WATERFOWL PRODUCTIVITY AND A COMPARISON OF WATERFOWL HABITATS AT ROSE LAKE WILDLIFE EXPERIMENT STATION, MICHIGAN

Thesis for the Degree of M. S.

MICHIGAN STATE UNIVERSITY

Robert Dean Curtis

1962

WATERFOWL PRODUCTIVITY AND A COMPARISON OF WATERFOWL HABITATS AT ROSE LAKE WILDLIFE EXPERIMENT STATION, MICHIGAN

By

ROBERT DEAN CURTIS

AN ABSTRACT

Submitted to the College of Agriculture
Michigan State University of Agriculture and Applied Science
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

Department of Fisheries and Wildlife

1962

Approved by Milo D. Pirnie

ABSTRACT

Waterfowl populations, both resident and migrant, were studied between March and October, 1957, on the Rose Lake Wildlife Experiment Station. The station is located in the south-central part of the Lower Peninsula of Michigan.

Populations numbers fluctuated during all seasons of the year. Peak periods occurred in late April, mid-June, and mid-September. A fourth peak came in October during the hunting season.

Study techniques included field observations of resident and migrant birds, observation and determination (by behavior) of breeding pairs, location of nests, determination of production by brood counts, and observation of summer concentrations.

During the study, many difficulties were encountered. Mobility and shifting of birds complicated estimating of populations; dense cover and concealment of nests made nest finding difficult; and cover, concealment, and elusiveness of the hen and her brood made observation of broods difficult.

Various cover types used for nesting were studied. Uplands, shallow swales, and surrounding fields, and floodings and surrounding fields were seemingly preferred by waterfowl for nesting purposes. The margins of lakes, cattail marshes, and stream and creek bottomlands were the least suitable or preferred by nesting waterfowl.

Since no studies of waterfowl productivity have been conducted on the study area in the past, no comparisons can be made between years. In 1957, 15 broods of ducks were calculated to be in the area, 13 broods in the artificial flooding and 2 were found on the lakes. The mallard with 9 broods, was by far the most numerous nester observed. Four broods of blue-winged teal, a brood of black ducks, and a brood of wood ducks were also observed during the study.

All of the water areas at the Rose Lake Station have a certain value to waterfowl at one time or the other. Migrant birds use the lakes and flooding quite heavily during the spring, but to a lesser degree in the fall. The lakes are used very little during the breeding season.

The determination of limiting factors is usually difficult. The factors that may limit production on the study area are the availability of space (territorialism), interference by man's activities (disturbance), predation, and lack of water.

Summer concentrations of drakes began shortly after the majority of the hens were incubating. There were no steady build-ups of populations, but rather a shifting of populations from area to area and from flock to flock. My first observation of summer concentration was during the first week in June when 12 mallard drakes were observed; these birds were starting their post-nuptial moult. These early gatherings of older birds may make up the nucleus of many of the larger concentrations that are seen later in the summer.

In the past, waterfowl hunting at Rose Lake was almost negligible; however, the recent construction of the artificial flooding (1953-1954) and the greater utilization of the area by waterfowl have stimulated the interest of many waterfowl hunters. Consequently, the total waterfowl kill on the flooding jumped from 1 in 1954 to 19 in 1955 to 31 in 1956 and finally to 132 in 1957.

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INTRODUCTION

Intensive waterfowl studies of relatively small areas are necessary for better understanding of these areas and for guidance in management. Waterfowl studies of this nature should provide valuable information on migration, behavior, production, and life histories of the species; also, these studies provide a visual picture of the physical features of the habitats that are so vital to these species.

The Problem

In southern Michigan, the majority of our resident waterfowl breed, nest, and produce young on relatively small areas (1/4 to 100 acres). At present, there are many small areas in the southern part of the state that are capable of producing waterfowl; some of these areas are productive and some are not. The problem is that these areas or at least areas that are representative of the southern part of the state should be studied and comparisons made. Studies of northern Michigan waterfowl and habitat should not be overlooked and should be continued and expanded.

This study is an inventory of waterfowl populations, both resident and migrant; of the production and productivity of the resident species; of the factors that influence local waterfowl populations; of hunting pressure and kill on an area with controlled hunting regulations; and of the waterfowl habitat on a comparison basis.

Importance of the Problem

Our present knowledge of waterfowl has advanced remarkably since the 1930's when waterfowl populations reached one of their lowest points in history. Today, waterfowl populations are up, but our search for knowledge of waterfowl must be continued, expanded, and developed by further research. Research on the condition of the breeding and wintering grounds, on the life history and ecology of the species and of the entire population needs additional study. More data on limiting factors, hunting pressure, drainage, pollution, and ecology of the habitat are needed if we are to manage the resource effectively and advantageously. Studies on food habits and migration will continue to be necessary for a complete understanding of the status of our waterfowl.

Definition of Terms

A few terms used in this paper are in need of definition. Webster's New Twentieth Century Dictionary (1951) defines the term waterfowl as "a bird that frequents the water, or lives about rivers, lakes, or on or near the sea; an aquatic fowl. Of aquatic fowls, some are waders, or furnished with long legs; others are swimmers and furnished with webbed feet." The Migratory Bird Treaty Acts (August 16, 1916 and February 7, 1936) defines the term waterfowl as "Anatidae, or waterfowl, including brant, wild ducks, geese, and swans." In this study the term waterfowl will refer to the species of the family Anatidae or all web-footed swimming birds with lamellate bills.

The term brood as used in this paper refers to a group of non-flying ducklings with or without an adult. After ducklings reach flying age, there is a tendency toward gregariousness and intermingling with other broods and older birds. This has been observed in black ducks (Anas rubripes) and mallards (Anas platyrhynchos).

All ducklings observed were aged and segregated into a plumage class and subclass according to the guide for aging duck broods by Gallop and Marshall (1954).

Class I consists of the downy young without visible feathers. Ia is the "bright ball of fluff"; Ib is the "fading ball of fluff"; and Ic is the "gawky-downy". Mallards and black ducks are in Class I until approximately the 19th day when they go into Class II. Blue-winged teal (Anas discors) are in this Class only until the 14th day when they go into Class II.

Class II ducklings are partly feathered as viewed from the side and are approximately half to two-thirds grown. Ducklings are placed in IIa when the "first feathers" appear on the side; IIb when the side and flank are "mostly feathered"; and IIc when the "last down" is visible on the nape, back, or rump. Mallards and blacks are in Class II until approximately the 45th day when they go into Class III; on the other hand, blue-winged teal are in this Class until about the 37th day.

Class III ducklings are fully feathered but flightless; ducklings remain in this Class until capable of flight. Mallards are capable

of flight anytime after they are 52-60 days old; black ducks take to the air after they are 58-63 days old; and blue-winged teal are flying at from 35 to 44 days.

This system of aging duck broods works fairly well under ideal field conditions and when there is an adult available for comparison, but during this study few observations were made under ideal field conditions. After the ducklings were in Class II, adult birds were rarely observed with the brood.

Acknowledgements

I wish to express my deepest appreciation to Dr. Miles David Pirnie of the Fisheries and Wildlife Department of Michigan State University for his guidance, valuable suggestions, helpful criticisms, and assistance in editing this paper. Appreciation is expressed to Dr. Peter I. Tack, Head of the Fisheries and Wildlife Department at Michigan State University, for his helpful editing and criticism. Permission to conduct this study was granted by H. D. Ruhl, Chief of the Game Division, Dr. R. A. MacMullan, Head of Research, and Dr. C. T. Black, biologist-in-charge of the Rose Lake Wildlife Experiment Station. I would also like to thank all other personnel of the Game Division, Michigan Department of Conservation who have contributed to this study. Finally to Mildred DeWitt, I offer my heartfelt gratitude for typing this manuscript.

DESCRIPTION OF THE AREA

The Study Area

The Rose Lake Wildlife Experiment Station, which was started in 1938, is located on morainic farm land and submarginal land in south central Michigan in Bath Township, Clinton County, and in Woodhull Township, Shiawassee County. At present, the total acreage of the station is 3020 acres.

The Rose Lake Station has many features that are valuable in a study of waterfowl habitat and production. Five lakes are located on or partially on the Station. There are a number of swales that are capable of producing suitable nesting and rearing sites for waterfowl. Two small streams with their respective bottomlands pass through parts of the Station. Artificial floodings, blasted level ditches, and ponds offer additional habitat.

In addition to the above physical features, marsh management is a part of the Station's development program; hunting pressure and kill can be measured by controlled hunting regulations; and advice, observational assistance, and many years of biological experience are provided by the staff of the Rose Lake Station. Figure 1, p. 7 is a map of the Rose Lake Wildlife Experiment Station with general information, objectives, instructions for hunters, and a summary of hunting pressure and kill on the back of the map.

Soils and Topography

This area lies in the eastern lake section of the Central Lowland physiographic province of the United States (Johnsgard:1942). The topography is more or less of a rolling glacial plains type. Several depressions of a swampy nature and five glacial lakes (Rose, Potter, Moon, Mud, and Burke) are found on or partially on the area. Burke Lake and a part of Mud Lake are surrounded by bog with some tamarack (*Larix laricina*). The elevation of the area varies from 800 feet to about 900 feet above sea level. The slopes that were noted on the area ran from level to very steep; when expressed in per cent slope this will vary from 0 per cent to over 25 per cent. The degrees of erosion that were noted ran from little or no erosion to very severe erosion; a few areas had washed-in or accumulated material.

The general topography is the direct result of the glacial activities that were so common in the Northern Hemisphere during the Pleistocene epoch. Morainal characteristics are noticeable throughout most of the area.

From a soil map of this county the following information was made available (Soil Survey of Clinton County, Michigan, 1942). Approximately 100 soil types are found at the Rose Lake Station. A few of the more common ones are organic soils (Carlisle, Houghton, and Kerston mucks and Rifle and Greenwood peats); poorly-drained soils (Gilford, Brookston, and Granby loams); imperfectly drained soils (Brady, and Conover loams); and well-drained soils (Bellefontaine, Fox, and Hillsdale sandy loams and Fox and Miami loams). This list is by no means complete, but the above named types are fairly representative of the soils at the Rose Lake Station.

ROSE LAKE WILDLIFE EXPERIMENT STATION

GAME DIVISION
MICHIGAN DEPARTMENT OF CONSERVATION

GENERAL INFORMATION

LOCATION.....12 miles northeast of Lansing, just north of highway M-78.
OFFICE.....In Rose Lake Wildlife Research Center, 8562 Stoll Road.
MAILING ADDRESS.....Rose Lake Wildlife Research Center, Rt. 1, East Lansing, Michigan.
PHONES.....Lansing FE 9-8638; Bath MI 1-6921.
SIZE, TOPOGRAPHY, COVER.....3,200 acres of moderately rolling farmland, abandoned fields, oak and swamp woods, and marsh; includes 700-acre livestock farm.
G AND TRAPPING.....Daily permits issued to small game and deer hunters; seasonal permits available for trappers and raccoon hunters.
EATURES.....Game management demonstrations; soil conservation farm practices; multiflora rose; waterfowl flooding.
.....Paid for entirely by hunting license fees and federal excise tax (Pittman-Robertson Act) on sporting firearms and ammunition.
.....Arranged on request for schools, sportsmen's clubs, farm organizations, and similar groups.
.....Pan fish in Rose, Mud, Potter and Moon Lakes; trout in Burke Lake; camp site for supervised groups such as Boy Scouts.
OFFICE HOURS.....Week days only, 8:00 a.m.-5:00 p.m.; hunting seasons, daily, dawn to dark.

OBJECTIVES

To provide a solidly-blocked extensive area of publicly-owned land in southern Michigan, where experimental game research and management might be conducted and accurate continuous records of the results secured.

To develop practical, economical methods for increasing game and fur-bearing animals on farms and state game areas.

To determine the effect of sound farming practices on game and fur-bearers and vice versa.

Fig. 1 Map of the Rose Lake Wildlife Experiment Station, Michigan

Climate

The climate at the Rose Lake Station is typical of the Great Lakes region. The winters are cold while the summers are mild to moderately hot. Average monthly temperatures and departure from normal for the 1952-1957 waterfowl seasons are given in Table 1, p. 9. The annual precipitation amounts to around 35 inches of which 45-50 inches will be in the form of snow (about 10 inches of snow equals 1 inch of rain). Total precipitation for the 1952-1957 waterfowl seasons is given in Table 2, p. 10.

The precipitation is fairly evenly distributed throughout the year, but many of the shallow swales, ponds, and depressions suffer from drought in late summer. In 1956, we experienced one of the driest falls in many years; there was a precipitation deficiency of 5.75 inches for the combined months of September, October, and November. The humidity is fairly high throughout the year with the exception of the coldest days of winter. The prevailing winds are mostly from a westerly direction.

The frost-free season is around 160 days. There is seldom any early or late frost damage except in depressions or on organic soils. This area has very little climatic variations due to differences in elevation, but local variations may be present on organic soils or in depressions.

Table 1. Average Monthly Temperatures for the Waterfowl Season at Rose Lake, 1952-57

	1952		1953		1954		1955		1956		1957	
	Av.Temp °F	Depart. Normal	Av.Temp °F	Depart. Normal	Av.Temp °F	Depart. Normal	Av.Temp °F	Depart. Normal	Av.Temp °F	Depart. Normal	Av.Temp °F	Depart. Normal
March	31.7	-0.1	36.0	2.8	30.7	-2.5	34.3	1.1	31.0	-2.2	36.0	2.8
April	47.1	1.8	42.7	-2.6	48.5	3.2	54.5	9.2	44.6	-0.7	48.9	3.6
May	56.1	-0.7	59.3	2.8	53.0	-3.5	61.0	4.5	56.4	-0.1	57.0	0.5
June	70.0	3.2	69.6	2.2	69.8	2.4	67.7	0.3	70.2	2.8	69.0	1.6
July	73.6	2.0	72.0	0.9	69.5	-1.6	77.8	6.7	69.8	-1.3	72.8	1.7
August	68.8	-0.5	70.7	1.7	69.1	-0.1	75.4	6.4	70.0	1.0	69.8	0.8
September	61.7	N	61.5	-0.3	64.4	2.6	63.9	2.1	60.0	-1.8	61.6	-0.2
October	44.7	-5.6	54.2	3.7	52.5	2.0	54.6	4.1	57.4	6.9	49.7	-0.8
November	40.3	3.1	42.2	4.3	40.3	2.4	35.3	-2.6	39.3	1.4	39.4	1.5
December	31.7	4.8	31.6	4.5	28.0	0.9	25.7	-1.4	32.7	5.6		

Temperatures are from the U. S. Weather Bureau at East Lansing, Michigan.

Table 2. Total Precipitation by Months for the Waterfowl Season at Rose Lake. 1952-1957

	1952		1953		1954		1955		1956		1957	
	Total Precip.	Depart. Normal	Total Precip.	Depart. Normal	Total Precip.	Depart. Normal	Total Precip.	Depart. Normal	Total Precip.	Depart. Normal	Total Precip.	Depart. Normal
March	2.22	-0.13	2.29	-0.28	3.25	0.68	2.97	0.40	2.76	0.19	2.08	-0.49
April	3.32	0.74	2.88	0.05	2.75	-0.08	1.56	-1.27	4.27	1.44	3.72	0.89
May	4.98	1.56	1.75	-2.00	1.14	-2.61	1.53	-2.22	5.60	1.85	5.16	1.41
June	1.46	-2.05	2.87	-0.50	4.23	0.86	3.81	0.44	1.80	-1.57	2.88	-0.49
July	3.24	0.14	1.03	-1.25	2.08	-0.20	3.99	1.71	2.69	0.41	7.55	5.27
August	3.30	0.48	3.80	1.12	1.43	-1.25	4.08	1.40	3.20	0.52	1.29	-1.39
September	1.54	-1.37	1.40	-1.65	2.24	-0.81	1.29	-1.76	0.53	-2.52	1.08	-1.97
October	0.35	-2.12	1.43	-1.02	4.88	2.43	3.06	0.61	0.28	-2.17	3.73	1.28
November	3.38	0.90	0.84	-1.46	1.97	-0.33	3.78	1.48	1.24	-1.06	2.75	0.45
December	1.84	0.23	1.48	-0.64	2.71	0.49	0.78	-1.34	1.47	-0.65		

Precipitation totals are from the U. S. Weather Bureau at East Lansing, Michigan.

Vegetation

Due to the great diversification of soil types, slope, and other characteristics of morainic farm land and submarginal land, the vegetation is likewise greatly diversified. On the well-drained uplands where the soils are of moderately coarse to medium texture, a hard maple-beech type of forest is found. Associate species include ash, basswood, black cherry, hickory, and oak. As the soils become coarse in texture on well-drained sites, oak and hickory become dominant. On poorly-drained sites, the elm-ash-red maple association is found. Butternut, cottonwood, ironwood, and sassafras trees are found scattered through this forest type. On poorly-drained organic sites, tamarack, aspen, willow, poison sumac, red maple, and shrubs (dogwoods, alder, spiraeas) of the lowlands will be found. On the wetter sites, leatherleaf bogs, cattail marshes, sedge marshes, or grass marshes are found.

Land Use

This area is maintained primarily for research on population dynamics, habitat improvement and evaluation, and the restoration of wildlife species. Many of the activities that are conducted at Rose Lake are directed at a wildlife management program.

Management activities include tree and shrub plantings, food patch development, fence-row improvement, brush pile construction, experimental herbiciding, woodlot management, and marsh management (level-ditching and flooding projects). About 700 acres are managed as a farm unit to determine the effect of farming activities on wildlife species.

Classification of Wetlands for Comparison

For comparison purposes, the wetlands on the study area have been segregated or classified into four general types:

(a) lakes - a natural body of water with a definite bed or basin and containing water throughout the year;

(b) streams or creeks - a natural body of flowing water with a definite channel or bed and containing water throughout the year;

(c) swales - a natural kettlehole or depression containing water throughout part of the year but subjected to drought; and

(d) floodings - an artificial area created by man's activities and containing water usually throughout the year. Shallow floodings are subjected to drought during certain dry years.

Animal Species on the Area

Data on species other than waterfowl were recorded, but information and data were confined merely to observations.

One species of the family Colymbidae was observed on frequent occasions; this species was the pied-billed grebe (*Podilymbus podiceps*). The pied-billed grebe was observed during most trips to the artificial flooding. Two nests were found during July. Broods were observed on several occasions during June and July of 1957. More information on this species is given in the Appendix.

Five species of the family Ardeidae were observed on various occasions during the study. Three species were observed quite frequently; these were the great blue heron (*Ardea herodias*), the American bittern (*Botaurus lentiginosus*), and the green heron (*Butorides virescens*). The green heron was seen most frequently. The black-

crowned night heron (Nycticorax nycticorax) and the least bittern (Ixobrychus exilis) were observed on but few occasions. With regards to the least bittern it should be pointed out that these birds are somewhat more plentiful than observation reveals; their calls were heard quite frequently, but they were usually so well hidden in the cattail and marsh vegetation that they were seldom seen.

Hawks that were observed during this study include the turkey vulture (Cathartes aura), sharp-shinned hawk (Accipiter striatus), Cooper's hawk (Accipiter cooperii), red-tailed hawk (Buteo jamaicensis), red-shouldered hawk (Buteo lineatus), rough-legged hawk (Buteo lagopus), marsh hawk (Circus cyaneus), and sparrow hawk (Falco sparverius). The marsh hawk, Cooper's hawk, and red-tailed hawk were the most commonly observed species and all nested in various parts of the study areas.

Two species of the order Galliformes are quite common as resident birds; these species are the bobwhite quail (Colinus virginianus) and the ring-necked pheasant (Phasianus colchicus).

One species of the family Gruidae was observed and nested on the area; this species is the sandhill crane (Grus canadensis).

Four species of the family Rallidae nested on the area; these include the sora (Porzana carolina), the Florida gallinule (Gallinula chloropus), the coot (Fulica americana), and the Virginia rail (Rallus limicola). Additional data on this species are given in the Appendix.

Three species of the family Scolopacidae were observed on various occasions. These include the woodcock (Philohela minor), the Wilson's snipe (Capella gallinago), and the greater yellow-legs (Totanus melanoleucus). Woodcock nests have been found at Rose Lake, but none was located in 1957.

One species of the family Laridae was observed and nested on the study area. This species is the black tern (Chlidonias niger) which was fairly common during the early part of the study.

Three species of the family Strigidae were observed during this study - the screech owl (Otus asio), great horned owl (Bubo virginianus), and the saw-whet owl (Aegolius acadica). A saw-whet owl adult and four downy young were found on April 30, 1957, in a wood duck nest box.

Crows (Corvus brachyrhynchos) were observed or heard on most trips afield. I found no evidence of crow depredation on waterfowl nests during the course of this study.

Of the family Sturnidae the starling (Sturnus vulgaris) proved to be quite a prolific species. During a wood duck nest box check on April 30, starling eggs (72) were found in twelve of fifteen boxes. One box contained four downy saw-whet owls and two boxes were empty. On May 29, a second check of the nest boxes was made. Ten boxes contained 47 immature starlings, four boxes contained a total of 20 starling eggs, and the other box contained the four saw-whet owls.

Due to the nocturnal habits of many of the mammalian species on the study area, few observations were made. Species or their signs that were observed in the immediate vicinity of the water areas include: the opossum (Didelphis virginiana), raccoon (Procyon lotor), mink (Mustela vison), long-tailed weasel (Mustela frenata), striped skunk (Mephitis mephitis), red fox (Vulpes fulva), muskrat (Ondatra zibethica), cottontail rabbit (Sylvilagus floridanus), and white-tailed deer (Odocoileus virginianus).

Few amphibians, reptiles, and fish were observed on the area. In the flooding only two species of fish were observed: the brook stickleback (Eucalia inconstans) and the western mudminnow (Umbra limi). The latter species were found by the thousands near the dam. Various species were found in the lakes on the area. No detail studies were made, but sight records include the bowfin (Amia calva), carp (Cyprinus carpio), northern black bullhead (Ameiurus melas melas), northern pike (Esox lucius), largemouth bass (Micropterus salmoides), yellow perch (Perca flavescens), and several species of the sunfish family (Centrarchidae).

Frogs were quite numerous near all water areas. Species that were identified include the common tree frog (Hyla versicolor), leopard frog (Rana pipiens), green frog (Rana clamitans), pickeral frog (Rana palustris), and the bullfrog (Rana catesbiana). The American toad (Bufo americanus) was seen on one or two occasions.

Casual sight observations of reptiles include the snapping turtle (Chelydra serpentina), painted turtle (Chrysemys picta), musk turtle (Sternatherus odaratus), northern water snake (Natrix sipedon), garter snake (Thamnophis sirtalis), blue racer (Coluber constrictor flaviventris), hog-nose snake or puffing adder (Heterodon contortrix), milk-snake or spotted adder (Lampropeltis triangulum), and the massauga rattlesnake (Sistrurus catenatus).

Many of the animals listed above are potential predators of waterfowl. This list would include the crow, great horned owl, several hawks, opossum, raccoon, mink, long-tailed weasel, striped skunk, red fox, snapping turtle, massauga rattlesnake, blue racer snake, bowfin, northern pike, and the largemouth bass.

Even though the list of predators is long, I found but two cases of depredation during the study period. One case was the destruction of a mallard nest with four eggs and the other was the remains of a Florida gallinule found on a stump near the artificial flooding. The den and tracks of a long-tailed weasel were found under the stump, but there is no proof that the weasel killed the bird. Therefore it would probably be safer to postulate that the mallard nest and the Florida gallinule were killed or destroyed by unknown predators. Undoubtedly, predation is a necessary, natural process in any biotic community.

MIGRATION DURING THE SPRING

Arrival Dates

It is difficult to establish the arrival dates of the first mallards or black ducks in southern Michigan since many of these birds winter here when open water is available. Table 3, p. 18 illustrates the wide variance in arrival dates for blacks and mallards on the study area. The dates of arrival of several common migrant and resident species over a 19 year period are given in Table 3.

When open water appears the first arrivals start coming in. During the second week of March, redheads (*Aythya americana*), lesser scaup ducks (*Aythya affinis*), pintails (*Anas acuta*), mallards (*Anas platyrhynchos*), black ducks (*Anas rubripes*), and American mergansers (*Mergus merganser americanus*) are arriving on the station's water areas. By the latter half of March ring-necked ducks (*Aythya collaris*), bufflehead (*Bucephala albeola*), baldpates (*Mareca americana*), canvasbacks (*Aythya valisineria*), and American goldeneyes (*Bucephala clangula americana*) are arriving in small groups or in pairs. The late arrivals are the gadwalls (*Anas strepera*), blue-winged teal (*Anas discors*), shovellers (*Spatula clypeata*), wood ducks (*Aix sponsa*), and the hooded mergansers (*Lophodytes cucullatus*).

In 1957, the most abundant migrants recorded were the ring-necked duck, the lesser scaup, the baldpate, and the American merganser.

Table 3. First Arrivals of Waterfowl at the Rose Lake Wildlife Experiment Station. 1940-1957

	Mallard	Black Duck	Gadwall	Baldpate	Pintail	G-winged Teal	B-winged Teal	Shoveller	Wood duck	Redhead	Ring-necked Duck	Canvasback	Scaup Duck	A. Goldeneye	Bufflehead	Ruddy Duck	H. Merganser	A. Merganser
1940	-	-	-	4/25	-	-	4/12	-	-	-	-	-	4/27	-	-	-	-	-
1941	-	3/21	-	-	-	-	-	-	5/22	-	4/25	-	-	-	-	-	-	-
1942	3/20	3/20	-	3/28	3/20	-	-	-	5/1	-	-	-	-	-	-	-	-	-
1943	3/15	2/27	-	3/31	-	-	3/31	4/6	4/15	4/6	3/26	4/6	4/2	3/22	3/31	-	-	3/26
1944	-	-	-	-	-	-	-	-	-	-	4/26	-	-	-	-	-	4/2	-
1945	3/25	3/25	-	4/9	-	-	-	-	-	-	-	-	4/29	-	3/15	-	-	-
1946	1/12	-	-	-	-	-	-	-	-	-	3/15	-	-	3/15	-	-	-	4/20
1947	-	4/2	-	-	-	-	4/13	-	-	-	-	-	4/12	4/13	4/12	-	-	-
1948	-	3/23	-	-	4/2	-	4/24	-	-	-	-	3/23	4/1	-	-	-	-	-
1950	-	4/7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1951	3/5	4/3	-	-	-	-	4/28	-	-	-	-	-	-	-	-	-	-	-
1952	3/25	-	-	-	-	-	-	-	-	-	-	-	-	3/25	3/25	-	-	-
1957	3/18	3/14	4/22	3/21	3/17	4/23	4/2	4/20	4/4	3/13	3/17	-	3/13	3/22	3/17	5/3	4/2	3/14

Many of these blank spaces are due to lack of interest by observers or failure to keep records.

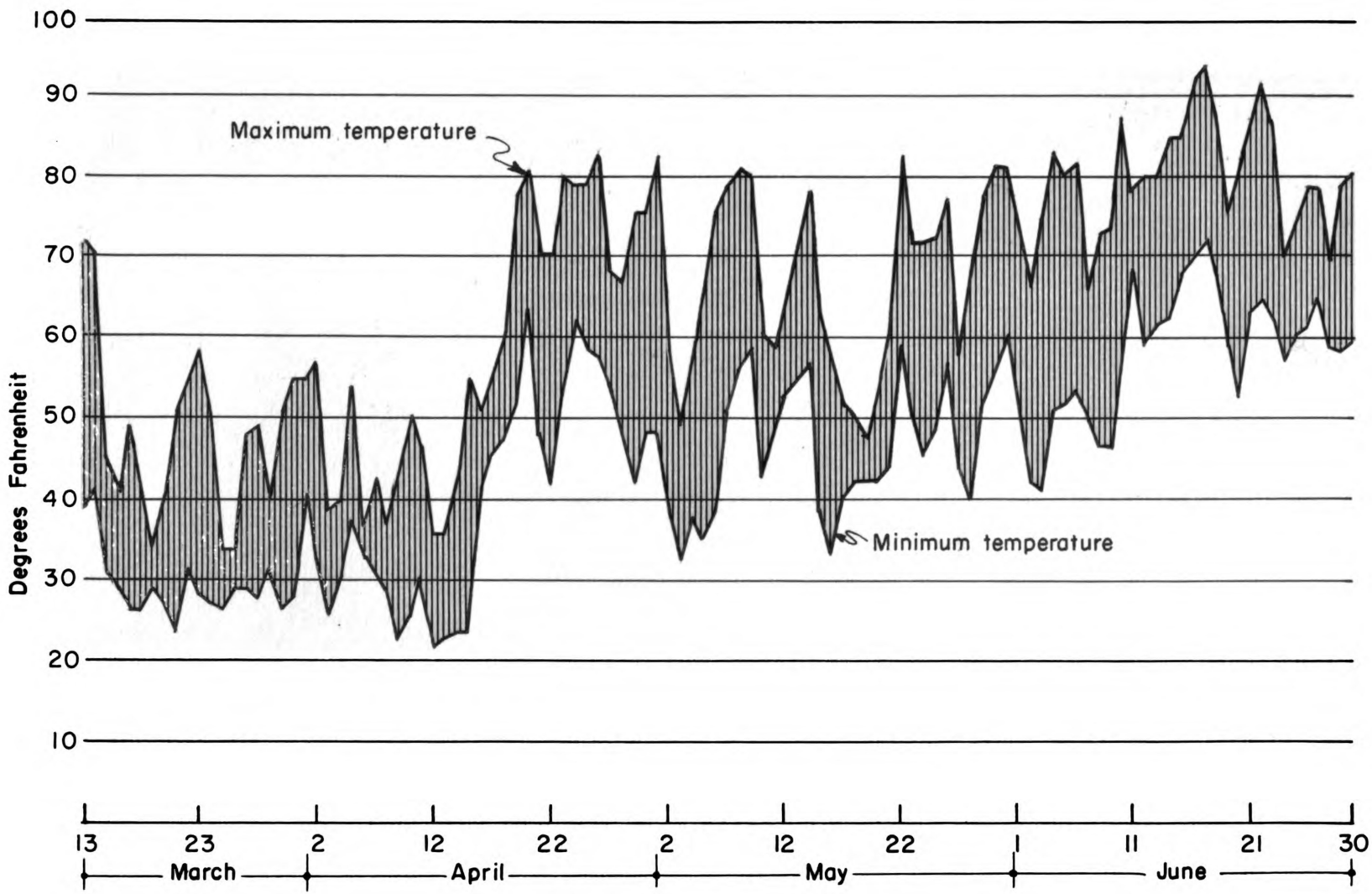
Weather and Migration

In southern Michigan, spring weather is seldom severe, but an occasional cold period in late March may delay birds from moving north. The break from winter temperatures to spring temperatures occurs during or shortly after the first week in March. In 1957, this break came on or about March 3. Figure 2, p. 20 illustrates this break by using daily extremes of temperature as given by the U.S. Weather Bureau in East Lansing, Michigan. From the 3rd to the 13th of March, 1957, there was a steady increase in temperature. During this period, the lakes on the study area started to become free of ice and the migrant and resident waterfowl started to appear.

Lincoln (1939) attempted to correlate spring temperature lines or isotherms with lines of migration. These lines may work well with the less-hardy species of waterfowl (baldpate, shoveller, blue-winged teal, and others), but not so well with the mallard, black duck, and pintail.

In this study there was a certain correlation between the relative number of migrant birds on the area and the average temperature. By comparing Figure 4, p. 52 with Figure 2, p. 20 it becomes clear that when the average temperatures are between 30° to 40° F. the waterfowl populations on the area increase, but when the average temperature climbs above 50° F. the population will start to decrease in a few days.

Fig. 2. Daily Extremes of Temperature, March 13 – June 30, 1957



Activity of Residents and Transients (March 15 - May 15, 1957)

During this spring period waterfowl are easily seen and appear less afraid of man's activities. Pirnie (op. cit.) says "This is the finest time of the year to enjoy the wild ducks and geese for they are in full plumage and much less timid than during the fall bombardment."

To enjoy the wild ducks and geese means different things to different people. To the amateur birdwatcher it means adding birds to the "list"; to the hunter it means that the birds are going north to breed and produce game for the "bag", but to the waterfowl biologist it means the easiest time to study the activities of the waterfowl species.

The first birds that were observed on the study area were redheads, lesser scaup, and American mergansers. These birds in their small flocks (10-40) confined their activities to the larger bodies of open water for feeding and loafing. During this period there was a constant shifting of birds from flock to flock and from water area to water area.

Pairs and Sexual Behavior

Both resident and transient pairs were observed on the study area. To the writer each grouping of birds (resident or transient) displayed a slightly different mannerism of behavior as described below.

For the transient birds sexual behavior was at a minimum during early migration. In some cases pairing was nothing more than a form of

traveling companion; while in other cases pairing would continue to the breeding grounds and into the nesting season. During this early period of spring migration (March) the traveling form of pairing was the rule, but as the season progressed courtship became more intensified and rivalry between males was observed on frequent occasions. This characteristic was quite noticeable among the ring-necked ducks.

During March and early April, the ring-necks were observed mostly in groups, but during late April, pairing and actual courtship became quite evident. To illustrate this point I will cite a fairly typical example of ring-neck courtship. On April 14, I observed a group of fifteen ring-necks in which six pairs were evident. One hen was swimming and feeding apart from the main group when a drake in the main group noticed her and left the group to court the hen. The drake swam around her a few times, started bobbing and nodding his head and arching it in a curved manner over his back. The hen accepted his courtship; copulation took place; and they swam off together.

Another example of courtship among transient birds was the courtship of the American merganser. On March 17, a group of seven birds - two males and five females - was observed by the writer. These large, black and white, handsome males were making great splashes in the water with wings and feet. They would race about and bend their head and neck over their back. The females appeared unconcerned and continued feeding. Another common behavior pattern observed by the writer was that of the female flushing first with the male in close pursuit.

For the mallards, black ducks, blue-winged teal, and wood ducks, the pairing and sexual behavior presented quite a different picture. Many of these birds are paired by the time they arrive on the area. Others are not paired and the task of finding a mate is continued. For these resident species this is a period of great excitement.

By the third week of March the majority of the blacks and mallards remaining on the study area seemed paired. Mallards were by far the most abundant breeding species on the area, and by the second week of April many mallard hens were in the process of nesting; this assumption was determined by the rather obvious increase in lone males observed and a decrease in the number of pairs observed.

Mating was observed between mallards and blacks on two occasions. On April 13 two drake mallards were observed with a hen black duck. The drakes were constantly crowding each other and each was trying to gain the attention of the hen. After fifteen or so minutes of this pushing and swimming around the hen, she flushed and was followed in close pursuit by the drakes. She raced back and forth over Potter Lake in an apparent nuptial flight. Finally one drake dropped out of the race and landed on the lake. The other drake and the hen flew out of sight. On another occasion while observing a flock of ring-necks and scaup on Moon Lake, I saw a hen black come onto the lake. In a few minutes a drake mallard came out of the cattails and bulrushes on the far side of the lake and flew over to where the hen was feeding. He bowed, swam around her, nudged her body with his bill, and displayed

himself beautifully; but she rejected his courtship and flew across the lake. The drake did not follow and resumed feeding.

It is apparent that actual mating between closely related species occurs since juvenile hybrids show up in the hunter bag during the hunting season. No apparent hybrid broods were observed on the study area in 1957, but three juvenile blackXmallard hybrids were taken by hunters during the first week of the waterfowl season.

Sex Ratio During Spring Migration

Lincoln (1932) discussed the possibility of a disturbed sex ratio being a factor in the then current waterfowl shortage. Today we know that other factors: drainage, drought, inadequate hunting regulations, and a multiplicity of factors probably contributed to this shortage. This "disturbed sex ratio" may still occur in our waterfowl populations, especially among the diving ducks. So, in this study, I tallied sexes of all waterfowl that were observed on the area. Only undisputed sight records appear in Table 4, p. 26, which shows the sex ratios of waterfowl that visited the study area in 1957. Repeats were undoubtedly included in this table because of the difficulties in separating previously recorded birds from unrecorded birds.

For the black ducks which are difficult to distinguish as to sex, only positive identification records are included in Table 4. Positive identification was made only under ideal field conditions and at close

range. Black ducks with yellow bills were identified as males while birds with olive to olive yellow bills and dark blotches on the ridge of the bill were identified as females. Some males may have green bills by mid-May, so when the birds flushed, the voice often aided positive identification.

Of the seventeen species that were observed, three species had more females than males in the sex ratio. The pintail and the redhead had a 1:1 ratio, but the totals of these species were too small to be considered significant.

Table 4. Waterfowl Sex Ratios at the Rose Lake Station - March 15-May 15, 1957

Species	Male	Female	Male:Female (100)	Sample
Mallard	50	31	161:100	81
Black Duck	34	24	142:100	58
Baldpate	553	297	186:100	850
Pintail	4	4	-	8
B-winged Teal	26	9	289:100	35
Wood Duck	8	4	-	12
Gadwall	1	0	-	1
Shoveller	6	2	-	8
G-winged Teal	2	1	-	3
Redhead	1	1	-	2
Lesser Scaup	432	243	178:100	675
R-necked Duck	454	326	139:100	780
Goldeneye, Am.	4	6	-	10
Bufflehead	4	2	-	6
Ruddy Duck	3	1	-	4
A. Merganser	58	85	68:100	143
H. Merganser	5	12	-	17

Ratios have been calculated (males per 100 females) for all cases where 25 or more individuals were recorded.

BREEDING SEASON

The breeding season as defined here includes the courtship period, the laying period, the incubation period, and the rearing of young. The rearing period extends from the hatching time of the first brood until the time of the last flightless brood.

Courtship starts soon after the first resident birds arrive on the area. Some of these residents appear to have paired prior to arrival. On the study area, this was on March 18 when the first pair of mallards was observed. Courtship continues on into late April for mallards and blacks. At this time, fewer pairs are observed and lone drakes become predominant in the population (see Table 9, p. 34). The laying period starts during late March or early April for blacks and mallards and two-three weeks later for the blue-winged teal. The incubation period follows the laying period and lasts about three and a half weeks for mallards and blacks or until the early part of May when the first brood appears. The first brood was observed on the study area on May 26. On June 19 a Class IIc brood of mallards were observed. By back-calculating the hatching date of this brood would be around May 10. Undoubtedly there were probably earlier broods that were missed. Old broods will continue to reappear and new broods will be located throughout the summer. The last flightless brood was observed on September 2; this was a brood of four Class IIc, blue-winged teal.

POPULATION DURING THE BREEDING SEASON

Nesting Population

Since the resident birds usually commence nesting before the late migrants leave the area, it is often difficult to determine the nesting population during late March and early April.

I approached this subject of determining the nesting population in the following manner: First of all, I kept a record of all observations on special 3X5 cards, see Figure 3, p. 51. On these cards I indicated the type habitat, the location, date, time, weather, species, age and sex of each species observed, and also data on nests, broods, and any other pertinent information. The location system is in accordance with the system that is used at Rose Lake (Allen, 1941). Each section is divided into sixteen units of approximately 40 acres; each of these units is divided into four smaller units of approximately 10 acres; and each of these 10 acres is divided into directional quarters: NW, NE, SW, and SE which are approximately 2-1/2 acres in size. A designation of 20-7-4 NW would indicate Section 20, unit 7 of section 20, unit 4 of unit 7, and the NW quarter of unit 4.

At the end of the nesting season I compiled the total observations of each species by location. Table 5, p. 29, is a summary of the nesting population by species. Table 6, p. 30, is a summary of the nesting population by location.

Broods

All broods were aged according to the system used by Gallop and Marshall (op. cit.). The first brood was observed on May 26 when a mallard hen with nine Class Ia ducklings was sighted in the artificial flooding. The last brood observation was on September 2 when four Class IIc blue-winged teal ducklings were observed near the dam at 21-4-3.

Table 5. Summary of the Nesting Population of Waterfowl by Species at the Rose Lake Wildlife Experiment Station, Michigan - 1957

Species	Males	Females	Totals	Broods	Total Young
Mallard	17	16	33	9	80
Black Duck	10	6	16	1	9
B-winged Teal	5	5	10	4	22
Wood Duck	6	4	10	1	2
Totals	38	31	69	15	113

Normally by the end of July or the first part of August young birds will be flying and will seldom be classified as broods. However, this is the time to look for late broods.

After careful calculations and elimination of probable repeats, I came up with a total of 15 broods for the entire study area; 13 of these broods were found in the 100 acre artificial flooding. One brood was observed on Mud Lake and one brood on Rose Lake. Table 7, p. 32 lists all brood observations on the study area while Table 8, p. 33 is a summarization of these observations.

Table 6. Summary of the Waterfowl Nesting Population by Location at Rose Lake. Summer, 1957

Potter & Burke L.	Mud L.	Rose L.	Moon L.	Vermillion Creek	Swale at 23-3-1	Swale at 13-9-2	Swale at 21-2-4	Floodings	Upland
Nothing	Mallard pair & brood (9)	Mallard pair & brood (7)	Mallard pair	Mallard pair Black Duck pair & three males Wood Duck pair & one male	Mallard pair Black Duck pair & nest B-w Teal pair	Mallard pair & nest	Mallard pair Wood Duck pair	Mallard 18 Adults (7 broods) 9 young 12 young 7 young 3 young 11 young 14 young 8 young Black Duck 7 Adults (1 brood) 9 young B-w Teal 8 Adults (4 broods) 3 young 4 young 11 young 4 young Wood Duck 5 Adults (1 brood) 2 young	Mallard hen & nest (8 eggs) hatched

One interesting observation is that mallard broods in Class I and Class II averaged 8.00 birds per brood while broods in Class III averaged but 6.5 birds per brood. Accident, sickness, and predation are possible causes for this loss; however, I found no factual evidence to substantiate these claims.

Drake Concentrations

During the study period, lone drakes were observed on frequent occasions, and as the season progressed, the frequency of drake appearances, either alone or in a group, increased. After the initial period of pairing and courtship, the relationship of hen and drake is less significant in our common resident species. As Bent (1923) states it, "The drakes usually take no interest in family cares after the eggs are laid, but gather in small flocks by themselves, moult into eclipse plumage and hide among the rushes in the sloughs where they spend the summer in seclusion." My first observation of summer concentration was on June 2 when 12 mallard drakes were sighted in a flooded field; this was the earliest indication of summer concentration on the study area. This shift in population and break-up of pairs is illustrated in Table 11.

Lone Hens

The females are usually in the company of a male or a brood during the breeding season; consequently, observations of lone hens were rather uncommon. However, when a lone hen is observed it is possible that she is either a non-breeder, had lost her nest or brood, or is laying still or incubating.

Table 7. Waterfowl Brood Observation at Rose Lake - Summer, 1957*

Location	Date	Time	Species	Age Class	No. in Brood
South Flooding	May 26	2:00 PM	Mallard	Ia	9
South Flooding	May 28	9:30 AM	Mallard	Ia	9
South Flooding	May 28	9:30 AM	Mallard	Ib	12
Mud Lake	June 2	11:50 AM	Mallard	Ia	9
North Flooding	June 11	9:00 AM	Mallard	IIa	7
North Flooding	June 19/	9:55 AM	Mallard	IIa	10
North Flooding	June 19/	10:30 AM	Mallard	IIc	3
North Flooding	June 19/	10:30 AM	B-winged Teal	IIb	11
South Flooding	June 19/	9:40 AM	Mallard	Ic	11
South Flooding	June 19/	11:00 AM	Mallard	IIb	11
Rose Lake	June 19	8:00 AM	Mallard	Ic	7
North Flooding	June 27	11:00 AM	Mallard	III	14
North Flooding	June 27	11:10 AM	Mallard	III	5
North Flooding	June 28	3:50 PM	Mallard	IIc	7
North Flooding	July 7	6:00 AM	Mallard	IIa	8
North Flooding	July 7	6:10 AM	B-winged Teal	III	4
South Flooding	July 19 /	8:45 AM	Mallard	III	3
North Flooding	July 19/	9:45 AM	Mallard	III	4
North Flooding	July 19/	10:00 AM	Wood Duck	IIc	2
North Flooding	July 19/	9:45 AM	B-winged Teal	III	3
North Flooding	July 19/	9:45 AM	Black Duck	III	9
North Flooding	July 27	9:20 AM	B-winged Teal	III	3
North Flooding	Sept. 3	4:30 PM	B-winged Teal	IIc	4

*Repeats are included in this table.
/ "Mass" brood counts with nine members of the Rose Lake Staff.

Table 8. Waterfowl Brood Summary at the Rose Lake Wildlife Experiment Station, Michigan - Summer, 1957

Species	Total Broods Observed	Estimated Actual Broods	Range of Brood Size	Average Brood	Total Young
Mallard	16	9	3-14	8.89	80
B-winged Teal	5	4	3-11	5.50	22
Black Duck	1	1	9	9.00	9
Wood Duck	1	1	2	2.00	2
Totals	23	15			113

Table 9. Summer Shift in Waterfowl Populations as the Season Progresses at the Rose Lake Wildlife Experiment Station - Summer, 1957

Period	Mallard			Black Duck			B-winged Teal			Wood Duck		
	Pairs	Drakes	Hens	Pairs	Drakes	Hens	Pairs	Drakes	Hens	Pairs	Drakes	Hens
Mar.15-Apr.15	13	10	2	11	2	3	3	2	0	2	0	1
Apr.16-Apr.30	14	19	4	8	9	0	6	14	0	1	1	1
May 1-May 15	3	23	5	1	0	2	7	0	1	1	0	0
May 16-May 31	4	11	12	1	3	1	2	7	0	0	3	0
June 1-June 15	1	35	5	0	0	1	0	4	0	1	0	0

NESTING TERRAIN (COVER TYPES)

For the purpose of this study nesting terrain or cover types were arbitrarily established by the writer to include lakes and marshes, stream and creek bottomlands, floodings and surrounding fields, swales, uplands, and artificial nesting boxes.

Lakes and Marshes

A lake as defined on p. 12 refers to a natural body of permanent water with a definite basin. A marsh refers to that area of wet or low land bordering on a lake or stream. Normally we think of a marsh as being adjacent to a lake, but streams have marshes adjacent to them and some marshes may be alone.

Five lakes are wholly or partially on the study area: Potter, Mud, Rose, Burke, and Moon Lakes. Each is different in its own rights; therefore, each will be discussed separately.

Potter Lake is the newest addition to the Rose Lake Station; it officially became a part of the station in 1957. This lake is quite shallow; for the most part it is between 12" - 18" in depth with a few slightly deeper depressions in the middle. Exposed mud flats are found along the eastern shore and near the northwestern end. It is bordered by a narrow band of cattail (*Typha latifolia*) with scattered patches of spike rush (*Eleocharis* spp.) and a few patches of loosestrife (*Decondon* spp.). The emergent vegetation of the lake proper includes waterlilies (*Nuphar* sp. and *Nymphea* sp.), and spike rush.

Important waterfowl food plants that are submerged include coontail (Cerataphyllum demersum), muskgrass (Chara sp.), pondweeds (Potamogetan natans, P. gramineus, and P. alpinus), and bushy pondweed (Najas sp.). Duckweeds (Lemna spp.) are also present as floating vegetation. This lake was used quite heavily by spring migrants and a few residents, but during the summer and fall months only a few residents and very few migrants were observed in the vicinity of the lake. At present, Potter Lake and its surrounding marsh appear unsuitable for waterfowl production. On the other hand I believe that with proper management it has the potential of becoming productive. Probably the most persistent problems are the control of the vegetation and creation of suitable nesting environment.

Mud Lake is somewhat deeper than Potter, Moon, and most of Rose Lake; its greatest depth is 8-10 feet. The lake is bordered by a narrow cattail edge near the water, backed by a belt of tamarack, small trees, and shrubs (Salix spp. and Cornus spp.). Emergent vegetation includes cattail, pickerelweed (Pontederia cordata), arrow arum (Peltandra Virginica), waterlilies (Nuphar sp. and Nymphea sp.), watershield (Brasenia Schreberi), spikerush (Eleocharis acicularis), water marigold (Megalodonta Beckii), and a variety of other emergent aquatics. Submergent vegetation includes bladderwort (Utricularis sp.), muskgrass (Chara sp.), pondweeds (Potamogeton alpinus, P. gramineus, and P. natans), and a number of other submergent aquatics. Potamogeton alpinus was by far the most abundant pondweed in the lake. This lake is used by a fair number of migrant and resident birds during the spring and fall

migration, but the summer (breeding) population is low. One mallard nest was found near the base of a tamarack at the north end of the lake. A brood of 9 ducklings (Class Ia) was observed on June 2. I visited the lake on numerous occasions but did not see the brood again. Fishing pressure may have caused too much disturbance and the hen may have moved her brood to a more secluded location, but this is pure speculation. Plate 1 illustrates the border of cattail around Mud Lake.

Rose Lake is the largest lake on the study area; it is approximately 27 acres in size. It is shallow (1-5 feet), but has a few deeper depressions in the middle; it has a muck bottom with exposed mud bars and flats. Cattails (*Typha angustifolia*) and bulrushes (*Scirpus* spp.) surround the lake in a floating bog which extends back some 500 yards in many places. Some tamarack and lowland shrubs (*Cornus* and *Salix*) border the east side and portions of the other sides behind the cattail and bulrushes. Other emergents are the pickerelweed, spike rush, yellow waterlily, white waterlily, and water shield. Submergent vegetation includes the following species: pondweeds (*Potamogeton pectinatus*, *P. natans*, *P. amplifolius*, *P. gramineus*, *P. angustifolius*, and *P. americanus*), muskgrass (*Chara* sp.), coontail (*Ceratophyllum demersum*), water milfoil (*Myriophyllum* spp.), and bushy pondweed (*Najas flexilis*).

Rose Lake is used regularly by waterfowl in the spring and fall, but few ducks were seen on it during the summer. One brood of mallards (7(Class Ic)) was observed on June 19.

Plate 1. A View of the north end of Mud Lake showing emergent vegetation.

Perhaps due to the dense growth of cattail and bulrush around Rose Lake, this lake is only fair for nesting waterfowl. Disturbance by fishermen and the dense growth of emergent vegetation may well be detrimental factors to the potential of this lake as suitable nesting grounds.

By proper management practices this lake and its extensive marsh might become one of the better waterfowl habitats on the station. These management practices may include herbicide spraying of the emergent vegetation, blasting of level ditches, dredging, and burning. Openings are quite important and efforts should be made to establish them.

Very little can be said about Burke or Moon Lakes as potential waterfowl areas. The area to the southwest of Burke is marshy and may produce an occasional brood of blacks or mallards, but the lake is quite unsuitable as a rearing area due to its lack of desirable vegetation. Plate 2 illustrates this lack of suitable vegetation around Burke Lake.

Plate 2. Burke Lake and its lack of suitable vegetation for waterfowl.

On the other hand, Moon Lake has sufficient cover, but as yet few ducks, with the exception of a few wood ducks or mallards, use it. No broods were observed on either of the two lakes. Plate 3 illustrates the vegetation that surrounds Moon Lake.

Plate 3. A view of the west shore of Moon Lake illustrating emergent vegetation.

Stream and Creek Bottomlands

Two creeks, Vermillion and Mud, flow through parts of the Station. Mud Creek is quite shallow with fairly open land along its shores. On the other hand, Vermillion Creek flows mostly through a floodplain forest with the dominant trees consisting of red maple (Acer rubrum), elm (Ulmus spp.), white ash (Fraxinus americana), white oak (Quercus alba), bur oak (Quercus macrocarpa), basswood (Tilia americana), and

blue beech (Carpinus caroliniana). Shrubs, such as elderberry (Sambucus spp.), grey dogwood (Cornus paniculata), red-osier dogwood (Cornus stolonifera), and various others, are found in more or less fair numbers. Willows (Salix spp.) line the banks in many places. In other places, the creek flows through open marsh with grasses (Granineae) and sedges (Carex spp.) dominating the vegetation. Yellow waterlilies (Nuphar spp.) are found in many parts of the stream proper.

Wood ducks and black ducks were found in bottomland habitat on frequent occasions. I observed nuptial flights over Vermillion Creek by black ducks on several occasions, but no nests were located or broods observed.

In 1957 Vermillion Creek reached flood stage during the last week in April, second and third weeks in May, and the second week in July. Flooding of nesting habitat may be detrimental to nesting of the blacks and mallards.

Management practices such as diking and other water-control devices would alleviate the flooding situation, would create new water areas, and would help maintain water levels during the summer months.

Swales

Swales as defined in this study are shallow, natural depressions either containing water throughout all or part of the year or dry most of the year. Wet swales are subjected to drought conditions during dry years. Approximately 40 acres were classified as swales.

In 1957 the water levels of these swales were significant to waterfowl productivity. During the breeding season (March-August), precipitation was approximately 4.11 inches above normal; these higher water levels in swale-type habitat are usually beneficial to the rearing of young.

Cover is fairly dense on some swales but sparse on other. Plant species, such as cattail, willow, and grasses, were found on all areas. Reed canary grass (Phalaris arundinacea) was present on most areas but was absent on several others. Sedges, smartweed (Polygonum spp.), foxtail (Setaria spp.), bluegrass (Poa spp.), love grass (Eragrostis spp), cutgrass (Leersia oryzoides), manna grass (Gylceria nervata), water plantain (Alisma plantago-aquatica), and arrow-head (Sagittaria latifolia) were present on some areas but absent on others.

These areas support, in addition to the higher plant species listed,abundant blue-green and green algae. Animal life in the form of invertebrates such as snails, insects, and crustaceans are also found on these areas. Plate 4, p. 43 illustrates a small swale with open water and bordered by elm, willow, and button bush (Cephalanthus occidentalis). Plate 5, p. 43 illustrates a larger grassy swale with little open water and bordered by willow and dogwood on one side only. Figure 5, p. 71 represents a small, willow-cattail-grass swale located on the farming unit of the station.

Waterfowl use was erratic on the several swales that are found on the study area. Several swales were used quite heavily during the

Plate 4. A small swale with open water on the Rose Lake Wildlife Experiment Station.

Plate 5. A grassy swale bordered by willow and red-osier dogwood on the Rose Lake Wildlife Experiment Station.

spring and early breeding season. This type of swale was bordered by a dense growth of vegetation and was fairly open in the center.

During the breeding season, three nests were found in the vicinity of small swales; two nests apparently hatched and the other was destroyed by an unknown predator. Undoubtedly not all of the nests were actually found and better methods of nest locating are needed in order to get an accurate picture of the value of small swales.

During this study it became evident to the writer that swales contain water that is necessary to rearing, but most of the actual nests are found a few feet to a half mile from water. Therefore, suitable nesting areas that are a few feet to a half mile from these swales are necessary for increased production. Suitable nesting areas include permanent pasture (clover-timothy-brome), grain fields (rye-oats-wheat), hay fields (timothy-brome-alfalfa), and wild grass fields (Gramineae).

Uplands

Uplands are usually dry places and on the study area several such habitats are found a considerable distance from water. Few inexperienced people would search cover of this type for duck nests. Consequently, prior to this study I was uncertain of the potential that is afforded by this type of cover. Dr. C. T. Black, in charge of the station, and Dr. M. D. Pirnie of Michigan State University, urged me to search the uplands for nests. Dr. Black found a mallard nest with 11 eggs in a food patch of sericea lespedeza (Lespedeza sericea) in 1951 and he believes that such nestings are fairly common.

Searches were made of all such plantings at Rose Lake during the spring of 1957, but all were unsuccessful; however, a mallard nest was accidentally located by two members of the Rose Lake staff on May 10 while planting buckwheat. I examined this nest and found 9 eggs. Several observations were made of the nest and the hatching date was established as June 1 or 2. Due to the careful concealment of the eggs when the hen is away feeding, I fully realize the difficulty of finding nests in this type of cover. Plate 6 is a view of sericea lespedeza in upland nesting cover. Plate 7, p. 46 is a picture of the mallard nest that was found in the sericea lespedeza.

Plant species that were observed in this area include sericea lespedeza, blackberry, blue-grass, multiflora rose, sweet clover, quackgrass, goldenrod, wild carrot, common mullein, and a host of other less important herbaceous plants.

Plate 6. Upland nesting cover of sericea lespedeza at Rose Lake - 1957

Plate 7. Mallard nest with nine eggs in sericea lespedeza at the Rose Lake Wildlife Experiment Station, Michigan - Spring, 1957

Floodings and Surrounding Fields

A flooding was created on the study area by the construction of two earthen dams, one in May, 1953, and the other during December, 1954. The 1954 dam flooded a seepage marsh and diverted the flow of an intermittent stream. At present approximately 100 acres of lowland timber and marsh are flooded. When necessary additional work is conducted on this flooded area and the dams. This additional work consists of increasing the height of the dams, creating openings by cutting of timber, and continuation of seeding to maintain vegetative cover on the dams.

The surrounding fields are managed for wildlife use. The management practices include strips and fields of corn, buckwheat, rye, and permanent meadow. Coniferous plantings include Scotch pine, red pine, white spruce, and Oriental arbor vitae. Shrub plantings include highbush cranberry, nannyberry, multiflora rose, bicolor lespedeza, Siberian crab, and honeysuckle.

These areas are prepared for planting with lime and fertilizer; the buckwheat is plowed under and the crops are left unharvested in the field. These treatments and practices contribute to the "well being" of the land and, undoubtedly, they have contributed somewhat to the fertility of the flooding. Little data were found concerning the relation of land fertility to the fertility of an adjacent waterfowl flooding; consequently studies of this nature are needed and should be undertaken.

The flooding proper and its immediate shore line contain a mixture of plant species. Vegetation and the change that came about over a 5-year period were studied on 24 milacre plots by members of the Rose Lake staff. Results of this study are found in Table 10, p. 48.

One very important factor that does not appear in this table but is a definite part of the study is the abundance of cattail that surrounds the flooding. I have estimated that approximately 40 per cent of the unshaded water area of the flooding has some cattail growth. In 1957 the cattail came in with remarkable speed; control methods are needed to maintain openings. About 5 acres of the flooding are in reed canary; observations indicate that this cover was preferred by moulting birds and broods.

Table 10. Vegetation changes of some important species on 24 milacre plots in the artificial flooding at the Rose Lake Wildlife Experiment Station, Michigan - 1953-1957

	July, 1953		August, 1954		August, 1955		August, 1956		August, 1957	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Algae (Chlorophyceae)							6	4.1	16	25.4
Ash, white (Fraxinus americana)	2	-	2	-			8	0.7		
Bulrush (Scirpus validus)	8	4.0	3	1.2	5	5.2	1	-	1	-
Bur-reed (Sparganium eurycarpum)							2	1.7	2	2.2
Bur-marigold (Bidens comosa)	6	-	3	0.2	1	1.1	2	0.9		
Cattail (Typha angustifolia)							1	0.1		
Dock (Rumex verticillatus)	2	-	2	0.1						
Dogwood, grey (Cornus paniculata)	2	2.0	1	2.5	1	3.0	1	1.1	1	0.2
Dogwood, silky (Cornus obliqua)	2	-	2	0.4	1	0.9	6	1.9	1	-
Duckweed, common (Lemna minor)			1	-	3	0.1	17	2.3	16	-
Duckweed, star (Lemna trisulca)							11	0.2	17	0.6
Goldenrod (Solidago spp.)	5	4.0	2	1.0	1	-				
Grass (Gramineae)	11	2.0	9	7.1	8	2.4	15	3.6		
Horsetail (Equisetum spp.)	11	3.0	5	2.7	4	0.7	7	4.8	5	0.1
Loosestrife, false (Ludwigia palustris)	1	-					4	0.5		
Manna grass (Glyceria fluitans)			3	1.0						
Muskgrass (Chara sp.)							1	0.4	8	8.9
Nut grass (Cyperus strigosus)			1	0.2						
Open water or dead vegetation	5	5.0	19	40.4			22	41.5	10	30.0
Pondweed (Potamogeton foliosus)							7	0.6	17	33.6
Riccia (Ricciacarpus natans)							14	1.3	1	-
Riccia, slender (Riccia fluitans)							14	1.5	4	-
Rush (Juncus sp.)	2	1.0	1	0.1	1	-	11	6.0		
Sedge (Carex sp.)	23	49.0	21	20.5	14	17.1	15	5.7	4	-
Smartweed (Polygonum natans)	11	6.0	12	2.9	11	4.3	12	20.2	8	18.5
Spike rush (Eleocharis sp.)	11	14.0	13	15.9	7	3.7	1	0.2		
Watermeal (Wolffia sp.)									2	1.7
Water parsnip (Sium suave)	1	-	2	0.4			4	0.3		
Willow (Salix sp.)	1	2.0	1	1.7	1	3.0	4	3.9	1	0.4

The area surrounding the flooding is ideal for nesting purposes. No nests were found adjacent to the flooding, but two were found within one-quarter mile. Thirteen broods were observed on the flooded area. Plate 8 illustrates the more open part of the flooding while Plate 9 illustrates the dying, timbered part.

Plate 8. A view of an open portion of the artificial flooding at the Rose Lake Wildlife Experiment Station, Michigan - 1957

Nest Boxes

Fifteen nest boxes were located in the flooding and were intended for use by wood ducks. These boxes were erected in 1956, but were not used in 1956 or 1957 by waterfowl. Two checks were made of the boxes in 1957 to determine usage. Table 11 summarizes the results of these checks.

Plate 9. A view of the dying, timbered portion of the flooding at Rose Lake

Table 11. Summary of wood duck nest box checks at Rose Lake, Michigan - 1957

	No. of boxes occupied by:		
	Wood Duck	Starling	Saw-whet Owl
April 30, 1957	0	12 (72 eggs)	1 (4 young)
May 29, 1957	0	10 (47 young) 4 (20 eggs) 14	1 (4 young)

STUDY TECHNIQUES

Observations

Waterfowl observations were started on March 13, 1957, and were made with the aid of Bushnell 7X35 binoculars. A spotting scope would have proved more helpful on repeated occasions, and is recommended for subsequent studies of this type.

Observations were conducted daily when time permitted. All water areas were covered during the course of the study. A jeep was used to good advantage while traveling from water area to water area, but the actual coverage of each area was principally by foot or canoe. Observational information was recorded on special 3X5 cards - see Figure 3. Figure 4, p.52 illustrates waterfowl population changes during the year.

Figure 3. Special 3X5 cards for recording waterfowl information

Waterfowl Obs. (Subject) (Date) April 23, 1957

South Flooding (File subhead) (Time) 11:25 AM

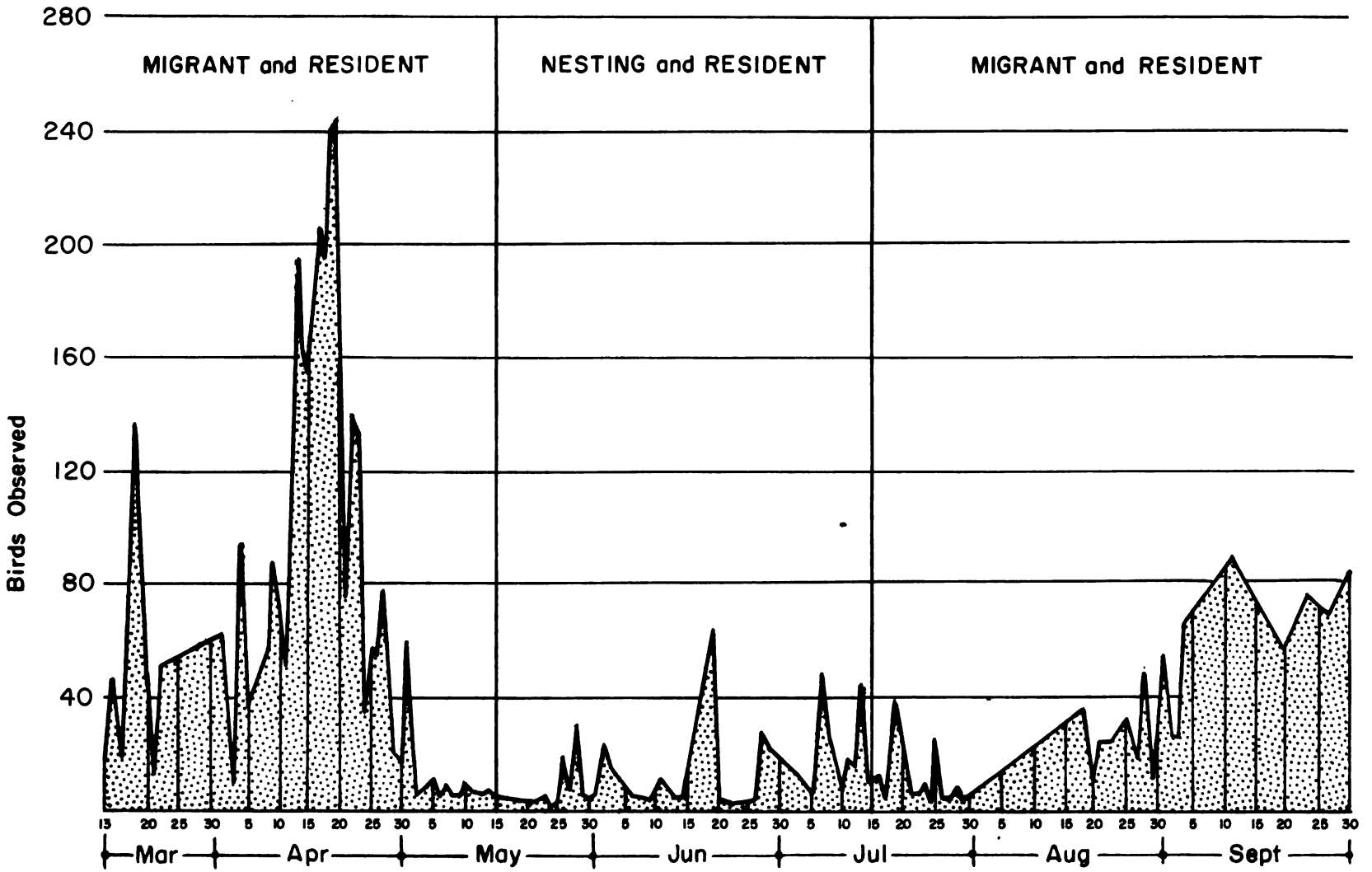
20-7-4 (Location)

Warm 80°, partly cloudy
light breeze s. (5 mph)

Baldpates (3) 1♂, 2♀
Ring-necked Ducks (9) 5♂, 4♀ (4 pair)
Mallards (2) ♂ & ♀ (pair)
Blue-winged Teal (4) 3♂, 1♀ (1 pair)
Green-winged Teal (1) 1♂

Note: one of the male Blue-winged teal was with the Green-winged teal

Fig. 4 Waterfowl Populations at Rose Lake W.E.S., March 13 – September 30, 1957



Early morning hours proved most successful for breeding pair observations. At this time of the day, the pairs were usually feeding together and were observed easily and frequently.

Two habitats proved to be difficult to study. These types were the wooded sections of the floodings and the creek bottoms. Trees and heavy brush were a hindrance to observations.

Additional observations were made during other hours of the day to obtain information on breeding pair activities, but the morning hours were still the most rewarding.

Finding nests

This phase of the study was the most difficult. Pirnie (op. cit.) says "that nesting populations are far from easy to inventory and that the bulk of Michigan waterfowl breed at widely scattered places and not only at the larger marshes famous for their shooting." The Rose Lake study area includes some of "those widely scattered places."

Various methods were employed in nest searching. One method was to observe breeding pairs during the early morning hours, as described by Sowls (1955). At this time the hen joins her mate in feeding. After feeding when the hen returns to her nest, careful observations may reveal the exact location of the nest. When a hen dropped in an area suitable for nesting, the location was carefully determined by various landmarks (lone tree, fence, clump of brush, or other landmarks). By going to this location and walking in tight circles outward from

the calculated location, it was hoped that the hen would be flushed and the nest located. This method proved successful on one occasion only.

Another method was to walk through nesting terrain on planned transects and flush the hen from the nest, but this method proved successful on only three occasions.

A final method is the accidental locating of nests. One nest was located by two staff personnel while preparing ground for a food patch.

Approximately 93 actual hours were spent looking for nests; four nests were found by the writer and one by other personnel. This is an effort of 18.6 man-hours per nest excluding the one nest found accidentally. I am convinced that we find only a low per cent of the nests. Judging from the broods observed later in the season the nests that were found represented not more than 25-30 per cent of the total nests on the area. A trained retriever would be a valuable assistance in nest locating and should be included in any subsequent study of this nature.

Brood Observations

According to Pirnie (op. cit.): "In southern Michigan the first broods hatch in late April or early May." I found no evidence of late April broods on the study area, but one brood observed in June was a Class IIc brood of mallards for which back-dating indicates the hatching date to have been around May 10. My first observation of a brood was on May 26 - a brood of 9 - Class Ia mallards.

Brood observations on the water areas were conducted daily with but few exceptions. Travel from water area to water area was by jeep with actual coverage of each water area by foot or canoe. At times I found it advantageous to sit quietly and wait for the hen to bring her brood from hiding.

Pirnie (op. cit.) says "Mid-July is the proper time to study the output of local duck marshes, for then most young birds are still unable to fly and few migrants have arrived." An attempt was made to get complete coverage on the artificial flooding by drive counts. The first drive census was conducted on June 19; nine men and three dogs (two springers and one golden retriever) participated in the survey. Results of the first census appear in Table 12. The second drive was on July 19 with nine men and one dog (springer). Results of this survey are given in Table 13, p. 56. It is possible that the mallard broods and the blue-winged teal brood observed on July 19 were probably also recorded on June 19.

Table 12 - Results of "Drive" Brood Count at Rose Lake on June 19, 1957

Species	Adults	Number Young	Size Class	Habitat
Mallard	0	11	Ic	Flooding
Mallard	0	10	IIa	Flooding
Mallard	0	3	IIc	Flooding
Mallard	0	11	IIb	Flooding
Mallard	1 (♀)	7	Ic	Rose Lake
Blue-winged Teal	0	11	IIb	Flooding
	1	53		

Waterfowl flushed other than broods:

Species	Number
Wood Duck	2 (male and female - not paired)
Blue-winged Teal	1 (male)
Mallard	5 (3 males, 2 females - no apparent pairs)

Table 13 - Results of "Drive" Brood Count at Rose Lake on July 19, 1957

Species	Adults	Number Young	Size Class	Habitat
Mallard	0	4	III	Flooding
Mallard	0	3	III	Flooding
Black Duck	0	9	III	Flooding
Blue-winged Teal	0	3	III	Flooding
Wood Duck	1 (♀)	2	IIc	Flooding
	1	21		

Waterfowl flushed other than broods:

Species	Number
Mallard	2 (birds in eclipse plumage)
Mallard	14 (believe to be Class III, not certain)
Wood Duck	1 (male, eclipse plumage)

SUMMER CONCENTRATION

Janson (1953) says "Apparently little data have been collected on summer waterfowl after the end of the brood season." It is my purpose here to contribute to the available data on summer waterfowl concentrations.

My first observation of summer concentration was on June 2 when 12 drake mallards were observed in a flooded field (see Plate 10). These birds were in their post-nuptial or "eclipse" moult.

These small gatherings of males undoubtedly are the start of many of the larger concentrations that occur later in the summer. Table 14, p. 58, is a summary of the summer concentrations at Rose Lake in 1957. Immature birds that behaved as broods were not included in this table. I found no evidence that would indicate large concentrations of only young-of-the-year birds; all flocks of over 15 birds contained some older birds which were the apparent leaders.

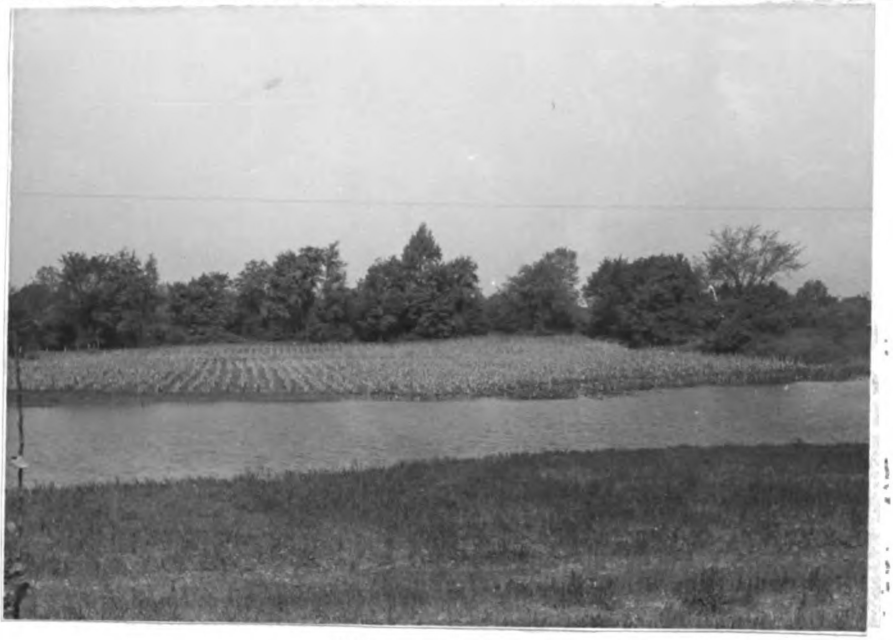
The growth of summer concentrations is not a rapid increase but rather a shifting and gradual build-up. Figure 4, p. 52, illustrates this; consequently, shifting of populations and individuals cannot be illustrated graphically. Evidence of population and individual shifts can be realized only by careful observation and knowledge of the species on the area.

Table 14 - Summer Concentrations of Waterfowl at the Rose Lake Wildlife Experiment Station, Michigan - 1957

Date	Mallard	Black Duck	B-W Teal	Baldpate	Pintail	Wood Duck
June 2	12 ♂♂					
June 27	16 ♂♂					
July 7	21	10				
July 8	19	5				
July 11	12	7				
July 13	30	10				
July 19	14	9				
July 25	18	6				
August 19	32	3				
August 23	13	2				
August 25	30					
August 27	16					
August 28	33	3				
August 31	29	7				
September 1	18	7		2 ♂♂		
September 3	23	16				
September 11	20	2		50		
September 20	38	6				
September 23	54	7	4	4	1	
September 26	24	5				
September 27	27	7	2			5

Sex is given to birds that were positively identified as to sex.
It is difficult to determine sex of birds in eclipse plumage and juveniles.

Plate 10. First observation of summer concentration of waterfowl was made in this flooded field at the Rose Lake Station on June 2, 1957



AUTUMN MIGRATION AND THE HUNTING SEASON

The southward movement of waterfowl is a joyous sight to the ardent duck hunter. At Rose Lake we experience slight southward migration, but it is nothing when compared with the huge Saginaw Bay area or the marshes along the Great Lakes.

In spite of the hundreds of divers (ring-necked ducks, lesser scaup, goldeneyes, and American mergansers) which stop in the spring, few come in the fall. Geese and whistling swans fly over the region, but they are usually quite high and rarely stop. A few of the divers are taken by hunters, but this kill is of minor importance.

The annual kill at Rose Lake has been below 50 birds. The bulk of this kill is normally made up of resident species with but few migrants. Table 15, p. 60, is a breakdown of the kill by species for the years 1952-1957.

Prior to 1956 the total kill for a 60 or 70 day season would be less than 50 birds; however, since the construction of the artificial impoundment in 1953 and 1954, the total kill has increased remarkably. Table 16, p. 61, illustrates this increase in kill and also illustrates several other hunter-kill relationships.

One glance at Table 17, p. 62, reveals the increase in kill on the artificial impoundment and will also illustrate the kill on the various other habitat types at Rose Lake.

Table 15. Waterfowl kill by species at the Rose Lake Wildlife Experiment Station, 1952-1957

Year	Mallard	Black Duck	Baldpate	Pintail	Green-winged Teal	Blue-winged Teal	Shoveller	Wood Duck	Redhead	Ring-necked Duck	Lesser Scaup	Bufflehead	Ruddy Duck	Hooded Merganser	Canada Goose	Snow Goose	Black X Mallard	Totals
1952	7	2	-	3	-	7	-	11	-	-	-	-	1	1	1	-	-	33
1953	5	4	-	1	-	1	1	14	-	1	-	-	-	-	-	1	-	28
1954	2	2	2	-	-	2	-	*	2	1	-	-	-	-	-	-	-	11
1955	11	2	-	-	2	5	-	7	-	-	-	-	-	-	-	-	-	27
1956	29	7	1	3	2	3	-	*	-	2	1	-	1	-	-	-	1	50
1957	88	37	3	3	7	11	-	*	2	2	-	2	-	1	-	-	3	159
Total:	142	54	6	10	11	29	1	32	4	6	1	2	2	2	1	1	4	308

* The season was closed to wood ducks in 1954, 1956, and 1957.

Table 16. Waterfowl hunting pressure and kill at the Rose Lake Wildlife Experiment Station, 1952-1957

Year	Total Hunters	Total Hours Hunted	Total Kill	Average No. of Hours/Hunter	Kill/100 Gun Hours	Gun Hours/Kill	Kill/Hunter
1952	253	593	32	2.34	5.39	18.53	.13
1953	166	386	25	2.33	6.48	15.44	.15
1954	134	273	8	2.04	2.93	34.13	.06
1955	216	504	26	2.33	5.16	19.38	.12
1956	321	712	50	2.22	7.02	14.24	.16
1957	685	1844	159	2.69	8.62	11.59	.23

Only species of the family Anatidae are included in this table.

Waterfowl killed by "small game hunters" are not included in this table.

Table 17. Waterfowl kill by habitat on the Rose Lake Wildlife Experiment Station - 1952-1957

Year	Artificial Water Areas		Rose Lake		Mud Lake		Moon Lake		Vermillion Creek		Swales		Other Habitats		Totals
	Kill	%	Kill	%	Kill	%	Kill	%	Kill	%	Kill	%	Kill	%	
1952	-	-	16	49	1	3	1	3	15	45	-	-	-	-	33
1953	-	-	16	57	2	7	-	-	10	36	-	-	-	-	28
1954	1	9	6	55	1	9	-	-	-	-	2	18	1	9	11
1955	19	70	6	22	1	4	-	-	1	4	-	-	-	-	27
1956	31	62	10	20	5	10	-	-	1	2	3	6	-	-	50
1957	132	81	10	6	6	4	1	1	1	1	10	6	2	1	162

All waterfowl killed on the station are included in this table.

PRODUCTIVITY AND A COMPARISON OF THE AREAS

First of all production (total broods) and productivity (broods per pair, young per pair, and rate of increase) will be discussed for the entire study area; then will follow a comparison of the various areas.

Since no waterfowl productivity studies have been conducted on the study area in the past, no comparisons can be made. The results that were obtained represent the approximate breeding population (breeding pairs), but only the minimum production (total broods); therefore, the productivity (broods per pair, young per pair, and rate of increase) can only be a minimum. I feel that 95 per cent of the total breeding pairs was observed, but only 70 per cent, or less, of the broods were located.

The rate of increase for each species was obtained by using the Kelker Method (1947): $r = 1 + fy$, when f equals the proportion of females in the adult population and y equals the average number of young per adult female.

Data relating to brood production and productivity of the entire study area in 1957 are shown in Table 18, p. 64. A glance at this table shows that the mallard, with nine broods, was by far the most numerous, followed by the blue-winged teal, with four broods. Only one brood of black ducks and one of wood ducks were observed during the entire study, but these two species are notorious skulkers and elusive, so additional broods were undoubtedly present.

Table 18. Brood production and productivity of waterfowl on the Rose Lake Wildlife Experiment Station - 1957

Species	Breeding Pairs	Production: *Total Broods	Production: Total Young	Productivity: Broods/Pair	Productivity: Young/Pair	Productivity: Rate of Increase	Per Cent of Broods
Mallard	15	9	80	0.60	5.33	3.51	60
Blue-winged Teal	5	4	22	0.80	2.22	3.22	27
Black Duck	6	1	9	0.17	1.5	1.56	6
Wood Duck	4	1	2	0.25	0.5	1.19	6

*Actual broods minus repeats

Lakes

Production and productivity on and in the immediate vicinity of the five lakes and marshes on the study area were low. Three pair of mallards and one pair of black ducks were observed on the lakes on frequent occasions. Behavior patterns indicate that the four females were nesting in the vicinity of the marshes surrounding the lakes. One mallard nest was located near Mud Lake on May 13; a brood of nine, Class Ia ducklings was observed on June 2. On June 19 a mallard and her brood of seven, Class Ic ducklings were observed on Rose Lake. Table 19 summarizes the production and productivity data for the lakes and marshes.

Table 19. Brood production and productivity of waterfowl on the lakes and marshes on the Rose Lake Wildlife Experiment Station-1957

		Production		Productivity			
Species	Breeding Pairs	Total Broods	Total Young	Broods per Pair	Young per Pair	Rate of Increase	Per Cent of Broods
Mallard	3	2	16	0.67	5.33	5.00	100
Black Duck	1	-	-	-	-	-	-

Swales

There are between 30-40 acres of swales on the study area; eight contained water throughout the 1957 breeding season and all were capable of providing nesting habitat. Nests were found on only two

areas that were classified as swales. A black duck nest with four eggs was located on April 13 (see Table 6, p. 30). On April 15 I revisited this nest and found it destroyed by an unknown predator. In another swale a mallard nest with 10 eggs was found on May 6 and hatched on or about May 26.

Brood counts were made by skirmish-line drives on June 17, June 19, and July 19, by 4 to 10 members of the Rose Lake staff, but each failed to find broods on any swale. Despite this failure I am of the opinion that the broods were there but we simply missed them due to their elusiveness.

In general I believe that small swales with suitable water areas and nearby nesting cover provide some of the finest nesting habitat in southern Michigan; furthermore, all areas with the above requirements should be preserved whenever possible.

Streams and Creeks

There are approximately seven miles of creek on the study area. Vermillion Creek is bordered by lowland timber (elm, white oak, red maple, white ash, and willow) while Mud Creek is bordered mostly by a grass-shrub vegetation (foxtail, sedge, dogwood, elderberry, and grass).

Vermillion Creek was studied in considerable detail; nest hunting was conducted frequently in early spring and summer and brood counts were made in June and July. All efforts to find nests or locate broods were in vain, as none was found. Table 6, p. 30, gives the data on

breeding pairs, but no data on production or productivity are available.

I feel that nesting was attempted by several pairs of black ducks and mallards, but I have no evidence except behavior observations to substantiate this claim.

Naturally I cannot claim that these areas are unproductive, but they are extremely difficult to sample. Pirnie (op. cit.) said "Few people know the almost insurmountable difficulties in the way of tallying either the breeding pairs or the annual crop of young ducks." These same difficulties are found in the creek bottomlands of the study area and as yet these problems are still unsolved.

Floodings

During the breeding season of 1957, there were approximately 100 acres of water in the artificial flooding at Rose Lake. The surrounding fields of lespedeza sericea, permanent meadows, sedges and grasses, grain patches, and miscellaneous conifer and shrub strips provide excellent nesting habitat for the resident waterfowl.

Production and productivity were high in the immediate vicinity of the flooding. Table 20 illustrates this claim. The mallard species, with seven broods, was by far the most productive on this area. The blue-winged teal was also productive with four broods. Black ducks and wood ducks had one brood each.

This flooding is an excellent example of man's effort to restore and create suitable habitat for waterfowl. I feel that my findings

substantiate this claim. If 100 acres of impoundment and 200 acres of surrounding fields provide suitable cover to produce 97 young ducks, this project was well worth the time, money, and effort.

One word of caution is that not all floodings are as productive as this one at the Rose Lake area; consequently, subsequent studies of this nature are necessary to evaluate the quality or requirements of the many different floodings that are found in southern Michigan.

Table 20. Brood production on the artificial flooding at the Rose Lake Wildlife Experiment Station, Michigan - 1957

		Production		Productivity			
Species	Breeding Pairs	Total Broods	Total Young	Broods per Pair	Young per Pair	Rate of Increase	Per Cent of Broods
Mallard	8	7	64	0.88	8.0	4.52	54.0
Blue-winged Teal	4	4	22	1.00	5.5	3.75	31.0
Black Duck	3	1	9	0.33	3.0	2.29	7.5
Wood Duck	2	1	2	0.50	1.0	1.40	7.5
Totals	17	13	97	0.76	5.71	3.86	100.0

UTILIZATION AND VALUE OF THE AREAS

All of the various areas or cover-types have a certain value at one time of the year or the other. The lakes are used quite heavily by migrant waterfowl in the spring and fall. In the spring hundreds of diving ducks (scaup, ring-necked ducks, redheads, and American mergansers) were observed on all the lakes with the exception of Burke Lake. Potter Lake has very few summer residents, but in the spring many hundreds of the above mentioned divers utilize this area for resting and feeding. I believe that all the lakes and their adjacent marshes with the exception of Burke could be improved for the resident species if proper management practices and vegetation controls were conducted. Burke Lake is quite deep and I doubt whether it could be improved to be of value to waterfowl.

The two creeks on the area are utilized to a certain degree by the resident species but very little, if at all, by the migrants. Wood ducks and blacks are the most common species found on or near the creeks. Fluctuating water levels appear to be a detrimental factor in black duck nesting.

Vermillion Creek flooded three times during the spring of 1957 and once in July; following each flooding black duck pairs were observed on frequent occasions. I interpreted this to mean that the hens had lost their nests due to the flooding. I realize that this claim is purely hypothetical, but much can be inferred from duck behavior.

The eight or so swales on the study area are utilized throughout the waterfowl season. They provide resting and feeding sites for resident birds in the spring, nesting and rearing sites during the production period, and concealment, resting, and feeding sites during the moulting period and the hunting period.

During the moulting period and just prior to hunting season, a flock of 35-40 blacks and mallards was observed on repeated occasions utilizing a small swale as illustrated by Figure 5, p. 71. With regards to hunting pressure and hunter success the value of the swales is low, but this is usually attributed to lack of hunting pressure and in dry years - drought conditions. During a five-year period (1952-1956), the per cent kill on swales amounted to only 3 per cent of the station's total kill.

The artificial impoundment or flooding is, in my opinion, the finest waterfowl habitat on the entire study area. More migrants were observed, more breeding pairs were seen, more broods were recorded, and more ducks were killed in or about this area than on all other areas combined. In 1957, 13 of the 15 broods recorded on the station were from the flooding. In 1955, 70 per cent of the total kill was from the flooding. In 1956, 62 per cent of the total kill was from the flooding; and in 1957, 81 per cent of the total kill was from this impoundment.

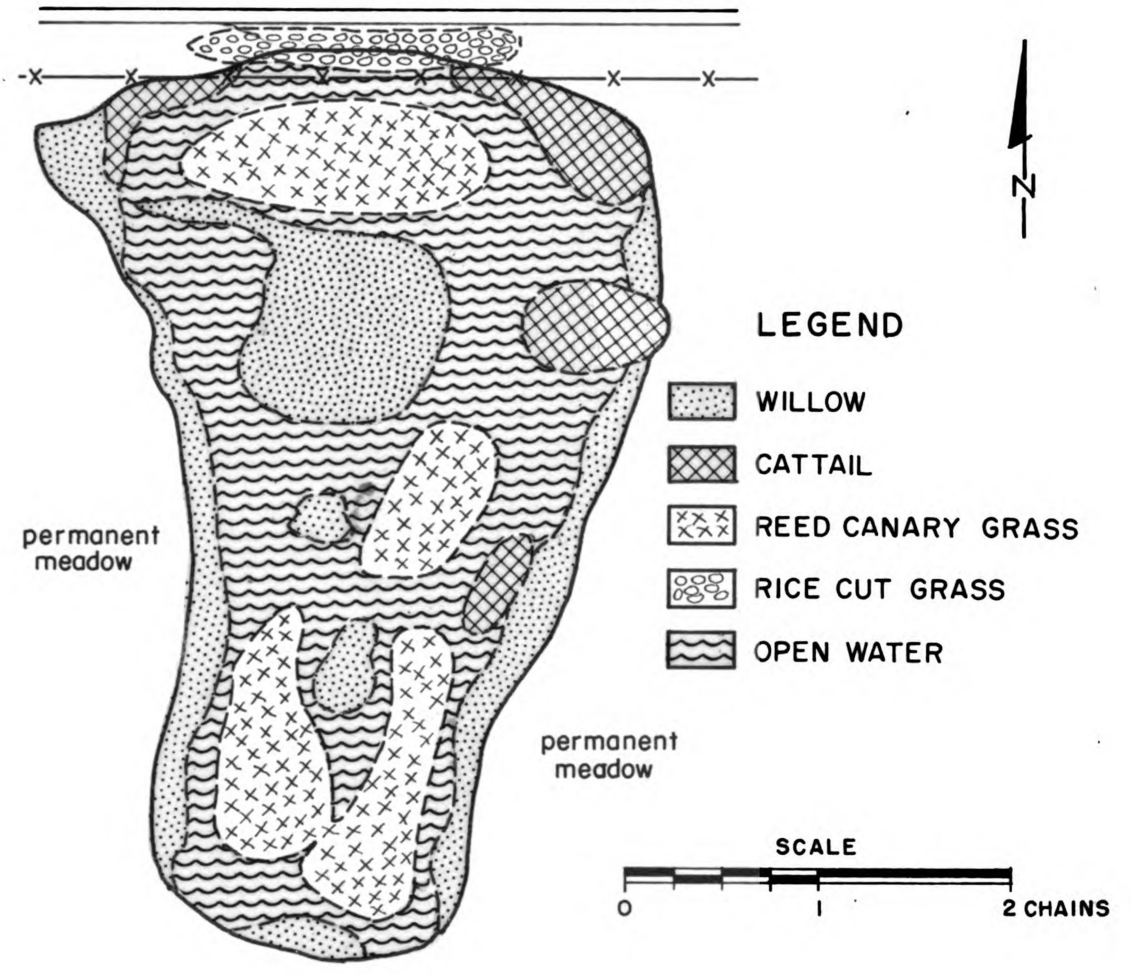


Fig. 5. Diagram of a Typical Willow-Cattail-Grass Swale at the Rose Lake Station.

LIMITING FACTORS

Odum (1953) says "The presence and success of an organism or a group of organisms depends upon a complex of conditions. Any condition which approaches or exceeds the limits of tolerance is said to be a limiting condition or a limiting factor."

At times limiting factors are quite difficult to determine or measure; this is due to their complexity or diversity. On the study area several factors that may limit production were noted: these are availability of space, interference by man's activities, predation, and lack of water areas.

Availability of Space

Evans and Black (1956) say "that breeding birds in the spring were responsive to conditions that enabled them to disperse and remain separated from other pairs of the same species. They showed little preference for areas especially attractive from the standpoint of food, cover, or any measurable factor. Clearly, at this time they sought space and freedom from interference, and it is probable that the ability to find such isolation had an effect on the productivity of the birds as individuals, as well as on the carrying capacity of a given area."

I found this statement to be true on the study area in 1957. Mud Lake and Rose Lake each had but one breeding pair of mallards and one brood on each lake. This same condition existed on the several swales which supported but one breeding pair.

On the artificial impoundment with its diversified habitat, complete isolation of species was not the rule. Several breeding pairs of the same species were observed on frequent occasions at the same time but always well separated from each other. Later in the season seven broods of mallard, four broods of blue-winged teal, one brood of black duck, and one brood of wood duck were observed on this area of approximately 100 acres. On several occasions I observed two different mallard broods in fairly close proximity (100-150 feet).

This limiting factor of space is undoubtedly recognized as territorialism and must not be overlooked in productivity studies. Wing (1956) says "Paradoxical though it may seem, territory appears to limit population to the number of possible territories on the one hand and to assure the habitat needs of a capacity population on the other."

Therefore, it appears that the small swales and small lakes each constitute one territory for one given species while the flooding with its diversified habitat constitutes several territories.

Interference by Man

The influence of measurable interference by man on nesting waterfowl is difficult to determine. During the course of this study, a brood of mallards was observed on Rose Lake and one at Mud Lake, but after the initial observation, neither brood was observed again. Each lake was fished to a moderate degree and was, therefore, subjected to man's interference. I suspect that the hen simply moved her brood to a less disturbed area, but I have no evidence of this.

Desertion of nests was reported by Sowls (1955) in his study of the prairie ducks. He said, "Hence we can say that desertion resulting from disturbance is most likely to occur during the early part of the laying period. It occurs most frequently with the mallard and least frequently with the blue-winged teal." This is another example of man's interference on nesting waterfowl and is, undoubtedly, a limiting factor on productivity.

Predation

Two cases of possible predation were observed during this study. I use the adjective, possible, because who can ascertain with certainty the guilty culprit.

The first case of predation was at a mallard nest in which four eggs were broken. Raccoon tracks were observed in the soft mud near the nest, but this is only circumstantial evidence. The other case was of a Florida gallinule. During a brood count, I came upon the bird's remains - yellow legs, parts of the viscera, and a few feathers; these remains were found on a stump. I returned later with my camera for pictures, but the legs and viscera were gone. Beneath the stump was a small hole and what appeared to be long-tailed weasel tracks; however, I am dealing again with circumstantial evidence.

I have no way of knowing the total effect of predation on the resident waterfowl population, but the average number of birds per brood declined as the brood became older. This would indicate a loss to an unknown cause and this cause may be predators. Predator-control

may reduce loss, but what predator should be controlled - opossum, raccoon, weasels, skunks, squirrels, hawks, owls, cats, dogs, or crows? The predator list is long.

Lack of Water

In waterfowl terminology lack of water means lack of habitat. Lack of habitat means loss of suitable range, hence a possible check to production.

Naturally, no drainage program is in operation on the experiment station, but natural drainage and drought have a marked effect on the shallow swales.

During 1952, 1955, 1956, and 1957, precipitation on the study area was above normal for the breeding season, but in 1953 and 1954 precipitation on the area was below normal during the breeding season. The records at Rose Lake reveal that hunting pressure and kill per unit area were lowest in 1953 and 1954 and higher in 1952, 1955, 1956, and 1957. Table 16, p. 61, illustrates the kill at the Rose Lake Wildlife Experiment Station from 1952-1957. The large kill in 1957 is undoubtedly due to the increased use of the flooding by shooters and by ducks.

Naturally, other factors are usually involved in a lower kill for a particular year, but there appears to be a certain correlation between dry breeding seasons and low hunting pressure and kill at Rose Lake during this period (1952-1957)..

CONCLUSIONS AND DISCUSSIONS

This study has dealt with four major questions: What are the difficulties encountered in waterfowl studies? What are the waterfowl populations of a small area during various seasons of the year? What are the major cover types and their values? What are the productivity rates for these major cover types?

1. What are the difficulties encountered in waterfowl studies?

The difficulties encountered in waterfowl studies in southern Michigan are numerous. During the spring migration, it is nearly impossible to determine which birds will remain on the area and which birds will continue northward. Also, determination of the total number of breeding pairs on the area is difficult. Some mallards and blacks begin to nest in April while others are still migrating northward. Due to dense cover and concealment of hens and nests, it is most difficult to locate many nests for study purposes. Dense cover and mobility of the species make it difficult to determine the total number of broods on an area. Aging of young ducklings is also difficult, except under ideal field conditions.

Consequently, in any waterfowl study, all the facts are not clearly evident, but by careful observation and interpretation of data additional knowledge of waterfowl and waterfowl habitat can be gained.

2. What are the waterfowl populations of a small area during various seasons of the year?

I believe that most people will concede that absolute numbers of a population are difficult to determine. However, relative numbers are important when they are indicative of population changes or shifts.

In this study I have indicated population changes by use of graphs and tables. I believe that it is clear that population changes are highest in the spring and fall and lowest during nesting.

3. What are the major cover types and what are their values?

As a whole the study area has considerable value to waterfowl because it offers assorted habitats that satisfy certain food and cover requirements. However, due to lack of vegetation controls, certain areas have lost considerable value and are below their potential.

On the other hand, newly flooded areas seem to be of the highest value to migratory birds. Consequently, in order to maintain these high values, proper management practices must be continued.

4. What are the productivity rates for the major cover types?

Productivity on the streams and bottomlands was difficult to determine, but it was considered to be low due to limiting factors (flooding and lack of available cover). Rates of productivity were low for the lakes and swales, but with proper management of cover these rates may increase. Productivity on or near the artificial

impoundment was high. This was believed due to the diversity of cover and the availability of numerous territories for nesting purposes.

From this study I have concluded that artificial impoundments of the type that is found at Rose Lake are a great asset to waterfowl production, but before new areas are flooded careful studies are necessary. These studies should include:- the effects of flooding on the land, the flora, and the fauna; the natural topography; the condition of the bottom soils for possible waterfowl food plantings; a pre-flooding vegetation survey; and a knowledge of what species of waterfowl may eventually use the area.

SUMMARY

Waterfowl populations, both resident and migrant, were studied between March and October, 1957, on the Rose Lake Wildlife Experiment Station which is located in Bath Township, Clinton County and Woodhull Township, Shiawassee County. Both counties are located in the south-central part of the Lower Peninsula of Michigan.

Population numbers fluctuated in the spring, summer, and early fall. Peak periods were during the third week of April, the third week of June, and the second week of September. In April, the peak was reached at the height of the spring migration; in June, the peak was reached at the height of the rearing season; and in September, the peak was reached at the height of late summer concentration. A fourth peak came in October when the height of the hunting season was reached.

Study techniques consisted of field observations which were conducted daily with but few exceptions. The various techniques included observation of resident and migrant birds in the spring, observation and determination (by behavior) of breeding pairs, location of nests, observation and determination (by age class) of broods, and observation of summer concentrations.

Each study technique presented certain difficulties; mobility and shifting of birds complicate estimating of populations; dense cover and concealment of nests made nest finding difficult; and cover, concealment, and elusiveness of the hen and her brood made observation of broods difficult.

Various nesting cover types were studied. The margins of lakes and marshes, and stream and creek bottomlands were the least suitable or preferred by nesting waterfowl. Uplands, shallow swales and surrounding fields, and flooding and surrounding fields were seemingly preferred by waterfowl for nesting purposes. In the flooding, the nest boxes for wood ducks were not used by any species of waterfowl. However, starlings occupied 14 of 15 boxes and a saw-whet owl brought off a brood of four in the other.

Since no studies of waterfowl productivity have been conducted on the study area in the past, no comparisons can be made between years. In 1957, 15 broods of ducks were calculated to be on the area, 13 broods in the artificial flooding, and 2 were found on the lakes. The mallard, with 9 broods, was by far the most numerous, but 4 broods of blue-winged teal, a brood of black ducks, and a brood of wood ducks also were observed during the study.

All of the water areas have a certain value to waterfowl at one time or the other. Migrant birds use the lakes and flooding quite heavily during the spring and to a lesser degree in the fall. The lakes are used very little during the breeding season.

In the past most areas have received about equal hunting pressure by duck hunters, but during the last three years (1955-1957), the artificial flooding has received the bulk of the hunting pressure; consequently, the kill on the artificial flooding amounts to 75 per cent of the station's total kill.

The determination of limiting factors is usually difficult. The factors that may limit production on the study area are the availability of space (territorialism), interference by man's activities (disturbance), predation, and lack of water.

Summer concentrations of drakes began shortly after the majority of the hens were incubating. There were no steady build-ups of populations, but rather a shifting of populations from area to area and from flock to flock. My first observation of summer concentration was on June 2 when 12 mallard drakes were observed; these birds were starting their post-nuptial or "eclipse" moult. These early gatherings of older birds may make up the nucleus of many of the larger concentrations that are seen later in the summer.

In the past, waterfowl hunting at Rose Lake was almost negligible; however, the recent construction of the artificial flooding (1953-1954) and the greater utilization of this area by waterfowl have stimulated the interest of many waterfowl hunters. Consequently, the total waterfowl kill on the flooding jumped from 1 in 1954 to 19 in 1955 to 31 in 1956 and finally to 132 in 1957.

APPENDIX

Pied-billed Grebe

In 1957, the pied-billed grebes arrived on the station about three weeks after the first ducks arrived. I observed the first "helldiver" on April 9, on Potter Lake.

The pied-billed grebe was a common nester on the flooding, but only three broods were observed on the lakes. A nest with 3 young and 3 eggs was found on June 19 on the flooding. This nest was constructed of soft mud and plant material, was floating, and was anchored to a buttonbush in about 4 feet of water.

Only casual observations were made on the pied-billed grebe, but my observation records reveal approximately 10 broods on the station; 7 from the flooding and 3 from the lakes. Table 21 is a listing of all pied-billed grebe observation at Rose Lake in 1957.

Table 21. Pied-billed grebe observations at the Rose Lake Station-1957

Date	Habitat	Number Observed
April 9	Potter Lake	(1) adult
April 26	Flooding	(2) adults
June 16	Flooding	(4) 1 adult and 3 young
		(3) 1 adult and 2 young
June 19	Flooding	(3) 3 young and 3 eggs
June 21	Mud Lake	(5) 1 adult and 4 young
June 25	Potter Lake	(3) 1 adult and 2 young
June 26	Flooding	(5) 3 adults and 2 young
June 28	Mud Lake	(8) 6 adults and 2 young
June 30	Flooding	(7) 5 adults and 2 young
July 16	Flooding	(5) 1 adult and 4 young
July 22	Flooding	(6) 1 adult and 5 young
August 31	Flooding	(8) 2 adults and 6 young
September 20	Flooding	(12) 4 adults and 8 young

Florida Gallinule

The Florida gallinule was not observed until June 16; however, they undoubtedly were here earlier than this date since two broods of five and three young were observed on June 19.

The flooding was the only area on the station where gallinules were observed. Approximately 5 broods were reared there; Table 22 is a summary of Florida gallinule observations.

Table 22. Observations of Florida gallinule on the artificial flooding at the Rose Lake Wildlife Experiment Station - 1957

Date	Number Observed	
June 16	(3)	adults
June 19	*(10)	1 adult and 5 young
		1 adult and 3 young
June 24	*(16)	5 adults and 11 young (three broods)
June 25	(7)	2 adults and 5 young
June 26	(1)	1 adult
June 27	(6)	1 adult and 5 young
July 7	(1)	1 adult
July 10	(1)	1 adult
July 11	*(4)	1 adult and 3 young
July 25	(3)	3 adults
July 27	(3)	1 adult and 2 young
August 31	(2)	2 adults
September 11	(3)	3 juveniles
September 20	(1)	Age undetermined

*These are the possible broods on the area

The last observation was on September 20 and none was reported after that date or taken by hunters. I believe that the last started south sometime between September 20-25.

American Coot

Coots arrived early on the station and were observed daily during the entire month of April and the first week in May. The next observation was not until June 19 when a brood of three was seen in the flooding. Table 23 summarizes coot observations at Rose Lake in 1957.

Table 23. Observations of coots at Rose Lake, Michigan - 1957

Date	Habitat	Number Observed
April 4	Flooding	(3) adults
April 5	Flooding	(1) adult
April 8	Flooding	(1) adult
April 9	Flooding	(2) adults
April 11	Flooding	(2) adults
April 13	Flooding	(3) adults
April 14	Flooding	(4) adults
April 17	Flooding	(4) adults
April 21	Flooding	(5) adults
April 22	Flooding	(6) adults
April 26	Flooding	(6) adults
April 30	Flooding	(6) adults
May 3	Rose Lake	(4) adults
June 19	Flooding	(4) 1 adult and 3 young
July 27	Flooding	(1) 1 adult
September 23	Flooding	(6) 2 adults and 4 young
September 26	Flooding	(5) age undetermined
October 3	Flooding	(1) juvenile ♀ female shot by hunter

Virginia Rail

Only one pair of the Virginia rail was observed on the area in 1957. On July 19 an adult was flushed from the marsh grass (reed canary) near the flooding and on August 19 two juveniles were observed in the same area of the flooding.

LITERATURE CITED

Allen, Durwood L. 1941. A method for recording place locations in the field. Jour. of Mammalogy, 22(4):454-456.

Bent, Arthur C. 1923. Life histories of North America wild fowl. Order Anseres (Part 1), U.S. Nat. Hist. Mus., Bull.126(1):1-244.

Evans, Charles D. and Kenneth E. Black. 1956, Duck production studies on the prairie potholes of South Dakota. U.S. Dept. of Interior, Fish and Wildlife Service, Sp. Sci. Rpt. Wildlife No. 32.

Gollop, J. B. and W. H. Marshall. 1954. A guide for aging duck broods in the field. Report for the Mississippi Flyway Council Technical Section, 14 pp., mimeo.

Janson, V. S. 1953. A survey of the summer-waterfowl of a township-Gull Lake, Michigan. M.S. thesis, Michigan State College, East Lansing, Michigan.

Johnsgard, G. A. et. al. 1942. Soil survey of Clinton County, Michigan. Mich. Agr. Exp. Station and U.S. Dept. of Agr. Series 1936, No. 12, Washington, D. C.

Kelker, George H. 1947. Computing the rate of increase for deer. Jour. Wildl. Mgt. 2(11):177-183.

Lincoln, F. C. 1932. The sex of banded ducks. The Auk, 49(3).

_____. 1939. The migration of American birds. Doubleday, and Doran, New York, New York.

Odum, Eugene P. 1953. Fundamentals of ecology. W. B. Saunders Company, Philadelphia, Pa.

Pirnie, Miles David. 1935. Michigan waterfowl management. Department of Conservation, Game Division, Lansing, Michigan.

Sowls, Lyle K. 1955. Prairie ducks: a study of their behavior, ecology and management. The Stackpole Co., Harrisburg, Pa., and The Wildl. Mgt. Institute, Washington, D. C.

Webster's New Twentieth Century Dictionary. 1951. The Publishers Guild, New York, New York.

Wing, Leonard W. 1956. Natural history of birds. The Ronald Press Company, New York.

GENERAL REFERENCES

Addy, C. E. and L. G. MacNamara. 1948. Waterfowl management on small areas. Wildlife Management Institute, Washington, D. C.

American Ornithologists Union. 1931. Check list of North American birds. Ed. 4, and supplements.

Anderson, Maurice and Ray Murdy. 1953. A comparison of methods of estimating duck brood density. South Dakota Dept. of Game, Fish, and Parks, Pierre, South Dakota.

Burt, William H. 1954. The mammals of Michigan. University of Michigan Press, Ann Arbor, Michigan.

Emerson, Frederick B., Jr. 1961. Some aspects of the ecology and management of wildlife marshes in New York State. N.Y. State Conservation Dept., Albany, N.Y.

Fassett, Norman C. 1940. A manual of aquatic plants. McGraw-Hill Book Company, New York.

Fernald, Merritt L. 1950. Gray's manual of botany. 8th edition. American Book Company, New York.

Hochbaun, H. Albert. 1955. Travels and traditions of waterfowl. The University of Minnesota Press, Minneapolis, Minn.

Hubbs, Carl L. and Karl F. Lagler. 1949. Fishes of the Great Lake Region. Cranbrook Institute of Science, Bul. No. 26. Bloomfield Hills, Michigan.

Kortright, F. H. 1953. Ducks, geese, and swans of North America. Wildlife Management Institute, Washington, D.C.

Leopold, Aldo. 1933. Game management. Charles Scribner's Sons, New York.

Martin, Alexander C. 1953. Improving duck marshes by weed control. U. S. Dept. of Interior, F&WS Circular 19, Washington, D. C.

Mendall, Howard L. 1958. The ring-necked duck in the Northeast. University of Maine Bul. No. 16. Orono, Maine.

Mumford, Russell E. 1954. Waterfowl management in Indiana. Indiana Department of Conservation, P-R Bull. No. 2. Indianapolis, Ind.

Ruthven, Alexander G., Crystal Thompson, and Helen T. Gaige. 1928. The herpetology of Michigan. Mich. Handbook Series No. 3. Published by the University of Ann Arbor, Michigan.

Shaw, Samuel P. and C. Gordon Fredine. 1956. Wetlands of the United States, their extent and their value to waterfowl and other wildlife. U.S.F.W.S., Circular 39. Washington, D.C.

Sowls, Lyle K. 1950. Techniques in waterfowl nesting studies. Trans. 15th North American Wildl. Conf.:478-487.

Townsend, Charles W. 1916. The courtship of the merganser, mallard, black duck, baldpate, wood duck, and buffle-head. Auk, 33(1):9-17.

Trippensee, Reuben E. 1953. Wildlife management. Volume II, McGraw-Hill Book Company, Inc., New York.

Wolfson, Albert Ed. 1955. Recent studies in avian biology. University of Illinois Press, Urbana, Ill.