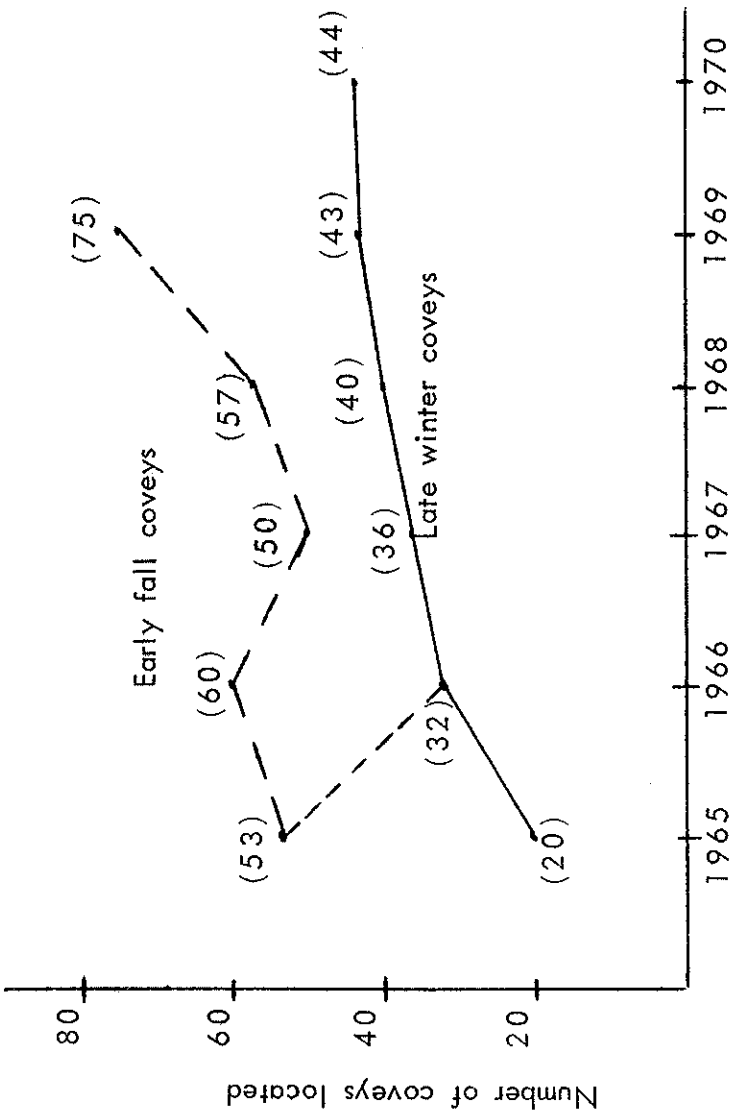
Eleven of the 15 farm dwellers on the Decatur-Wayne site work full time at farming: only six of those on the Wapello site work full time at farming their own places or land controlled by them; two work elsewhere part-time; and ten work full time in town, or at custom farm work. Some rent their land to others.

Farmers on the combined study areas reported in the period (1965 to 1969) that they saw 50 late winter quail coveys; whereas, the biologists found 171, or the farmers saw one covey to each 3.4 found by biologists (Table 4). It is obvious that few of these rural residents had a very good idea of the number of quail wintering on their place.

Fall Counts

On combined study areas, farmers reported that they saw 176 fall coveys while the biologists found 296, or farmers saw one covey to each 1.7 located by biologists (Table 5). This farmer/biologist covey ratio in the fall was just half that was found in winter. Such would be expected for the farmers are afield much more in the fall in connection with crop harvest and other field work and in checking on livestock that are still on pasture.

Figure 1. Trends in quail population on the Decatur-Wayne and Wapello Areas combined



Annual loss of quail coveys on both areas combined	
1966	40%
1967	40%
1968	20%
1969	25%
1970	41%
5 yr. Avg.	33%

Figure 2. Highest count of different cock quail heard calling by different observers on two 10-stop study area routes run bi-monthly from May through August, 1965 - 69.

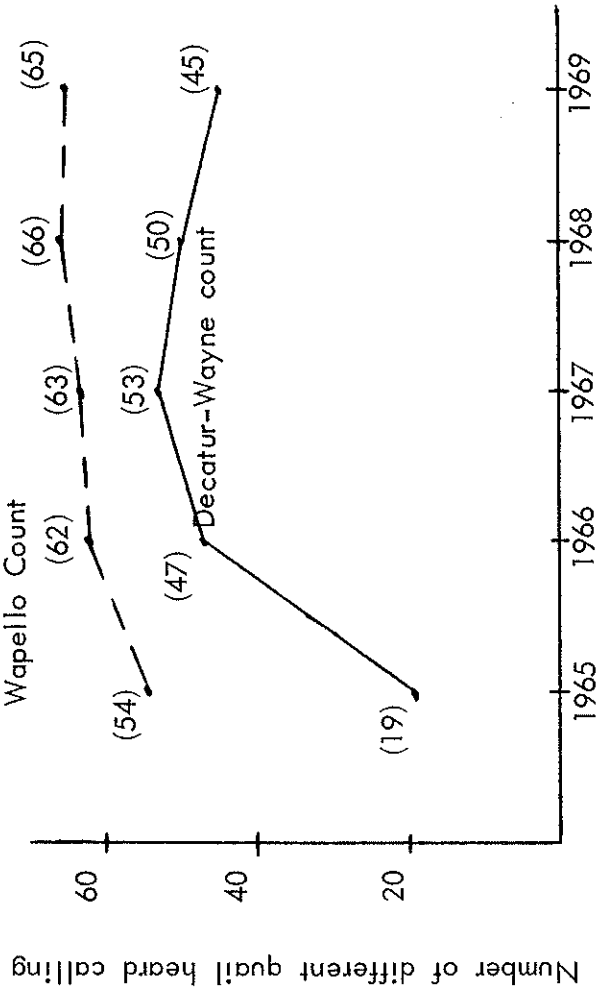


Table 1. Number of weeks 20 or more different cock quail were heard calling on two 10-stop study area routes compared to state-wide quail bag.

Year	Decatur-Wayne Route	Wapello Area Route	State-wide Quail Bag
1965	--*	12	513,760
1966	10	12	1,051,630
1967	10	14	736,520
1968	14	12	777,687
1969	14	12	1,144,700
4-yr. Avg.	12.0	5-yr. Avg. 12.4	

* For a period of four weeks, 18 to 19 different cock quail were heard calling.

Table 2. Iowa quail season dates and lengths from 1965-66 to 1969-70

Seasons	Dates of Quail Season	Number of Days in Quail Season
1965 - 66	Nov. 6 - Jan. 31	87
1966 - 67	Oct. 22 - Jan. 31	102
1967 - 68	Oct. 21 - Jan. 28	100
1968 - 69	Oct. 26 - Jan. 31	98
1969 - 70	Oct. 25 - Jan. 31	99
	5-yr. Avg.	97

Table 3. Percent of total hunting activity by parties on Decatur-Wayne and Wapello Areas combined - 1965-66 to 1969-70

	1965-66	1966-67	1967-68	1968-69	1969-70	5-yr. Avg.
October	---	19 (10)*	10 (11)	30 (6)	16 (6)	19
November	53	27	41	40	38	36
December	26	27	31	16	24	25
January	21 [34] **	27 [37]	18 [27]	14 [22]	22 [29]	20 [30]

* Number in parentheses is the number of quail-hunting days in October.

** Number in brackets is percent of total trips made in January as calculated from Hunter Postal Card Survey.

Table 4. Comparison of farmer estimates of late winter coveys to coveys located on Decatur-Wayne and Wapello Areas combined - 1965 - 1969

Year	Farmer Estimates	Coveys located
1965	11	20
1966	5	32
1967	8	36
1968	12	40
1969	14	43
TOTALS	50	171

Ratio of farmer estimates to coveys located: 1 to 3.4

Table 5. Comparison of farmer estimates of early fall coveys to coveys located on Decatur-Wayne and Wapello Areas combined - 1965 - 1969

Year	Farmer Estimates	Coveys located
1965	27	53
1966	41	60
1967	43	50
1968	34	57
1969	31	76
TOTALS	176	296

Ratio of farmer estimates to coveys located: 1 to 1.7

SUMMARY

1. Quail studies have been carried out on the Decatur-Wayne and Wapello research areas for five years.

2. The late winter brood stock increased from 20 coveys in 1965 to 44 in 1970 on the two areas.

3. More than 10 weeks of significant quail calling annually has indicated continuing good reproduction and high hunter harvest.

4. Highest number of fall coveys was 75 in 1969; lowest was 50 in 1967.

5. The average annual loss from early fall to late winter is 33% of the fall coveys.

6. Quail sighted per 100 miles on calling quail routes ranged from 9 to 20 birds. This has not been consistent with other counts; no doubt because of small sample size.

7. The 5-year average amount of hunting per month as reported by farmers on the area was:

October	19%
November	36%
December	25%
January	20%

LITERATURE CITED

Stempel, M. E. and Gene Hlavka.
1966. Quail studies on two areas in southern Iowa show increased populations and early-season hunting activity. Quarterly Biology Reports, Iowa State Conservation Commission. Vol. XVII, No. 1., pp. 13-19.

RESULTS OF POSTAL CARD SURVEY FOX, COYOTE, RACCOON AND WOODCHUCK HUNTERS FOR THE 1969-70 SEASON

Ron Andrews
Game Biologist

INTRODUCTION AND METHODS

This paper constitutes a report on the second phase of the post card survey of licensed Iowa hunters for the 1969-70 hunting season. The methods used here are slightly different from the previous five years in that the sample size increased from less then 2% to over 3% (approximately doubled) and the licenses were drawn on a more random basis. License sellers were to return a card giving the address of the first sale from each book of hunting, combination and non-resident licenses. Approximately 10,000 questionnaires were sent out to Iowa hunters.

RESULTS AND DISCUSSION

Response

Sales of resident, non-resident, and combination hunting and fishing licenses total approximately 321,000 in 1969. Of the 10,000 cards sent out for the second phase of the postal card survey, 3,819 responded for a 38% response. During previous surveys, a 32-34% response to the second phase of the postal card survey was received. A complete tabulation of the harvest data on foxes, coyotes, raccoon and woodchucks is shown in Table 1.

Foxes and Coyotes

Iowa fox and coyote hunters comprised 18% of the licensed resident hunters. This compares to 22% in 1968-69 and 16% in 1967-68. The expanded date reveals that 54,650 hunters bagged 142,100 foxes and coyotes in 1,874,495 hours. A total of 393,480 hunter trips were made during the fall and winter of 1969-70.

More effort was spent to bag a fox this year compared to 1968-69, while the total harvest was down 23% over the 1968-69 season. The reduced kill was anticipated because of the heavy hunting pressure late in the season in 1968-69. Prices on fox pelts remained relatively high this year and this was an added incentive for hunters to continue to pursue these animals. However, the sporting aspect of the red fox has spurred increased recreational interest and this has attracted many novice hunters to pursue this animal.

An attempt was made this year to separate the coyote harvest figures from the fox harvest figures. Fox populations fluctuate yearly due to hunting conditions, food availability and other factors. Coyote populations appear to be increasing over the past few years. Harvest figures were separated because of the differences in the population dynamics of the two species. These figures are shown in Table 1. Over 10,000 coyote hunters tallied more than 23,000 coyotes according to the survey. However, as is the case in Missouri (Krause, Sampson and Orr, 1969), the harvest figures are highly biased on both fox and coyotes. Successful hunters responded to the questionnaire better than unsuccessful ones. Many fox and especially coyotes are killed incidental to other activities and this biases the kill upward. The tendency of individual hunters to report the take of their party as their own is also a factor (even though letter of instructions asks them to report only those they kill themselves).

The 1969 bounty report shows 5,035 coyotes were bountied. Most of the counties that have any significant coyote population pays a bounty on them. Even if only half of the coyotes were bountied, the postcard survey indicates still twice as many coyotes were killed (and likelihood is that nearly all are bountied). This further points to the discrepancy of the survey for these fur-bearing species. A concerted effort will be made prior to next year's survey to reconciliate the various figures obtained for foxes and coyotes.

Raccoon

Raccoon hunters represented 6% of the licensed hunters during the 1969-70 season. The expanded data reveals that 748,842 hours were expended by 18,220 hunters and 300,630 raccoon were bagged. Fewer hunters hunted more hours and took fewer total raccoon than in the previous season; however, the bag per hunter season was up slightly. Pelt prices for raccoon were higher than they had been for several years early in the season and this increased hunting presure. Near the end of the season, prices dropped considerably.

The raccoon hunter probably responds similar to the fox and coyote hunter in that the individuals taking large numbers of raccoons or foxes respond more readily than the person taking one or two animals. The reporting of party rather than individual take also enters in here. Fairly reliable trend information should be shown for all three species, however. Comparison with fur buyer reports (which also include pelts purchased from trappers) shows wide discrepancies. However, there is strong evidence to indicate the fur buyer reports also leave a great deal to be desired from the accuracy standpoint. Again, trends should be similar. A more detailed evaluation of this will be made in the coming year.

Woodchuck

Woodchuck hunting continues to be a relatively minor sport as compared to other species. The number of woodchuck hunters has remained fairly stable during the five years that the species has been included in the survey. Because of the small number of returned cards with woodchuck data on them, confidence limits on the figures

presented in Table 1 would be rather wide; however, it is the only harvest information available at the present time.

LITERATURE CITED

Krause, Gary F., Frank W. Sampson and J. Martin Orr.
1969. Biased coyote harvest estimates: a paradox. J. Wildlife Management 33 (2):444-446.

Table 1. Results of Postcard Survey for Fox, Coyote, Raccoon, and Woodchuck 1969 - 1970 Season

Species	Percent of all Hunters Hunting Species	State-wide Bag	No. Hunting This Species	Total Hours Hunted	Total Hunting Trips Made
Fox & Coyote	18	142,100	54,650	1,874,495	393,480
* (Fox)	14.5	118,710	44,030	1,829,507	306,127
* (Coyote)	3.5	23,390	10,360	44,908	87,353
Raccoon	6	300,630	18,220	748,842	205,885
Woodchuck	0.5	6,385	1,520	15,048	5,928

Species	Avg. Trips /Hunter/ Season	Avg. Hours /Hunter/ Season	Avg. Hours /Hunter/ Day	Avg. Bagged /Hunter/ Season	Avg. Bagged /Hunter/ Day	Avg. Bagged /Hunter/ Hour	Avg. Hours To Bag One Animal
Foy & Coyote**	7.2	34.3	4.8	2.6	0.4	0.08	13.2
Raccoon	11.3	41.1	3.6	16.5	1.5	.41	2.5
Woodchuck	3.9	9.9	2.5	4.2	1.1	.43	2.4

* Kill figures for fox and coyotes figured separately; 5,035 coyotes bountied in 1969 - see text.

** Effort per hunter not figured separately for foxes and coyotes because of small sample size.

RESULTS OF THE 1969 SQUIRREL SEASON

Bob Sheets
Game Biologist

Expansion of information received through postcard surveys indicated a statewide squirrel harvest of 1,164,031. This is 149,000 more than the 1968 season (12 percent increase). The total number of squirrel hunters rose 12,805 but for the second consecutive year remained at 42% of Iowa's total license sales. The average number of days each hunter pursued squirrels rose from 5.2 in 1968 to 5.3 in 1969. Conversely, the average number of hours spent by each squirrel hunter decreased from 16.9 to 16.8. Although slightly less time was spent hunting each day, the increase in hunters and days hunted did result in an increased daily bag from 8.4 squirrels in 1968 to 8.7 animals in 1969. This year's higher success resulted in only 1.9 hours needed to bag one squirrel compared to 2.1 hours required in 1968. Results of the past seven years harvest data have been compiled to provide a comprehensive view of Iowa's squirrel harvests since 1963 (Table 1).

Measurements of last year's mast crop on nut-bearing trees have been completed and are much below the 1968 crop. This trend factor, derived by rating nut production as abundant (3 points), moderate (2 points), or poor, (1 point) dropped from 2.1 in 1968 to 1.6 last fall. Table 2 depicts Iowa mast production since 1958. This occurence coupled with an increased squirrel harvest last fall suggests, on the surface, a lower squirrel harvest may result in 1970, at least in some areas of the state. An opportunity therefore is at hand to gain further insight into the importance of corn and other domestic crops as a buffer food supply for squirrels in years of poor mast production.

Table 1. Results of hunter-postcard survey in Iowa for Squirrels - 1963 - 1969

Year	Statewide Bag	No. of Hunters	% of all Hunters	Total Hours Hunted	Total Days Hunted	Average Days Per Hunter	Average Hours Per Hunter/ Season
1963	1,440,057	150,932	49%	2,199,589	770,258	5.1	14.6
1964	1,111,290	136,415	44%	1,840,620	638,415	4.7	13.5
1965	1,236,400	123,640	44%	2,225,520	704,750	5.7	18.0
1966	1,370,250	130,500	45%	2,210,000	717,750	5.5	17.0
1967	1,196,810	138,520	47%	2,229,830	719,300	5.2	16.3
1968	1,014,940	120,790	42%	2,041,440	628,110	5.2	16.9
1969	1,164,030	133,595	42%	2,237,915	705,240	5.3	16.8

Table 1 (continued)

Year	Average Hours/ Hunter/ Day	Average Bag/Hunter Per Season	Average Bag/Hunter Per Day	Average Bagged Per Hunter Per Hour	Average Hours To Bag One Squirrel	Length of Season (Days)
1963	2.9	9.5	1.9	0.65	1.5	91
1964	2.9	8.2	1.7	0.60	1.7	91
1965	3.2	10.0	1.8	0.55	1.8	114
1966	3.1	10.5	1.9	0.62	1.6	115
1967	3.1	8.6	1.7	0.58	1.8	115
1968	3.3	8.4	1.6	0.47	2.1	109
1969	3.2	8.7	1.6	0.52	1.9	110

Table 2. Indices of mast yield by species in Iowa: 1958 - 1969

Species	Index of Production *											
	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Black Walnut	1.3	2.2	2.0	1.7	2.3	1.6	2.7	1.7	1.9	1.4	2.2	1.8
Butternut	1.0	1.9	1.7	1.2	2.3	1.4	2.4	1.3	1.4	1.2	1.3	1.7
Shagbark hickory	1.1	2.3	1.9	2.1	2.2	1.9	2.4	2.2	1.9	1.5	1.9	2.2
Bitternut hickory	1.4	2.1	1.9	1.7	2.0	1.8	3.3	1.9	1.8	1.4	2.0	2.2
White oak	1.1	2.3	1.9	1.4	2.5	1.9	2.6	2.0	2.0	1.7	2.4	1.4
Burr Oak	1.1	2.3	2.1	1.9	2.0	1.7	2.8	2.0	2.2	1.6	2.5	1.6
Swamp white oak	1.0	1.7	1.0	1.0	1.5	1.0	2.0	1.4	1.4	1.2	1.3	1.2
N. red oak	1.8	2.0	2.0	2.0	2.0	2.0	2.2	2.1	2.0	1.6	1.8	1.5
Black oak	1.6	1.8	1.7	1.6	2.2	1.9	2.2	2.1	2.0	1.7	2.0	1.6
Pin oak	1.2	2.2	2.5	1.9	2.1	1.9	2.4	1.6	1.6	1.7	2.1	1.6
Blackjack oak	1.0	2.0	1.0	1.0	2.0	2.0	1.6	1.4	1.6	1.6	2.0	2.0
Shingle oak	1.0	2.0	1.0	1.7	1.7	2.0	1.8	1.6	1.4	1.5	1.5	1.4
Post oak							2.0	1.3	1.3	1.4	2.5	1.0
Chinquapin oak					3.0	3.0	2.0	1.4	1.6	1.1	1.9	1.4
AVERAGE ALL SPECIES	1.3	2.1	1.9	1.7	2.2	1.8	2.4	1.9	1.9	1.5	2.1	1.6

* The index of production is based on observations which are recorded as "abundant, moderate, or poor." Numerical values are assigned these observations as follows: Abundant - 3, Moderate - 2, and Poor - 1. Index of production for one species for any year is derived by totaling the numerical values and dividing by the total observations of that species.

SLIME DISTRIBUTION STUDIES ON THE MISSISSIPPI RIVER

PROGRESS REPORT NO. 2

Don R. Helms
Fisheries Biologist

INTRODUCTION

A distribution and abundance study of the bacterial slime, Sphaerotilus natans, was initiated on the Mississippi River in the vicinity of Dubuque in June, 1969. This is the second progress report on the study. Methods remain the same except for adding certain sampling stations to facilitate eventual statistical analysis.

The preliminary report covered the months of June through October. During that period, 6.5 miles was the maximum distance downstream from Dubuque's STP (sewage treatment plant) that slime was detected. Slime was noticeably less abundant in September and October, and none was observed on the Illinois side of the river.

RESULTS AND DISCUSSION

Data for the period of November, 1969 through March, 1970 are presented in this report.

November

Slime abundance and distribution remained at a low level. In November, it did not differ substantially from September and October samples (Table 1).

February

Ice and snow conditions did not permit sampling during December and January. When sampling resumed in February, intermittent and flowing ice still prevented sampling a number of strategic stations, particularly those downstream from the Dubuque STP. This sample, however, did show a marked increase. Slime was detected from the STP effluent downstream to the lower most station. This station was located just above L & D #13 near Clinton. Although it undoubtedly extended much farther, additional slime originating from Clinton would have masked any results we might have obtained from additional samples.

In contrast to previous sampling, slime was also detected on the Illinois side of the river beginning at river mile 572. From that point, distribution along the Illinois

side was comparable to the Iowa side and was continuous except for stations at R.M. 561 and 559. Reduced amounts at these stations probably resulted from the introduction of fresh water from the Galena River via Stone Slough at R.M. 562.

It should be noted that slime may have been exceptionally dense this year. A commercial fisherman in Sabula expressed alarm because in his 60 years of fishing, this was the first he had observed it. Bellevue fishermen, 21 miles upstream, indicated it's winter occurrence has been common for several years. However, they too thought it was worse this year.

March

A reduction in slime was observed in the March sampling. Visual observations indicate most of this reduction occurred in conjunction with increased turbidity and water level following the first run off of the season.

Table 1. Results of Slime Traps Set for 24-hour Periods in the Dubuque Slime Bed

Station Description		Date of Sample	Nov. 1969	Feb. 1970	Mar. 1970
		River Discharge	24,000	35,000	35,000
		Temperature	38°	32° (ice cover)	32°
River Mile	Location		Weight of slime in ounces		
582.0	Iowa side (upper end of Peosta Channel)				0
580.5	Iowa side (lower end of Peosta Channel)				0
580.5	Illinois side				0
579.5	Iowa side				0
578.5	Iowa side		3/4 *		0
580.0	Illinois side		0	0	0
577.5	Iowa side		0		13 *
576.5	Iowa side		1/2		5 1/2
575.5	Iowa side		0		2 1/4
574.5	Iowa side		0	1	4 1/2
574.5	Center of channel			0	
574.5	Illinois side		0	0	0
574.0	Iowa side (Shaundassee Sl)		1 1/4	9	11 3/4
574.0	Iowa side (Molo Slough)		0	5 1/2	8 1/4
574.0	Iowa side		0	1/2	5
573.0	Iowa side (cut between Shaundassee & Molo Sl)		1/4	11 1/2	6
572.0	Iowa side (Molo Slough)		1/4	10	4 1/2
572.0	Iowa side		0	9 1/2	0
571.0	Iowa side		1/2	6	6

Station Description		Nov. 1969	Feb. 1970	Mar. 1970
571.0	Center of channel		10	
570.0	Iowa side	0	9 1/2	3
570.0	Illinois side			1 1/4
569.0	Iowa side	0	13	3
567.0	Iowa side		6 1/2	1
567.0	Center of channel		10	
567.0	Illinois side		5 1/2	1 1/2
563.0	Iowa side		3 1/2	1/2
563.0	Center of channel		5 1/2	
563.0	Illinois side		8	4 1/2
559.0	Iowa side		7	5 1/2
559.0	Center of channel		8	
559.0	Illinois side		1/2	0
550.0	Iowa side		7 1/2	
550.0	Center of channel		9	
550.0	Illinois side		5	
542.0	Iowa side		7 1/2	
542.0	Center of channel		10 1/2	
542.0	Illinois side		8 1/2	
530.0	Iowa		7	
530.0	Center of channel		5 1/2	
530.0	Illinois side		3	

Location is described with respect to the navigation channel unless otherwise noted.
* Weight consists of debris other than slime.

PROGRESS REPORT OF SPIRIT LAKE WALLEYE STUDIES STATUS OF MARKED FINGERLING STOCKING STUDY

Terry Jennings
Fisheries Biologist

Previous studies have shown that the walleye is an important part of the angler's catch from Spirit Lake (Jennings, 1968). Normally, they are the third most abundant species harvested. There is also evidence that angling pressure on Spirit Lake is related to walleye fishing success. Other studies have shown the adult walleye population in the lake fluctuates between approximately 27,000 and 80,000 (Jennings, 1965 and 1969; Moen, 1962).

Since walleye are important to Spirit Lake, they have received intensive management for more than 20 years. A recent study of natural reproduction indicates that walleye populations equal to those observed in the past are contingent upon intensive management (Jennings, 1969).

September and October stocking of fingerling walleye from nursery lakes is a part of the Spirit Lake walleye management program. Except in 1956, the contribution of stocked fingerlings to their respective year classes has not been evaluated. Results of the 1956 study have not been published, but records are available. During the fall of 1956, approximately 125,000 fingerling walleye were stocked into Spirit Lake. In 1960 they comprised about 10% of the 1956 year class observed in the creel. Records indicate that 1956 year class walleye were more numerous than average.

This paper is only a progress report of data collected to date. It is not intended as a complete evaluation of this program.

PROCEDURE

Nearly all fingerling walleye stocked into Spirit Lake between 1964 and 1969 were marked. Instructions for marking these fish were to clip the right pectoral fin as close to the body as practical. Past experience has shown that in close-clipped fins regeneration is quite slow and the mark is recognizable for a long period of time.

All fish used in this study were seined from nursery lakes. They were marked at the nursery lake, transported to Spirit Lake and stocked. No annual stocking quota was established. Stocking was determined by the availability of fingerling walleye and the needs of other lakes in this region of the state.

It is evident from Table 1 the number of fingerlings available each year for stocking into Spirit Lake is extremely variable. The number stocked ranged between

0 in 1968 and 61,175 in 1969. Generally, at the time of stocking the total length of stocked fish was comparable to the length of same aged fish in Spirit Lake. While seining for fingerlings during the fall of 1967, 1,050 fish from the 1966 year class were also captured. These fish were marked and stocked.

In subsequent years, nearly all walleye captured during spawning and summer test-netting were measured and recorded. Scale samples were obtained from most sizes of fish captured. From unpublished age and growth data, it was possible to determine the total lengths where overlap between year classes was most likely to occur. Added emphasis was placed on taking samples at the lengths where overlapping of year classes containing marked fish could occur.

All fish that could possibly belong to one of the year classes containing marked fish were examined for evidence of prior fin-clipping. The total length of all marked fish was recorded. So that they could more accurately be assigned to a year class, scale samples were taken from nearly all of the marked fish.

By using the length-frequency distribution and age data obtained from scale samples it was possible to estimate the number of fish captured in each year class. The number of marked fish belonging to each year class was also determined by using length-frequency and age data.

RESULTS

As the number of marked walleye stocked varied, so did their contribution to the individual year classes; but, not necessarily in relation to the number stocked. The contribution made by marked fish to their respective year classes varied between 12.8% in 1965 and 1.1% in 1967 (Table 2). The number of observations, particularly of the older year classes, has been adequate. For instance, 1,445 observations have been made of 1964 year class; 847 of 1965 year class fish; and 726 of 1966 year class walleye have been examined. The number from the 1967 year class observations has been small because most of these fish will not enter the spawning population until 1970. Table 3 represents only these walleye observed during their spawning "run". It shows large numbers of age group III and older walleye can be observed during the spring.

Ideally, the percentage of marks observed annually within each year class would have remained constant. For the 1964 year class, the observed percentages fluctuate. Tables 3 and 4 show these fluctuations occurred more in seining data than in electrofishing data. Considering all sources of error and the relatively small number of fish examined during the summer, the differences are not unexpected. Thus, 1.7% is considered a valid estimate of marked fish within the 1964 year class. Because of extreme overlapping, it was impossible to accurately estimate the number of fish in individual year classes after age V. For this reason, no further observations will be made of this year class.

In 1968, an estimate was made of the number of walleye in Spirit Lake ≥ 12

inches total length (Jennings, 1969). From these data, it was estimated the 1964 year class comprised about 4,800. If 1.7% of these fish were marked, then only 82 fish survived to age IV. It is obvious the 1964 marked fingerling stocking contributed little to that year class.

Annual fluctuations within the 1965 year class were more pronounced. Observations made in 1967 were 7.1% less than observed in 1966. However, these observations are based on relatively small numbers and probably are not as meaningful as the 8.1% discrepancy between 1968 and 1969 observations. The 1969 observation is significantly different from the mean of previous years ($P>0.05$). Tables 3 and 4 show the differences between these two years occurred during spring and summer. The annual decline in percentage of marked fish within the 1965 year class, as indicated in Table 4, is suggestive of fin regeneration. Since 1965 was one of the peak years of fingerling stocking, it is possible that in the haste of marking this number of fish some of the fins were not clipped close enough to the body. Consequently, it is possible fins on some of the marked fish had regenerated to the point where only careful examination would have detected them. Failure to recognize marked fish is probably responsible for the decreased percentage of recaptures. With this in mind, the percentage of recaptures listed in Table 2 is probably below the actual figure. The true figure is probably nearer 16%.

From the 1968 population data, it is estimated that during the spring of 1968, the 1965 year class of walleye in Spirit Lake totaled about 6,800. Assuming 16% of these fish were marked, 1,088 marked fingerlings stocked in 1965 survived to age III. This planting contributed fair numbers to the 1965 year class.

A difference also occurred within the 1966 year class. The percentage of marks observed during 1968 was 11.8% greater than observed in 1969 and 14.7% greater than 1967 observations. The 1968 observation does differ significantly from the mean ($P>0.05$). The difference occurred because a large number of recaptures were collected during the spring of 1968. Experience has shown that only a small percentage of age II walleye at Spirit Lake are sexually mature and are the larger individuals of the age group. If these fish are sexually mature, it is expected they would be found at the spawning grounds. It is also possible fish of similar size but not mature would also inhabit the spawning grounds. Only a small percentage of the 1966 walleye year class were available at spawning locations during 1968. It is possible these were the larger fish of the year class. If marked fish were more prevalent in this segment of the population, the percentage of recaptures would be higher. Mean total length of marked fish collected during the spring of 1968 was 10.2 inches. Mean total length of this year class during 1968, as estimated by back-calculation from scale samples collected in 1969, was 9.5 inches. It is possible the observed difference was caused by size differentiation. Since fish of comparable size with those in Spirit Lake were stocked during 1966 and 1967, this author cannot explain the cause of this apparent size differentiation.

Although more data will be collected during 1970, marked fish probably total about 2% of the 1966 year class.

To date, only 175 observations have been made of the 1967 year class. Presently, 1.1% of this year class are marked. Since most of these fish will enter the spawning population in 1970, many more observations will be obtained before final analysis.

DISCUSSION

Another part of walleye management at Spirit Lake includes annual fry stocking at rates up to 3,000 per acre. With annual fry stocking and natural reproduction the number of age 0 walleye inhabiting Spirit Lake is probably near carrying capacity at all times. In a situation such as this, the addition of more fish would increase the total to carrying capacity, if possible, and some probably would replace weaker fish. Thus, the percentage of marked fish observed does not necessarily mean the total number of fish was increased by that percentage. Since the amount of replacement was not determined, it was assumed if a large number of marked fish were observed in a year class that stocking was successful.

The next problem is to determine the breaking point between success and failure. This point is a matter of conjecture and, most certainly, will vary with the individual making the analysis. This author does not know where the point is. But I doubt if success is not attained where 2% or less of a year class is comprised of marked fish.

Data collection from the 1964 year class of walleye in Spirit Lake has been completed. From these data, it is reasonable to assume the addition of 16,880 marked fingerlings in 1964 did not substantially increase the total number in that year class. Although it cannot be proven, data collected from summer test-netting, etc., seems to indicate the number of fish stocked in 1964 was only slightly less than the population already in the lake.

Before final analysis, more data will be collected from other year classes containing marked fish. The data already collected suggest that only the 1965 marked fingerling stocking can be termed a success. All factors considered, it is doubtful if a contribution of marked fish much greater than 16% will be attained at Spirit Lake.

ACKNOWLEDGEMENT

This author wishes to thank the personnel at the Spirit Lake Fish Hatchery for their cooperation in making stocking records available. A special thank you is extended to Wally Jorgensen and his crew for their able assistance in marking the fish for this study.

LITERATURE CITED

Jennings, Terry
1965. Spirit Lake walleye study, 1963. Iowa State Conservation Commission. Quarterly Biology Reports 17(1):28-32.

_____ 1968. Summary of 22 consecutive years of creel census on Spirit Lake. Proceedings of Iowa Academy of Science. 75:159-163.

_____ 1969. Progress Report of Spirit Lake walleye studies, 1968 population estimate. Iowa State Conservation Commission Quarterly Biology Reports 21(2):73-77.

_____ 1969. Progress Report of Spirit Lake walleye studies, natural reproduction. Iowa State Conservation Commission Quarterly Biology Reports 21(3):--.

Moen, Tom.
1962. Walleye population studies, Spirit Lake, 1961-62. Iowa State Conservation Commission Quarterly Biology Reports 14(2):21-24.

Table 1. Number, average total length, and age of fin-clipped walleye stocked into Spirit Lake annually from 1964 through 1969:

Year	Total Number	Average Total Length (inches)	Age
1964	16,880	4.8	0
1965	17,905	4.6	0
1966	5,382	3.5	0
1967	2,115	4.5	0
1967	1,050	8.5	1
1968	0		
1969	61,175	5.1	0

Table 2. Total, total recaptures, and percent recaptures of 1964, 1965, 1966, 1967, and 1968 year classes of walleye taken from Spirit Lake by electro-fishing and seining

Total	1964 Year Class			1965 Year Class			1966 Year Class			1967 Year Class			1968 Year Class		
	Total	Marked	%	Total	Marked	%	Total	Marked	%	Total	Marked	%	Total	Marked	%
1965	64	1	1.5												
1966	41	2	4.8	47	10	21.2									
1967	756	16	2.1	64	9	14.1	48	0	.0						
1968	426	4	0.9	399	63	15.8	150	22	14.7	29	0	0			
1969	158	2	1.3	337	26	7.7	528	15	2.9	146	2	1.4	208	0	0
TOTALS	1,445	25	1.7	847	108	12.8	726	37	5.1	175	2	1.1	208	0	0

Table 3. Total, total recaptures, and percent recaptures of 1964, 1965, 1966, and 1967 year classes of walleye taken from Spirit Lake at their spawning sites by electrofishing

Year	1964 Year Class			1965 Year Class			1966 Year Class			1967 Year Class		
	Total	Marked	%	Total	Marked	%	Total	Marked	%	Total	Marked	%
1967	705	13	1.8	19	3	15.7						
1968	411	4	1.0	380	61	16.1	102	21	20.6			
1969	142	2	1.4	308	26	8.4	465	14	3.0	37	1	2.5
TOTAL	1,258	19	1.5	707	90	12.7	567	35	6.2	37	1	2.5

Table 4. Total, total recaptures, and percent recaptures of 1964, 1965, 1966, 1967, and 1968 year classes of walleye taken from Spirit Lake during summer test netting

Year	1964 Year Class			1965 Year Class			1966 Year Class			1967 Year Class			1968 Year Class		
	Total	Marked	%	Total	Marked	%	Total	Marked	%	Total	Marked	%	Total	Marked	%
1965	64	1	1.5												
1966	41	2	4.8	47	10	21.2									
1967	51	3	5.8	45	6	13.6	48	0	0						
1968	15	0	0	19	2	10.5	48	1	2.1	29	0	0			
1969	16	0	0	29	0	0	63	1	1.6	109	1	0.9	208	0	0
TOTALS	187	6	3.2	140	18	12.9	159	2	1.3	138	1	0.7	208	0	0

POPULATION ESTIMATES OF COMMERCIALLY VALUABLE FISH SPECIES IN CORALVILLE RESERVOIR

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A primary objective of current investigations at Coralville Reservoir was to determine population magnitude of commercially valuable fish. In 1969, population estimates were made at Coralville for carp, river carpsucker, bigmouth buffalo and channel catfish. Previous quarterly report described the movement patterns of these species to determine the extent of dilution by marked individuals moving from a study area. This movement or dilution of marked fish could cause considerable over estimation error of the population.

The lower boundary of the study area was located six miles upstream from the dam. The area contained 1,979 surface acres at elevation 680' msl and was subdivided into ten - one mile segments. Each segment was numbered consecutively from the downstream direction [1(1)10]. Physical characteristics in the area were similar to the entire pool.

Fish were marked only in segments 4, 5, 6, and 7. In segments 4 and 5, they received a left pelvic fin clip as distinguished from fish marked in 6 and 7 with a right clip. Surface area was 1,188 surface acres at elevation 680' msl for segments 4 - 7. Additional capture and recapture effort was exerted in segments 1 - 3 and 8 - 10 to determine dispersal of marked fish from areas 4 - 7.

Capture, marking, and recapture of carp, carpsucker and bigmouth buffalo were done concurrently from April 8th through August 12th. Pound nets were used to capture fish for both marking and recovery. Baited slat traps were used to capture channel catfish in the pool from May 12th to October 24th, while baited hoop nets were used in the headwaters starting September 26th. The season was divided into 16 bi-weekly periods with the first starting March 26th. Records were made of number caught, recaptured, origin of each recaptured, and number marked and released for each segment in each period. The method of estimation was multiple and sequential. Fish were marked and captured continuously through the season and individual estimates were made for each period in addition to cumulative estimates. Recaptures, number caught for segments 4, 5, 6 and 7 were combined for each period.

ESTIMATE OF THE CARP POPULATION

Carp received 7,396 marks and 57 were recaptured from 7,453 examined fish. Maximum rate of recatpure was in the seventh period when 2.4% of all captured fish were previously marked. Loss of marked fish reduced the available marked fish in the study area for recapture by 17%. The number of marked fish for each period was multiplied by 83% and was considered to be available for recapture as shown in Table 1.

Individual estimates for each period varied from 16,317 in the second period to 2,366,400 in period 10. These were based on only two and one recaptures, respectively. Cumulative estimates varied from 16,317 in period 2, to 275,449 in period 10. The cumulative estimate was more precise because of the larger sample.

Standard deviation and confidence interval was based on equation (3.14) of Ricker (1958). The 95% confidence interval for the final cumulative estimate was 208,333 to 384,610. Reducing this to unit area there were 232 + 91 or - 57 per surface acre.

ESTIMATE OF THE RIVER CARPSUCKER POPULATION

Movement determinations indicated 61% of marked carpsucker stayed within the four mile study area. During 10 periods 2,100 fish were marked, of which 1,281 were estimated to stay within the study area and available for recapture. Carpsucker recaptures were not taken until the fourth period, but the population estimate stabilized by the seventh period (Table 2). Maximum recapture rate was in the tenth period with 3.5%. Recapture rate for all periods was 1.8%.

Estimate for each of the 10 periods ranged from 11,925 in the fourth period to 113,680 in the seventh period. Cumulative estimates ranged from 13,368 in period 4 to 36,169 in the ninth period. The cumulative estimate in the tenth period was 30,245 and was considered the most accurate. Confidence limits were computed by the method previously described. An estimated 26 + 14 or - 7 carpsucker per surface acre existed in the reservoir at the start of period 1.

ESTIMATE OF THE BIGMOUTH BUFFALO POPULATION

Movement of the bigmouth buffalo was similar to carp. An estimated 81% of all marked individuals remained in the four mile study area. Of 8,065 fish marked only 6,533 were estimated to have remained in the study area.

Recaptures were taken in all periods except the third with 52 recaptures taken in all periods. Greatest recapture rate was in period 7. Mean recapture rate was 0.6%. Individual estimates varied from 69,643 to 1,887,578 in the second and sixth periods, respectively (Table 3). Cumulative estimates were less variable and ranged from 69,643 in period 2 to 566,957 in period 6.

An approximation of the final population estimate was reached as early as period 5. Some variation was noted in the sixth period but the estimate was stable thereafter. Total cumulative estimate was 435,182 or 366 bigmouth buffalo per surface acre with 95% confidence limits of + 160 or - 85 fish from the mean.

ESTIMATES OF THE CHANNEL CATFISH POPULATION

Channel catfish were marked in only segments 4 and 5 of the pool study area. The marking started in the fourth period and was continuous through the fifteenth period with exception of period 12. Of 1,374 fish marked during the experiment, 1,082 were marked in periods 13, 14, and 15.

Movement determination by Mitzner (1968) indicated channel catfish in the pool would disperse from the study area and only 34% would reamin in the 2 mile segment. Increased activity in 1969 was evident by an abnormal number of marked fish being recaptured 14 miles from the marking area during periods 14 and 15. No specific determinations were made of the movement in 1969 and the population of marked fish was reduced by 34% as determined previously. The population estimate was considered to be slightly over estimated.

Recaptures were taken continuously from period 7. The largest recapture/capture ratio was 12:100 in period 10. The ratio was 6.5:100 for the entire season. Estimates were based on 109 recaptures from a sample of 1,684 individuals (Table 4).

Estimates for individual periods ranged from 192 in period 7 to 4,633 in period 16 with extreme variation between. Cumulative estimates varied from 343 to 4,035 with less variation. Confidence intervals at the 95% level on the final cumulative estimate, 4,035, were 3,098 to 5,780. The study area contained 686 surface acres at elevation 680' msl and the density of channel catfish was 6 fish + 3 or - 1 per acre.

A population estimate was initiated late in the season for channel catfish in the headwaters area of the reservoir. Marking was done in periods 14 and 15. Only 10 recaptures were taken after marking 1,283 and inspection of 1,318 individuals for fin clips. The recovery of $>$ 1% of the marked fish was considered too low for an accurate population estimate. Recovery of marked fish in the pool as described in the last quarterly report indicated movement during this period was greater than normal and the population estimate would also have been in error for that reason.

DISCUSSION

Population estimates are considered to be accurate by fisheries investigators only if the following assumptions are true:

1) Mortality of marked and unmarked fish is equal.

2) Vulnerability to fishing gear is equail for marked and unmarked fish.

3) Loss of identifying mark is minimal.

4) Marked fish become randomly mixed with the unmarked; or the distribution of fishing effort (in subsequent sampling) is proportional to the number of fish present in different parts of the body of water.

5) All marks are recognized and reported on recovery.

6) A negligible amount of recruitment to the catchable population occurs during the time of recovery.

In all species studied at Coralville conditions, 3 and 5 existed as stated above. Assumption 6 was only attained for channel catfish and bigmouth buffalo. Length-frequency distribution could be used to age these species. Only age group II and older fish were marked. This method could not be used on carp and carpsucker and the unadjusted estimate may be high. After seasonal growth for these species is computed for the age groups involved then appropriate adjustments may be made.

Some mortality due to catching, marking and handling of carpsucker and bigmouth buffalo occurred, enumeration data was not available to determine the extent of increased natural mortality of these species. Assumption 1, if not met, would cause the estimate to be larger than if no increased mortality has occurred. None or little increased mortality was attributed to marked carp and channel catfish.

Conditions 2 and 4 would be difficult to determine if they were not true. This was the primary purpose of using a sub-sample technique or study area. The vulnerability of marked fish in the study area was determined by movement data of the species involved. Random mixing was assumed to have occurred because of the relatively small sampling area combined with intensive sampling.

LITERATURE CITED

Mitzner, Larry. 1968. Movement of channel catfish in Coralville Reservoir. Iowa Conservation Commission, Biology Quarterly Report, Vol. 20, No. 4. pp. 1-6.

Ricker, W. E. 1958. Handbook of computation for biological statistics of fish populations. Queens Printer and Controller of Stationery, Ottawa. 300 pp.

Table 1. Independent and cumulative estimates of carp in 1969

Period	Marked Fish At Large	Fish Captured	Number Recaptured	Independent Estimate	Cumulative Estimate
1	0	119	0	-	-
2	98	333	2	16,317	16,317
3	373	3972	25	59,262	56,081
4	3649	553	5	403,579	110,370
5	4104	552	3	755,100	165,642
6	4560	166	4	189,240	168,063
7	4694	330	8	193,628	172,414
8	4961	282	4	349,751	186,329
9	5192	738	5	766,339	238,110
10	5800	408	1	2,366,400	275,449
11	6138	0	0	-	-

Table 2. Independent and cumulative estimates of carpsucker in 1969

Period	Marked Fish At Large	Fish Captured	Number Recaptured	Independent Estimate	Cumulative Estimate
1	0	6	0	-	-
2	4	15	0	-	-
3	13	225	0	-	-
4	150	159	2	11,925	13,368
5	246	207	3	16,974	15,531
6	370	155	1	57,350	22,501
7	464	245	1	113,680	35,526
8	613	99	6	10,115	23,798
9	670	402	3	89,780	36,169
10	913	625	22	25,937	30,245
11	1281	0	0	-	-

Table 3. Independent and cumulative estimates of bigmouth buffalo in 1969

Period	Marked Fish At Large	Fish Captured	Number Recaptured	Independent Estimate	Cumulative Estimate
1	0	626	0	-	-
2	507	1511	11	69,643	69,643
3	1722	750	0	-	187,050
4	2330	736	2	857,400	290,180
5	2924	715	2	1,045,300	390,874
6	3502	1078	2	1,887,578	566,957
7	4374	2038	30	297,100	394,730
8	6000	150	1	900,000	405,260
9	6121	397	4	607,509	420,818
10	6439	116	0	-	435,182
11	6533	0	0	-	-

Table 4. Independent and cumulative estimates of channel catfish in 1969

Period	Marked Fish At Large	Fish Captured	Number Recaptured	Independent Estimate	Cumulative Estimate
4	0	16	0	-	-
5	5	17	0	-	-
6	9	40	0	-	-
7	22	26	3	192	343
8	30	35	1	1,047	519
9	40	113	8	562	548
10	71	49	6	580	559
11	82	113	2	4,633	966
13	99	177	8	2,197	2,331
14	157	153	10	2,399	2,416
15	197	164	17	1,903	1,896
16	245	13	1	3,188	4,035

POPULATION ESTIMATE AND GROWTH OF CARP IN RED ROCK RESERVOIR DURING THE FIRST YEAR OF IMPOUNDMENT

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During the third quarter of the project, effort was directed toward analysis and interpretation of data collected in 12 bi-weekly netting periods. Carp was numerically the most important species in the reservoir and it was fitting that time be devoted to data collected for this species.

Red Rock Reservoir is a new impoundment and it was extremely important that the fish species with commercial or industrial importance be intensively studied to record changes in population dynamics and growth as the area was suddenly changed from a stream ecosystem to that of a man-made lake. As a result of the impoundment, the water surface area increased to a maximum of 44,000 acres with a mean of 26,000 acres in 1969. It was anticipated that the fish population already present in the river would undergo rapid and drastic increases in both population densities and growth rates to fill the void created by the new lake. In order a systematic and meaningful record of these increases be obtained, a population estimate and knowledge of growth rate was essential.

METHOD AND PROCEDURES

Population Estimate

All fish captured with commercial or industrial value in 1969 were marked by removing one pectoral or pelvic fin. Fins were removed according to the region in which the fish were netted to provide intra-reservoir movement data. The Schnabel method of computation from mark and recapture was used. This method provides both an independent and cumulative estimate of population density anytime after the initial group of fish is marked and homogeneity is established. Population estimates were made at the end of each bi-weekly netting period. The estimates were computed with the Schnabel equation.

$$\hat{N} = \frac{\sum (C_t M_t)}{\sum R_t}$$

where

$\hat{N}$ = population estimate

M_t = total number of marked fish at large in the t^{th} period

C_t = total sample collected at t

R_t = number of marked fish in the C_t sample

Growth

Scale samples were obtained at weekly intervals from carp chosen randomly from the catch. Lengths and weights were recorded for each sample. Scales were viewed and aged on a microprojector (x17). Measurements were also made to determine scale radius, grouped at 0.5 inch body length intervals (L) and a mean scale radius (R) determined for each group. Using total length as the dependent variable, a straight line was fitted to the plotted values by the function

$$L = a + bR$$

The value was used as the origin of nomographs in calculating total length at the end of each year of life. Back calculation of total length was facilitated by this length-scale radius relationship.

Length frequency distributions were recorded at weekly intervals by measuring all carp captured in one randomly selected net. The distributions were grouped into 0.5 inch length intervals, a mean determined for each length group and a weighted mean computed for the entire distribution. Calculation of percent of young-of-the-year carp in the catch was also made from the distribution using an arbitrary maximum size limit of 11.0 inches for the young carp. The size limit was obtained from scale samples taken during the netting operation.

RESULTS

Population Estimate of Carp

During 12 bi-weekly netting periods, 52,508 carp were marked from a total sample of 72,519. Of these marked fish, 703 or 1.3% were subsequently recaptured. Independent population estimates of carp varied from a minimum of 35,839 at the end of period 6 to a maximum of 168,347,928 in period 17 (Table 1). The variation in these estimates is directly related to the number of recaptures in each period. Cumulative estimates ranged from 35,839 to 2,854,436 in periods 6 and 18, respectively. The final estimate is considered to be most reliable. The cumulative number of recaptures assumes the characteristics of a Poisson distribution where the square root (26.5) of this recapture number can be considered the standard deviation and confidence intervals computed for the estimate. Confidence intervals of 95% for the estimated 2,854,436 carp were $\pm$ 228,004.

The rapid increase in the cumulative estimate between period 8 and 14 is attributable primarily to the recruitment of young-of-the-year carp into the population vulnerable to pound nets. Data from the length frequency distributions (Table 2) collected in each sampling period gives credance to this contention (Figure 1).

Growth in total length

The body-scale regression expressing the relationship for carp between total length

and scale radius for 1969 was

$$L = 0.4 + 2.7R$$

Estimated total length at the end of each year of life based on summation of mean estimated increments was 4.2, 7.3, 10.4, 12.8, 15.1, 17.0, 18.7, 20.2, 21.4, 22.4, 23.6 respectively for the first 11 years of life. Increment of annual growth gradually declines as the carp grew older (Figure 2). Estimated increments and total length at the end of each year of life are given in Tables 3 and 4.

Growth index

A growth index was computed to compare growth increments for each calendar year with the total mean increment for carp sampled in 1969. The growth index ranged from 79 in 1966 to 148 in 1958. Growth was above normal in 1958-62 and during the combined year 1968-69. Below normal growth was recorded for 1963-67 (Figure 3).

Growth of age 0 Carp

Age 0 carp became vulnerable to the pound nets in period 8 and were sampled the remainder of the netting periods. Growth of age 0 carp increased systematically from 5.4 inches in period 8 to 10.5 inches in period 15 with a mean of 7.6 inches (Figure 4).

Length frequency distributions

Means for length frequency distributions taken at weekly intervals ranged from 15.0 inches in period 5 to 7.3 inches in period 10. The systematic decline in mean length between periods 5 and 10 and then the increase between periods 10 and 16 is attributable to the recruitment of young-of-the-year carp into the population and their gradual increase in size (Figure 4).

Figure 1. Population estimates and percent of carp under 11.0 inches in Red Rock Reservoir, 1969.

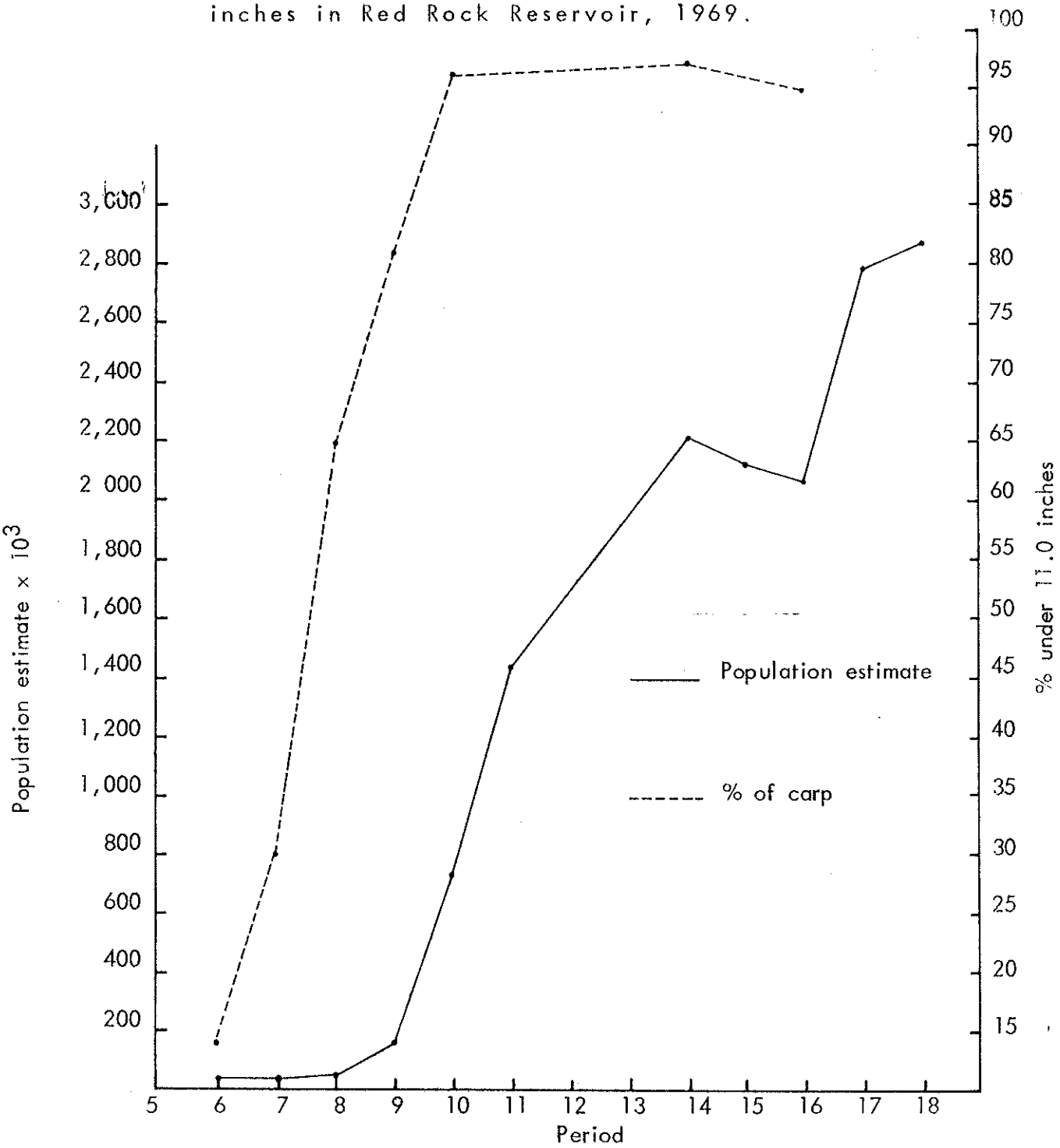

Figure 2. Mean estimated length of carp in Red Rock Reservoir, 1969

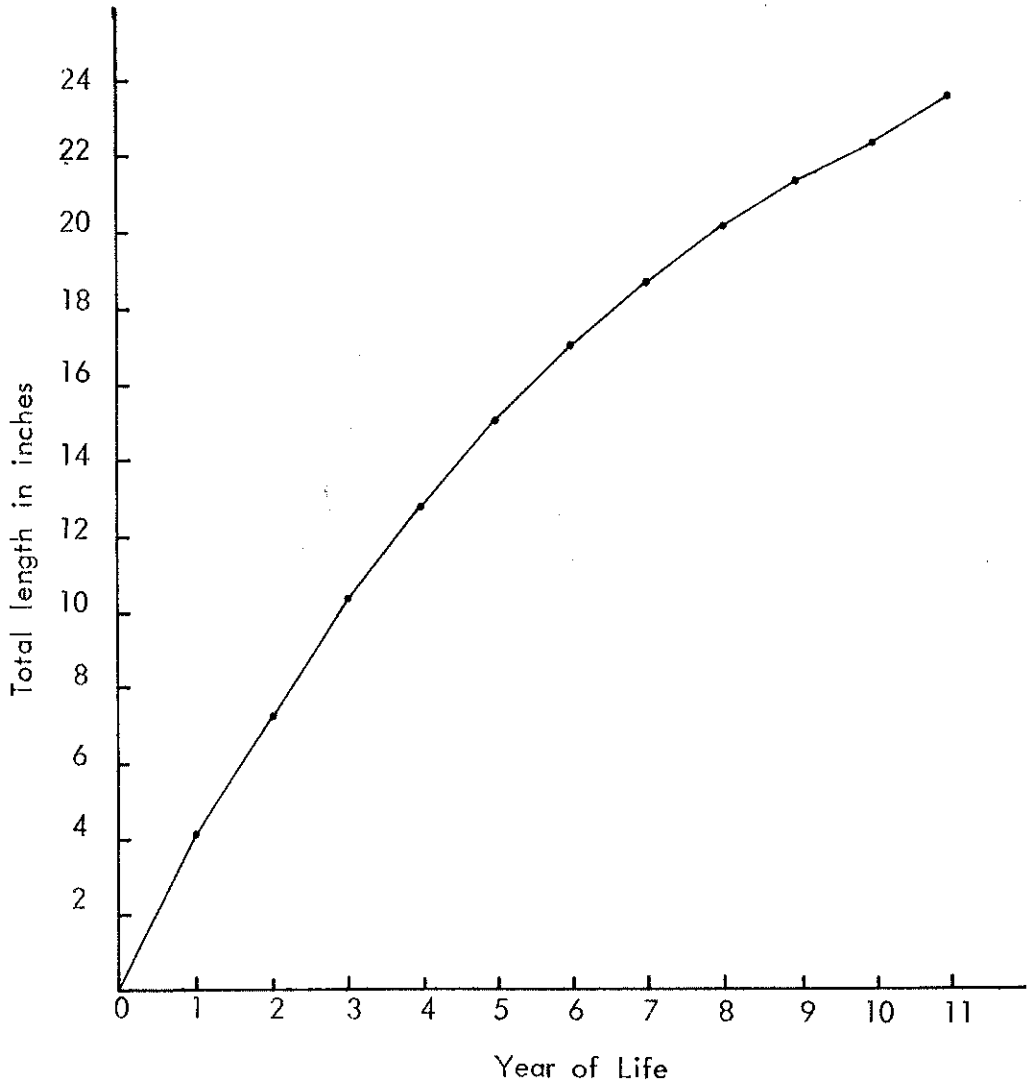

Table 1. Population estimates of carp in Red Rock Reservoir, 1969

Period	Cumulative Number Marked	Number Captured	Number Recaptured	Independent Population Estimate	Cumulative Population Estimate
5	1,256				
6	1,597	1,655	58	32,839	35,839
7	2,115	523	5	167,046	46,252
8	2,624	512	3	360,960	60,557
9	8,819	6,261	66	248,922	154,739
10	21,564	12,795	50	2,256,782	732,223
11	40,886	19,507	205	2,051,946	1,431,301
12					
13					
14	47,400	13,910	118	4,817,339	2,222,494
15	52,248	4,977	129	1,828,758	2,142,381
16	52,385	1,582	61	1,355,021	2,073,274
17	52,508	9,641	3	168,347,928	2,787,922
18	52,508	1,156	5	12,139,849	2,854,436
TOTAL	52,508	72,519	703		

Table 2. Percent of carp under 11.0 inches in Red Rock Reservoir, 1969

Period	Number Captured	Number Captured Under 11.0 Inches	% Under 11.0 Inches
5	5	0	0
6	7	1	14
7	47	14	30
8	7	11	64
9	343	280	81
10	273	263	96
11			
12			
13			
14	435	422	97
15			
16	66	63	95
17			
18			

Table 3. Estimated growth increments at the end of each year of life for carp in Red Rock Reservoir, 1969

Year Class	Number	Age Group	Year of Life 1	2	3	4	5	6	7	8	9	10	11
1969	33	0	7.6										
1968	39	I	5.4										
1967	21	II	4.2	3.8									
1966	14	III	3.6	3.3	3.2								
1965	9	IV	3.4	2.8	3.2	3.0							
1964	11	V	3.4	3.4	3.3	2.7	2.3						
1963	9	VI	3.9	3.4	3.8	1.2	2.5	1.7					
1962	7	VII	3.5	2.1	2.6	2.4	2.1	2.4	2.2				
1961	6	VIII	3.7	2.6	2.6	1.9	2.1	1.9	1.9	1.6			
1960	4	IX	4.1	3.6	2.7	2.6	2.7	1.5	1.4	1.4	1.2		
1959	4	X	3.9	3.1	3.4	3.1	2.7	2.1	1.4	1.5	1.2	0.8	
1958	3	XI	3.9	2.9	2.8	2.3	1.4	1.6	1.8	1.4	1.1	1.1	1.2
Grand Avg. Est. Inc.			4.2	3.1	3.1	2.4	2.3	1.9	1.7	1.5	1.2	1.0	1.2
Number in Group			160	88	67	53	44	33	24	17	11	7	3
Mean Observed. Inc.			4.2	3.6	2.2	1.3	1.3	0.7	1.3	0.4	2.6	1.7	-1.5

Table 4. Estimated total body length at the end of each year of life for carp in Red Rock Reservoir, 1969

Class Year	Number in Group	Age Group	Length at Capture	1	2	3	4	5	6	7	8	9	10	11
1969	33	0	7.6	7.6										
1968	39	I	10.6	5.4										
1967	21	II	12.7	4.2	8.0									
1966	14	III	14.9	3.6	6.9	10.1								
1965	9	IV	16.2	3.4	6.2	9.4	12.4							
1964	11	V	17.5	3.4	6.8	10.1	12.8	15.1						
1963	9	VI	18.2	3.9	7.3	11.1	12.3	14.8	16.5					
1962	7	VII	19.5	3.5	5.6	8.2	10.6	12.7	15.1	17.3				
1961	6	VIII	19.9	3.7	6.3	8.9	10.8	12.9	14.8	16.7	18.3			
1960	4	IX	22.5	4.1	7.7	10.4	13.0	15.7	17.2	18.6	20.0	21.2		
1959	4	X	24.2	3.9	7.0	10.4	13.5	16.2	18.3	19.7	21.2	22.4	23.2	
1958	3	XI	22.7	3.9	6.8	9.6	11.9	13.3	14.9	16.7	18.1	19.2	20.3	21.5
Mean Est. Total Length				4.2	6.9	9.8	12.2	14.4	16.1	17.8	19.4	20.9	21.8	21.5