INTRODUCTION OF MAX MCGRAW WILDLIFE FOUNDATION MALLARD DUCKS INTO OKLAHOMA AND EVALUATION OF THEIR SURVIVAL AND ADAPTATION

By

JOE WESLEY ALLEN

Bachelor of Arts
Kearney State College
Kearney, Nebraska
1961

Master of Science
University of Omaha
Omaha, Nebraska
1966

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Thesis Approved:

John A. Morrison
Thesis Adviser

L. Herbert Bruneau

Thomas D Johnston

Thomas C. Laurmann

N N Durham
Dean of the Graduate College

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[1]Oklahoma Department of Wildlife Conservation, Oklahoma State University, U.S. Fish and Wildlife Service, and the Wildlife Management Institute cooperating.

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CHAPTER I

INTRODUCTION

The purpose of this study was to evaluate survival and adaptation of hand-reared mallard ducklings *Anas platyrhynchos* L., liberated near the southern edge of their breeding range.

The hypotheses for this investigation were: (1) a breeding population of mallards will develop in areas where ducklings are released; (2) experimentally-reared ducklings will exhibit greater survival than will control ducklings (rearing techniques and experimental design will be described later); and (3) rearing techniques can eliminate the "taming" effect of artificial production.

Assumptions associated with the hypotheses for this experiment were: (1) Environmental conditions in Oklahoma are within the tolerance range for survival and reproduction of mallard ducks. Although few in number, adult wild mallards and mallard broods were reported, prior to this project, by personnel of the Oklahoma Department of Wildlife Conservation, the Oklahoma Cooperative Wildlife Research Unit, and the federal wildlife refuges. These reports supported the belief that hatchery mallards could reproduce in Oklahoma. Additional support came from a preliminary release of Max McGraw Wildlife Foundation (MMWF) ducklings on the property of Col. Howard Jarrell, Stillwater, Oklahoma. The result of this pilot study was a small breeding population of mallards. (2) Ducks will return as adults to the area where they learned to fly. Banding studies conducted by Hickey (1943), McCabe (1947), Brakhage (1953) and Sowls (1955) demonstrated tendencies of waterfowl to return to natal areas. It was found that hand-reared ducks returned to the location where they learned to fly, even though they were ancestrally associated with other flyways (Williams and Kalmbach, 1943). (3) It is necessary to liberate large numbers of ducklings so that a few female mallards will survive to reproduce. The hen mallard is the key to a successful stocking effort because female ducks return to the release area and select the nest location. The breeding area, therefore, is determined by the hen. According to Foley (1954a) about 80 percent of released ducklings reach flight age. About one-half are female. Sowls (1955) indicated that about 13 percent of the surviving females are expected to return to the natal area. At this survival rate and return rate, 1000 mallard ducklings released into natural areas will yield about 50 adult female mallards returning in the spring.

The hypotheses of this project raise questions concerning the release of mallard ducklings in Oklahoma: (1) Will immature mallards survive, migrate, and return as adults to Oklahoma release areas? (2) How do behavioral patterns of released mallard ducklings affect survivorship? (3) Can breeding, imprinting, and rearing techniques designed to develop hardier ducklings improve survival of hand-reared ducklings? (4) How does survival of mallards released in Oklahoma compare with survival of mallards released in other areas? (5) Will returning mature ducks reproduce in release areas?

Specific objectives were designed to provide data to support or refute the project hypotheses and to answer the questions raised concerning waterfowl stocking in Oklahoma. The objectives were: (1) to attempt to establish a breeding population of MMWF mallard ducks in Oklahoma by releasing hand-reared ducklings; (2) to study the general and adaptive behavior of experimental and control ducklings released in natural habitat; (3) to evaluate an imprinting technique on duckling survival; (4) to observe reproductive behavior and nesting attempts by released MMWF mallards; (5) to classify release lakes according to water quality and vegetation and to correlate these characteristics with use by wild waterfowl and with survival of released ducklings.

This project began in March, 1969, and continued through February, 1971, at which time a 6-month's extension was granted so that an experiment on supplemental feeding of released ducklings could be conducted. With the exception of spring counts of returning matured ducks in 1972, field work was terminated on the first of September, 1971.

All field work was conducted within Oklahoma. Birds were released at lakes in both eastern and western Oklahoma in 1969. In 1970 and 1971, birds were released only on the eastern lakes to reduce the observer's travel time between release sites.

CHAPTER II

TERMINOLOGY

It was suggested by Dr. George V. Burger, General Manager of the Max McGraw Wildlife Foundation, Dundee, Illinois, that standardized terminology should be used so that future comparative studies of waterfowl releases can be made. This suggestion came after a symposium on the role of hand-reared ducks was hosted by Dr. Burger at the Max McGraw Wildlife Foundation. The symposium was co-sponsored by the U.S. Fish and Wildlife Service. The terms associated with rearing techniques listed below were suggested by Dr. Burger and by Dr. Aelred D. Geis of the Migratory Bird Population Station, Laurel, Maryland (Burger, 1971).

1. Pure Wild: in relation to human activity, pure wild indicates any behavior of the animal that reduces contact with people; in relation to waterfowl species, the term indicates free-ranging, migratory birds exhibiting characteristic morphology, reproduction, and behavior of the species.

2. Hand-reared: either wild or game-farm birds that are hatchery reared. The duration of the rearing period

may vary from 3 weeks to life depending on desired characteristics in the birds being produced.

3. Standard: game-farm waterfowl reared by commercial techniques for at least four generations without breeding with wild birds. Standard game-farm waterfowl are semi-domestic in behavior, and they are the type of bird usually available for purchase at game farms.

4. Improved: hand-reared waterfowl with any degree of genetically wild background. This includes "pure wild" birds.

5. Isolated: "standard" or "improved" hand-reared waterfowl hatched and/or reared by methods that significantly reduce contact with man. Isolation is believed to reduce imprinting on humans by the ducklings and to reduce the ducklings' association of food with humans.

6. Hardened: "standard" or "improved" hand-reared waterfowl that have had exposure to natural environmental conditions during rearing. This process was originated and developed in 1963 by Jack Frost, owner of Frost Game Farm, Coloma, Wisconsin.

7. Period of Adjustment: a period of unstable behavior, occurring immediately after release, which is characterized by failure of the ducklings to enter water and by ducklings remaining in closely packed groups at the release site. This unstable behavior is exhibited by ducklings that are released into unfamiliar surroundings

directly from shipping crates, and it usually ends when feeding begins.

8. Hyperreaction: unnecessary escape runs resulting from the stimuli of any sudden movements or noises near released birds. This behavior is most noticeable during the "period of adjustment," and it often continues into the behavioral phases described below.

9. Accommodation Phase: a period in which young birds commence adaptation to the new environment. Feeding marks the beginning of this phase, and the end occurs when birds leave the release site. During this phase, ducklings are still hyperreactive, but the length and intensity of the escape-runs are reduced. Ducklings are not apt to preen and oil their feathers during the "accommodation phase."

10. Exploration Phase: a period during which the released birds appear to investigate the new habitat. During this phase, released birds are difficult to locate. Duckling movements during the "exploration phase" can often be followed considerable distances overland away from the release lake.

11. Range Establishment Phase: a period during which the ducklings' behavior becomes reasonably predictable in regard to daily use of the habitat. This phase is terminated when the birds reach flight age and leave the release lakes.

12. Approach Distance: the minimum distance between a human and a bird prior to any effort by the bird to increase that distance. The term "flight distance," used synonymously to "approach distance" by other authors, may be confused with "length of flight." Also, some birds may not take flight when they are approached.

13. Flight Age: the age of birds at first flight, regardless of causal stimulus, or length, or altitude of flight.

14. Gentle-Release: maintaining hand-reared waterfowl in a holding pen at the release site. This is believed to reduce the period of adjustment and the accommodation phase by allowing penned ducklings to become calm prior to release. This technique was developed at the Delta Waterfowl Research Station, Delta, Manitoba, Canada, possibly by Edward Ward, Resident Manager. Although the retention period may vary according to individual release circumstances, the gentle-release method first employed at the Delta Waterfowl Research Station maintained penned ducklings on an artificial food supply until the birds were able to fly. These ducks eventually joined wild flocks to migrate (Brakhage, 1953).

CHAPTER III

DESCRIPTION OF STUDY AREA

Oklahoma Wetland Habitat

Most of Oklahoma's wetlands were created behind impoundments built across drainage routes. In the mid 1950's, Shaw and Fredine (1956) credited Oklahoma with only 113,200 hectares (ha) of wetland, of which only 7,490 ha were considered high-quality for waterfowl. Buller (1964) estimated that Oklahoma's high-value wetlands and permanent water had increased to nearly 162,000 ha by the mid 1960's. The increase in wetland habitat resulted from the construction of flood-control reservoirs by the United States Army Corps of Engineers and the construction of farm ponds and upstream watershed-control structures by the Bureau of Reclamation and the Soil Conservation Service.

In an attempt to classify wetlands of the United States, Martin *et al*. (1953) placed the majority of Oklahoma wetlands in a category entitled "seasonally flooded basins or flats." Seasonally flooded basins or flats are used considerably by feeding ducks. Martin *et al*. (1953) described this wetland type as:

> Soil covered with water or water logged during variable seasonal periods; usually well

> drained during much of the growing season. Along river courses, flooding ordinarily occurs in late fall, winter, or spring; in upland areas, basins or flats may be filled with water during periods of heavy rain or melting snow.

Martin _et_ _al_. (1953) credited Oklahoma with three additional wetland types which at that time were less common than seasonally flooded basins or flats. The three wetland types are "fresh meadow," "open fresh water," and "saline flats." These wetland types were described by Martin _et_ _al_. (1953) as:

> (1) Fresh Meadow--soil without standing water but waterlogged within at least a few inches of its surface during the growing season.
>
> (2) Open Fresh Water--water of variable depth. Located principally in glaciated country in the northern States, and in the Nebraska sandhills and Florida. It also occurs in artificial ponds, lakes, and reservoirs throughout the United States. Open water may completely occupy lake and pond basins, potholes, limestone sinks, sloughs, or stream beds, or it may be fringed with marsh.
>
> (3) Saline Flats--soil without standing water, but waterlogged to within at least a few inches of its surface during the growing season.
>
> Vegetation (often sparse or patchy) of salt-tolerant plants such as seablite, saltgrass, Nevada bulrush, saltbush, and burro-weed.

The descriptions of wetland types and the conclusions reached by Martin _et_ _al_. (1953) were to a large extent repeated in a similar but more extensive report published by Shaw and Fredine (1956).

Several characteristics adverse to waterfowl populations are commonly found in fresh-water habitat in Oklahoma.

These are: (1) high levels of water turbidity, (2) overgrazed lake margins, (3) decline of water level in late summer, (4) either lack of or sparse occurrence of aquatic vegetation, (5) cover plants along the edges of water areas include high proportions of prairie grasses, forbs, and oak trees, and (6) reservoir waters are heavily used for recreation by humans. Few lakes have all of these adverse characteristics, yet most lakes have one or more of them, reducing their value for waterfowl use.

Location of Release Lakes

Among the impoundments studied in this project (Table I), differences in geographical location, physical conditions and ecological communities distinguish impoundments of eastern Oklahoma from those in the western part of the state.

Western Lakes (Figures 1 to 3), examined only in 1969, are located in the short-grass prairie biome. The major land use in the area is cattle grazing, but there are scattered fields of sorghum and winter wheat that feeding waterfowl may reach by short flights from the lakes.

Eastern Lakes (Figures 1 and 4 to 9) are located in a region containing a mixture of tall-grass prairie and deciduous forest which has undergone considerable clearing in the past. There is some farming in the vicinity, but cattle grazing is the major land use.

TABLE I

GROSS CHARACTERISTICS[1] OF RELEASE LAKES FOR MAX MCGRAW WILDLIFE FOUNDATION MALLARDS IN OKLAHOMA

Release Lake	Maximum Size (ha)	Submerged Vegetation	Emergent Vegetation	Edge Trees	Trees on Dam	Islands	Logs and Stumps	Open Beach	Water Shallow	Water Clear	Water Drained	Wild Ducks	Human Use	Heavy Hunting	Heavy Grazing	Nest Cover
Red Bird	32		X		X	X	X	X		X		X	X			X
Penoski	10	X	X	X	X	X	X		X	X		X		X		X
Curry	14		X		X		X		X		X	X	X	X	X	
Grassy	20	X	X	X		X			X	X		X	X			X
Canton	3160			X		X	X	X			X	X	X	X		
Taylor	12					X		X				X	X		X	
Chalfant	24							X				X			X	X
Coym	28	X						X	X	X	X	X			X	X
Ham	40			X				X	X	X		X	X	X	X	
Sangre	2			X		X				X		X	X			X
Zink 1	18			X		X	X						X			X
Zink 2	2			X				X		X			X			X
Zink 3	6		X	X				X	X		X		X			
Brown	260		X	X		X		X					X			X
Rocket	8	X	X	X	X	X	X		X			X				X
Duck Marsh	60	X	X	X	X	X	X		X	X	X	X	X			X
Ashland (NAD 66)	10			X	X		X	X	X		X	X				
NAD 2	5		X	X					X	X		X				X
NAD 3	7		X	X								X				X

TABLE I (Continued)

Release Lake	Maximum Size (ha)	Submerged Vegetation	Emergent Vegetation	Edge Trees	Trees on Dam	Islands	Logs and Stumps	Open Beach	Water Shallow	Water Clear	Water Drained	Wild Ducks	Human Use	Heavy Hunting	Heavy Grazing	Nest Cover
NAD 4	5			X			X	X								
NAD 23	2				X											
NAD 58	1		X	X			X			X						
NAD 39	4	X	X				X		X		X					X
NAD 6	3	X		X			X	X	X						X	
NAD 52	2			X	X			X		X					X	
NAD 7	2			X	X			X	X						X	
NAD 51	2	X		X	X			X	X						X	
NAD 48	3		X					X	X	X		X			X	
NAD 45	2	X	X	X	X		X		X							X
NAD 50	7			X				X	X						X	
Blue Stem	21			X			X	X				X	X			
Vogel	4							X				X			X	
Capart	1			X		X		X			X	X	X	X	X	

[1]Characteristics are marked with an X for each lake where they are prominent.

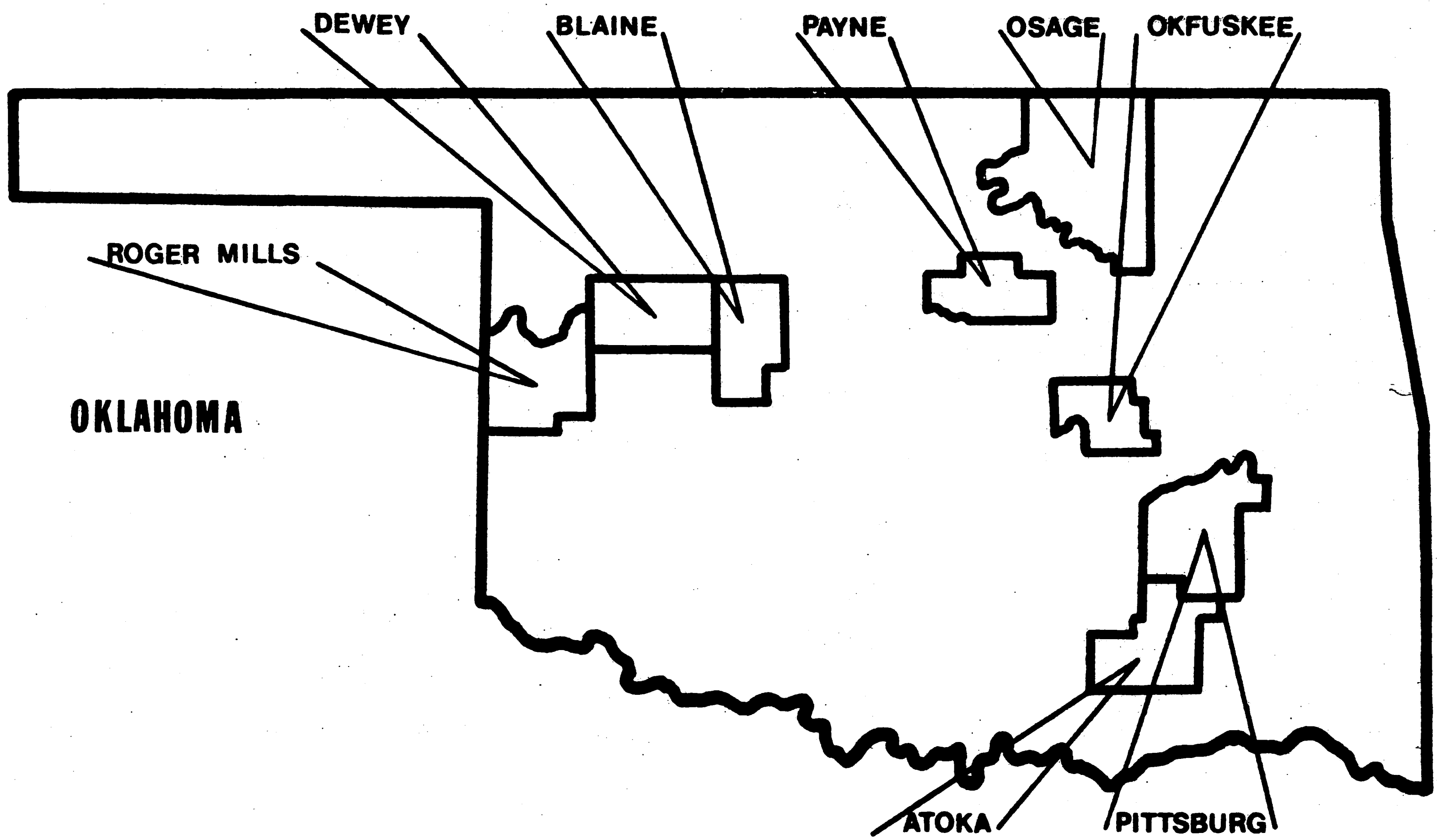

Figure 1. Oklahoma Counties Used in the Max McGraw Wildlife Foundation Mallard Release Project

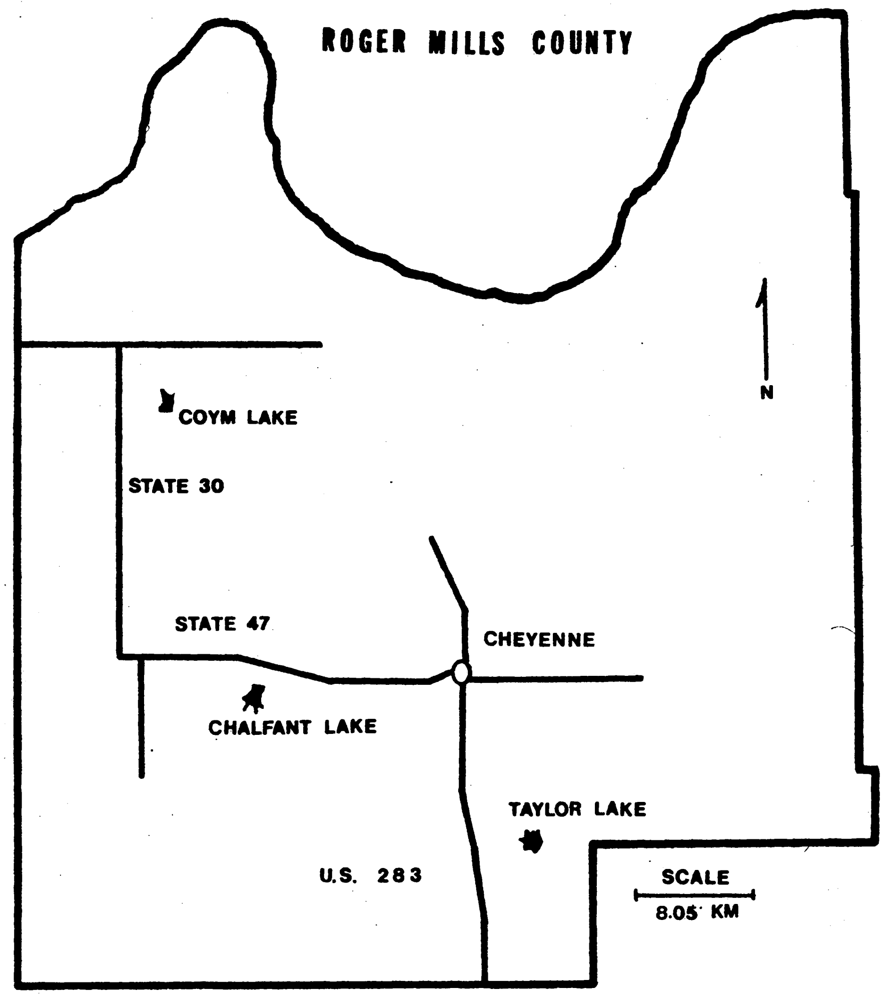

Figure 2. Location of Release Lakes in Roger Mills County

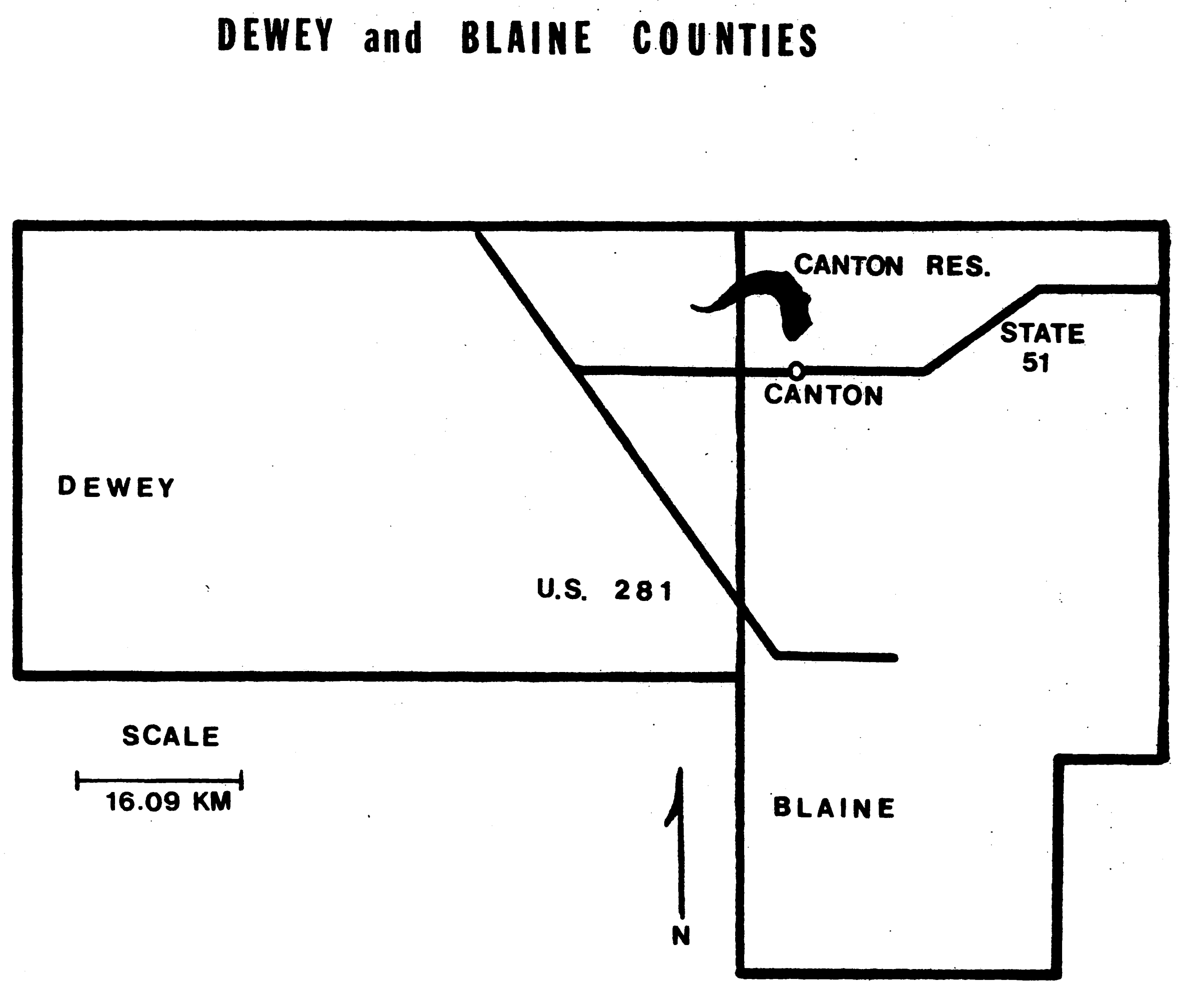

Figure 3. Location of the Release Lake in Dewey and Blaine Counties

PAYNE COUNTY

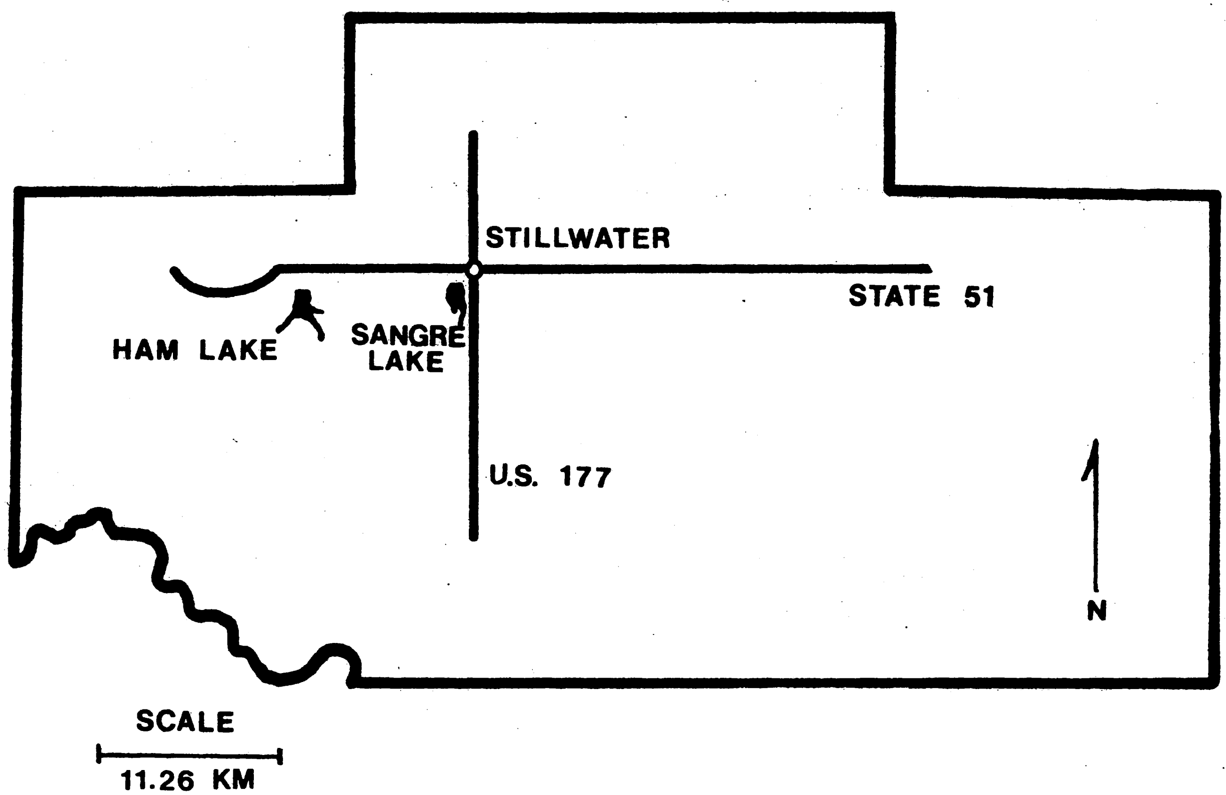

Figure 4. Location of Release Lakes in Payne County

OSAGE COUNTY

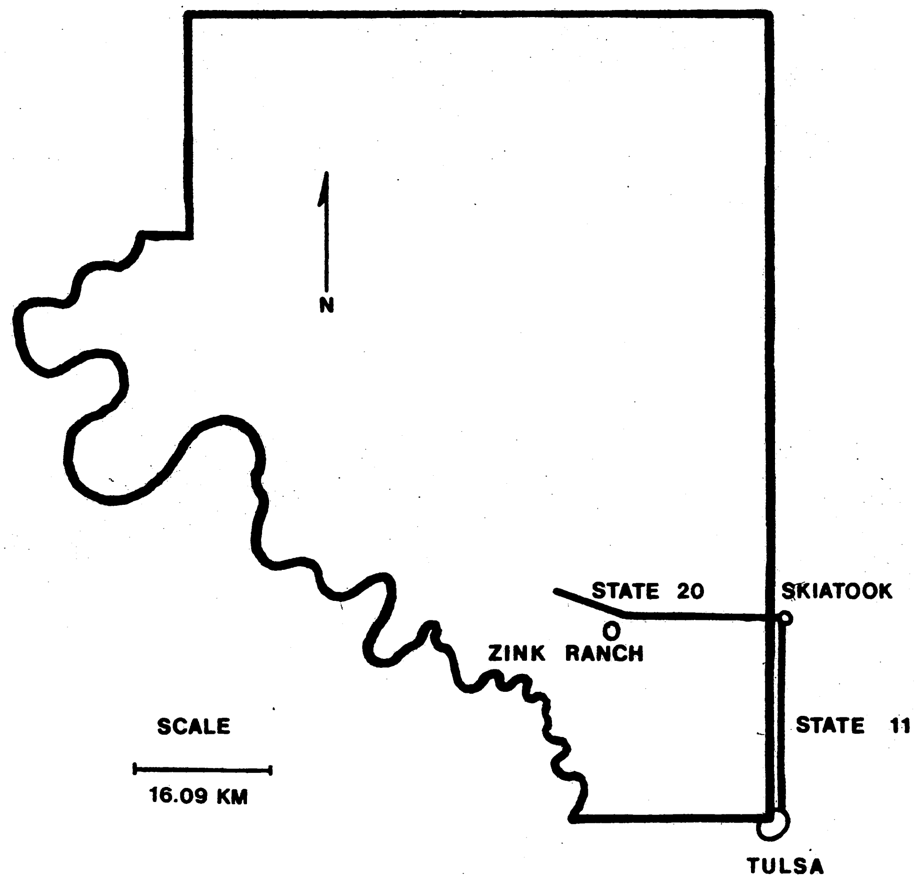

Figure 5. Location of the Zink Ranch in Osage County

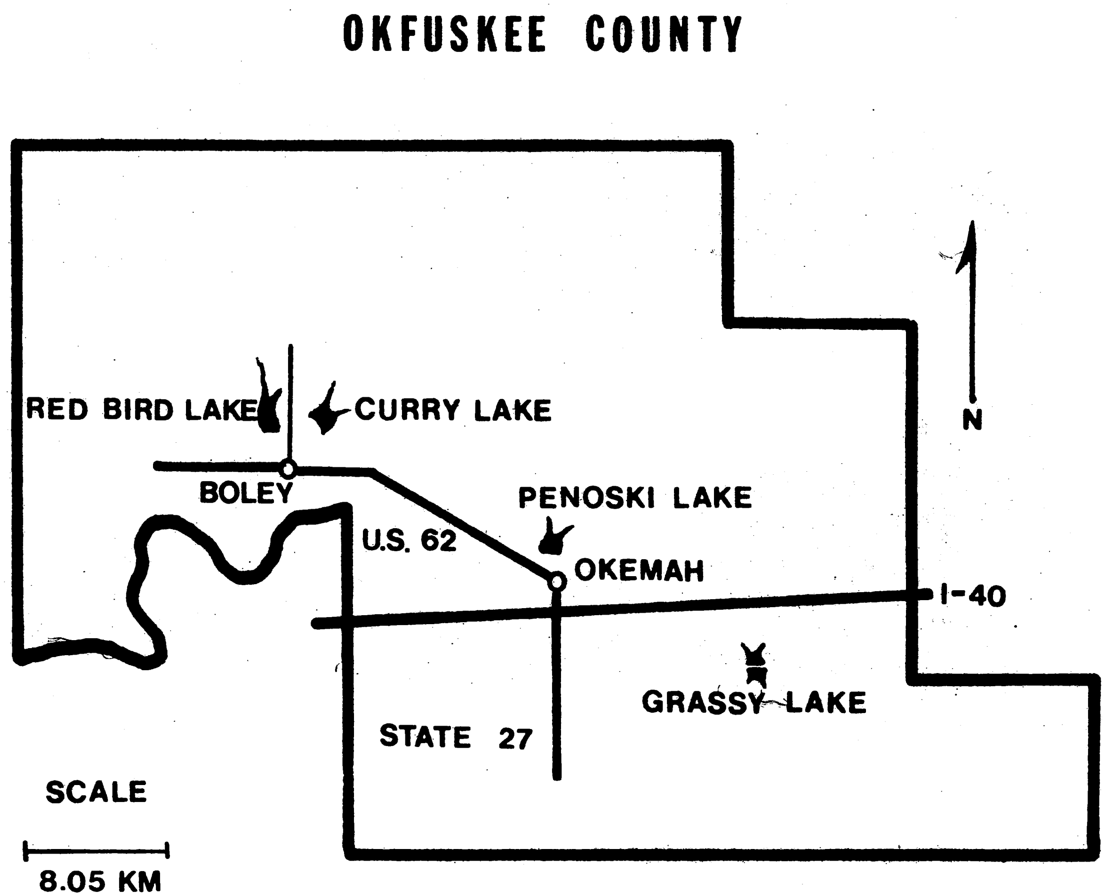

Figure 6. Location of Release Lakes in Okfuskee County

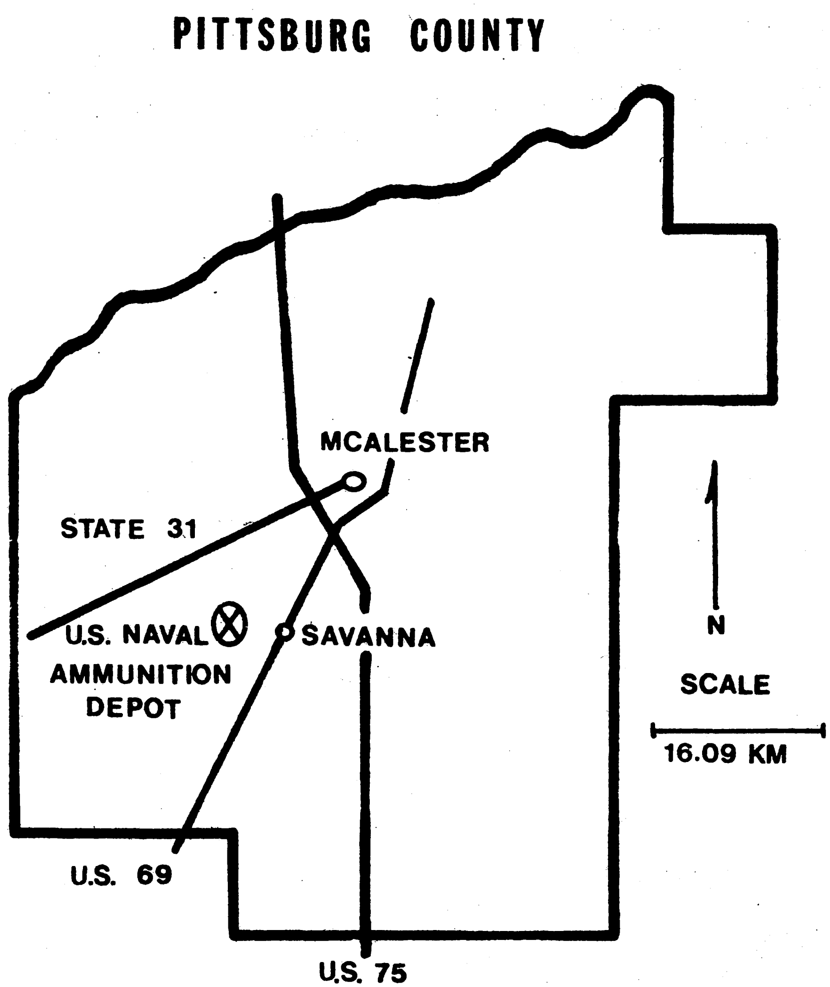

Figure 7. Location of the U.S. Naval Ammunition Depot in Pittsburg County

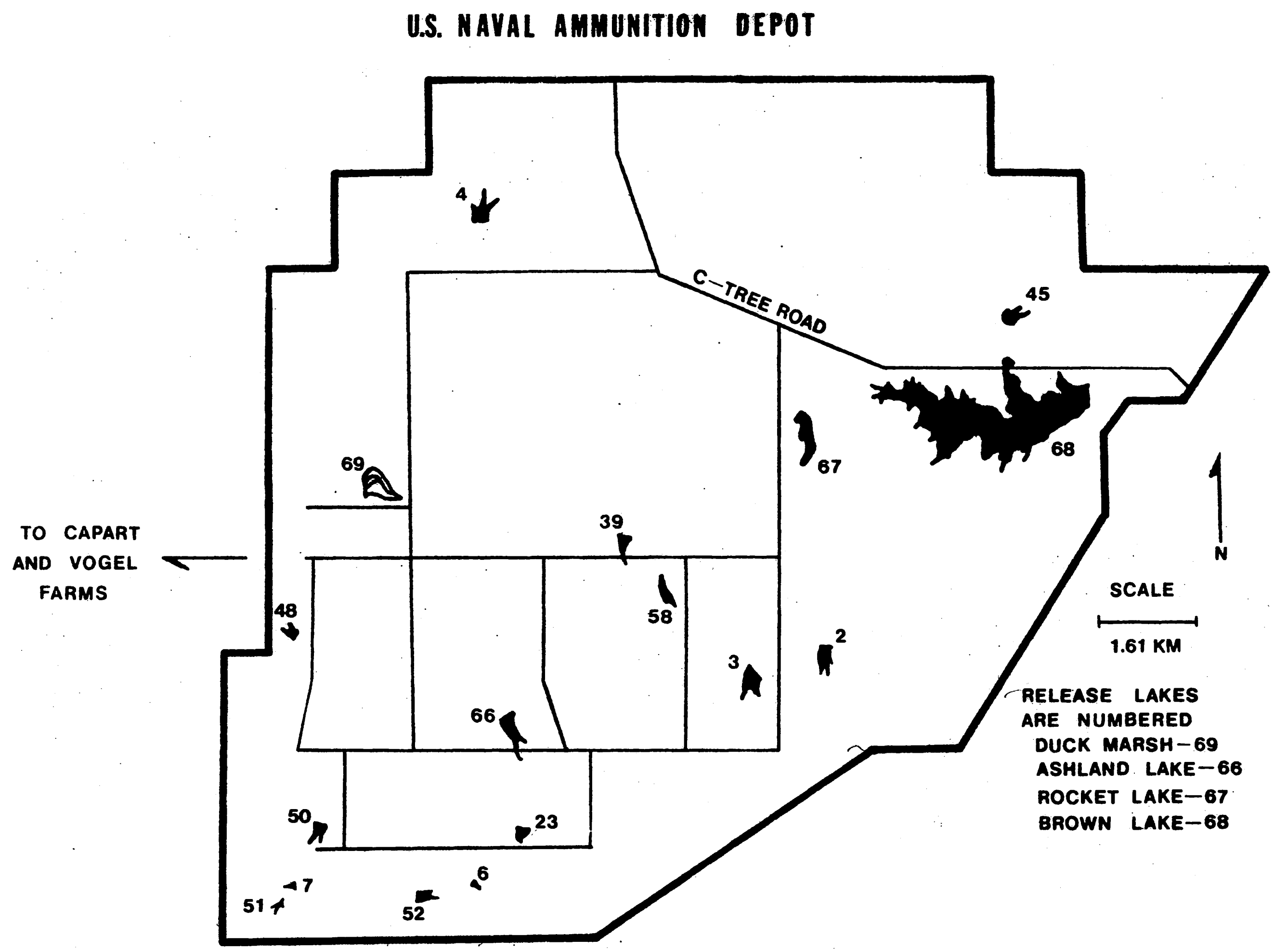

Figure 8. Location of Release Lakes on the U.S. Naval Ammunition Depot

ATOKA COUNTY

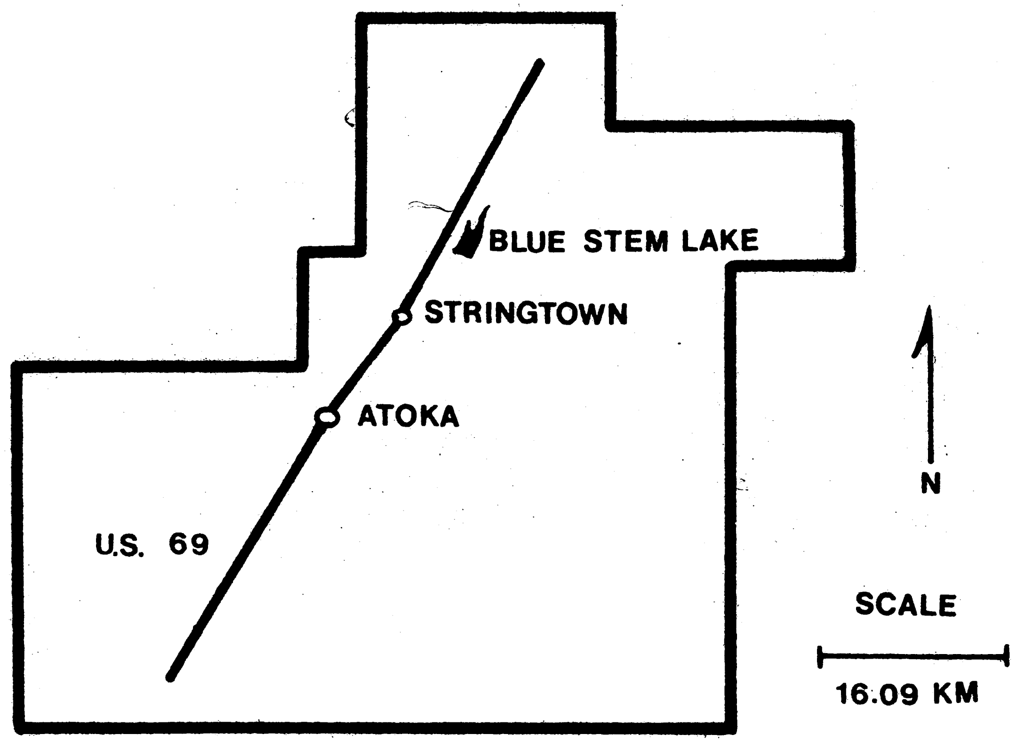

Figure 9. Location of the Release Lake in Atoka County

The exact locations of the release lakes are listed in Table XXXXIII in the Appendix.

General Characteristics of Release Lakes

Mallard ducklings were released on a total of 33 bodies of water in Oklahoma (Table I). Only one release site is a natural body of water. The rest of the sites are man-made reservoirs and are similar in form though they vary in size from 1 ha to 3160 ha.

Reservoirs often increase abruptly in depth near the water's edge, and any marsh or extensive shallow water is located opposite the dam. The amount of shallow water increases in most lakes when maximum water depth is reached and water backs up into the shallow area. In lakes under 40 ha in water-surface area, maximum water depths behind the dams are usually less than 6 meters (m). Nearly 75 percent of each of 17 shallow release lakes falls within the littoral zone, and about 25 percent of each of the 17 lakes is less than 60 centimeters (cm) deep.

Submergent vegetation is abundant in nine lakes, and 14 lakes have large stands of emergent vegetation around the edge. Trees and shrubs grow around 24 lakes, and 11 lakes have trees covering the dams. Vegetation in the marshes at nine reservoirs is dominated by cattail (_Typha_ spp.) and/or buttonbush (_Cephalanthus occidentalis_). Logs and stumps protrude from the water surface in 14 lakes, and 11 lakes contain one or more islands. Long sections of open beach occur on 20 lakes. Thirteen lakes show heavy use by cattle, which decreases vegetation along the shoreline and increases water turbidity. During the study period, eight lakes were either drained or their water levels lowered to the point that impoundments were no longer useful to waterfowl. Clear water is present in 12 lakes at least part of the year. Large populations of wild waterfowl winter on 18 of the release lakes, but heavy hunting takes place on only five. Fourteen release lakes received heavy human use because of the close proximity of residential areas or of recreational areas. Only three lakes were used as release sites in each of the three summers when birds were released. Nineteen of the release lakes are less than 8 ha in surface-area. Only three bodies of water used in this study are larger than 40 ha (Table I). Nearly all of the lakes are less than 40 years old.

CHAPTER IV

HABITAT ANALYSIS

The physical and biological characteristics of release lakes are important variables contributing to the survival or death of ducklings liberated on these lakes. Although the effect of specific characteristics on released birds cannot be measured, the combined effect of habitat characteristics of release lakes can be compared between lakes and rated according to duckling survival at each lake. Observations on weather conditions, water quality, vegetation, aquatic macroinvertebrates, wild waterfowl, and other vertebrate animals were made at each release lake throughout the duration of the study period.

Climate

Aquatic plant communities in Oklahoma lakes are distributed according to four major climatic factors: precipitation, evaporation, wind, and temperature (Penfound, 1953). The weather conditions that determine climate in Oklahoma are characterized by large deviations from mean measurements. Annual, monthly, and daily extremes are irregular and at times quite large. High and low temperatures within a month may span as much as 52 degrees centigrade.

The appendix contains average monthly temperatures in Table XXXXIV, average annual precipitation in Table XXXXV, total evaporation during growing season in Table XXXXVI, and average monthly wind speed and relative humidity in Table XXXXVII. These measurements represent average conditions, and they are the most accurate data available for the general area of the release sites during this study. Climatic conditions at each release lake would be more useful or more informative only if significant differences in climatic variables exist within each division and only if these differences exert a detectable affect on duckling behavior or survival. Variation in weather conditions within divisions was low, and the mallard ducklings were tolerant of the changes that did occur. Division boundaries were set by and weather data compiled by the United States Department of Commerce and published in Climatological Data, 1969, 1970, and 1971.

Table XXXXIV illustrates the small difference in average monthly temperatures that existed between different divisions of the state during the study. However, averaging tends to mask the rather suddenly occurring temperature changes that are characteristic of Oklahoma weather. During the winter, average monthly temperatures were above freezing. During the summer, high average monthly temperatures were of particular importance when precipitation was low in late July and August. This combination resulted in low water levels due to evaporation in reservoir lakes. During the growing seasons, total evaporation was large (Table XXXXVI), especially when compared with the average annual precipitation (Table XXXXV). This indicates that each reservoir must have a watershed of sufficient size to collect enough water to allow for evaporation and human use and to have some water left over to maintain the biotic community that is dependent on it. High average monthly wind velocity and low humidity (Table XXXXVII) add to the problem of declining water levels by increasing the rate of evaporation.

Wind direction during the spring and summer is predominantly from a southerly direction, whereas much of the fall and winter wind is from a northerly direction. In addition to evaporation, wind contributes directly to water turbidity because of the wave action it creates. In turn, turbidity reduces vegetation growth upon which ducks are dependent for both food and protective cover. Most high or low air pressure fronts, which influence wind direction, move through this area from the northwest.

Because the western lakes were unstable, and because of their distance from eastern lakes, the use of Western Oklahoma lakes was discontinued after the 1969 release. There was little detectable direct effect of weather on duckling behavior or survival. Most weather conditions affected the success of this project indirectly through their influence on water quality and plant communities.

Water Quality

Water chemistry, aquatic vegetation, and waterfowl use are closely related. Several factors that influence water chemistry of landlocked lakes are, according to Moyle (1956): watershed characteristics, geology of the lake bed, source of water supply, rate and seasonal time of water loss, chemical systems, and biological systems. Water quality for any one body of water is not the same from month to month because changes are brought about by seasonal fluctuations in environmental conditions. Because of this, measurements of water quality variables should be made at regular intervals during the annual cycle.

Several of the physical characteristics of the release lakes and their surrounding watersheds have already been described, as were the climatic influences on water quantity. The following variables in water quality were measured monthly in order to describe the influence of water quality on aquatic vegetation used by ducks for food and cover: total alkalinity, pH, temperature, and turbidity.

Moyle (1956) suggested that measurements of phosphorus and nitrogen were good indicators of fertility, and that total alkalinity was a good indicator of general water quality. Total alkalinity is a measurement of calcium carbonate in parts per million (ppm). Moyle (1956) stated:

> Total alkalinity expresses concentrations of two substances directly necessary to plant life, calcium and carbon dioxide, and also is a resultant of the entire biological and chemical system of waters. This has lead to the use of total alkalinity as a rough index of the productivity of waters. Within wide limits this is a justifiable approach. Hard-water lakes are usually more productive than soft-water lakes. Total alkalinity can be considered as one of a number of measurements that can be used jointly to evaluate a water.

Moyle (1945) used total alkalinity, sulphate ion, and pH to describe the distribution of aquatic plants in Minnesota. Macon (1963) suggested that calcium concentration was directly related to invertebrate distribution. Jahn and Hunt (1964) used total alkalinity as a major criterion in calculation of duck-carrying capacity of Wisconsin Lakes. Sculthorpe (1967) criticized the use of total alkalinity in classifying water into nutrient types because of the wide range of alkalinity tolerance exhibited by some aquatic plants. Sculthorpe (1967) suggested that electrolyte content, measured by conductivity, reflects the total make-up of metabolically important ions such as potassium, calcium, magnesium, iron, ammonium, nitrate, sulphate, chloride, phosphate, and bicarbonate, in addition to calcium and carbon dioxide. The general view of water quality provided by comparisons of total alkalinity were considered sufficient for this project.

The division between hard and soft water, based on total alkalinity, has several interpretations as far as vegetation is concerned. Spence (1964, In Burnett, 1964) indicated that alkalinity from 1 to 15 ppm produces poor plant growth, alkalinity from 16 to 60 ppm produces moderate plant growth, and alkalinity over 60 ppm produces rich plant growth. Jahn and Hunt (1964) used Juday's scale in which alkalinity from 0-5 ppm is very soft, 5-10 ppm is soft, 10-20 ppm is medium, 20-30 ppm is medium hard, and over 30 ppm is hard. Moyle (1945) used biological evidence to set his limitation on hard and soft water. Hard-water species of aquatic plants have a lower tolerance limit to total alkalinity at about 30 ppm while soft-water species of aquatic plants have an upper tolerance limit to total alkalinity at about 50 ppm. The natural separation point appears to be 40 ppm.

Figures 14 to 18 in the Appendix illustrate the changes occurring in water-quality variables over 1-year's time in five Oklahoma lakes chosen as release sites. Table XXXXVIII, in the Appendix, contains averaged data for release lakes that were not included in the monthly water quality survey.

According to the alkalinity standards set by Moyle (1945), Spence (1964), and Jahn and Hunt (1964), the total alkalinity of most Oklahoma lakes used in this project indicated a potential productivity between moderate and high. Western lakes have the highest total alkalinity (Table XXXXVIII), but their water levels are less dependable during periods of low precipitation.

Total alkalinity and pH of the lakes illustrated in Figures 14 through 18 indicate good productivity of aquatic vegetation. It appears that turbidity, reducing light transmission during the growing season, is a prominent limiting factor at Ashland Lake (Figure 17) and Brown Lake (Figure 18). Ashland Lake and Brown Lake have relatively poor stands of aquatic vegetation, poor light transmission, and moderate total alkalinity; however, a complete profile of chemical, physical, and biological attributes of any lake is needed prior to formulating a cause and affect statement on any one biological event in the system.

Common characteristics contributing to the turbidity of Oklahoma lakes are low landscape, reduced edge cover, strong winds, mud flats, and relatively shallow depth. The combination of these characteristics permits the wind to circulate water vertically, resulting in turbidity (Norton, 1968; Spall, 1968; Jearld, 1970; and Mauck, 1970).

Vegetation

Penfound (1953) listed 48 plant communities for Oklahoma reservoirs: 13 are terrestrial, 15 are wetland, and 20 are aquatic. The 48 plant communities are composed of 420 species of which only 56 species are truly aquatic. From this, Penfound (1953) concluded that Oklahoma reservoirs are not good habitat for aquatic plants.

A list of plant species and their habitat form is contained in Table XXXXIX in the Appendix. Identification references used were Britton and Brown (1913), Fernald (1950), Muenscher (1967), Fassett (1969), and Waterfall (1969). The most common habitat forms are emersed or paludal grasses and forbs. This indicates a high tolerance to wet soil by the majority of plants found at the release lakes.

Each plant species is rated according to its coverage and abundance for each of the release lakes. Table L in the Appendix contains the species ratings. Table L shows that each lake contains many plants considered as rare and a few that are rated as occasional or frequent. It is a common ecological occurrence to have two or three dominant species and several rare species in one habitat type such as that observed at a lake. Table L also shows that the species most apt to be observed at each lake are the common prairie grasses and forbs and trees of the oak forest. Sedges are the most common paludal plants.

In Oklahoma the dominant plant types are prairie grasses, forbs, and oak forest, few of which provide suitable vegetation for waterfowl. Annual weeds are common in parts of lake beds that are alternately wet and dry because of seasonal changes in water level. Cottonwood (Populus deltoides) and willow (Salix spp.), because of their tolerance of water and their pioneering ability to move into disturbed or bare soil, are often found in the seasonally flooded border areas. Many species of sedge are found in shallow water and in the seasonally flooded area in addition to annual weeds, cottonwoods, and willows. The seasonally flooded borders of reservoirs are often narrow due to steep shore angles, but the side opposite to the impounding structure of a reservoir is usually shallower and may have a seasonally wet and dry zone up to 20 m wide.

Lakes having relatively stable water levels and relatively clear water appear to have several vegetational zones, each of which is characteristic of a certain water depth. These zones represent growth areas for common prominent plant species and were described in detail for some of the larger lakes in Oklahoma by Penfound (1953).

The lakes used for duck releases contain zonation similar to that observed by Penfound (1953), although there is considerable variation in zonation between the release lakes. At least part of this variation is due to changing water levels, grazing animals, turbidity, and phenology. Table II lists the prominent species of aquatic and wetland plants according to zones observed on released lakes.

Chronology of plant growth and development should be described in any habitat rating system because dominance by any one species changes as the growing season progresses. Dominance, according to Carpenter (1938), is:

> Nichols '23, Ecol. 4:11. Organisms that characterize the community in its larger aspects; they receive the full impact of the environment and so alter it as to affect the habitats of their associates; they are usually plants on the land and animals in the water; they typify the lifeform of the community and are usually preponderant either numerically or in mass effect.

Phenology of dominant plant species for the eastern Oklahoma release lakes was observed weekly during 1971 and is presented in Table III

TABLE II

PLANT GROWTH ZONES ON RELEASE LAKES FOR MAX MCGRAW WILDLIFE FOUNDATION MALLARDS

Zone	Depth (m)	Width (m)	Prominent Species
One	1-3	Varies	*Chara* spp. and other Algae
		Varies	*Ceratophyllum demersum*
		Varies	*Myriophyllum* spp.
Two	0.5-1.5	2-10	*Potamogeton* spp.
		Scattered	*Utricularia* spp.
Three	1-1.5	Scattered	*Nelumbo lutea*
		Clumps	*Scirpus sylvaticus*
		2-10	*Typha* spp.
	0-0.5	2-6	*Jussiaea* spp.
		2-6	*Justicia americana*
		Scattered	*Hydrolea ovata*
		Scattered	*Sagittaria* spp.
Four	Damp	1-10	*Eleocharis* spp.
		1-15	*Juncus* spp.
		Clumps	*Polygonum* spp.
		Scattered	*Cyperus* spp.
		Scattered	*Carex* spp.
		Scattered	*Cephalanthus occidentalis*
		Scattered	*Salix* spp.

In early spring, each year, the first plant becoming dominant is *Juncus effusus*. By April, locally heavy growths of *Typha latifolia*, *Polygonum* spp. and several species of sedges reduce the dominating effect of *Juncus effusus*. Large stands of *Nelumbo lutea*, *Jussiaea decurrens*, *Eleocharis quadrangulata* and *Justicia americana* develop

TABLE III

PLANT PHENOLOGY ON RELEASE LAKES FOR MAX MCGRAW WILDLIFE FOUNDATION MALLARDS IN 1971

Species	First Growth Date	Blooming Date	Maximum Growth (cm)	Comments
P. pectinatus	-	4-27	-	Submerged
Ceratophyllum demersum	-	4-29	-	Seeds 6-19
Potamogeton diversifolius	-	5-4	-	Floating leaves 4-27
P. foliosus	-	5-4	-	Submerged
P. nodosus	-	5-19	-	Floating leaves 4-29
Utricularia spp.	-	5-19	-	Floating mat year around
Myriophyllum spp.	-	5-21	-	13-cm spike above water 4-12
Juncus effusus	1-21	4-13	90	Very common early
Typha latifolia	3-7	6-1	120	Very common
Cyperus spp.	3-7	4-13	40	Several species bloom by June
Scirpus sylvaticus	3-8	4-21	180	-
Thalia dealbata	3-8	5-21	60(leaves)	Spike-70 cm
Jussiaea decurrens	3-8	5-20	20	Floating rosette in winter
Callitriche heterophylla	3-8	4-29	10	Floating rosette in winter
Eleocharis spp.	3-15	5-6	small	-
Polygonum spp.	4-13	5-21	85	Some overwinter under water
Justicia americana	4-13	5-14	45	On poor waterfowl lakes
Pontederia cordata	4-14	5-26	55(leaves)	Spike-200 cm
Eleocharis quadrangulata	4-15	5-13	45	Very common
Rhynchospora macrostachya	4-15	5-14	65	-
Nelumbo lutea	4-21	6-13	70	Seeds falling in August
Sagittaria spp.	4-21	5-5	40	-

TABLE III (Continued)

Species	First Growth Date	Blooming Date	Maximum Growth (cm)	Comments
Juncus spp.	4-21	5-4	60	Common around edge
Carex spp.	4-21	5-4	60	-
Cephalanthus occidentalis	4-21	6-13	190	-
Amorpha fruticosa	4-21	5-5	200	-
Tamarix galica	4-22	4-29	400+	-
Nymphaea odorata	4-27	7-29	-	Floating leaves
Nuphar advena	4-27	7-24	50	-
Alisma sp.	5-5	7-9	40	Leaves float if plant is under water
Hydrolea ovata	6-8	7-29	45	-

during May and June, and during July and August *Cyperus* spp., annual weeds, and grasses start growth in bare lake margins. A few wetland species such as *Myriophyllum* spp., *Scirpus sylvaticus*, *Typha latifolia*, *Jussiaea decurrens*, *Callitriche heterophylla*, *Polygonum* spp., *Eleocharis quadrangulata*, *Juncus effusus* and other sedges are capable of growing in both wet and moderately dry conditions. This wide tolerance range undoubtedly has contributed to the success of these species in Oklahoma. The months named above are associated with plant growth in the eastern part of the state because the growing season begins earlier there as compared with the western part of the state.

Aquatic Macroinvertebrates

Invertebrate organisms are important foods for duckling broods. Chura (1961) graphically illustrated the importance of invertebrates in the diet of 1- to 6-day-old ducklings. Also, he illustrated how the reliance of ducklings on invertebrate organisms declines with age. Beard (1953), Collias and Collias (1963) and Bartonek and Hickey (1969) provided additional discussion concerning the necessity of invertebrates as a source of protein in the diets of young ducklings.

Aquatic macroinvertebrate samples were taken in May, 1971, while duck broods were on some of the release lakes. The results of the invertebrate samples are summarized in the Appendix, Table LI. At each lake investigated, three samples were taken, and the collected invertebrates were counted and identified. Pennak (1953) was used as an identification reference. The sample sites were confined to shallow water about 45 cm in depth, and the sites were selected randomly. Samples were taken with a 3.05 m sweep of a plankton net through aquatic vegetation. Approximately 358 liters (l) of water were sampled with each sweep of the net. The numbers of identified invertebrate organisms were averaged for each lake to provide a comparative index for the lakes under investigation.

Rocket Lake and the Duck Marsh had the highest diversity and population of aquatic macroinvertebrates (Table LI). Red Bird Lake, Penoski Lake and Brown Lake were moderate in diversity and population compared with Rocket Lake and the Duck Marsh. Ashland Lake, which is quite turbid the year around, had poor invertebrate diversity and population density.

Use of Release Lakes by Vertebrate Animals

Vertebrate animals are an important segment of any habitat receiving hand-reared ducks. Of particular importance are predator species to which the released birds must adapt and wild waterfowl with which they must compete for food. The behavior of the MMWF mallards in response to other vertebrate animals is discussed in Chapter VIII.

Table LII in the Appendix contains a species list of vertebrate animals observed on or near the Oklahoma release lakes. Identification references were Smith (1950), Pough (1951), Burt and Grossenheider (1952), Murie (1954), Einarsen (1956), Seton (1958), Robbins, Bruun and Zim (1966), Kortright (1967) and Sutton (1967). The occurrence rating used in Table LII is based on the relative appearance of each species at each lake. A more specific rating of each species per lake cannot be made because of the mobility of most species, because of the unequal observation periods at some lakes, and because of the seasonal occurrence of migratory species that may be found on Oklahoma lakes for very short time periods. This rating is designed to suggest relative abundance of vertebrate animals most likely to come into contact with the experimental ducks.

The mammals, reptiles, amphibians, and fish listed in Table LII, with the exceptions of the cottonmouth (*Agkistrodon piscivorus*) and the gar (*Lepisosteus* spp.) observed only in lakes in the eastern part of the state, are common to all release lakes. Direct observations were recorded, as were indirect observations such as tracks, droppings, feathers, skins, shells, nests and eggs, and bones.

The most common mammalian predators observed directly and indirectly were raccoons (*Procyon lotor*), coyotes (*Canis latrans*), bobcat (*Lynx rufus*), and striped skunks (*Mephitis mephitis*). Of the reptiles, only snapping turtles (*Chelydra serpentina*) and pond sliders (*Pseudemys* *scripta*) were large enough or were present in sufficient numbers to damage a population of released birds. The largemouth bass (*Micropterus salmoides*) was common to all release lakes and is known to attack young ducks.

The most commonly observed avian predators were barred owls (*Strix varia*), great horned owls (*Bubo virginianus*), red-tailed hawks (*Buteo jamaicensis*), ferruginous hawks (*Buteo regalis*), marsh hawks (*Circus cyaneus*), and Mississippi kites (*Ictinia misisippiensis*). All of the avian predators listed above were directly observed either feeding on dead released ducks or diving at released ducks, or signs of their presence were observed indirectly at the site where released ducks were killed and eaten.

In addition to water quality and vegetation characteristics, release lakes may be rated according to their usage by wild waterfowl. Table LIII, in the Appendix, contains the average number of wild waterfowl per month on selected release lakes where observations were made at least monthly for more than 1 year. The usual number of observations per month was four or five. The average number per species per month was totaled in order to make a comparative index for the release lakes (Table IV). Table IV also contains the total number of species of wild waterfowl observed on the release lakes. According to Table IV, the Duck Marsh received the greatest average use by wild birds. Penoski Lake, the Duck Marsh, Coym Lake, and Brown Lake had the greatest species diversity. Ashland Lake and Curry Lake were used by the least number of wild waterfowl, and fewer species were involved. According to usage by wild waterfowl, Duck Marsh and Penoski Lake rate highest among the release lakes.

TABLE IV

SUMMARY OF THE USE OF SELECTED RELEASE LAKES BY WILD WATERFOWL

Lake	Index[1] Number	Total Number of Species
Duck Marsh	3433	12
Penoski	765	13
Coym	479	12
Taylor	408	11
Brown	339	12
Chalfant	272	10
Rocket	172	10
Curry	126	7
Ashland	36	4

[1]The index number was calculated by adding the average monthly use of each release lake by each species observed.

In order to obtain a better picture of the movement of wild waterfowl through Oklahoma, weekly observations were made in 1970 and 1971 at two release lakes near Stillwater. These lakes are Ham Lake and Sangre Lake, both of which received MMWF ducklings in 1969. These observations are in Table LIV in the Appendix. Both Table LIII and Table LIV illustrate the failure of waterfowl to use Oklahoma lakes during June, July, and August. Large numbers of birds, however, may be found on Oklahoma lakes during migrational periods.

Habitat Evaluation Summary

In general, Oklahoma release lakes show potentiality for waterfowl production. Water fertility indicates that food and cover plants could become abundant, and indeed these plants are already abundant in a few lakes. All lakes used as release sites show some use by wild migratory waterfowl. From time to time wild waterfowl nest in Oklahoma. On local farms where food and cover is provided artificially, many species of ducks and geese appear to reproduce without difficulty. Two factors that appear to limit waterfowl nesting in Oklahoma are the high level of turbidity associated with most of the lakes and the unstable water level due to evaporation. Turbid water inhibits the growth of the necessary wild aquatic vegetation needed for food and cover by reproducing ducks. If land owners used good wetland management practices, it could reduce turbidity level and improve water quality for both livestock and waterfowl.

According to water quality, vegetational ratings, macroinvertebrates and wild waterfowl counts, Penoski Lake and the Duck Marsh are the best lakes for waterfowl releases, and Ashland Lake appears to be least desirable for waterfowl releases. The other lakes show neither consistently good nor consistently poor characteristics for waterfowl use.

CHAPTER V

PRODUCTION AND SHIPMENT OF MAX MCGRAW WILDLIFE FOUNDATION MALLARD DUCKLINGS

Breeding and Rearing Techniques

The mallard ducklings obtained for release in this study were produced at the Max McGraw Wildlife Foundation, Dundee, Illinois. Information concerning rearing techniques was supplied by Dr. George V. Burger, Director, Mr. Michael R. Richardson, Foundation Biologist, and from a paper presented at the 33rd Midwest Wildlife Conference by Montgomery, Burger and Oldenburg (1971).

Breeding and Rearing Experimental Design

The Max McGraw Wildlife Foundation has developed techniques for producing game farm stock that are believed to reduce undesirable domestic characteristics in their mallard ducks.

Backcrossing standard hens with pure wild drakes is believed to improve the wild characteristics desired in offspring. An isolation technique, described below, was developed to decrease contact of ducklings with humans during the vulnerable imprinting age in the first 3 weeks of life. The foundation intended this isolation technique to decrease domestication of experimental birds. The hardening technique, conducted at the foundation, was intended to improve the ability of ducklings to survive once they were released into the wild.

The goal of the experiment presented here was to release ducklings in areas that appeared capable of supporting them and, by careful observation, to evaluate the success of the techniques employed by the Max McGraw Wildlife Foundation. Standard ducklings were released in similar habitat as controls to compare with experimental birds.

Breeding

Standard game farm mallard stock was produced by conventional commercial techniques and used as controls for this experiment. The experimental ducklings were produced from about 500 improved mallard hens mated with about 200 pure wild mallard drakes. The following breeding program was used to produce experimental birds:

P_1 = Pure Wild Drake X Standard Hen

F_1 = Improved Half - Wild Offspring

P_2 = Pure Wild Drake X F_1 Hen

F_2 = Improved Three-Quarter Wild Offspring

F_2 ducklings were released in 1969. In 1970 and 1971, the breeding program was limited to F_1 ducklings for release.

Artificial nesting structures were provided in holding pens at the foundation, and eggs were collected daily for incubation by commercial methods. Hens and drakes were kept together from March 15 to May 22, during which time egg production averaged about 400 eggs per day.

Hatching and Imprinting

After 26 days of incubation, eggs were placed in high-humidity, still-air hatchers which were isolated to prevent prehatching exposure to human sounds. After the majority of the birds had hatched, ducklings were removed silently from hatchers during darkness, then transported to brooders without their seeing the workers.

In 1970, imprinting techniques included exposing ducklings to a stuffed mallard hen while a recording of the "exodus" call was played. The exodus call is made by the hen when ducklings leave the nest. This imprinting method was described by Montgomery *et al.* (1971) as follows:

> Several hours after most birds had hatched trays were moved from the hatcher to the transfer cabinet, which was lined with reed matting to provide a more "natural" setting. A ramp was inserted, leading from the tray to a chick box. The cabinet was closed and a light turned on to illuminate a stuffed hen mallard, mounted over the chick box and moved in an approximation of the normal attitude of a hen leading young away from the nest. Simultaneously, a recording of the so-called "exodus" call was played. We experimented with two such recordings, one obtained from Dr. Gottlieb of the Dorothy Dix (sic) Hospital in Raleigh, North Carolina, and a similar recording made at our game farm. By

> these elaborations we hoped to expose the ducklings to an imprinting experience as well as to achieve transfer to chick boxes without direct handling.
>
> Response by ducklings to the recordings ranged from an immediate movement toward the hen and into the chick box to no apparent response. When each group had been given ample time to move to the hen, the light was turned off and any remaining birds swept into the chick box manually, in darkness. In 1971, the recordings and mounted hen were not used, since their effect--if any--on post-release behavior could not be measured and since this method had not worked well in transferring the ducklings. Hatching trays were still placed in the transfer cabinet in silence and darkness, and the birds moved by hand in the dark cabinet.

The ducklings were taken in a closed transfer cabinet to a brooder building.

Rearing

The rearing techniques used for control and experimental ducklings released in Oklahoma were described by Montgomery et al. (1971) as follows:

> Our brooder building contains 48 12X12 foot brooder units, separated into 2 sets of 24 by a feed-and workroom in the center. Each set of 24 units is divided by a central working aisle, with 12 units on each side. Each brooder unit is enclosed with masonite sides 24 inches high and contains 2-3 inches of wood chips as litter over a concrete floor. A 4-bulb brooder lamp provides heat. Under standard procedures, 3-4 chick tray feeders, 2-3 large tube feeders, 2-4 small fount waterers and an automatic waterer are provided, to insure that ducklings find food and water quickly. A corrugated brooder ring is used for the first 4-5 days to confine the ducklings until they learn the source of heat, food and water. Soiled litter is changed as necessary, usually daily, eliminating ammonia buildup. Fount waterers and tray

feeders are cleaned and refilled daily until the ducklings are accustomed to using the automatic waterers and feeders. Depending upon weather, ducklings are usually allowed access to 24X140 foot outside yard after 2 weeks, and are locked out after 3-4 weeks.

For our experiment we used all 12 brooder units along one side of the central aisle in that half of the brooder building farthest from most game farm activity. The door to this half of the building was shut, locked and posted, and entrance restricted. No talking was permitted. To further insure isolation, it was necessary to modify brooders structurally and to reduce usual maintenance procedures (i.e., feeding, watering and changing litter).

The 12 isolation units were screened from the central aisle and regular units on the opposite side of the aisle by installing a nylon and plastic poultry screen manufactured by the Anderson Box Company. This screen could be rolled up to the ceiling when not in use.

We cut the number of birds in each brooder unit from the normal 250-300 to 150, to reduce litter soiling. Most litter problems center around the water source. We placed a wire rack, 3 feet wide and extending the full width of the pen, in each unit. All waterers were placed on this rack, which was 4 inches above the floor and open beneath on the aisle side. Droppings fell through the wire and could be scraped out from the aisle without workers entering the pen.

Four large tube feeders were placed in each unit, containing enough feed for the 3 weeks the birds were in the pen. Feed also was scattered in disposable trays and on paper under the brooder lamp before ducklings were introduced, but these sources were not renewed. Water was supplied by an automatic waterer, overflowing with a slow trickle so that the sound of dripping water would attract birds to the water source. Small fount waterers, normally placed in the pens for the first few days, were not used.

An escape shelter, provided at the rear of the pen by a sheet of plastic extending 3½ feet into the pen, 2 feet above the floor, with the sheet falling in front to within 2 inches of the floor, gave the birds a place to hide when frightened. The usual 4-bulb brooder lamp provided heat, but no brooder ring was used. Dead birds were removed with a golfball-retrieving "claw" extending through a slit in the curtain. If it was necessary to enter the pen, brooder lights were turned off and the worker donned a rain poncho to disguise his appearance.

Experimental birds were kept in the brooder units for a minimum of 12 days before they were given access to outside yards, and were locked outside at 21 days. The yard contained a 3X8 foot pond with a constant flow of water and were screened with reed matting to reduce visibility. Enough feed for 2 weeks was provided in range feeders.

The "hardening" process was described by Montgomery et al. (1971) as follows:

At the end of 4 weeks the birds were herded into a trailer and transported approximately one mile to one of our lakes for pre-release "hardening". Since this was the first time that these birds had seen man, we made this as frightening an experience as possible.

The 10-acre manmade lake which we used contains small stands of emergent aquatics and moderate amounts of submerged vegetation, algae and aquatic invertebrates. Feeders were provided and feed was scattered along the shore at night. Access was limited to one or two observers checking behavior of the birds from blinds. The lake was not fenced and we made no effort to control predators.

After 7-10 days the birds were driven from the lake, caught, banded, crated and shipped to cooperating agencies for release. Again, this experience was made as unpleasant as possible.

Marking

Aluminum leg bands issued by the United States Fish and Wildlife Service were placed on the ducklings by the MMWF biologists prior to shipment. The 1969 ducklings were marked with federal band numbers 867-06001 to 867-07000, 807-90296 to 807-90300, and 807-90326 to 807-90359. The band number series for 1970 included 937-35501 to 937-36000 and 937-36250 to 937-36750. In 1971 band numbers were 967-52501 to 967-53500.

In addition to federal bands, ducklings released in 1969 were marked with colored plastic leg bands at the release sites. In 1970 and 1971 colored plastic nasal saddles (Sugden and Poston, 1968) were attached to the ducklings at the Max McGraw Wildlife Foundation. Color codes for bands and saddles are described in the release procedures.

Shipping Procedures

In 1969 and 1970, ducklings were shipped in four-compartment, cardboard poultry crates. In 1971, aluminum poultry crates were used. All ducklings were shipped by American Airlines from O'Hare Airport, Chicago, Illinois, to either Tulsa International Airport, Tulsa, Oklahoma, or to Will Rogers World Airport, Oklahoma City, Oklahoma (Table V). Ducklings were transported by truck to release sites.

TABLE V

SHIPMENT TIMES FOR MAX MCGRAW WILDLIFE FOUNDATION MALLARDS FROM O'HARE AIRPORT, CHICAGO, ILLINOIS TO OKLAHOMA

Date	Time Departure	Time Arrival	Destination	Cost
June 17, 1969	8:35 AM	10:15 AM	Tulsa	$ 56.43
June 24, 1969	8:35 AM	11:00 AM	Tulsa	32.59
July 1, 1969	12:10 PM	1:58 PM	Oklahoma City	41.19
July 8, 1969	5:25 PM	7:18 PM	Oklahoma City	86.31
July 15, 1969	8:35 AM	10:15 AM	Tulsa	-
July 8, 1970	5:45 PM	7:26 PM	Tulsa	156.71
July 29, 1970	5:45 PM	7:26 PM	Tulsa	159.50
June 8, 1971	7:04 PM	9:11 PM	Oklahoma City	-
June 9, 1971	5:25 PM	7:18 PM	Oklahoma City	-

Mortality During Production and Shipment

About 80 percent of the eggs collected for incubation at the Max McGraw Wildlife Foundation in 1970 were expected to hatch (Richardson, 1970). Experimental ducklings (isolated-hardened-improved) suffered total losses of 17.0 percent and 18.8 percent in 1970 and 1971, respectively, in the hatchery (Montgomery et al., 1971). During the same period, loss of improved control ducklings was 9.7 percent and 6.8 percent, respectively (Chapter IX, Table XXXXII). Greater losses of experimental birds were attributed to lack of intensive care during the experimental rearing period, dehydration due to failure of ducklings to use automatic waterers, ammonia fumes, and stress from being handled. The most critical period, during which most losses of experimental brooder ducklings occurred, came between the third and fifth days during which the remaining yolk in the yolk sac was absorbed and ducklings had to learn to feed.

Losses of experimental birds were observed also in shipments to Oklahoma. Shipping deaths for 1969, 1970, and 1971 are compared in Table VI.

A total of 54 birds was lost in transit in 1969. Fifty of them died in one shipment delayed at O'Hare Airport. During this shipment, ducklings remained without water in shipping boxes for nearly 12 hours. The 50 dead birds included 28 control and 22 hardened ducklings. Three of the remaining four ducklings that were dead on arrival were control birds.

During the 1970 shipments, 14 ducklings were lost, 13 of which were on the last shipment. A total of 12 experimental and two control birds died in transit in 1970.

Some deaths were caused by mishandling the cardboard shipping boxes. These shipping boxes contained partitions that divided each box into four compartments. When a box was lifted by the lid, a space large enough for a duckling to put its head through was created between the lid and the top edges of the partitions. When the boxes were put down again and stacked one on another, a duckling having its neck over the partition was trapped and choked to death. No records were kept on the exact number of deaths caused in this manner. In 1971, rigid aluminum shipping crates were used, and no deaths occurred from strangulation.

TABLE VI

MAX MCGRAW WILDLIFE FOUNDATION MALLARDS LOST IN TRANSIT TO OKLAHOMA IN 1969[1], 1970 AND 1971

Date	Total Shipment	Total Dead	Experimental Dead	Control Dead	Comments
1969					
June 17	252	2	-	-	3 escaped-3 no federal bands
June 24	232	2	-	-	1 escaped-2 no federal bands
July 1	256	0	-	-	- 1 no federal band
July 8	255	50	-	-	2 escaped-1 no federal band
July 15	40	0	-	-	- -
1970					
July 8	501	1	1	-	- 5 no federal bands
July 29	500	13	11	2	- 2 no federal bands
1971					
June 9	999	14	8	6	- 4 no federal bands
Total	3035	82	20[2]	8[2]	6 escaped-18 no federal bands

[1]Because of age differences the 1969 birds were not figured in the totals for experimental and control ducklings.

[2]Statistical analysis is in Chapter IX, Table XXXXII.

Morphological Measurements

Measurements of the culmen, tarsus, and weight of released ducklings were recorded during several of the releases in 1969, 1970, and 1971. Averages, standard errors, and confidence intervals of measurements of experimental ducklings and control ducklings are compared in Table VII.

Large sample sizes were used to reduce error. In 1969 individual weights were not taken, but average weights of birds contained in each box were calculated and are included in Table VII.

In this experiment, the null hypothesis is that there is no difference, due to experimental rearing techniques at the Max McGraw Wildlife Foundation, in culmen growth, tarsus growth and weight between experimental and control ducklings.

A pooled estimate of variance was used in a test of the difference between measurement averages of an experimental-duckling sample and a control-duckling sample (Snedecor and Cochran, 1968). Student's t-distribution was used to compare the average values obtained from experimental and control birds. Values for calculated and tabulated t are found in Table VIII.

In this experiment, rejection of the null hypothesis indicated a difference in two duckling measurements due to experimental rearing procedures at the Max McGraw Wildlife

TABLE VII

THE AVERAGE MEASUREMENTS OF CULMEN, TARSUS, AND WEIGHT
OF MAX MCGRAW WILDLIFE FOUNDATION MALLARDS

Treatments	Age (Weeks)	Culmen (mm)	Sc[1] (±)	CI[2] (±)	Tarsus (mm)	St[1]	CI[2] (±)	Weight (gm)	Sw[1] (±)	CI[2] (±)	Sample Size
1969											
Experimental	4.5	43.6	2.4	0.54	48.8	7.9	1.76	468.7	-	-	81
Control	4.5	44.1	3.0	0.67	54.7	3.5	0.77	560.4	-	-	81
1970											
Experimental	5.5	48.9	2.6	0.36	46.8	2.8	0.39	759.8	3.4	0.47	201
Control	5.5	48.4	3.0	0.41	46.3	3.0	0.41	688.9	3.2	0.44	201
1971											
Experimental	5.5	51.3	2.9	0.58	48.0	2.3	0.46	799.5	3.8	0.75	99
Control	5.5	50.6	2.8	0.56	47.5	2.9	0.58	756.9	3.3	0.66	99
Collected Birds in 1970											
Experimental	10	49.0	-	-	42.3	-	-	757.0	-	-	3
Control	10	54.0	-	-	45.0	-	-	918.0	-	-	3
Average Growth of Collected Birds 1970											
Experimental		2.7	-	-	-	-	-	104.3	-	-	3
Control		5.0	-	-	-	-	-	180.0	-	-	3

[1]Standard Error.

[2]Ninety-five percent confidence interval about the mean measurement.

Foundation. The null hypothesis, that there was no difference in weight between experimental and control birds, was rejected. This was true of releases both in 1970 and in 1971. The experimental rearing procedures produce heavier birds than do standard hatchery procedures. There appears to be little difference between culmen and tarsus lengths except in the 1969 release.

TABLE VIII

THE EFFECT OF TREATMENTS ON MORPHOLOGICAL GROWTH OF MAX MCGRAW WILDLIFE FOUNDATION MALLARDS

Characteristic	Students t: Calculated t	Students t: Tabulated $t_{(0.05)}$	Conclusion
Within 1969			
Culmen	1.14	1.99	No Difference
Tarsus	7.58	1.99	Difference
Weight	-	-	-
Within 1970			
Culmen	1.78	1.96	No Difference
Tarsus	1.79	1.96	No Difference
Weight	7.58	1.96	Difference
Within 1971			
Culmen	1.70	1.98	No Difference
Tarsus	1.35	1.98	No Difference
Weight	3.00	1.98	Difference

Measurements of birds collected at 10 weeks of age are included in Table VII, but the sample size was too small for statistical analysis. The difference between the weight gained by experimental and control birds at 10 weeks of age may have been influenced by an intestinal parasite infection that existed in each of six experimental ducklings necropsied. Three control ducklings examined harbored no intestinal parasites.

CHAPTER VI

RELEASE AND DISPOSITION OF EXPERIMENTAL AND CONTROL DUCKLINGS

Release Procedures

At all release sites, federal band numbers were recorded, and samples of morphological measurements were taken. Changes in release procedures from year to year were made to facilitate bird handling and to improve post-release behavior characteristics (Table IX). The locations, dates, and characteristics of ducklings in the 3-year stocking project are summarized in Table X.

The chi-square statistic was used to analyze all observed differences between control and experimental ducklings. This analysis, along with a comparison of the results of this project with a summary of the results of other mallard releases, is summarized in Chapter IX.

The use of a holding pen (Table IX) was suggested by Dr. Burger after his participation in the 1969 release at Canton Reservoir. Small holding pens were constructed at the water's edge of release lakes in 1970 and 1971. Using these pens improved processing released birds and improved duckling behavior following release.

TABLE IX

COMPARISON OF RELEASE ACTIVITIES IN 1969, 1970 AND 1971

Location	Date	Time Completed	Crew Number	Holding Pen	Measurements: Weight (gm)	Measurements: Culmen (mm)	Measurements: Tarsus (mm)	Banding (Plastic)	Release Methods
1969									
Okemah Area	6-17	4:00 PM	5	No	None	None	None	Yes	Singly
McAlester NAD	6-24	4:30 PM	9	No	All	All	All	Yes	Singly
Canton Res.	7-1	6:00 PM	11	No	Estimated	All	All	Yes	Singly & Group
Roger Mills Co.	7-8	10:30 PM	5	No	None	None	None	Yes	Singly
Stillwater Area	7-15	1:00 PM	2	No	Estimated	All	All	Yes	Singly
1970									
McAlester NAD	7-9	10:30 AM	14	Yes	64	64	64	No	Singly & Group
Okemah and Zink	7-29	11:00 AM	9	Yes	425	425	425	No	Singly & Group
1971									
McAlester NAD[1]	6-9	10:00 AM	15	Yes	None	None	None	No	Group
McAlester NAD[1]	6-10	12:10 PM	15	Yes	200	200	200	No	Group

[1]Ducklings were transported by truck to the Zink Ranch and to lakes in the Okemah area from the processing site at McAlester Naval Ammunition Depot (NAD).

TABLE X

THE RELEASE OF MAX MCGRAW WILDLIFE FOUNDATION MALLARDS IN OKLAHOMA IN 1969, 1970 AND 1971

Location	Date	Age Weeks	Control[1]	Experimental[1]	Marker	Total
1969						
Okemah						
Penoski Lake	6-17	4.5	44 Red	45 Red	Leg Bands	89
Grassy Lake	6-17	4.5	35 Red	32 Red	Leg Bands	67
Curry Lake	6-17	4.5	44 Red	44 Red	Leg Bands	88
McAlester NAD						
Duck Marsh	6-24	4.5	80 Yellow	96 Green	Leg Bands	176
Rocket Lake	6-24	4.5	23 Yellow	31 Green	Leg Bands	54
Canton Res.	7-1	4.5	128 Blue	128 Red	Leg Bands	256
Roger Mills Co.						
Taylor Lake	7-8	4.5		47 Green	Leg Bands	47
Chalfant Lake	7-8	4.5		58 Green	Leg Bands	58
Coym Lake	7-8	4.5	100 Yellow		Leg Bands	100
Stillwater						
Ham Lake	7-15	4.5	31 Blue		Leg Bands	31
Sangre Lake	7-15	4.5	9 Blue		Leg Bands	9
Total for 1969						975
1970						
McAlester NAD						
Brown Lake	7-9	5.5	98 Black	102 Orange	Nasal Saddles	200
Rocket Lake	7-9	5.5	102 Black		Nasal Saddles	102

TABLE X (Continued)

Location	Date	Age Weeks	Control[1]	Experimental[1]	Marker	Total
Duck Marsh	7-9	5.5		101 Orange	Nasal Saddles	101
Ashland Lake	7-9	5.5	51 Black	46 Orange	Nasal Saddles	97
Okemah						
Penoski Lake	7-30	5.5		210 Orange	Nasal Saddles	210
Curry Lake	7-30	5.5	215 Black		Nasal Saddles	215
Zink Ranch						
Zink Lakes (3)	7-30	5.5	32 Black	30 Orange	Nasal Saddles	62
Total for 1970						987
1971						
Zink Ranch						
Zink Lakes (3)	6-10	5.5	50 Green	50 White	Nasal Saddles	100
Okemah Area						
Red Bird Lake	6-10	5.5		99 White	Nasal Saddles	99
Penoski Lake	6-10	5.5	100 Green		Nasal Saddles	100
McAlester NAD						
Lake 4	6-10	5.5		31 White	Nasal Saddles	31
Lake 23	6-10	5.5	31 Green		Nasal Saddles	31
Lake 58	6-10	5.5		31 White	Nasal Saddles	31
Lake 39	6-10	5.5	31 Green		Nasal Saddles	31
Lake 7	6-10	5.5		31 White	Nasal Saddles	31
Lake 51	6-10	5.5	31 Green		Nasal Saddles	31
Lake 50	6-10	5.5		31 White	Nasal Saddles	31
Lake 66 (Ashland)	6-10	5.5	31 Green		Nasal Saddles	31
Lake 2	6-10	5.5		31 White	Nasal Saddles	31

TABLE X (Continued)

Location	Date	Age Weeks	Control[1]	Experimental[1]	Marker	Total
Lake 3	6-10	5.5	31 Green		Nasal Saddles	31
Lake 48	6-10	5.5		31 White	Nasal Saddles	31
Lake 45	6-10	5.5	31 Green		Nasal Saddles	31
Lake 6	6-10	5.5		31 White	Nasal Saddles	31
Lake 52	6-10	5.5	31 Green		Nasal Saddles	31
Duck Marsh	6-10	5.5		100 White	Nasal Saddles	100
Rocket Lake	6-10	5.5	100 Green		Nasal Saddles	100
Farm Ponds						
Capart Farm	6-10	5.5	23 Green		Nasal Saddles	23
Vogel Farm	6-10	5.5		23 White	Nasal Saddles	23
Atoka Refuge						
Blue Stem Lake	6-10	5.5	2 Green	4 White	Nasal Saddles	6
Total for 1971						985

[1]The color following the number of released birds indicates the color of band or color of nasal marker used to recognize bird groups.

Experimental and control ducklings were released together on six lakes in 1969 (Table X) to compare survival under identical conditions. In 1969, three lakes received control birds and two lakes received experimental birds to enable independent observations of control and experimental birds. Only three lakes in 1970 and two lakes in 1971 received both experimental and control ducklings.

Disposition of Released Ducklings

Of the 2947 mallard ducklings released in Oklahoma, 134 died of various causes at the release lakes and 1662 were unaccounted for. The remaining 1151 ducklings survived to flight age.

Observation of released birds began as soon as the releases were completed. The behavior of released ducklings was of particular interest, and it is discussed in Chapter VIII. Behavioral observations were continued until the birds reached flight age and eventually left the lakes. Habitat investigations were conducted monthly throughout the remainder of the study period. Behavioral observations resumed as soon as some of the birds returned in the spring.

Records were kept on all mortality at release lakes, duck flight, spring returns of released adult mallards, and reproduction involving the hand-reared birds.

Mortality at Release Lakes

Released ducklings were vulnerable to a number of dangers during their preflight period on Oklahoma lakes. Evidence of 134 mortalities was recorded (Table LV in the Appendix). This represents 4.6 percent of the 2947 ducklings released during the 3-year project. Table LV shows that out of 134 mortalities, 93 were eaten, 24 were uneaten, 8 were killed by cars, and 9 suffered accidental or unknown deaths. It cannot be stated with certainty that the 93 eaten birds were killed by predators because many carnivorous animals will scavenge birds that have died of other causes. Only two incidences of predation on hand-reared ducks were observed during the study period. One observation was of a red-tailed hawk, and the other involved a snapping turtle and a pond slider turtle. Sixteen of the 24 uneaten, dead ducklings showed no signs of the cause of death. This indicates that some dead birds were available for opportunistic carnivores. Eight of the 24 uneaten dead birds were damaged considerably on the head and neck, indicating they may have been killed without being eaten by the killer.

In Table XI, dead experimental and control ducklings are compared according to conditions of their body remains. In total, 66 control birds, 47 experimental birds, and 18 unknown birds were found dead at release lakes (Chapter IX, Table XXXXII). The classification of remains described as

TABLE XI

SUMMARY OF MORTALITY OF EXPERIMENTAL AND CONTROL MAX MCGRAW WILDLIFE FOUNDATION MALLARD DUCKLINGS ACCORDING TO DUCKLING REMAINS OBSERVED AFTER RELEASE IN OKLAHOMA IN 1969, 1970 AND 1971

Year	Condition of Remains	Experimental	Control	Unknown	Totals
1969	Eaten	6	3	8	17
	Undamaged	4	3		7
	Damaged but Uneaten			2	2
	Killed by Cars				
	Accidental or Unknown	1	2		3
	Subtotals	11	8	10	29
1970	Eaten	11	19	6	36
	Undamaged	2	4	1	7
	Damaged but Uneaten	3	2		5
	Killed by Cars	5	1		6
	Accidental or Unknown	2	1	1	4
	Subtotals	23	27	8	58
1971	Eaten	12	27		39
	Undamaged		2		2
	Damaged but Uneaten		2		2
	Killed by Cars				
	Accidental or Unknown	1			1
	Subtotals	13	31	0	44
	Totals	47	66	18	131[1]

[1]Three observations from 1972 are not included in this total.

"eaten," which may indicate the number of birds that fell prey to predators, shows the largest difference between experimental and control birds. There were 29 experimental birds in this classification compared with 49 control birds, and 14 unknown birds (Chapter IX, Table XXXXII). The remaining four categories of dead-bird remains show little difference in total number between experimental and control birds. These four categories contain a total of 18 experimental birds, 17 control birds, and four unknown birds. Comparing 1970 and 1971, the total number of "eaten" birds is similar, 36 and 39 respectively. In 1969, there were 17 birds contained in the "eaten" classification with the largest number being unknown as to experimental or control origin. As described earlier, the hand-reared ducklings released in 1969 were 1 week younger than ducklings released in 1970 and 1971. The supplementary feeding experiment conducted in 1971 may have influenced duckling mortality. This will be discussed in Chapter VII.

There was a tendency, in all three releases, for duckling mortality to decrease as the birds grew older. This is illustrated in Table XII. Most released birds were flying by the end of their 8th week, and the majority of dead birds were found prior to this time. It appears that control birds were more vulnerable for a longer time period than were the experimental birds. Except for the seven experimental ducklings killed at 13 weeks of age in 1970, which may have been influenced by human activity, mortality

TABLE XII

SUMMARY OF MORTALITY OF EXPERIMENTAL AND CONTROL MAX MCGRAW WILDLIFE FOUNDATION MALLARD DUCKLINGS ACCORDING TO THE AGE OF DEAD BIRDS OBSERVED AFTER RELEASE IN OKLAHOMA IN 1969, 1970 AND 1971

Year	Age Weeks	Experimental	Control	Unknown	Totals
1969	4	4		2	6
	5	4	5	4	13
	6				0
	7			3	3
	8			1	1
	9				0
	10	1	2		3
	11	2			2
	12				0
	13				0
	14				0
	15		1		1
	Subtotals	11	8	10	29
1970	5	5	6		11
	6	2	7		9
	7	3	4	3	10
	8	4	2	3	9
	9	2	4	1	7
	10		1	1	2
	11				0
	12		1		1
	13	(7)[1]			7
	14				0
	15				0
	16				0
	17		1		1
	18				0
	19		1		1
	Subtotals	23	27	8	58
1971	5		2		2
	6	4	8		12
	7	2	9		11
	8	5	6		11

TABLE XII (Continued)

Year	Age Weeks	Experimental	Control	Unknown	Totals
1971	9	1	2		3
	10	1	3		4
	11		1		1
	Subtotals	13	31	0	44
	Totals	47	66	18	131[2]

[1]Age is questionable.

[2]Observations from 1972 are not included in this total.

in experimental birds was not observed after the 11th week of age. Mortality of control birds extended to the 19th week.

In 1969, Curry Lake had the largest mortality with 14 dead birds. Ashland Lake was high in 1970 with 20 dead birds, and Rocket Lake was high in 1971 with 8 dead birds.

In 1970 and 1971, mortality figures at each release lake strongly favor survival of experimental ducklings, while in 1969 the control ducklings appeared to do better. The relative size of the unknown classification in 1969 reduces the comparability of mortality among experimental and control birds during that year.

Flight

Prior to flight in 1969, 578 of the 975 ducklings released could not be accounted for by the time they were 8 weeks of age (Table XIII). In 1970, 551 of the 987 birds were unaccounted for at 8 weeks of age, and in 1971, 569 of the 985 ducklings were missing at 8 weeks of age. The remaining 374 ducklings in 1969 could not be identified as control or experimental birds, but in 1970 the remaining 397 birds consisted of 209 control ducklings, 175 experimental ducklings, and 13 unmarked ducklings. Of the 380 8-week-old ducklings remaining on release lakes in 1971, 201 were experimental ducklings and 179 were control ducklings. Percentages of surviving experimental and control ducklings are compared in Table XIV.

TABLE XIII

PERCENTAGES OF DUCKLING MORTALITY, LOST DUCKLINGS, AND DUCKLING SURVIVAL TO FLIGHT AGE IN 1969, 1970 AND 1971 RELEASES OF EXPERIMENTAL AND CONTROL MAX MCGRAW WILDLIFE FOUNDATION MALLARD DUCKLINGS

Year	Total Release	Known Mortality Prior to Flight		Unaccounted for		Surviving to Flight	
		Number	Percent	Number	Percent	Number	Percent
1969	975	23	2.4	578	59.3	374	38.4
1970	987	39	4.0	551	55.8	397	40.2
1971	985	36	3.7	569	57.8	380	38.6

TABLE XIV

PERCENTAGES OF MAX MCGRAW WILDLIFE FOUNDATION EXPERIMENTAL AND CONTROL MALLARD DUCKLINGS SURVIVING TO FLIGHT AGE IN 1970 AND 1971

Year	Total Number Surviving	Experimental[1]		Control[1]		Unmarked	
		Number	Percent	Number	Percent	Number	Percent
1970	397	175	44.1	209	52.6	13	3.3
1971	380	201	52.9	179	47.1		

[1]Statistical analysis is in Chapter IX, Table XXXXII.

According to Table XIV, control ducklings showed better survival to flight age than did experimental birds in 1970. This may be misleading because the age of first flight, which is commonly set at about 8 weeks of age, may not hold true for all birds used in this project. As is illustrated in Table XV, some experimental ducklings gained flight ability by the 6th week of age. (Results of the 1971 release may not be comparable because of the feeding experiment.) Because of the variability of flight-causing stimuli and because of variability in tendency to use flight as an escape method, flight age may not be a reliable criterion for comparing experimental and control ducklings.

With the limitations concerning flight age in mind, the following generalizations were noted. On most lakes, ducks flew only when they were disturbed or were escaping. External stimuli such as those listed in Table XV were responsible for starting the first observed flight, as they were with most flights that followed. Undisturbed flight occurred when birds older than 8 weeks were moving across open water into a wind or when they were trying to catch up to other ducks that had left them behind. In both 1970 and 1971, experimental ducklings were observed in flight between 1 and 2 weeks earlier than were the control birds.

After ducklings had reached flight age, there was a steady decline in duck population at most release lakes.

TABLE XV

FIRST OBSERVED FLIGHT IN THE MAX MCGRAW WILDLIFE FOUNDATION MALLARDS IN 1969, 1970 AND 1971

Location	Date	Age[1] (Weeks)	Duckling Type	Stimulus	Number of Ducks	Flight Length (m)	Flight Altitude (m)
<u>1969</u>							
Penoski Lake	8-14	12	Both	Human	12	1200	30
Curry Lake	8-14	12	Both	Human	6	10	2
Duck Marsh	8-18	12	Both	Human	5	600	10
Rocket Lake	8-19	12	Both	Human	3	300	3
Canton Res.	8-5	9	Both	Human	5	50	10
Canton Res.	8-22	11	Experimental	Truck	18	1000	25
Chalfant Lake	8-7	8	Experimental	Wind	3	400	3
Coym Lake	8-8	8	Control	Truck	6	450	10
<u>1970</u>							
Brown Lake	8-2	8	Experimental	Human	2	5	1
Duck Marsh	8-25	11	Experimental	Human	2	100	10
Penoski Lake	8-6	6	Experimental	Human	2	20	1
Penoski Lake	8-21	8	Experimental	Human	11	200	6
Curry Lake	8-26	9	Control	?	7	150	3
Zink Ranch	9-3	10	Both	?	28	1500	60
<u>1971</u>							
Lake 50	6-26	8	Experimental	Human	4	30	1
Red Bird Lake	7-1	8.5	Experimental	?	8	700	6
Lake 58	7-2	8.5	Experimental	Human	18	20	1
Blue Stem Lake	7-7	9	Both	Human	6	100	10
Lake 51	7-8	9	Both	Human	6	200	3

TABLE XV (Continued)

Location	Date	Age[1] (Weeks)	Duckling Type	Stimulus	Number of Ducks	Flight Length (m)	Flight Altitude (m)
Ashland Lake	7-8	9	Control	Human	1	10	1
Lake 4	7-10	10	Experimental	Gr. Blue Heron	25	300	12
Zink Ranch	7-11	10	Both	Human	2	50	3
Lake 39	7-16	11	Control	Human	8	300	15
Capart Pond	7-25	12	Control	Human	1	1000	10

[1]All remaining birds were strong flyers by 12 weeks of age.

Table XVI has, on a monthly basis, tabulated the number of ducks remaining past flight age for each release lake. The population numbers were taken during the final count made each month. By the end of September, 1969, most birds were gone. By the end of November, 1970, ducks were still using Brown Lake, Curry Lake, Penoski Lake, and the Zink Ranch. At Brown Lake and the Zink Ranch, ducks were receiving food which undoubtedly attracted them to the area. The project was terminated August 31, 1971; however, 165 of the 171 ducks remaining on release lakes through August, 1971, were associated with supplemental feeding. There were 121 experimental birds remaining through August, 1971, with 69 of those located on one lake where food was supplied.

Band Returns

All information concerning migration of experimental and control mallard ducklings released in Oklahoma during this study, came from recoveries of banded birds by hunters. Band return data supplied by hunters are presented in Table LVI in the Appendix. Hunters reported a total of 81 MMWF mallards that were part of the release project in Oklahoma. These mallards were killed during the 1969, 1970, 1971, and 1972 duck hunting seasons in 10 states and two Canadian provinces. There were 47 drakes and 33 hens taken during the four hunting seasons, the sex of one bird was not reported. Little difference in total numbers exists

TABLE XVI

MAX MCGRAW WILDLIFE FOUNDATION MALLARDS REMAINING ON THE RELEASE LAKES AFTER REACHING FLIGHT AGE IN 1969, 1970 AND 1971

Location	Year	Conditioning	July	August	September	October	November
Penoski Lake	1969	Both	16	13	8	0	0
Grassy Lake	1969	Both	1	0	0	0	0
Curry Lake	1969	Both	14	12	0	0	0
Duck Marsh	1969	Both	80	69	18	0	0
Rocket Lake	1969	Both	33	33	29	0	0
Canton Res.	1969	Control	42	17	0	0	0
Canton Res.	1969	Experimental	24	24	0	0	0
Taylor Lake	1969	Experimental	1	1	0	0	0
Chalfant Lake	1969	Experimental	31	14	1	1	0
Coym Lake	1969	Control	98	72	8	8	0
Ham Lake	1969	Control	31	18	18	0	0
Sangre Lake	1969	Control	3	3	3	0	0
Brown Lake	1970	Control	24(2)[1]	6(3)[1]	6(2)[1]	3(2)[1]	1(5)[1]
Brown Lake	1970	Experimental	22	1	1	4	2
Rocket Lake	1970	Control	8	8	0	0	0
Duck Marsh	1970	Experimental	14	6	3	0	0
Ashland Lake	1970	Control	8(3)[1]	(1)[1]	0	0	0
Ashland Lake	1970	Experimental	12	0	0	0	0
Curry Lake	1970	Control	0	102	82	26	5
Penoski Lake	1970	Experimental	0	62	11	4	3
Zink Ranch	1970	Control	0	12(11)[1]	15(4)[1]	?	?
Zink Ranch	1970	Experimental	0	15	13	?	?

TABLE XVI (Continued)

Location	Year	Conditioning	July	August	September	October	November
Zink Ranch	1971[2]	Experimental	28	27			
Zink Ranch	1971	Control	17	17			
Red Bird Lake	1971	Experimental	69	69			
Penoski Lake	1971	Control	0	0			
Lake 4	1971	Experimental	25	0			
Lake 23	1971	Control	20	1			
Lake 58	1971	Experimental	18	0			
Lake 39	1971	Experimental	0	4			
Lake 39	1971	Control	0	11			
Lake 7	1971	Experimental	4	4			
Lake 7	1971	Control	3	3			
Lake 51	1971	Experimental	17	0			
Lake 51	1971	Control	16	0			
Lake 50	1971	Experimental	24	12			
Lake 66(Ashland)	1971	Experimental	0	1			
Lake 66(Ashland)	1971	Control	25	10			
Lake 2	1971	Experimental	0	0			
Lake 3	1971	Control	0	1			
Lake 48	1971	Experimental	0	0			
Lake 45	1971	Control	0	0			
Lake 6	1971	Experimental	0	0			
Lake 52	1971	Control	0	0			
Duck Marsh	1971	Experimental	0	0			
Rocket Lake	1971	Control	5	5			
Capart Farm	1971	Control	7	0			
Vogel Farm	1971	Experimental	0	0			
Blue Stem Lake	1971	Experimental	4	4			
Blue Stem Lake	1971	Control	2	2			

[1]() = Number of McGraw Foundation Mallards without nasal saddles.

[2]In 1971 field work was ended the last day of August.

between experimental and control birds killed during regular duck hunting seasons. Hunters collected 41 experimental ducks and 39 control ducks.

Prior to the regular duck hunting season in 1970, nine birds were collected. Three control ducklings were taken from Curry Lake, and three experimental ducklings were taken from Penoski Lake. Three additional experimental birds were killed illegally by hunters at Penoski Lake. All nine birds were necropsied.

Table XVII shows that 63 hunters killed one released mallard each, four hunters had two birds each, and three hunters killed three mallards each. Because of the relatively large number of hunters reporting only one MMWF mallard each, it appears that the released birds were not congregating in large vulnerable groups at the release lakes during the hunting season.

Hunters taking two birds each on the same day were hunting on Canton Reservoir in 1969 (Appendix, Table LVI). In the two situations in 1971 where hunters killed three birds each on the same day, the three recovered birds, in each case, came from one group of birds. One recovery site was 135 km from the release site, and the other recovery site was 160 km from the release site. This suggests that in some cases released birds migrated together.

When the hunter harvest of released mallards is broken down into various groupings (Table XVIII), birds killed during their first duck hunting season represent the largest group with 46 birds. There were 22 released birds killed during their second duck hunting season, ten during their third season, and two during their fourth season. Of the 46 ducks taken during their first hunting season, 16 were experimental males, 11 were experimental females (totaling 27 experimental ducks), 12 were control males, and 7 were control females (totaling 19 control ducks plus one unidentified by sex). These numbers are compared statistically in Chapter IX, Table XXXXII.

TABLE XVII

NUMBERS OF MAX MCGRAW WILDLIFE FOUNDATION MALLARDS REPORTED PER HUNTER DURING THE 1969, 1970, 1971, AND 1972 DUCK HUNTING SEASONS

	1969	1970	1971	1972	Totals
One bird per hunter	8	20	25	10	63
Two birds per hunter (taken on different days)	1	0	0	0	1
Two birds per hunter (taken the same day)	3	0	0	0	3
Three birds per hunter (taken on different days)	1	0	0	0	1
Three birds per hunter (taken the same day)	0	0	2	0	2

TABLE XVIII

HUNTER HARVEST OF MAX MCGRAW WILDLIFE FOUNDATION MALLARDS ACCORDING TO MONTH OF KILL, AGE, SEX, AND DUCK TYPE FOR THE 1969, 1970, 1971, AND 1972 HUNTING SEASONS

Year of Release	Month and Year of Recovery															
	First Season				Second Season				Third Season			Fourth Season				
	Sept	Oct	Nov	Dec	Oct	Nov	Dec	Jan	Oct	Nov	Dec	Sept	Oct	Nov	Dec	Jan
1969																
Experimental																
Male		3	1	1		1		1		1		1				
Female		3	3		3	1					2					
Control																
Male		3	1		1	2	2	1			1					1
Female		2	2		1				1							
1970																
Experimental																
Male	1	1	1				1									
Female				1	1				1							
Control																
Male		3			2				3							
Female					2				1							
1971																
Experimental																
Male		6	1	1												
Female		2	1	1	1											
Control																
Male		3	1	1	1											
Female			3			1										
Total			46			22				10				2		

Table XIX indicates a small difference, between experimental and control ducks, in survival to flight age. In 1971, 201 experimental ducks survived to flight age, whereas 179 control ducks survived. This survival rate could account for some difference in band returns in 1971. In 1970, 209 control ducks survived to flight age compared with 175 experimental ducks surviving to flight age. Unfortunately band returns for the 1970 hunting season were low and may not express true relationships during a time when survival rate between experimental and control ducks was reversed from that of 1971.

Of the 22 birds taken during their second season, three were experimental males, six were experimental females, nine were control males, and four were control females. This was a total of nine experimental ducks killed and a total of 13 control ducks killed during the second season after release. During the third season there were three experimental females, one experimental male, four control males and two control females reported, totaling 10 birds. As with second-season returns, third-season returns showed more control birds than experimental birds reported as hunter kills. This is the reverse of first-season kill reports. In the fourth season, two males were reported, one each of experimental and control ducks.

Table XVIII shows that October had the greatest kill record. In the four hunting seasons, a total of 44 ducks were taken in October, followed by November with 20

TABLE XIX

PERCENTAGES OF MAX MCGRAW WILDLIFE FOUNDATION MALLARDS OCCURRING IN THE HUNTER HARVESTS OF THE 1969, 1970, 1971, AND 1972 HUNTING SEASONS

Year	Release Number of Ducks	Known Survival to Flight Age		First Season Band Returns		Percent of Release as First Season Band Returns	Percent of Flight Age Birds as First Season Band Returns	
1969	975	374		19		1.9	5.1	
1970	987	397[1]		8[2]		0.8	2.0	
		Exp.	Cont.	Exp.	Cont.		Exp.	Cont.
		175	209	4	4		2.3	1.9
1971	985	380		20		2.0	5.2	
		Exp.	Cont.	Exp.	Cont.		Exp.	Cont.
		201	179	12	8		5.9	4.5

[1]Six experimental ducks and three control ducks were killed prior to the 1970 hunting season and are not included in the "survival to flight" group for the 1970 release.

[2]One control duck included in this table and in Table XVII is not included in Table XVIII because the sex was unknown.

mallards killed. There was a steady decline in hunter reports each month after the opening of hunting season.

Based on data presented in Table XVIII, it appears that survival of the 1969 release was the best of the three releases. Mallards from the 1969 release were reported as follows: 1969 season, 19 returns; 1970 season, 13 returns; 1971 season, five returns; and 1972 season, two returns. Eighteen of the band returns from ducks released in 1969 came from Canton Reservoir. This is almost half of the success of the 1969 release; however, Canton Reservoir had more hunting pressure than did other release lakes.

There was little difference between numbers of band returns for the first, second, and third seasons of the 1970-released birds, compared with the large difference observed between first and second seasons for 1971-released birds. The 1970 and 1971 releases should be comparable because the same types of ducklings were released both years. The 1970 first-season hunter report contained seven banded birds whereas 20 bands were reported from the 1971 first-season birds. Feeding experiments conducted with the 1971 release may have influenced results in 1971 and reduced their comparability with 1970 results.

Table XVIII indicates that there may be some advantages in releasing male and female mallards together. Male birds may act as a buffer to hunting pressure on the females should they migrate together. Selective force of the sex-based point system in duck hunting regulations is an example of why such a buffer might be advantageous. Sex ratio of first-season kills in Table XVIII illustrates selection of drakes over hens by hunters. There were 28 drakes taken during their first season compared with 18 hens.

The percentage of released birds killed in their first season (Table XIX) was between 1 and 2 percent. A more realistic number may be the percentage of birds surviving to flight age that occurred as first-season hunter kills. This number indicates the percentage of available released birds taken by hunters. The band returns for the number of birds that reached flight age in 1969 were 5.1 percent, in 1970 it was 2.0 percent, and in 1971 the return was 5.2 percent. Percentages no greater than 5 percent are low for ducks killed in their first hunting season. The harvest percentage of birds reaching flight age becomes more important as the number of birds reaching flight age gets smaller. The ducks returning in the spring, upon which reproduction depends, come from this group.

The number of birds possibly available for return to release areas in the second year postrelease are found in Table XX. Band returns for returning birds killed during their second hunting season were small except for those released in 1969. The harvest percentages of possible-returning birds, released in 1970 and 1971, during their second hunting season shows that control ducks were killed in a slightly larger percentage than were experimental

TABLE XX

PERCENT OF FIRST-YEAR SURVIVORS OF THE MAX MCGRAW WILDLIFE FOUNDATION MALLARDS FOUND IN THE SECOND-SEASON HUNTER HARVEST

Year	Survival to Flight Age Minus First Season Known Losses		Second Season Band Returns		Percentage of First Year Survival to Flight Age Minus Known Losses	
1969	355		13		3.7	
1970	389		6		1.5	
	Experimental	Control	Experimental	Control	Experimental	Control
	171	205	2	4	1.2	2.0
1971	360		3		0.8	
	Experimental	Control	Experimental	Control	Experimental	Control
	189	171	1	2	0.5	1.1

ducks. This is the reverse of first-hunting-season percentages. The number of band returns is probably too small to indicate any definite trends in comparing experimental and control birds past their first hunting season as released birds. There was a steady decline in band returns for second season birds from the 1969, 1970, and 1971 releases.

Migrations

Forty-eight of the 80 band returns came from Oklahoma hunters (Table XXI). Kansas hunters were second with 12 band returns. Three or fewer bands were reported from the eight remaining states (Table LVI, Appendix) and from Canada. Of the 48 ducks killed in Oklahoma, 26 were experimental birds and 22 were control birds (Chapter IX, Table XXXXII). Of the 32 ducks killed elsewhere, 15 were experimental ducks and 17 were control.

Table XXI shows that the ratio of birds shot in Oklahoma to birds shot elsewhere declined from 38:8 for first-season birds to 9:15 for second-season birds and to 2:8 for third-season birds. It appears that Oklahoma did not retain the released ducks; the ratio trends indicate a movement away from Oklahoma. It was noted, however, that there was considerable movement of young mallards after they had reached flight age and after nesting was completed in the spring after release. The random movement of young birds after reaching flight age was discussed by Hochbaum

TABLE XXI

MAX MCGRAW WILDLIFE FOUNDATION MALLARD MOVEMENTS AS REVEALED BY BAND RETURN DATA FROM STATES WHERE PROJECT MALLARDS WERE KILLED

	Okla.	Kan.	Tex.	Nebr.	N.D.	S.D.	Ark.	Minn.	La.	Canada	Mo.
First Season											
Experimental											
Male	11	2					1		1		1
Female	11										
Control											
Male	10	2									
Female	6								1		
Second Season											
Experimental											
Male	2	1									
Female	1	1	1			1		2			
Control											
Male	3	3		1		1	1				
Female	1	1		1	1						
Third Season											
Experimental											
Male			1								
Female	1	1		1							
Control											
Male	1		1		2						
Female		1								1	

TABLE XXI (Continued)

	Okla.	Kan.	Tex.	Nebr.	N.D.	S.D.	Ark.	Minn.	La.	Canada	Mo.
<u>Fourth Season</u>											
Experimental											
Male										1	
Female											
Control											
Male	1										
Female											
Totals	48	12	3	3	3	2	2	2	2	2	1

(1955) and was expected in the Oklahoma project. The movement trend away from Oklahoma observed in older birds was not expected.

Table XXII shows the direction of movements of mallards released in Oklahoma. Fifty of the 80 band returns indicated movements in a northerly direction. The remaining band reports indicated no movement or slight movement to the south and east. There was little difference between experimental and control birds as to the directions of their movements.

Table XXIII shows that the distance traveled by experimental and control birds was similar even though there were more experimental birds taken in Oklahoma. Eighteen birds showed no movement while 29 birds were killed between 40 km and 160 km from their release sites. Twenty-four birds were killed between 200 km and 800 km away. There were 25 experimental birds and 22 control birds taken less than 160 km from their release area, and there were 16 experimental birds and 17 control birds killed at distances of 200 km or greater from their release areas (Chapter IX, Table XXXXII). The difference in distance traveled between the two types of ducks was slight, and as far as the objectives of this project are concerned the experimental birds would be slightly better because they were closer to Oklahoma when they were killed. If this were the only evidence used in determining differences between experimental and control birds, it would be too meager to consider.

TABLE XXII

THE DIRECTION OF MOVEMENTS BY MAX MCGRAW WILDLIFE FOUNDATION MALLARDS ACCORDING TO BAND-RETURN DATA

	No Movement	N	NE	E	SE	S	SW	W	NW
<u>First Season</u>									
Experimental									
Male	2	7	3		1		2		1
Female	5	2	2					2	
Control									
Male	5	4	1		1				1
Female	2	3			1			1	
<u>Second Season</u>									
Experimental									
Male		2	1						
Female		4	1			1			
Control									
Male	2	3	2	1					1
Female	1	2	1						
<u>Third Season</u>									
Experimental									
Male						1			
Female		1	2						
Control									
Male	1	2				1			
Female			1						1
<u>Fourth Season</u>									
Experimental									
Male									1
Female									
Control									
Male									1
Female									
Totals	18	30	14	1	3	3	2	3	6

TABLE XXIII

THE DISTANCE OF MOVEMENTS BY MAX MCGRAW WILDLIFE FOUNDATION MALLARDS ACCORDING TO BAND RETURNS

	No Movement	40 to 160 (km)	200 to 800 (km)	Over 800 (km)
First Season				
Experimental				
Males	2	9	5	
Females	5	6		
Control				
Males	5	5	2	
Females	2	4	1	
Second Season				
Experimental				
Males		1	2	
Females		1	2	3
Control				
Males	2	1	5	1
Females	1		2	1
Third Season				
Experimental				
Males			1	
Females		1	2	
Control				
Males	1		1	2
Females			1	1
Fourth Season				
Experimental				
Males				1
Females				
Control				
Males		1		
Females				
Total	18	29	24	9

Hunter Questionnaire

A questionnaire was sent to each hunter who returned a federal band taken from one of the experimental or control birds killed during regular duck hunting seasons in 1969, 1970, and 1971. Fifty-eight questionnaires were sent out and 40 were returned. One report was made by a wildlife biologist . The results of the questionnaires are presented in Table XXIV.

Comparisons of questionnaire data pertaining to experimental and control birds indicated that there was a greater tendency for experimental birds than for control birds to associate with wild mallards (Table XXV). Experimental ducks were taken, by hunters, from flocks that ranged in size from one bird to 150 birds. The average flock size for hunter-killed experimental birds was about 14. Control ducks were taken from flocks that ranged in size from one bird to 20 birds, and the average flock was about 6 ducks (Chapter IX, Table XXXXII). A total of 69 wild mallards were killed at the same location and during the same hunting hours as were 27 experimental ducks. This is a ratio of 2.6 wild mallards to one experimental mallard. In comparison, 47 wild mallards were killed at the same location and during the same hunting hours as were 21 control ducks. This ratio is 2.2 wild mallards to one control mallard (Chapter IX, Table XXXXII).

TABLE XXIV

RESULTS OF QUESTIONNAIRES SENT TO HUNTERS RETURNING FEDERAL BANDS TAKEN FROM MAX MCGRAW WILDLIFE FOUNDATION MALLARDS RELEASED IN OKLAHOMA IN 1969, 1970, AND 1971

Year of Kill	Hunting Technique	Location	No. of Mallards In Flock	Distance (m)	Unusual Behavior	Wild Mallards Killed	Sex
							Experimental
1969	Jumping	Okla.	4	30	None	3	F
1969	Blind	Okla.	3	15	None	0	M
1969	Blind	Kansas	-	--	No Details	-	M
1969	Blind	Arkansas	150	40	None	4	M
1969	Blind	Okla.	12	25	None	6	M M
1969	Boat-Blind	Okla.	6	45	Less Wild	4	F F
1970	Blind	Okla.	1	40	None	1	M
1970	Blind	Minn.	6	50	None	5	F
1970	Blind	Okla.	5	45	None	4	F
1970	Jumping	Okla.	15	30	None	5	M
1970	Jumping	S.D.	8	35	None	3	F
1970	Blind	Minn.	18	20	None	6	F
1970	Jumping	Kansas	15	15	Less Wild	0	M
1971	Jumping	Okla.	5	50	Less Wild	0	M
1971	Blind	Kansas	1	20	None	1	F
1971	Blind	Arkansas	4	30	None	2	F
1971	Jumping	Okla.	1	20	None	3	F
1971	Blind	Okla.	3	40	None(Large)	5	M
1971	Blind	Texas	25	35	Last Bird Up	7	M
1971	Blind	Mo.	4	25	None	7	M
1971	Jumping	Okla.	2	70	None	0	M

TABLE XXIV (Continued)

Year of Kill	Hunting Technique	Location	No. of Mallards In Flock	Distance (m)	Unusual Behavior	Wild Mallards Killed	Sex
							Experimental
1971	Blind	Okla.	7(+9 Pin-tail)	25	None	2(+2 Pin-tail)	M
1971	Blind	Okla.	12	20	Less Wild[1]	1	M M F
							Control
1969	Jumping	Okla.	1	20	Bird was wounded and infected	0	M
1969	Blind	Okla.	5	40	None	5	M
1969	Blind	Okla.	1	40	None	3	F
1969	Blind	Okla.	2	30	None	2	M M
1969	Blind	La.	5	25	None	1	F
1970	Blind	Arkansas	5	20	None	11	M
1970	Jumping	S.D.	7	25	None	3	M
1970	Blind	N.D.	6	30	None	5	F
1970	Jumping	Kansas	10	15	None	0	M
1970	Jumping	Kansas	20	50	None	3	M
1970	Blind	Okla.	1	75	None	1	M
1970	Jumping	Kansas	1	45	None	0	M
1970	Jumping	Okla.	17	30	None	5	M
1970	Jumping	Okla.	4	75	Less Wild	1	M

TABLE XXIV (Continued)

Year of Kill	Hunting Technique	Location	No. of Mallards In Flock	Distance (m)	Unusual Behavior	Wild Mallards Killed	Sex
							Control
1971	Boat	Okla.	1	20	Less Wild	2	M
1971	Jumping	Okla.	5	50	None	2	M
1971	Blind	Kansas	5	20	None	3	M
1971	Blind	Okla.	6	40	None	0	F F F

[1] A flock of banded mallards was observed in this area for over a month. Some were seen feeding on spilled grain on the shoulder of Highway 69.

TABLE XXV

SUMMARY OF COMPARISONS BETWEEN EXPERIMENTAL AND CONTROL MAX MCGRAW WILDLIFE FOUNDATION MALLARDS OBTAINED FROM HUNTER QUESTIONNAIRES IN 1969, 1970, AND 1971

Duck Type	Maximum Flock Size	Minimum Flock Size	Average Flock Size	Single Birds	Wild Mallards Killed	Released Mallards Killed
Experimental	150	1	14	3	69	26
Control	20	1	6	5	47	21

Duck Type	Release Birds Killed Where no Wild Mallards Were Killed	Average Distance of Kill (m)	Considered Less Wild by Hunters
Experimental	4	33	5
Control	6	36	2

Altogether 116 wild mallards were taken, whereas 48 released mallards were killed. This ratio is 2.5 wild mallard to one hand-reared mallard. Apparently there was no selection, by hunters, for the mallards used in this project. In only five cases were more than one hand-reared bird taken on the same day by the same hunting party. In all cases, but one, a comparable number of wild birds was included in each of the hunter's bag (Table XXV).

Hunter estimates of distance of kills and unusual behavior gave a slight advantage to the control birds (Table XXV). The difference between average kill distances of experimental and control birds was slight considering that they were estimated by 40 different people. The average kill distance, by hunters using blinds, was 33 m. Hunters using a stalking method averaged 37 m per kill. All hunters who considered that released birds were "less wild" had killed one or more wild mallards during the same hunting hours, and several thought that this less-than-wild behavior was normal because the kill occurred on the opening day of the duck hunting season.

In general, information provided by hunters indicated little difference between hand-reared mallards released in Oklahoma and wild mallards. Apparently the behavior of hand-reared birds did not contribute to their selection, by hunters, over wild ducks. Experimental ducks associated with wild mallards to a larger extent than did control ducks in the central flyway.

Except on Canton Reservoir, the introduced ducks were not subjected to heavy hunting pressure. In most cases MMWF ducks left the release lakes before duck hunting season started.

Spring Returns and Reproduction

According to records kept by Washita, Salt Plains, and Tishomingo National Wildlife Refuges and according to personal observations (Table IV), most wild mallards are north of Oklahoma by April. It is my belief that most mallards observed in this area during and after the month of April in 1970, 1971, and 1972 were MMWF mallards.

Table XXVI shows that nine of the 43 mallards observed during the spring of 1970 were banded and were found with birds identified as experimental or control ducks. Positive identifications were made of two experimental and five control ducks.

In the spring of 1971, the minimum number of different mallards observed was 119. In order to reduce duplication of observations, the minimum number of birds was determined by adding only the largest mallard counts for each lake during one spring season. This should reduce the influence of duplicated counts on lakes that contain a resident flock of released birds. A minimum number of 75 of the 119 mallards observed in the spring of 1971 were banded, and they were found with either experimental or control birds.

TABLE XXVI

OBSERVATIONS OF MAX MCGRAW WILDLIFE FOUNDATION MALLARDS RETURNING TO OKLAHOMA RELEASE AREAS IN THE SPRING OF 1970, 1971, AND 1972

Location	Date	Total Mallards Observed	Released Birds				
			Number	Experimental M*	Experimental F*	Control M*	Control F*
1970							
Coym Lake	4-5	4	-	-	-	-	-
Penoski Lake	4-25	5	2(1 -1)	-	-	-	-
Grassy Lake	4-25	2	-	-	-	-	-
Rocket Lake	4-26	4	-	-	-	-	-
Brown Lake	5-2	2	-	-	-	-	-
Chalfant Lake	5-2	1	-	-	-	-	-
Rocket Lake	5-10	5	-	-	-	-	-
Rocket Lake	5-26	1	-	-	-	-	-
Canton Res.	6-2	3	-	-	-	-	-
Chalfant Lake	6-17	8	2	1	1	-	-
Coym Lake	6-17	8	5	-	-	3	2
1971							
Brown Lake	1-21	8	8	1	1	1	-
Brown Lake	2-28	13	4	1	1	-	-
Brown Lake	3-9	17	9	3	-	1	1
Rocket Lake	3-15	2	2	-	1	1	-
Brown Lake	3-15	18	18	3	-	-	4
Curry Lake	3-17	23	13	-	-	4	-
Ashland Lake	3-24	25	1	-	-	1	-
Brown Lake	3-24	21	21	1	1	2	1
Zink Ranch	3-28	36	36	-	-	-	-
Brown Lake	4-3	21	21	1	1	2	1
Rocket Lake	4-4	2	-	-	1	1	-
Lake 3	4-12	3	-	-	-	-	-
Brown Lake	4-12	14	14	1	1	1	-
Penoski Lake	4-14	2	-	-	-	-	-
Brown Lake	4-21	10	10	1	1	1	-
Coym Lake	4-25	5	4	-	-	-	-
Duck Marsh	4-27	1	-	-	-	-	-
Brown Lake	4-27	10	10	3	-	1	-
Red Bird Lake	5-3	4	4	-	-	1	-
Zink Ranch	5-4	6	6	1	-	2	-
Brown Lake	5-5	11	11	-	-	-	-
Red Bird Lake	5-6	7	7	-	-	1	-
Coym Lake	5-12	3	-	-	-	-	-
Taylor Lake	5-13	1	-	-	-	-	-
Red Bird Lake	5-13	6	6	-	-	-	-
Brown Lake	5-14	9	9	2	-	1	-
Brown Lake	5-19	8	8	2	-	1	-

TABLE XXVI (Continued)

Location	Date	Total Mallards Observed	Number	Released Birds Experimental M*	Released Birds Experimental F*	Released Birds Control M*	Released Birds Control F*
Zink Ranch	5-25	7	7	-	1	2	-
Red Bird Lake	5-26	6	6	-	-	-	-
Brown Lake	5-26	16	16	1	2	1	-
Brown Lake	6-9	16	16	1	2	1	-
Capart Farm	6-11	1	1	-	-	-	-
Red Bird Lake	6-17	6	6	-	-	-	-
Brown Lake	6-19	19	19	1	2	1	-
Red Bird Lake	7-1	5	5	-	-	-	-
Taylor Lake	7-14	2	-	-	-	-	-
Coym Lake	7-14	4	2	-	-	-	-
Dead Indian L.	7-14	1	-	-	-	-	-
Zink Ranch	7-22	7	7	-	1	2	-
Brown Lake	7-31	19	19	2	2	1	-
<u>1972</u>							
Zink Ranch	3-20	18	18	4	3	1	1
Rocket Lake	3-21	3	3	-	-	1	1
Lake 3	3-21	5	5	-	2	-	-
Brown Lake	3-21	4	-	-	-	-	-
Duck Marsh	3-21	14	1	1	-	-	-
Curry Lake	3-22	8	-	-	-	-	-
Red Bird Lake	3-22	35	35	23	12	-	-
Brown Lake	4-29	8	8	-	-	-	-
Rocket Lake	4-29	3	3	-	-	1	1
Red Bird Lake	4-30	12	12	8	4	-	-
Curry Lake	4-30	6	6	3	3	-	-
Red Bird Lake	5-16	40	40	22	18	-	-
Brown Lake	5-17	14	14	1	-	1	-
Rocket Lake	5-17	3	3	-	-	1	1
Blue Stem Lake	5-18	6	6	1	3	-	2
Zink Ranch	6-9	27	27	4	6	7	1
Lake 39	6-10	3	3	-	-	-	2
Duck Marsh	6-10	2	2	-	-	-	1
Red Bird Lake	6-11	46	46	16	12	-	-

*M=Male
F=Female

Positive identifications were made of three experimental and 10 control ducks.

A minimum number of 126 different mallards was observed in the spring of 1972, 105 of which were banded and were with identified mallards. Positive identifications were made of 46 experimental and 15 control ducks (Chapter IX, Table XXXXII).

Accurate comparisons between experimental and control ducks were difficult because of the large number of banded birds that had evidently lost their color markers. However, comparisons of minimum numbers of mallards observed and of minimum numbers of suspected returning mallards can be made between yearly counts. The minimum number of sightings of mallards in the release areas during spring months increased from 43 in 1970 to 119 in 1971, and increased to 126 in 1972. The minimum number of returning mallards suspected of being MMWF birds also increased from 9 in 1970 to 75 in 1971, and increased to 105 in 1972. This trend lends support to my supposition that most mallards remaining in the study area after March were ducks previously released there. The retention of color markers showed yearly improvement from five in 1970 to 13 in 1971, and to 61 in 1972.

If all of the mallards observed after March, 1970, were returned MMWF mallards, they represent 4.4 percent of the birds released in 1969 and 11.5 percent of the released birds that survived to flight age. If the 43 birds returning from the 1969 release were assumed to return in a comparable percentage in 1971, a correction factor of five birds might be subtracted from the 1971 minimum number observations so that a return percentage for the 1970 release may be calculated. This correction factor is based on the assumption that five ducks released in 1969 returned and were observed in the spring of 1971.

The corrected minimum number of all mallards sighted in the spring of 1971 was 114. If those 114 returning mallards were all released birds, they represented 11.6 percent of the birds released in 1970, and they represented 28.7 percent of the released birds that survived to flight age. The correction number for suspected second year returning birds showing up in the spring observations in 1972 is 33 birds.

The corrected minimum number of all mallards sighted in 1972 was 93. This number represents 9.4 percent of the 1971 release, and it represents 24.5 percent of the released birds surviving to flight age.

Part of the larger return percentages, noted in 1971 and 1972, was due to the supply of supplemental food at some of the release sites. This will be discussed later.

There was evidence that birds, returning from the 1969 release, were reproducing or attempting to reproduce on or near release lakes. These observations are summarized in Table XXVII. On April 25, 1970, at Penoski Lake, two copulations were observed involving MMWF birds. One

TABLE XXVII

OBSERVATIONS OF ATTEMPTED REPRODUCTION BY MAX MCGRAW WILDLIFE FOUNDATION MALLARDS RETURNING TO OKLAHOMA RELEASE LAKES IN THE SPRING OF 1970, 1971, AND 1972

Location	Date	Number of Eggs	Brood Size	Type of Duck	Comments Nest Location - Success
1970					
Chalfant Lake	6-17	-	2	Exp.	Location of nest is unknown
Rocket Lake	6-x	-	2	-	Believed to have attempted nesting
Ham Lake	5-21	-	-	-	Believed to have attempted nesting
Capart Farm	5-15	-	13	-	Nested on small island--8 survived to flight age
1971					
Sangre Lake	3-1	-	-	Control	Nest box-hen laying eggs
Brown Lake	3-24	1	-	-	No nest-egg found on lake edge
Leonard's Pond	3-26	2	-	-	No nest-eggs found on pond edge
Zink Ranch	3-28	12	-	-	Nest abandoned
Sangre Lake	4-21	11	11	Control	Nest box-all eggs hatched-hen laying 3-1-71
Red Bird Lake	4-23	-	-	Control	Nest started by a house
Sangre Lake	4-28	12	-	Control	Nest box-abandoned
Sangre Lake	5-1	11	11	Control	Nest box
Sangre Lake	5-1	14	13	Control	Nest box
Sangre Lake	5-1	6	4	Control	Nest box
Sangre Lake	5-1	-	3	Control	Nest unknown
Sangre Lake	5-1	-	1	Control	Nest unknown
Sangre Lake	5-1	12	-	Control	Ground nest in poor cover-5 eggs destroyed by dogs-nest abandoned
Red Bird Lake	5-3	-	-	Control	One pair nesting in heavy cover-nest could not be found

TABLE XXVII (Continued)

Location	Date	Number of Eggs	Brood Size	Type of Duck	Comments Nest Location - Success
Sangre Lake	5-8	5	5	Control	Nest box-may have been a renesting attempt
Zink Ranch	5-13	9	9	-	Nest box
Zink Ranch	5-15	9	9	-	Nest box
Okemah Lake	5-15	7	-	-	Nest on small island-hen incubating
Brown Lake	5-19	-	9	-	Two hens and one drake were attending the brood
Brown Lake	6-7	9	-	-	Nest about 100 m from lake was destroyed by a mower
Brown Lake	6-9	-	5	-	Nest could not be found-first reported 6-1-71
Capart Farm	6-11	-	7	-	3-week-old brood first observed
Sangre Lake	6-27	9	9	Control	Nest box
Dead Indian L.	7-14	-	5	-	Brood was flying well-8 or 9 weeks old
Eufaula Res.	7-29	-	6	-	Reported by Game Ranger
Brown Lake	7-31	-	-	-	Brood of 9 had 7 survive
					Brood of 5 had 5 survive
1972					
Red Bird Lake	4-12	13	-	Exp.	Nest in garden area-destroyed
Red Bird Lake	4-12	10	-	Exp.	Nest in garden area-destroyed
Red Bird Lake	4-12	9	9	Exp.	Nest in garden-5 survived
Red Bird Lake	4-12	7	5	Exp.	Nest in garden-2 survived
Red Bird Lake	4-12	7	-	Exp.	Nest in garden area-destroyed
Red Bird Lake	4-12	5	-	Exp.	Nest in woods-destroyed-renesting attempt-3 eggs-destroyed
Red Bird Lake	4-12	10	-	Exp.	By this date 10 eggs were scattered around feeding area
Blue Stem Lake	4-15	10	-	Exp.	Poor nest site-destroyed
Blue Stem Lake	4-15	11	-	Control	Poor nest site-destroyed

TABLE XXVII (Continued)

Location	Date	Number of Eggs	Brood Size	Type of Duck	Comments Nest Location - Success
Blue Stem Lake	4-15	7	-	Exp.	Poor nest site-destroyed
Blue Stem Lake	4-15	6	-	Exp.	Poor nest site-destroyed
Blue Stem Lake	4-15	3	-	Control	Poor nest site-destroyed
Brown Lake	5-8	-	9	-	Nest could not be found
Brown Lake	5-15	5	-	-	Reported-nest in good cover-destroyed
Lake 2	5-17	-	8	-	Reported-moved off lake
Sangre Lake	5-21	14	-	Control	Nest box-hen incubating
Sangre Lake	5-21	-	7	Control	Nest box-7 survived
Sangre Lake	5-21	-	4	Control	Nest box-2 survived
Zink Ranch	5-28	9	9	-	Nest box-9 survived
Zink Ranch	6-1	11	11	-	Nest box-10 survived
Zink Ranch	6-2	5	-	-	Poor nest site-destroyed

identified bird was a MMWF mallard drake that mounted an unidentified hen. They were accompanied by another unidentified hen which was an accepted member of the small group. She was not driven off as were other mallards that came too close. The other copulation involved an unidentified drake and a MMWF mallard hen. After this observation no subsequent mallard sightings were made on Penoski Lake or on any lakes or farm ponds in the surrounding area. State wildlife biologists and game rangers in the Okemah area reported no evidence of mallard nesting. It was undetermined whether the two identified birds were experimental or control ducks.

On June 17, 1970, at Chalfant Lake, eight mallards were observed. One pair was unmarked, one pair was identified as birds released in 1969, and one pair was not close enough for identification. The drake of the identified pair was an experimental bird. The female of the identified pair could not be identified as experimental or control because the color band was dirty. Because of reasons to be discussed in the chapter dealing with behavior, the hen was assumed to be an experimental bird. Two young ducks in immature plumage accompanied the pair of marked adults. It is possible that the two young birds were the remaining members of a brood produced by the two experimental adult ducks. By that date both young birds were strong flyers.

A lone unidentified but banded hen was observed during the spring and summer of 1970 on Rocket Lake. I believe that the hen attempted to nest although no nest could be found on Rocket Lake to support this belief. On more than one occasion the hen performed a "wounded bird" behavior while I was walking along the southeast side of the lake. This hen was often seen with the ducklings released on Rocket Lake in 1970.

Another mallard hen was reported by Col. Howard Jarrell, Assistant Director, Oklahoma State University Research Foundation. This hen was sighted on May 21, 1970 at Ham Lake with five other mallards. Col. Jarrell reported that the hen acted nervous and gave a call typical of a nesting bird.

The Gail Capart Farm near Ashland, Oklahoma, is about 4 miles west of the Duck Marsh on the U.S. Naval Ammunition Depot, McAlester, Oklahoma. Mr. Capart reported that 13 downy young ducklings were hatched on an island in an irrigation impoundment on his property. The ducklings were first noticed about June 15, 1970, as they were leaving the small island. By the end of July, the eight surviving ducklings were flying well and were using seven impoundments on or near the Capart farm. According to Mr. Capart, who is a long-time resident of Ashland, this hen was the first mallard duck he had observed nesting in that part of the state. He described the bird as being a little less wild than the mallards that wintered on his farm. A drought in southern Oklahoma forced Mr. Capart to drain the impoundments, and the ducks moved before a positive identification could be made. From the description supplied by Mr. Capart, I believe the hen was one of the MMWF mallards released on the U.S. Naval Ammunition Depot in 1969.

On Coym Lake, eight adult mallards were observed June 17, 1970. Three drakes and two hens were recognized as control mallards released in 1969. There were no immature birds with them.

Observations indicate that at least 10 ducklings were produced from the 1969 release. Two hens were suspected of attempting to nest, and two mated pairs involving MMWF mallards were breeding. Lakes other than the release lakes were commonly used by breeding birds. No mallard broods were reared on the release lakes. With the possible exception of Canton Reservoir, brood activity would have been detected on all lakes. The release lakes were small enough that a thorough search of lake margins and surrounding areas was possible during each observation period. Any bird movement on the lakes or to and from the lakes would have been noticed. Also, the lack of tracks and duck droppings in customary roosts and loafing areas indicated a lack of use. A few wood duck broods were discovered, and I doubt that mallard broods would have been more secretive.

Reproduction of released birds increased in 1971 (Table XXVII). A total of 126 eggs were found in 13 nests. This is an average of 9.7 eggs per nest. Four nests were destroyed or abandoned resulting in the loss of 45 eggs. Fifteen broods containing 107 ducklings were observed. The success of one nest was unknown. The average number of ducklings per brood was 7.1. The broods came from eight successful nests and from seven nests that were never found. At least five additional observations at release lakes indicated reproduction was in progress. These observations included breeding and nesting behavior, nests with no eggs, and eggs dropped by hens at the water's edge. Comparisons between experimental and control ducks as to reproductive success cannot be made because some birds were being fed and because many hens had lost their color markers.

In 1972, a total of 132 eggs were found in 16 nests. This is an average of 8.3 eggs per nest. Eleven nests containing 82 eggs were destroyed or abandoned. The success of one nest was unknown. Eight broods containing 62 ducklings were sighted. This was an average of 6.9 ducklings per brood. Four of the eight broods came from nests that were never found. A total of 10 eggs were scattered about an area where grain was supplied by the property owner. As in 1971, comparisons between experimental and control ducks cannot be made because of the loss of color markers and because of supplemental feedings.

In 1971 and 1972, hatching success of 12 identified nests was 95.5 percent. In all 3 years, the released birds have demonstrated that duck reproduction can occur in

Oklahoma. Of the 29 nests found, 15 were located in nest boxes erected on the release lakes. A major observation was that 15 nests were destroyed or abandoned, and 10 of these nests were located on the ground in poor cover. This supports the possibility that inexperienced birds might pick poor nest sites. Unfortunately, nesting wild mallards were not present, so their nesting habits cannot be compared with that of released mallards.

Cost

Montgomery _et al_. (1971) estimated that the production cost of a standard duckling reared to 5.5 weeks of age is $1.12. The estimated cost of each experimental bird reared to release age is $1.26. According to Montgomery _et al_. (1971):

> Cost per bird could have been reduced by increasing the number of birds reared per year--since modified brooders were used only part of the total rearing season--as well as by prorating construction costs over the expected lifetime of the modifications. Costs also could be cut by reduced rearing losses, which we believe could be accomplished by profiting from past experience. With these factors in mind, we feel that we could produce birds by the isolation-hardening procedures described with no significant increase over standard production costs.

The shipping costs are estimated at $0.32 per bird. The expenses of the feeding experiment will be discussed in the next chapter.

Comparison of the Oklahoma Release with Similar Releases in Other Areas

One of the problems in past waterfowl stocking projects was failure to set up comparable and measurable objectives. A second problem was the method of evaluation, based only on band returns. The third problem was a shift in criteria by which success was judged.

Instead of including a history of waterfowl release projects in the introduction, the literature was analyzed to provide tabulated data with which this project can be compared. Table XXVIII contains a summary of data concerning releases and fates of mallards stocked in other projects. The data from the Oklahoma project follow the percentage averages for comparison. Data from species other than mallard are included in Table XXIX for comparison of possible trends. Few species other than mallard have been released in sufficient numbers to be analyzed reliably, but it appears that the trends associated with mallard releases may be similar to those of other species listed in Table XXIX.

The data in Table XXVIII come from successful and unsuccessful projects conducted in countries all over the world. The average percentages in this table are not to be correlated with either success or failure. These average percentages are merely the available data. They are averaged to reduce the effect of variables such as release

TABLE XXVIII

SUMMARY OF MALLARD RELEASE DATA FROM PROJECTS SIMILAR TO THE RELEASE OF MAX MCGRAW WILDLIFE FOUNDATION MALLARDS IN OKLAHOMA

Author Date	Mallard Release Totals	Unaccounted for Total	Unaccounted for Percent	Nonhunting Mortality Total	Nonhunting Mortality Percent	Reaching Flight Age[1] Total	Reaching Flight Age[1] Percent	First Season Band Returns Total	First Season Band Returns Percent	Returning Ducks Total[2]	Returning Ducks Percent
Benson 1939	70	29	41.4	-	-	41	58.6	-	-	-	-
Browne No Date	210	128	61.0	-	-	82	39.0	13[3]	6.0	5	2.2
	399	193	48.4	-	-	206	51.6	32[3]	8.0	15	3.8
	202	64	31.7	-	-	138	68.3	16[3]	8.1	18	9.1
Foley 1954b	336	135	40.2	15[3]	4.6	186	55.4	14	4.2	8	2.4
	221	58	26.2	14[3]	6.2	149	67.4	18	8.1	7	3.2
	244	79	32.4	9[3]	3.6	156	63.9	14	5.7	8	3.3
Bednarik 1963	48	10	20.8	-	-	38	79.2	1	2.1	-	-
	54	27	50.0	-	-	27	50.0	4	7.4	-	-
	100	33	33.0	-	-	67	67.0	29	29.0	-	-
Fog 1964	5236	33	0.6	70	1.3	-	-	1053[4]	20.1	-	-
Harrison 1964-65	604	-	-	35[4]	5.8	-	-	40	6.6	554	91.7
Ordal 1966	880	70	8.0	6	0.7	-	-	45	5.1	72	8.6
Reid 1966	6109	-	-	62	1.0	-	-	583	9.5	Non-migratory	

TABLE XXVIII (Continued)

Author Date		Mallard Release Totals	Unaccounted for Total	Unaccounted for Percent	Nonhunting Mortality Total	Nonhunting Mortality Percent	Reaching Flight Age[1] Total	Reaching Flight Age[1] Percent	First Season Band Returns Total	First Season Band Returns Percent	Returning Ducks Total[2]	Returning Ducks Percent
Marinaccio 1968		99	32	32.3	9	9.9	67	67.7	-	-	-	-
Zohrer 1969		301	103	34.2	-	-	198	65.8	19	6.3	6	2.0
Schladweiler 1969		179	60	33.5	52	29.1	67	37.4	23	12.9	-	-
Sellers 1971		821	-	-	19	2.3	158[2]	19.2	79	9.6	208	25.3
		653	-	-	5	0.8	127	19.5	-	-	-	-
Thomforde 1971		900	428	47.6	67	7.4	405	45.0	21	2.3	-	-
Lee 1973		648	0	0	21	3.2	627	96.8	68	10.5	89	13.7
WAGBI 1959-71	(59)	3412	-	-	23	0.7	-	-	153	4.5	-	-
	(60)	5278	-	-	17	0.3	-	-	158	3.0	-	-
	(61)	7268	-	-	43	0.6	-	-	292	4.0	-	-
	(62)	8972	-	-	67	0.8	-	-	349	3.9	-	-
	(63)	10193	-	-	53	0.5	-	-	387	3.8	-	-
	(64)	11364	-	-	50	0.4	-	-	456	4.0	-	-
	(66)	12891	-	-	55	0.4	-	-	568	4.4	-	-
	(68)	16838	-	-	33	0.2	-	-	560	3.3	-	-
	(69)	16817	-	-	31	0.2	-	-	579	3.4	-	-
	(70)	17241	-	-	38	0.2	-	-	474	2.8	-	-
	(71)	16054	-	-	33	0.2	-	-	352	2.2	-	-
Average Percentages of Mallards From Each Category				31.8		3.4		56.0		6.9		14.9

TABLE XXVIII (Continued)

Author Date	Mallard Release Totals	Unaccounted for Total	Percent	Nonhunting Mortality Total	Percent	Reaching Flight Age[1] Total	Percent	First Season Band Returns Total	Percent	Returning Ducks Total[2]	Percent
Allen 1974	975	578	59.3	23	2.4	374	38.4	19	1.9	9	0.9
	987	551	55.8	39	4.0	397	40.2	8	0.8	75	7.6
	985	569	57.8	36	3.7	380	38.6	20	2.0	105	16.6

[1]Flight age is considered to be 8 weeks of age.

[2]This column is minimum numbers.

[3]These numbers are approximate.

[4]This number represents the total recorded bands, however, band returns for the first year are by far the largest part of this number.

TABLE XXIX

SUMMARY OF WATERFOWL RELEASE DATA OF SPECIES OTHER THAN MALLARD

Author Date	Species Released Total	Unaccounted for Total	Percent	Nonhunting Mortality Total	Percent	Reaching Flight Age[1] Total	Percent	First Season Band Returns Total	Percent	Returning Ducks Total[2]	Percent
Browne No Date	Pintail 567	202	35.6	-	-	365	64.4	-	-	15	2.6
Foley 1954a	Pintail 72	42	58.3	-	-	30	41.7	8	11.1	11	15.3
	Redhead 50	27	54.0	-	-	23	46.0	6	12.0	6	12.0
	Canvasback 20	16	80.0	-	-	4	20.0	1	5.0	0	0
	B-W Teal 10	0	0	-	-	10	100.0	0	0	0	0
	Shoveller 10	6	60.0	-	-	4	40.0	2	20.0	0	0
Weller 1959	Redhead 556	0	0	17	3.1	539	97.0	106	19.1	4	0.7
	305	0	0	0	0	305	100.0	42	13.8	6	2.0
	177	-	-	-	-	-	-	37	20.9	-	-
	100	-	-	-	-	-	-	19[4]	19.0	-	-
Foley 1961	Redhead 260	96	36.9	-	-	164	63.1	65	25.0	5	1.9
	381	122	32.0	-	-	259	68.0	76[3]	20.0	-	-
Harrison 1968-69	Gadwall 94	-	-	2	2.1	Released Past Flight Age		0	0	6	6.3
Bevill 1969	Mexican Duck 85	27	31.8	4	4.7	Released Past Flight Age		0	0	52	61.2

TABLE XXIX (Continued)

Author Date	Species Released Total	Unaccounted for Total	Unaccounted for Percent	Nonhunting Mortality Total	Nonhunting Mortality Percent	Reaching Flight Age[1] Total	Reaching Flight Age[1] Percent	First Season Band Returns Total	First Season Band Returns Percent	Returning Ducks Total[2]	Returning Ducks Percent
Norman 1971	Chestnut Teal 1976	629	31.8	50	2.5	-	-	80	4.1	1217	61.6
Emmons 1971	Gadwall 173	-	-	72	41.6	102	59.0	0	0	75	43.4
	256	-	-	53	20.7	203	79.3	0	0	-	-
Doty 1972	Wood Duck 280	0	0	27	9.6	253	90.4	12	4.7	20	7.1
Flickinger 1973	Fulvous Tree Duck 165	-	-	1	0.6	Released Past Flight Age		5	3.0	-	-

[1]Flight age is considered to be 8 weeks of age.

[2]This column is composed of minimum numbers.

[3]This number is approximate.

[4]This number may be inaccurate because some birds were recaptured and held in captivity through the first winter.

habitat and release methods, which produce extremes in one or more of the categories listed. The average percentages can be used as a starting point to determine the degree of success or failure of a release project. Also, average percentages can be used in setting up statements of objectives and in locating specific areas of failure or success of a project.

When the average percentage of other mallard releases are compared with the Oklahoma project, it appears that the area of greatest concern lies in the category of birds that cannot be accounted for after release. The average value for this category is 31.8 percent, while the three Oklahoma releases all exceeded 55 percent. Both of these percentages represent a large loss to any project. This type of loss raises the cost per bird surviving to flight age by at least one-third. The gentle-release method (Lee and Kruse, 1973) can reduce this category to zero; however, not all release projects can afford the necessary control and expense of the gentle-release method.

The nonhunting mortality of released birds averaged 3.4 percent; this was about the same as was observed in the three releases in Oklahoma. The average percentage of birds reaching flight age was 56.0 percent, which is considerably higher than the 39.1 percent reaching flight age after release in Oklahoma. The large number of birds unaccounted for undoubtedly lowered this figure for the Oklahoma release project.

The first-season band returns (direct returns) were considerably lower in Oklahoma than in other projects. The average number was 6.9 percent, and the highest band return percentage of the Oklahoma release was 2.0 percent. The fact that the birds released in Oklahoma were south of the major hunting pressure can be seen in comparing these numbers.

In recent years, a more accepted criterion for a successful waterfowl release was that some birds return to the release area and reproduce in the first spring after liberation. The average percent of returning birds was 14.9 percent. The returning birds in the Oklahoma release were both below and above this figure. Each year that ducks were released in Oklahoma the return percentage increased. It could be that the maximum return of 16.6 percent could be improved with improvements in release methods, habitat, and food.

In addition to the comparable data presented in Tables XXVIII and XXIX, information concerning these and other waterfowl releases is analyzed in chronological order in the Appendix. This method of presenting the history of waterfowl releases was chosen because of the vast differences in the variables of each release.

CHAPTER VII

SUPPLEMENTAL FEEDING EXPERIMENT

In addition to the original project objectives, the objective of the 1971 release experiments was to study the effect of supplemental food, protection from avian and aquatic predators, and protection from human disturbance.

In order to test the effect of the three variables listed above, seven experimental situations were devised. For each experimental situation 31 experimental (conditioned) ducklings were released on one lake and 31 control (unconditioned) ducklings were released on another lake of similar characteristics. Each of the seven experimental situations involved two lakes with 31 birds per lake. The seven experiments were:

1. Supplemental feeding experiment: grain was provided in modified Scruggs Quail Feeders located in cover vegetation near the shoreline. The feeders were mounted on short poles in less than 60 cm of water with the openings to the feeder 8 to 16 cm above water.
2. Protection against predators experiment: two loafing rafts were anchored offshore at each of two ponds separate from the supplemental feeding

experiment. Each loafing raft was provided with a protective canopy of chicken wire; also, shoreside loafing areas selected by the birds were protected by overhead canopies of chicken wire. Cage traps were employed to capture and remove snapping turtles.

3. Minimal human contact experiment: several ponds in the release area had poor access roads or were locked against human intruders. Two ponds that were isolated from human use and were separate from the two experiments described above were used as release sites for this experiment.
4. Combined feeding and protecting experiment: on two separate ponds the conditions of Experiment One and Experiment Two were performed together.
5. Combined protecting and minimal human contact experiment: on two separate ponds the conditions of Experiment Two and Experiment Three were performed together.
6. Combined feeding and minimal human contact experiment: on two separate ponds the conditions of Experiment One and Experiment Three were performed together.
7. Combined feeding, protecting and minimal human contact experiment: on two separate ponds the conditions of Experiment One, Experiment Two and Experiment Three were performed together.

The data collected from each experiment were to be combined and evaluated statistically as a factorial experiment. This type of evaluation is designed to show interaction between variables.

After the 1971 releases were completed, it was evident that loafing areas along the shore line would not have to be protected because ducklings chose to loaf on logs in open water or under buttonbushs. The water edge of most release lakes was protected by plant growth. Also, water levels did not decline because unusual summer thunderstorms provided enough water to compensate for summer evaporation.

Unfortunately, duckling populations declined so rapidly on lakes receiving no supplemental food that adequate data could not be collected to distinguish accurately between experimental and control ducklings. The only variable having any obvious effect on duckling survival was supplemental food. The influence of food was so great that other variables being tested soon became obscure, and the evaluation by factorial experiment was abandoned. The survival rates for unfed experimental and unfed control ducklings are illustrated in Figures 10 and 11.

Figures 12 and 13 indicate the survival rates of experimental and control birds involved in supplemental food experiments (Chapter IX, Table XXXXII). The presence of grain appeared to remove some of the behavioral differences between experimental and control birds. For example, there was little difference between experimental and

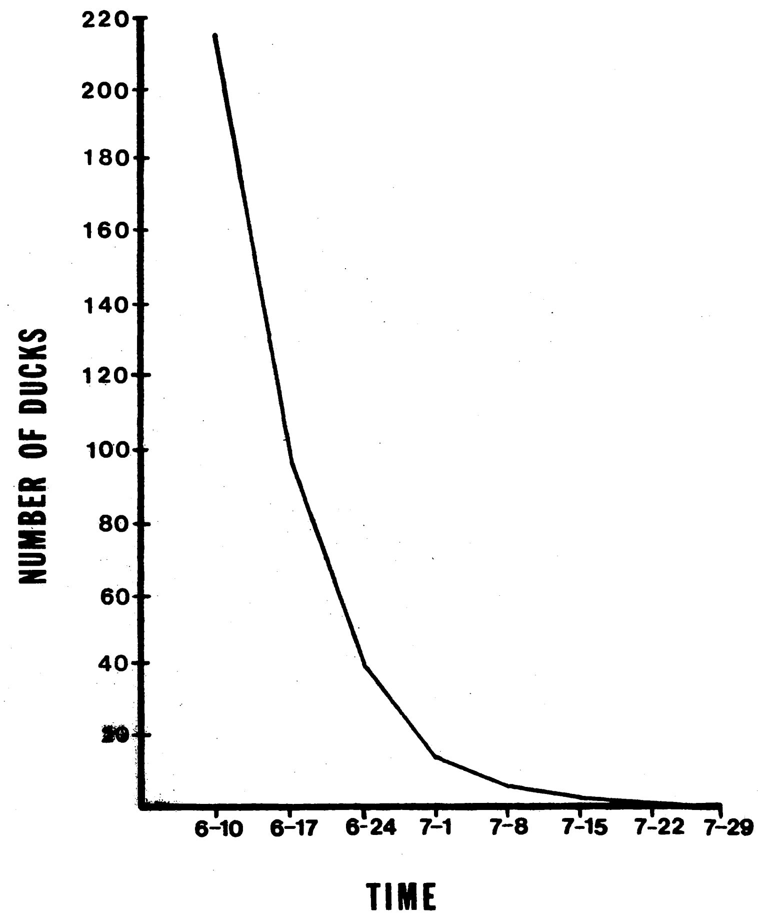

Figure 10. Survival of Experimental-Unfed Ducklings Released in 1971 on Five Release Lakes, Nine Ducklings Found Dead

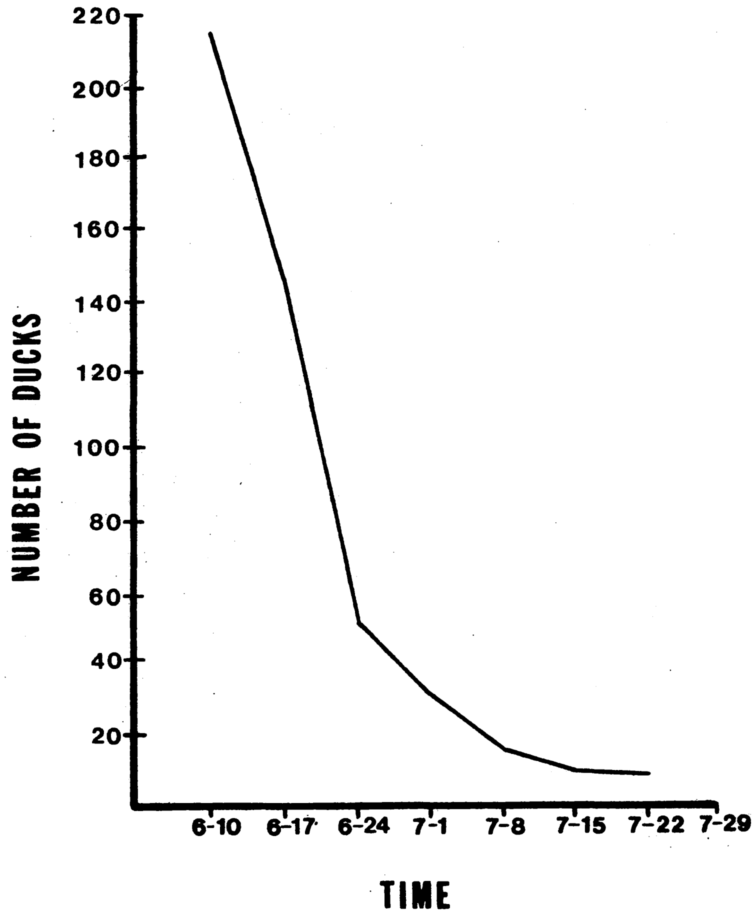

Figure 11. Survival of Control-Unfed Ducklings Released in 1971 on Five Release Lakes, Eighteen Ducklings Found Dead

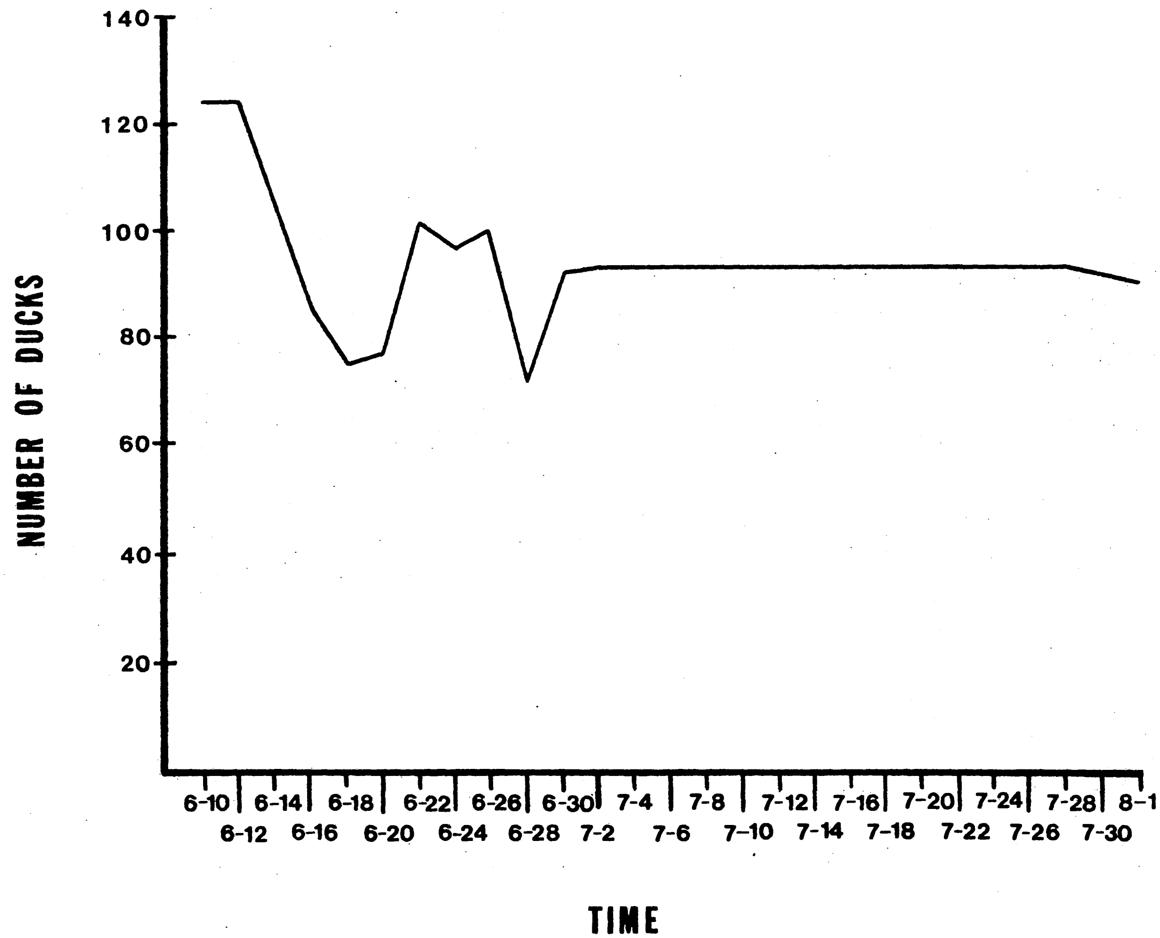

Figure 12. Survival of Experimental-Fed Ducklings Released in 1971 on Four Release Lakes, One Duckling Found Dead

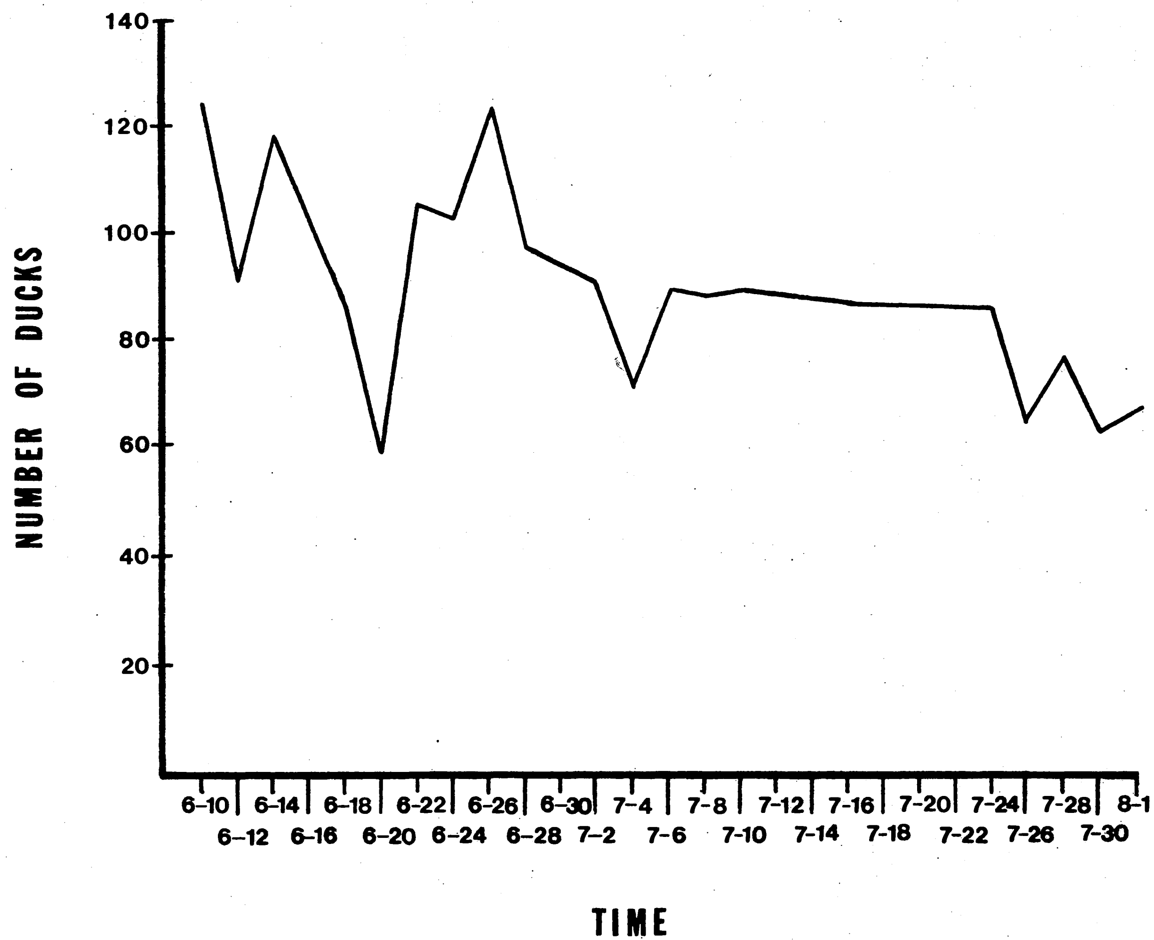

Figure 13. Survival of Control-Fed Ducklings Released in 1971 on Four Release Lakes, Five Ducklings Found Dead

control birds in flight age and length of time spent on release lakes where grain was provided, and all released birds tended to stay in one group. One difference did appear, however; there were fewer dead birds observed by lakes that had experimental ducklings than by lakes that had control ducklings. Also, there were fewer dead birds by release lakes that had supplemental food than by release lakes that lacked supplemental food.

Figures 12 and 13 show the following differences:

1. The population of experimental ducklings remained at a higher level than did the population of control ducklings.
2. There was less fluctuation in population levels in the experimental birds than in control birds after their release.

The feeders used in the supplemental food experiment held about 7.6 l of grain, and they were filled every other day. This was about the minimum daily quantity necessary to maintain a group of 25 to 30 ducklings on a release lake. Over 80 percent of the released birds receiving supplemental food survived and remained on their release lakes. Grain scattered on the ground and in shallow water at the site of liberation may serve to hold the ducklings at the release lake and reduce the 20 percent loss. Better feeding methods should improve survival and reduce the amount of feed necessary to keep the birds on the release lakes.

After feeder modifications were made to keep the grain flowing, duckling movements away from the release lakes declined. After the exploratory phase of duckling behavior was completed, nearly 100 percent of the established birds were maintained until the feeding operation was ended. The supplemental food cost per bird was $0.58.

Intensive observation of the feeder sites revealed no detrimental effects associated with feeding. Ducklings spent very little time at the feeders. Visits to the feeders occurred five or six times a day and lasted about 6 min per feeding. The rest of the time was spent away from the feeder area. Most ducklings seemed "apprehensive" and watchful when approaching feeders. The birds did not rely solely on supplemental food. The majority of their day was spent loafing and foraging for food in other parts of the lakes.

It is possible that a combination of released birds and supplemental food can be used as a habitat evaluation method. Although trends were noticed too late for quantitative evaluation, it appeared that ducklings released in better habitat, having a better supply of natural food, visited the feeders fewer times per day and consumed less grain than did birds released in poorer habitat. Similar observations were made in England by Olney (1962).

As soon as the feeding was terminated in late August, 1971, all ducks left the feeding-experiment release lakes. At other release lakes where feed was provided by the owners, large numbers of released birds remained all winter. Numbers of ducks dropped during the spring breeding season when paired ducks left the release lakes. Regardless of the amount of supplemental food, there is probably a maximum number of ducks per acre of water that a release lake will support. This is most evident during the breeding season when populations dropped even though sufficient grain was available.

CHAPTER VIII

BEHAVIOR

Behavioral science and ethology of species other than man and his primate relatives are comparatively recent fields of science. Some of the first recorded observations and analyses of waterfowl behavior were made by Heinroth (1910, 1911). These early observations, as well as a good many later behavioral studies, dealt mainly with courtship movements and reproduction. The reason for concentrating on courtship and reproductive behavior was to test hypotheses of evolution of behavioral patterns, species evolution, and behavior as criteria for classification. The foundation of these hypotheses comes from early observations indicating that related species had similar but not identical courtship and reproductive behaviors. Modification of reproductive or courtship behavior is one of the isolation mechanisms associated with speciation.

After the publications of Heinroth in 1910 and 1911, there followed many published observations dealing with reproductive behavior in mallards and other ducks. Noteworthy contributions concerning waterfowl courtship behavior were made by Brock (1914), Geyr von Schweppenburg (1924, 1929, 1930, 1952) and Christoleit (1929a, 1929b).

The landmark in comparative courtship behavior was published in 1941 by Lorenz. Many research papers dealing with courtship behavior of specific waterfowl species followed the lead set by Lorenz. Observations concerning courtship behavior of mallards and closely related species were brought forth by Delacour and Mayr (1945), Armstrong (1947), Hohn (1947), Lebret (1951, 1955, 1961), Gillham (1951), Weidmann (1956), Dzubin (1957), Sibley (1957), Wust (1960), Johnsgard (1960, 1965), von de Wall (1963, 1965), Hori (1963, 1964), Smith (1963), Stephen (1963), McKinney (1965) and Isakov (1967). Little new material can be added to the discussion of mallard courtship behavior provided by these researchers.

General behavior patterns occurring throughout the annual cycle of mallards and other similar species of waterfowl were described in reports by Bent (Part I, 1923), Pirnie (1935), Girard (1941), Munro (1943), Johnson (1952), Sowls (1955), Hochbaum (1955, 1959), Johnson (1961), Collias (1962), Madson (1963), Pulliainen (1963), Raitasuo (1964), Oring (1964), Geroudet (1965), Kortright (1967), Lockner and Phillips (1969) and McKinney (1969). Manning (1967), Hinde (1970) and Eibl-Eibesfeldt (1970) have authored textbooks on behavioral analysis that frequently refer to behavioral trends in mallards or related species.

Although Lorenz was not the first to observe imprinting (Hinde, 1970), his description and analysis was the best prior to the publication of his observations in 1935.

Imprinting and learning in ducks became popular research subjects in the late 1950's and 1960's. Research into learning by imprinting was reported by Ramsay and Hess (1954), Klopfer (1957, 1959, 1968), Hess (1959, 1964), Melzack (1960), Cofoid and Honig (1961), Gottlieb (1961, 1963, 1965), Klopfer and Gottlieb (1962a, 1962b), Nice (1962), Bandy (1965) and Madsen (1968).

Notes on the behavior of hand-reared mallards released into natural habitat may be found in Benson (1939), Browne (no date), Boyer (1959), Bednarik (1962, 1963), Foley, Benson, DeGraff and Holm (1961), Bednarik and Hanson (1965), Ordal (1966), Marinaccio (1968), Schladweiler (1969), Zohrer (1969), Sellers (1971), and Thomforde (1971). Although these authors have recorded data concerning some behavior patterns of released ducklings, there has been no attempt to put together an analysis of postrelease behavior of hand-reared mallard ducklings. The remainder of this paper will be an attempt to summarize and analyze the behavior of hand-reared mallard ducklings after their release. Some of this information should contribute to the formulation of improved techniques in the use of hand-reared waterfowl released as a management tool.

Behavior of Ducklings on Hardening Ponds

Behavior of ducklings released on hardening ponds at the Max McGraw Wildlife Foundation was described in a personal communication from Burger (1969). According to

Burger, four groups, containing 125-130 birds each, of 3-week-old ducklings, were each placed in an enclosed pen containing an estimated 70 sq m of surface water and about 210 sq m of mixed grasses and weeds. Several kinds of supplemental food were provided. Most released ducklings made their way directly to the water and swam in a compact group to the far side of the pond. Many individuals drank, bathed, and chased while swimming to the opposite side of the pond. If they found supplemental food floating on the surface of the water, the ducklings fed on this food for as long as 15 min. The birds spent short periods along the shore preening and resting. Tipping-up to feed was not observed until the second or third day after release. The most noticeable change was fear in response to the sudden appearance of a truck or person. If the ducklings noticed intruders they gave the alarm call and the flock entered the water or hid in the vegetation surrounding the pond. Only 20 birds put in the hardening pen disappeared during the week they occupied it.

Behavior of Ducklings During Release Activities

Some of the observations in this section deal with direct release of ducklings from shipping cartons into the new habitat. This type of release was similar to release methods for the majority of stocking projects by hunting clubs, state officials, and student researchers.

All birds observed in the 1969 release were placed in the water individually after recording desired information about each bird taken from shipping crates. The only exception was at Canton Reservoir where 128 control and 64 experimental ducklings were transported separately to other parts of the lake and released in two groups. Canton Reservoir was much larger than the other release lakes, so three release sites were chosen to take advantage of the lake size in separating some of the control and experimental birds.

During release activities, ducklings left the water and came back on land where they gathered in large bunches, usually less than 15 m from the people releasing them. A few birds rushed back to land without drinking or bathing. There were ducklings, in most releases, that moved directly away from the release activities as soon as they entered the water. These birds were both experimental and control ducklings, and they were usually alone or in pairs. Ducklings leaving the release site as soon as they were liberated constituted 2.7 percent of the released birds at the sites where this was observed.

Occasionally the ducklings were driven back into the water by people working at the release site. The birds milled about in closely packed clusters about 5 m from shore. Ducklings tried to gain the central position in the group by clawing their way over other birds, or by diving under the cluster and coming up in the center of the group. As soon as the disturbing factor was removed, the ducklings returned to land where they usually remained for long periods of time. The birds in the 1969 release were usually liberated in the afternoon or evening, and the birds were found in the same location on land the next morning. It appeared that the birds had not moved all night. They were even reluctant to move the next morning when approached by humans on foot.

In 1970 the ducklings were kept overnight in holding pens constructed of chicken wire at the water's edge so that shock, due to handling, banding and transporting, as observed in 1969, would be ended prior to release. The ducklings, released singularly from the pens, did not cluster around the release site. Although a few of the released birds were at first attracted to the ducklings still in the pen, they eventually left the area of human activity and traveled 30 m or more before getting out of the water onto logs or onto open beaches. At this time the ducklings paused to preen their feathers which had gotten muddy in the holding pens. As in 1969, a few birds left the release area completely as soon as they entered the water.

Ducklings released on Rocket Lake, Ashland Lake, Duck Marsh, and Curry Lake in 1970 were reboxed after spending the first night in a holding pen and trucked to other release sites. The birds at each release site were freed concurrently, and they tended to stay together near the point of release. The birds released singularly on Brown Lake and Penoski Lake, in 1970, were scattered along the bank for 100 m during the morning of the release, but they gathered into large groups by evening. The general uneasiness of ducklings released in 1969 was reduced in birds released in 1970 by allowing them to spend the night in a pen where water was available.

As in 1970, the ducklings released in 1971 were kept overnight in a holding pen. The experimental and control ducklings were kept apart and were released at different lakes the next morning. For the most part, these birds stayed in large groups and remained near the release sites through the first day in their new habitat. As expected, a few birds moved off to feed and bathe as soon as they were free. The ducklings released in 1970 and 1971 were not as reluctant to enter the water when humans approached on foot as were the birds released in 1969. This is most likely due to the retention of birds in a holding pen prior to release rather than to experimental hardening because it was noticed in both experimental and control birds.

The period of apprehension has been termed period of adjustment. Included in the period of adjustment of newly released ducklings are several behavioral characteristics. First, the majority of ducklings chose to remain on land rather than water. This is contrary to behavioral patterns noted in subsequent observations on the same birds. Second, ducklings did not feed although feeding was one of the major daily activities of more experienced birds. Third, there were only token efforts made by some birds to groom their plumage while most birds failed to groom themselves at all. Grooming movements were prominent in the same group of birds observed at a later date. Fourth, when approached by humans the ducklings released in 1969 ran down the shoreline ahead of the people rather than escape into the water. This was not observed in birds that had been on the lakes for several days, and this behavior was less common in the birds released in 1970 and 1971. If undisturbed, the birds merely sat at the water edge, occasionally sipping water.

The gentle release method modified the period of adjustment during which the ducklings appear to be quite vulnerable to human and predator attack. The period of adjustment was reduced in length and severity when the ducklings were allowed to recuperate overnight, from handling and shipping, in a holding pen prior to release.

Postrelease Behavior

Postrelease behavior can be divided into three distinct behavioral phases which have been named accommodation, exploration, and range establishment. These behavioral phases are defined in Chapter II.

Accommodation behavior follows the period of adjustment and includes initial behavioral activities that indicate the beginning of adaptation to the new environment.

Exploration behavior is the period during which ducklings appear to investigate the new habitat.

Range establishment behavior is the period during which behavior becomes reasonably predictable in regard to daily use of habitat.

Accommodation Behavior

During the accommodation behavior, which varied in length from 1 to 6 days, the majority of ducklings remained within 150 m of the release site and often returned to the release site to loaf. Some birds used the release site occasionally during the next phase, but their use was irregular. There were no consistent differences between experimental and control ducklings during the accommodation phase.

The first indication that ducklings were beginning to adapt to their new surroundings was the resumption of feeding by the majority of birds. Unfortunately, only a few release sites were observed continuously from the time birds were released until first feeding was detected. Distance between release sites made it impossible to make continuous uninterrupted observations at each site. Because of this, specific comparisons of the beginning of accommodation between experimental and control birds cannot be made. However, from the observations that were completed, it appears that the beginning of the accommodation phase of behavior began from 4 to 32 hr after release. Shorter time periods were associated with birds that were held overnight in a pen. Longer time periods were associated with birds released directly from shipping cartons. Even though accuracy cannot be 100 percent because continuous observations could not be made at each release site, duckling behavior at the release sites receiving partial observations was very similar to the behavior of birds observed continuously from release to first feeding. If ducklings were still in their accommodation phase of behavior, typical responses to a human were hiding and running along the shoreline. If the birds were forced into the water, they returned to land as soon as the intruder moved on. The birds seldom fed, and preening lasted only a few seconds. Most of the birds sat in a tightly packed group on the bank.

At release sites for which it was reasonably safe to assume that ducklings had not moved after release, first observed feeding was concurrent with movements away from the release area. There was large variation in the interval from release to the onset of first feeding period; members of one release might vary as much as 9 hr. Usually however, one vigorously feeding duck attracted others to feed in the same area.

The 5-week-old, one-half wild birds in 1970 and 1971 were usually feeding by evening of the day they were released, whereas the 4-week-old, three-fourths wild birds in 1969 were not observed feeding until the day after release. This appeared to be due to differences in release procedures rather than the result of differences in age or wildness.

During the accommodation phase ducklings were hyperactive (see Chapter II) to any movement or noise in their new habitat. Both experimental and control birds performed escape runs (Weidmann, 1956) by rushing over the water at the slightest noise or movement. These escape runs contained none of the escape dives described by Weidmann. The escape dive was performed prior to bathing and grooming in every instance in which it was observed in the mallard ducklings released in Oklahoma. Escape runs were less than 20 m in length, unless the disturbance that caused them continued, and they were always followed by winging (Weidmann, 1956) and eventually by feeding after the birds had settled down. Through habituation (Melzack, 1960) hyperreactive escape runs declined in length as birds grew older and more familiar with the area. One exception to this occurred in control birds released at Curry Lake in 1970. On Curry Lake ducklings were still hyperreactive at 9 weeks of age. This condition could have been maintained and even strengthened by the reinforcement of repeated encounters with people, dogs, and predators, which were common in the area.

Alarm calls, escape runs and escape flights of other animals induced escape runs in the newly released mallards (Table XXX). The response of ducklings to the alarm

TABLE XXX

THE REACTIONS OF MAX MCGRAW WILDLIFE FOUNDATION MALLARDS TO ALARM CALLS AND ESCAPE MOVEMENTS OF OTHER ANIMALS

Location	Age[1] Weeks	Type of Duck	Number of Ducks	Animal and Activity	Mallard Reactions
Curry Lake	4	Both	10-15	Red-winged blackbird, alarm calls-hovering over intruder. Frogs, escape runs.	Ran from loafing area into heavy cover before I was observed.
Canton Res.	4	Control	22	Great blue-heron-alarm call and escape flight.	Left loafing log and swam into marsh.
Penoski Lake	5	Both	5	Little blue heron-alarm call and escape flight.	Raised to their feet and rushed into the water.
Curry Lake	5	Both	Several	Red-winged blackbird and frogs. Alarm calls and escape runs.	Ducks rushed for cover before I was observed.
Ashland Lake	5	Both	16	Frogs-escape runs.	Moved off loafing area and into water.
Duck Marsh	5	Experimental	6	Wood duck-alarm call and escape flight.	Ducklings rushed for cover.
Penoski Lake	5	Experimental	60	Great blue heron-alarm call and escape flight.	Escape run-no escape dives.
Curry Lake	6	Control	39	Red-winged blackbirds and frogs. Alarm calls-escape runs.	Were up and watching on one of the loafing areas.

TABLE XXX (Continued)

Location	Age[1] Weeks	Type of Duck	Number of Ducks	Animal and Activity	Mallard Reactions
Curry Lake	7	Control	15-30	Frogs and green heron-alarm call and escape activity.	Rushed into the water from a loafing site.
Rocket Lake	7	Both	25	Green heron-alarm call and escape flight.	Stopped feeding and looked about.
Curry Lake	8	Both	14	Red-winged blackbirds and frogs. Alarm call and escape runs.	Raised to their feet and scanned the area.
Curry Lake	9	Control	41	Frogs-escape run.	Moved away from the loafing site into cover.
Ham Lake	12	Control	18	Common crow. Alarm call.	Moved off loafing area into water.
Penoski Lake	13	Both	7	American coot. Escape flight.	Stopped feeding and swam toward center of lake.
Rocket Lake	17	Both	25	Killdeer. Alarm calls and flight.	Caused the ducks to look up from their feeding.

[1]These duckling reactions were first noticed in the accommodation phase; however, these behaviors (in modified form) carried over into the other behavioral phases. Many observations of duckling reaction to escape or warning activities of other species were made. Only representative examples are included here to illustrate the changes in duckling reactions as they grew older.

activities of other animals changed from escape runs in younger birds to increased alertness in older birds. When escape runs or alarm calls were observed by older released ducklings, instead of escaping, the birds sat, stood, or swam with their heads held high. According to Weidmann (1956) this is the posture of an alerted duck. The recognition of escape activities of other animals as warning signals for ducks developed in ducks that were released on lakes with dense cover around the edge.

Exploration Behavior

For all birds, experimental and control, exploration lasted an average of 17.8 days in 1969, 17.4 days in 1970 and 11.8 days in 1971 (Table XXXI). These data can not be tested statistically because of the age differences between birds released in different years, because different lakes were used each year, and because different release procedures were used each year.

During the 3-year project, on lakes where control and experimental birds were not liberated together exploration lasted an average of 13.8 days in control birds and 17.5 days in experimental birds. Because of supplemental feeding, statistical tests cannot be made between years. In 1969, exploration lasted an average of 22.5 days for experimental birds and 14 days for control birds. This is significant at the $P=0.25$ level. In 1970, exploration lasted an average of 23 days for experimental birds and 18

TABLE XXXI

DURATION OF THE EXPLORATION BEHAVIOR SHOWN BY THE MAX MCGRAW WILDLIFE FOUNDATION MALLARDS AT EACH RELEASE LAKE

Location	Duckling Type	Number of Ducks	Age Range (days)	Duration (days)
1969				
Penoski Lake	Both	16	33-41	8
Grassy Lake	Both	1 to 6	32	?
Curry Lake	Both	14	33-61	28
Duck Marsh	Both	25	33-54	21
Rocket Lake	Both	65	32-53	21
Canton Reservoir	Experimental	35	33-66	33
Canton Reservoir	Control	42	32-50	18
Taylor Lake	Experimental	1	34	?
Chalfant Lake	Experimental	31	32-44	12
Coym Lake	Control	98	32-44	12
Ham Lake	Control	18	31-48	16
Sangre Lake	Control	3	31-41	10
1970				
Brown Lake	Both	46	39-53	14
Rocket Lake	Control	8	39-63	24
Duck Marsh	Experimental	7	39-72	33
Ashland Lake	Both	14	39-51	12
Penoski Lake	Experimental	137	39-52	13
Curry Lake	Control	102	53-65	12
Zink Ranch	Both	38	39-53	14
1971				
Zink Ranch	Both	65	39-48	9
Red Bird Lake	Experimental	69	39-49	10
Lake 4	Experimental	26	42-48	6
Lake 23	Control	26	39-48	9
Lake 58	Experimental	21	44-61	17
Lake 39	Control	25	46-50	4
Lake 7	Both	7	42-62	20
Lake 51	Both	44	42-48	6
Lake 50	Experimental	24	44-60	16
Lake 66 (Ashland)	Control	28	44-56	12
Rocket Lake	Control	5	44-65	21

days for control birds. This is significant at the P=0.50 level. In 1971, exploration lasted an average of 12.3 days for experimental birds and 11.5 days for control birds. This was not significant.

In all three releases, exploration behavior lasted longer in experimental ducklings than in control ducklings, and supplemental food tended to reduce the duration of this phase in both groups by an average of nearly 6 days.

The exploration phase of behavior usually began after the ducklings' first full day on the lake, with the exception of lakes where grain was provided, and its beginning was associated with feeding while moving away from the release site.

After the beginning of exploration, ducklings were usually difficult to find. The Duck Marsh, Rocket Lake, Ashland Lake, Taylor Lake and Coym Lake were fed by slow-flowing creeks which were explored by released ducklings early in this behavioral phase. Table XXXII contains the direction and maximum distance from the release site attained by ducklings during their movements around the lake.

Ducks released on Canton Reservoir in 1969 and on Brown Lake in 1970 traveled long distances during their first week on the lakes. On Canton Reservoir at least 42 control ducklings traveled 7.5 km southeast of their release site located in the cattail marsh around the inlet on the northwest end of the lake. The dam is located in

TABLE XXXII

MAXIMUM MOVEMENTS AWAY FROM THE RELEASE SITE OBSERVED IN MAX MCGRAW WILDLIFE FOUNDATION MALLARDS RELEASED IN OKLAHOMA

Location	Duckling Type	Age[1] (weeks)	Number[2] of Ducks	Release Site	Length of Movement (m)
1969					
Penoski Lake	Both	4	3	South side boat dock	380 North
Grassy Lake	Both	4	18	Southwest side by road	75 East
Curry Lake	Both	4	5	Southeast side near house	660 North
Duck Marsh	Both	7	3	North side near outlet	660 South
Rocket Lake	Both	7	25	West side boat loading area	660 East side
Canton Reservoir	Experimental	9	11+	Northwest end of lake	800 Southeast
Canton Reservoir	Control	6	42	Marsh near inlet-northwest side	7500 Southeast
Taylor Lake	Experimental	8	1	Northeast side near marsh	625 West
Chalfant Lake	Experimental	8	33	East side boat loading area	490 Southwest
Coym Lake	Control	8	64	West side boat loading area	880 South
Ham Lake	Control	8	18	Southeast of impoundment	550 Northwest
Sangre Lake	Control	7	3	Southeast end of lake	160 West

TABLE XXXII (Continued

Location	Duckling Type	Age[1] (weeks)	Number[2] of Ducks	Release Site	Length of Movement (m)
1970					
Brown Lake	Both	5	100	Island west end of lake	2000 East
Brown Lake	Both	5	6	East of Administration Building	900 West
Rocket Lake	Control	5	27	Southwest end of impoundment	700 South
Duck Marsh	Experimental	6	6	Southwest access road	660 Northeast
Ashland Lake	Both	5	4	Southwest side	600 North
Penoski Lake	Experimental	6	17	West end of impoundment	400 East
Curry Lake	Control	9	102	Northcentral side	600 South
Zink Ranch	Both	-	-	-	-
1971					
Zink Ranch	Both	6	38	Pond below lodge	250 Northeast
Red Bird Lake	Experimental	5	69	East side	900 South
Penoski Lake	Control	5	96	West end of impoundment	700 West
Lake 4	Experimental	6	28	South end of impoundment	200 Northwest
Lake 23	Control	5	31	West end of impoundment	1700 North
Lake 58	Experimental	5	31	North end of impoundment	80 East
Lake 39	Control	6	23	South end	60 South
Lake 7	Experimental	6	31	North side	300 Southwest

TABLE XXXII (Continued)

Location	Duckling Type	Age[1] (weeks)	Number[2] of Ducks	Release Site	Length of Movement (m)
Lake 51	Control	6	31	North side	300 Northeast
Lake 50	Experimental	6	26	East side	60 South
Lake 66 (Ashland)	Control	5	31	Southwest side	600 North
Lake 2	Experimental	6	24	East side of impoundment	800+ South
Lake 3	Control	5	12	East side of impoundment	200+ South
Lake 48	Experimental	5	31	East side	450+ South
Lake 45	Control	6	16	East side	150+ South
Lake 6	Experimental	5	29	South end of impoundment	30 West
Lake 52	Control	5	26	North side	80+ East
Duck Marsh	Experimental	5	22	South side	700 North
Rocket Lake	Control	5	68	South end of impoundment	600 South
Capart Farm	Control	7	15	Farm pond	450 Southeast
Vogel Farm	Experimental	7	2	Farm pond	1700 South
Blue Stem Lake	Both	8	5	Ranger Station	100 East

[1]This is the age, prior to flight, during which some of the birds were found at a maximum distance from the release site.

[2]The number of ducks involved was not necessarily all ducks at the release lakes.

the southeast end of the lake, and on both sides of the dam are campgrounds, swimming beaches, concession stands and boating areas. This area of intensive human use drew the attention of the 42 control ducklings. These birds accepted food from boaters and swimmers, and they moved around the boats with no apparent fear. A few of the birds were reported to have been killed, but no evidence was found to support this. The experimental ducklings were not observed in the southeast end of the lake; their movements were confined to areas of minimal human use at the northwest end of the lake.

Fifty experimental ducklings and 50 control ducklings were released together on a one-half acre island in the west end of Brown Lake. By the end of the second day after release, the ducklings had moved 2 km east into a housing area on the north shore of the lake. The young birds followed children and accepted food from them. Ducklings roosted on porches of houses and fed on lawns under water sprinklers. Ducklings traveled along asphalt roads, often stopping traffic. Between 8 and 12 birds were driven from the steps of the U.S. Naval Ammunition Depot Administration Building at least twice. Ducklings continued to use the area of concentrated human activity for the duration of the exploratory phase.

In general, the movements away from the release sites in 1971 were smaller than movements in 1969 and 1970 because 14 of the release lakes were small. On the larger release lakes used in 1971, the exploratory phase was comparable to the previous 2 years.

The presence of supplemental food apparently influenced the exploratory phase by attracting released birds to the feeding sites. Lakes without feeders must have held little attraction for wandering birds because there was a steady decline in duckling numbers during the 10 days that followed release (Figure 10 and 11). During the exploratory behavior in 1971 there was considerable movement by all released birds. However, ducklings returned to lakes where supplemental food was offered, and in general they failed to return to lakes where food was not offered. At the time exploration was ending on lakes with feeders, there were few if any birds to observe on the other lakes.

Age range and duration of this phase in each group of introduced ducklings is found in Table XXXI. Release lakes were omitted, for the 1971 release, where ducklings failed to return at the end of the exploratory phase to the lake on which they were released.

In 1969 and 1970 where experimental and control birds were released independently and could not influence each other, experimental ducklings were scattered in small groups of 20 members or less. Control birds traveled in large, closely bunched groups containing 100 or more members. Control ducklings were not observed alone or in pairs as were experimental ducklings. Hand-reared ducklings similar to the MMWF control ducklings congregated in large groups released by Bednarik (1962), Bednarik and Hanson (1965), Ordal (1966) and Schladweiler (1969).

It was not uncommon for ducklings to range long distances from water during the exploration phase (Table XXXIII). Both experimental and control ducklings walked along asphalt roads or unpaved automobile trails while feeding on seed heads of grass.

Ducklings walking away from release lakes were reported by Benson (1939), Browne (no date), Foley et al. (1961), Bednarik and Hanson (1965), Ordal (1966), Schladweiler (1969), Zohrer (1969), Sellers (1971), and Thomforde (1971).

As indicated in Table XXXIII, only five instances of ducklings leaving the water were recorded in 1969. This behavior was of minor importance in 1969 because: (1) in four of the five observations comparatively few birds were involved; (2) in three of the five observations the distance from water was small; (3) in four of the five observations the birds were 4 weeks old and subsequent observations of birds away from water did not occur; and (4) all observations were made at different lakes. There was no apparent difference between experimental and control birds in regard to movements away from water in 1969. In 1970, the duckling behavior pattern of wandering away from water while feeding on grass seed heads became significant in the Oklahoma release (Table XXXIII). Greatest

TABLE XXXIII

MAX MCGRAW WILDLIFE FOUNDATION MALLARDS FEEDING ON GRASS AWAY FROM RELEASE LAKES

Location	Date	Type of Duck	Number of Ducks	Distance From Lake (m)	Activity and Type of Area
1969					
Grassy Lake	6-18	Both	39	3	Hiding in roadside weeds.
Duck Marsh	6-26	Both	23	1 to 3	Feeding on grass seeds and loafing on dike.
Canton Res.	7-8	Experimental	?	350	Footprints down a sandy car path.
Coym Lake	7-11	Control	1	50	Walking down car path in a pasture.
Chalfant Lake	8-7	Experimental	1	3	Feeding on grass seed and chasing insects.
1970					
Brown Lake	7-10	Both	50	20	Feeding on freshly mowed grass.
Duck Marsh	7-10	Experimental	30	3	Loafing and feeding on grass seeds on dike.
Brown Lake	7-13	Both	40	800	Walking down asphalt road and around post buildings.
Ashland Lake	7-13	Both	36	900	Feeding on grass beside asphalt road.
Ashland Lake	7-14	Both	3	30	Feeding on grass seed in spillway.
Ashland Lake	7-15	Both	24	200	Feeding on grass seeds by asphalt road.

TABLE XXXIII (Continued)

Location	Date	Type of Duck	Number of Ducks	Distance From Lake (m)	Activity and Type of Area
Rocket Lake	7-15	Control	?	100	Duck tracks on sandy road.
Brown Lake	7-15	Control	1	10	Feeding on grass seed under trees.
Brown Lake	7-22	Both	8	25	Feeding on grass seed in picnic area.
Ashland Lake	7-23	Both	12	30	Feeding on grass seed in spillway.
Penoski Lake	7-30	Experimental	1	100	Walking down road leading to the lake.
Penoski Lake	8-5	Experimental	13	10	Feeding on grass seeds on road over the impoundment.
Penoski Lake	8-21	Experimental	3	10	Feeding on grass seeds on road over the impoundment.
Penoski Lake	9-6	Experimental	6	300	4 killed by a car and 2 more taken to a farm by dogs--they were walking down a gravel road.
<u>1971</u>					
Zink Ranch	6-19	Both	38	250	Moved along a road between lakes.
Red Bird Lake	6-13	Experimental	69	900	Moved past the impoundment and followed a natural drainage area.
Penoski Lake	6-20	Control	94	700	Walked away from lake on a road.
Lake 23	6-12	Control	31	1700	Followed a natural drainage area to another lake.

TABLE XXXIII (Continued)

Location	Date	Type of Duck	Number of Ducks	Distance From Lake (m)	Activity and Type of Area
Lake 58	6-16	Experimental	31	80	Followed a natural drainage area to a road.
Lake 7	6-18	Experimental	31	300	Moved overland to another lake.
Lake 51	6-15	Control	31	300	Moved overland to another lake.
Lake 2	6-18	Experimental	24	800+	Followed a natural drainage area away from the lake.
Lake 3	6-14	Control	12	200+	Followed a natural drainage area away from the lake.
Lake 48	6-12	Experimental	31	450+	Followed a natural drainage area away from the lake.
Lake 45	6-18	Control	16	150+	Feeding on grass on a slope and moving away from lake.
Lake 6	6-14	Experimental	29	30	Past the impoundment feeding on grass.
Lake 52	Several	Control	22	80	Moved several times overland between release lake and a marsh.
Capart Farm	6-29	Control	15	450	Moved overland to other farm ponds.
Vogel Farm	6-29	Experimental	2	1700	Followed a natural drainage area away from the lake.

population losses occurred during the time period when this behavior was most common. Similar observations of ducklings walking away from release lakes were made in 1971 although few birds were seen feeding on grass seed heads. Wandering away from release lakes stopped in most areas by the time birds were 7 weeks old and had entered the third phase of their behavior. Mortalities declined at the same time. Few remains of dead birds were found once the ducklings had reached 8 weeks of age.

In 1970, the practice of feeding on grass away from water was observed in 124 experimental ducklings and 98 control ducklings. Control birds did not leave the water to feed unless they were with experimental birds; however, experimental birds were observed far from water without control birds being present. It appeared that something in the conditioning techniques induced an appetite for grass. During their conditioning period, 2.5-week-old ducklings were placed in closed pens that contained watering ponds and growths of winter wheat. This was suggested as a likely source of influence on experimental ducklings' feeding behavior when they were confronted with an absence of commercial feed, which had been supplied throughout their rearing period in the hatchery.

Even though attempts were made in 1971 to remedy duckling attraction for grass by removing winter wheat from rearing pens and by scattering grain at the release sites of some lakes, both experimental and control ducklings were observed leaving the release lakes. However, there was a high return rate to lakes having supplemental food.

An example of ducklings feeding on grass seed in 1970 occurred at Ashland Lake, which was particularly deficient in aquatic vegetation suitable for duck food. Twelve ducklings on Ashland Lake made four or five trips daily to feed on grass growing in the spillway by the dam. Mortality occurred around the lake until only one duck could be located there.

After the duckling release in 1971, supplemental food was given to 31 control birds on Ashland Lake. Twenty-five ducks remained on the lake until the first of August, 1971, and only two mortalities were found. One of 100 ducklings, including both experimental and control birds, released in 1970 survived and 20 mortalities were found.

Ducklings were vulnerable to a number of dangers while they were away from water in 1970 and 1971:

1. Ducklings were hit by motor vehicles.

2. There was little escape cover from predators.

3. Ducklings moved away from lakes and continued to do so unless they were driven back by people.

4. Bits of asphalt or oil possibly were taken into the ducks' digestive tracts with gravel or seeds.

5. The radiant heat from unpaved road beds and asphalt road beds plus an ambient temperature of 35 C to 38 C was sufficient to cause panting (thermal polypnea) in ducklings.

Panting increased the rate of evaporation from the respiratory tract, increasing the need for water per unit of time. During continuous movement away from water, ducklings may have exceeded their ability to return to the lake, or they may have become lost and died of dehydration or hyperthermia (Sturkie, 1965).

Range Establishment Behavior

The start of range establishment for 1969, 1970, and 1971 occurred at an average age of 7.5 weeks for experimental birds and 7.2 weeks for control birds. This difference is not significant.

After the ducklings were on the release lakes for 2 to 3 weeks (Table XXXIV) they settled into a routine use of certain areas of the lakes for feeding and loafing. Benson (1939) made similar observations, "The mallards, fortunately for the investigator, unlike the black ducks, retained a fairly definite feeding ground until the young were full-winged even though they were disturbed frequently." Feeding occurred in beds of pondweed, coontail, or naiad which varied considerably in abundance at different lakes. Loafing was usually in locations that provided a clear view of most of the area such as mud flats in cattail marshes, islands, tree stumps, beaches void of cover, and under trees on impoundments. Birds often roosted at night in the cover of the marsh, under trees if

TABLE XXXIV

THE BEGINNING OF RANGE-ESTABLISHMENT BEHAVIOR IN MAX MCGRAW WILDLIFE FOUNDATION MALLARDS RELEASED IN OKLAHOMA

Location	Age[1] (weeks)	Type of Duck	Number of Ducks	Location and Activity on the Lake[2]
1969				
Penoski Lake	5	Both	16	Feed at north end, loaf under trees around lake.
Grassy Lake	?	Both	1 to 6	Feed and loaf near asphalt road by lake.
Curry Lake	8	Both	14	Feed at small bay near release site, loaf on small open mud flats in marsh area.
Duck Marsh	7	Both	63	Feed around tree stumps of north and southwest ponds; loaf on dikes, logs and tree stumps.
Rocket Lake	7	Both	65	Feed along southeast edge of lake; loaf on open mud flats and open islands.
Canton Reservoir	9	Experimental	35	Feed in marsh area around inlet river mouth; loaf on open beaches and under trees.
Canton Reservoir	7	Control	42	Area of high human use; southeast side near dam, loaf on logs and open beaches.
Taylor Lake	?	Experimental	1	Feed at marsh; loaf on open mud flats and on small island.
Chalfant Lake	6	Experimental	31	Roost in marsh, feed in north corner of impoundment. Loaf on open mud flats in marsh, sand, open beach.

TABLE XXXIV (Continued)

Location	Age[1] (weeks)	Type of Duck	Number of Ducks	Location and Activity on the Lake[2]
Coym Lake	6	Control	98	Entire lake; roost in marsh and loaf on any open area along the edge.
Ham Lake	7	Control	18	Feed in bay west of impoundment and south edge of lake; loaf on any open area along edge.
Sangre Lake	5	Control	3	Feed by large island and area around the feeder; loaf on islands.
1970				
Brown Lake	7	Both	46	Feed in north side bay west of office area; loaf on rocks and open areas around edge.
Rocket Lake	8	Control	8	Feed at southeast edge of lake; loaf on open mud flats and open islands.
Duck Marsh	9	Experimental	7	Feed in southwest pond west of long island; loaf on islands and logs.
Ashland Lake	7	Both	14	Feed in area of spillway and east edge of lake; loaf on open mud flats.
Penoski Lake	7	Experimental	137	Feed on north side, roost around lake edge under trees, loaf under trees and on boat docks.
Curry Lake	9	Control	102	Feed on northeast side, roost and loaf under trees on impoundment.
Zink Ranch	7	Both	38	Feed in area where grain was provided, loaf on open mud flats.

TABLE XXXIV (Continued)

Location	Age[1] (weeks)	Type of Duck	Number of Ducks	Location and Activity on the Lake[2]
<u>1971</u>				
Zink Ranch	6	Both	65	Feed at supplemental food area; loaf on fish traps and around the edge.
Red Bird Lake	7	Experimental	69	Feed on north end, loaf on east side and on an island.
Lake 4	6	Experimental	26	Feed on north side, loaf on an island and on tree stumps.
Lake 23	6	Control	26	Feed in south end shallows, loaf on dam under trees.
Lake 58	8	Experimental	21	Feed in south side shallows, loaf on rafts and under shrubs on south side.
Lake 39	7	Control	25	Feed in south end and east side, loaf on rafts and tree stump south end.
Lake 7	8	Both	7	Feed in west end shallows, loaf on dam under trees.
Lake 51	6	Both	44	Feed in west end shallows, loaf on mud flat created by cattle.
Lake 50	8	Experimental	24	Feed on east side, loaf on dam and on rafts.
Lake 66 (Ashland)	8	Control	28	Feed and loaf on spillway and east edge.

TABLE XXXIV (Continued)

Location	Age[1] (weeks)	Type of Duck	Number of Ducks	Location and Activity on the Lake[2]
Rocket Lake	9	Control	5	Feed and loaf at south east side of lake.

[1]This was the age during which range-establishment behavior was first observed on each lake with a population of released ducks.

[2]The feeding areas in 1971 are those other than where supplemental food was provided.

they were available, or on islands overgrown with vegetation.

In Table XII and Table XXXIV, it appears that observed mortality decreased as birds entered the range establishment behavioral phase. Ashland Lake and Penoski Lake in 1970 were exceptions. At Ashland Lake predator-killed ducks continued to be found until all birds but one were gone. Birds were found dead at Penoski Lake after they had become well-established there. Birds killed and eaten by predators occurred for 2 weeks, after which no additional dead birds were found at Penoski Lake. Other birds at Penoski Lake were killed away from the lake by automobiles and dogs.

Habits attained during accommodation behavior and exploration behavior were retained by the ducks until they left in the fall.

Behavior of Established Ducks

Habitat Use

Marsh areas in shallow ends of the lakes were used by ducks for roosting and for escape cover from human activities on the lakes. Experimental birds on Canton Reservoir in 1969, Chalfant Lake in 1969, Duck Marsh in 1970 and Penoski Lake in 1970 moved into heavy cover when human activity increased on the lake. Control birds at Coym Lake in 1969, Ham Lake in 1969, and Rocket Lake in

1970 either swam away from human activity toward deep water or got out of the water onto an open beach. At Canton Reservoir in 1969 several control ducklings were observed swimming toward human disturbance.

If human activity was at a distance greater than 100 m from experimental ducks, the birds moved slowly toward the marsh cover, feeding as they went. They often took as much as an hour to cover 300 m. Control ducklings usually made no specific move toward cover. Instead, control birds paid little attention to humans unless they approached the birds. Reactions of ducklings to humans will be described later.

Dead trees, logs and stumps rising above water level occurred at almost every release site, but they were extensively used only on the Duck Marsh in 1970, Lake 4 in 1971, and Lake 39 in 1971. Loafing rafts were used only on Lake 58, Lake 39, and Lake 50 in 1971. The islands in the Duck Marsh and Rocket Lake were used heavily as loafing and roosting sites by both experimental and control birds in 1969, 1970 and 1971. Islands on these two lakes were densely covered with vegetation. Islands on Taylor Lake and Canton Reservoir provided little cover and were used mostly for loafing by experimental birds. The island on Penoski Lake was low and usually covered with water. The ducklings released on Penoski Lake used the island for preening and oiling and for short rest periods less than 20 min in length. Islands on Lake 4 and Red Bird Lake were ordinarily used as loafing sites by ducklings released in 1971.

Eleven lakes had dense tree cover along the impounding structure, which received various degrees of use by ducklings. Only the tree-covered dams of Penoski Lake, Curry Lake, Duck Marsh, Lake 23, Lake 7 and Ashland Lake were used repeatedly as loafing and roosting sites by experimental and control birds.

Most ducklings observed during rain squalls sought cover under trees or bentover cattails. On lakes where overhead cover was not available, ducklings sat on logs with their heads held back and their bills resting on their breast feathers. Several birds appeared to sleep during rain showers. After the rain passed, ducks usually resumed their activities until the next squall hit.

On lakes of the reservoir type, a zone about 14 m wide along the lake margin was habitually used by all of the ducklings during feeding and loafing. This zone consisted of a strip of shoreline about 4 m wide and a strip of shallow water about 10 m wide. The width of the high-use zone on each lake depended on water depth, aquatic food plants, and plant growth along the bank. Deep water was used by birds in passing from one location on the lake to another location on the opposite side of the lake and as an area of safety during the approach of an intruder from land. These birds seldom slept or loafed on water as some wild birds do.

There appeared to be little difference between experimental and control ducklings in using their habitat once they became established. Habitat differences appeared to have a greater influence on behavior of older ducklings than did the experimental rearing techniques. It was noted that the presence of people, including the investigator, influenced duckling behavior.

Diurnal Activity Periods

In 1969 and 1970 the only activity performed by ducklings as a group on a regular basis was mid afternoon loafing observed in control birds on Coym Lake in 1969, Ham Lake in 1969, Rocket Lake in 1970 and Curry Lake in 1970. The loafing period began between 12:30 PM and 2:00 PM with a few ducklings (the number varied between repetitions of the activity) leaving the water at a regularly used loafing area. The rest of the ducks in the group continued to leave the water at the loafing site through a period of about 45 min until all birds on the lake were out of the water. Regular loafing periods lasted from 1 to 1.5 hr, and if there were no disturbances, it occasionally lasted several hours longer (Table XXXV).

Extended loafing periods occurred on lakes other than those listed in Table XXXV; however, only a few of the total population of birds were involved and there were no repetitions of the activity. Duration of loafing periods was limited by people, dogs, cattle, and activities of

TABLE XXXV

EXTENDED LOAFING PERIODS IN MAX MCGRAW WILDLIFE FOUNDATION MALLARDS

Location	Date	Type of Duck	Number of Ducks	Starting Time	Duration (min)
1969					
Canton Res.	8-6	Control	2	8:40 AM	81
Chalfant Lake	8-7	Experimental	9	1:15 PM	131
Coym Lake	8-8	Control	2	6:35 AM	505
Coym Lake	8-8	Control	6	9:22 AM	338
Rocket Lake	8-19	Both	15	2:36 PM	132
1970					
Penoski Lake	8-13	Experimental	4	10:30 AM	180
Curry Lake	8-26	Control	102	12:30 PM	400
Penoski Lake	8-27	Experimental	3	2:30 PM	210
Curry Lake	9-6	Control	70	1:30 PM	180
Curry Lake	9-19	Control	82	1:00 PM	480
1971					
Duck Marsh	6-19	Control	4	1:41 PM	107
Duck Marsh	6-19	Control	4	5:00 PM	145
Lake 50	6-24	Experimental	27	5:00 PM	180
Lake 39	6-25	Control	23	10:45 AM	105
Lake 39	6-25	Control	23	5:30 PM	105
Lake 51	7-31	Both	33	7:44 AM	132
Lake 51	7-31	Both	33	4:21 PM	114
Lake 51	8-3	Both	33	12:00 AM	135
Lake 51	8-3	Both	33	5:00 PM	150
Lake 50	8-11	Experimental	24	10:00 AM	135
Lake 50	8-11	Experimental	24	3:15 PM	165
Ashland Lake	8-17	Control	25	10:30 AM	150
Ashland Lake	8-17	Control	25	2:15 PM	90

other ducks. In 1971, regular loafing periods were usually under 1 hr in length, and extended loafing periods did not exceed 180 min (Table XXXV). On lakes where longer loafing periods occurred in 1971, birds mainly had two loafing periods, one in the morning and one in the evening, rather than one long period. As in 1969 and 1970, control ducklings in 1971 had longer rest periods than did experimental ducklings. Control ducklings fed and loafed as a group while experimental ducklings were often involved in a variety of activities. Where large numbers of birds were released together, there was considerable variation in length of time any one group of birds spent in feeding or loafing. This usually created considerable movement between loafing and feeding areas, particularly in experimental birds. Also, longer loafing periods occurred in lakes having the best natural food supply, although an infection by intestinal parasites apparently contacted at Penoski Lake in 1970 reduced loafing behavior on that lake. The influence of the parasite infection on duckling behavior at Penoski Lake in 1970 will be described later.

Exceptions to the continual movement between loafing and feeding areas were noted in a few individual birds on lakes where over 50 ducklings were released together. These birds were distinguished from others by virtue of their position on the lake, their distance from other birds, and their extended use of the same area during which time their numbers did not change. Two control birds on Coym Lake 1969 spent over 8 hr loafing (Table XXXV).

Figure 19 in the Appendix illustrates typical daily activities of 8-week-old control ducklings in 1969. Figure 20 in the Appendix illustrates typical daily activities of 8-week-old experimental ducklings in 1969. Weather conditions were similar during both observation periods. Figure 19 indicates the influence of the group over individual ducklings among control birds because of distinct activity changes in which nearly the entire population was involved. Influence of human activity is also indicated by an increase in the number of feeding birds after human interference. After ducklings were frightened into the water from a loafing place, they always began feeding shortly after the disturbing element was gone. The continuous change between feeding and loafing illustrated in Figure 19 was common in both control and experimental ducklings in 1969 although experimental birds were less influenced by group behavior.

Figures 21 to 23 in the Appendix are representative of daily routine of experimental and control ducklings released in 1970. Figure 21 illustrates daily activities of feeding and loafing in 9-week-old control ducks in 1970. Figure 22 illustrates daily activities of 9-week-old experimental ducks in 1970 and Figure 23 illustrates activities of experimental and control birds released together on the same lake in 1970. These observations were made during similar weather conditions.

Comparing Figures 21 and 22, the influence of the group over the individual is noted again in control birds because all birds present eventually became involved in the same activity. Although there is probably a bias toward feeding in the experimental birds at Penoski Lake because of intestinal parasites, these birds were not involved in feeding or loafing as a group during daylight hours. Even with the bias mentioned above, Figure 22 illustrates typical feeding and loafing routines in experimental ducklings.

The numbers of 7-week-old experimental and control ducklings illustrated in Figure 23 were small compared with the numbers illustrated in the other figures. These 12 birds consisted of six experimental, four control and two unmarked ducks. Behavior of experimental and control birds could not be separated graphically because of (1) unmarked birds, (2) concurrent movement of experimental and control birds about the area, and (3) unequal numbers of experimental and control ducklings. All of these conditions may have led to confusing interpretations. Figure 23 illustrates best the high degree of movement between feeding and loafing areas on a lake having a very poor food supply.

Figures 24 to 26 in the Appendix illustrate the daily feeding and loafing periods among experimental and control ducklings on lakes where supplemental food was provided in

1971. Feeding and loafing periods appear to be more stable although experimental birds were still less dominated by group behavior. The influence of quality, quantity, and availability of food on behavior may be illustrated by comparing daily activity periods on the graphs in Figures 19 through 26. Except on Penoski Lake and Curry Lake in 1970, where natural food was abundant, feeding appeared to dominate daily activities. Feeding activities did not dominate loafing activities in 1971 where released birds were provided with grain.

Compared with the time spent foraging for natural food, ducklings spent very little time at the feeders where grain was supplied. Table XXXVI shows that six or fewer visits to the feeder were made per day (when feeders were working properly) and the average time spent per visit to the feeders was about 6 min. This would place the birds at the feeders an average of 36 min per day.

Figures 19 through 26 in the Appendix are not meant to represent an average of daily activities. They are meant to represent a typical day in the life of experimental and control ducklings in regard to feeding and loafing. An average of time spent feeding and loafing, based on experimental and control rearing differences, is not statistically feasible. The effect of ever-changing conditions in the physical and biological environment cannot be removed from the ducklings' behavior patterns, and individual birds cannot be precisely identified. Also, graphs do not account for movements of individual birds between recording periods.

TABLE XXXVI

AVERAGE TIME SPENT AT FEEDERS BY MAX MCGRAW WILDLIFE FOUNDATION MALLARDS DURING THE SUPPLEMENTAL FEEDING EXPERIMENT CONDUCTED IN 1971

Location	Age (weeks)	Type of Duck	Number of Visits to Feeder per Day	Average Time at Feeder per Visit (min)
Lake 23	7	Control	4	20
Lake 23	7	Control	2	2
Lake 58	9	Experimental	12[1]	5[1]
Lake 4	9	Experimental	6	4
Lake 4	10	Experimental	5	4
Lake 23	11	Control	2	9
Lake 51	12	Control	6	3
Lake 50	12	Experimental	5	4
Lake 50	12	Experimental	1	5
Ashland Lake	13	Control	4	8
Ashland Lake	13	Control	1	4

[1]This number was large due to a malfunction of the feeder.

Feeding Behavior

Weidmann (1956) described the following feeding behaviors of mallards: diving, dabbling, straining, picking-up (on land), biting-off, gulping, snapping, browsing and reed-shaking. Both experimental and control MMWF mallards used all of these methods. There were no differences in feeding behavior that could be attributed to rearing techniques; although in 1970, experimental ducklings appeared to be attracted to grass seeds. Feeding methods were more apt to depend on available food and physical conditions of the feeding area.

Dabbling and straining represented over 99 percent of the feeding behavior because feeding areas were located in shallow water less than 1 m in depth. Except for diving, which was usually unnecessary because of the shallow water depth, the remaining feeding methods were usually opportunistic and were seldom observed after the ducks grew older. During dabbling, ducklings did not always tip-up. They used three feeding positions that were dependent on the depth of the food. The tip-up position occurred when the ducklings were feeding at greatest depth. If the food was shallower, ducklings fed in a sitting position with head and neck under water. If the food was near the surface, ducklings fed in a sitting position with only the bill under water. Birds feeding together in the same general area often fed at different depths using the three dabbling positions.

Two feeding behaviors of MMWF mallards were not described by Weidmann (1956). The methods of feeding on grass seed heads and on frog larvae were different. Except for the feeding methods involved, the habit of eating grass seeds was discussed previously. Most of the tall grass was recurved enough that ducklings could reach the seed head by jumping 4 or 5 cm. If the grass were tall and out of reach, experimental birds exhibiting this behavior pushed it over with their chests and fed on the seed heads as they came into reach.

Feeding on frog larvae (tadpoles) was observed by Mr. Paul Geroudet (1965). On Ashland Lake, where aquatic vegetation was not abundant, conditioned and unconditioned ducks fed on frog larvae as the larvae came to the surface of the lake. Fourteen birds were 3 to 6 m apart, side by side in a single row, working east and west across the lake catching frog larvae.

Loafing Behavior

Regularly used loafing sites for each release lake are described in Table XXXIV. Loafing time and movement to and from loafing areas are illustrated for experimental and control ducklings in 1969, 1970 and 1971 in Figures 19 through 26 in the Appendix. Morning and afternoon rest periods described by Weidmann (1956) did not occur in MMWF ducklings until the 1971 release where supplemental food was provided. The amount of sleep during a loafing period for ducklings released in Oklahoma could not be determined because the distances between birds and observer were often 300 to 600 m. Resting postures of MMWF mallards were the same as those described by Weidmann (1956).

Preening and Oiling

Grooming occurred prior to each loafing period and occasionally took place independently. Ducklings 8 weeks old or less usually preened and oiled less than 10 min at a time. In general, birds older than 8 weeks spent more time caring for their plumage (Table XXXVII). Burger (personal communication, 1971) suggested that "oil gland development and preening evolution may be interfered with by lack of adequate swimming water under rearing conditions in early life." This is being investigated at the Max McGraw Wildlife Foundation hatchery.

During the first 24 hr in the new habitat, ducklings seldom groomed themselves as they left the water. If grooming did occur it lasted less than 1 min. These ducklings commonly shook and ruffled their plumage and sat down without preening or oiling. Table XXXVII illustrates the increase in duration of the grooming period that developed in increasingly older birds.

There was no consistent difference between grooming activities of experimental and control ducklings. Also, one preening bird did not attract other birds to preen, whereas feeding birds did attract other birds to feed near them. Most differences in grooming seemed associated with individual need. Such things as ectoparasites, wind, water-soaked feathers, feeding drive, and molting apparently

TABLE XXXVII

DURATION OF MAX MCGRAW WILDLIFE FOUNDATION MALLARDS GROOMING ACTIVITIES PRIOR TO LOAFING

Location	Age[1] (weeks)	Type of Duck	Number of Ducks	Duration[2] (min)	Activity
1969					
Duck Marsh	4	Both	30	5	Preening breast and abdomen plumage, oiling.
Canton Res.	4	Control	12	15	Escape dives, bathing, preening and oiling.
Chalfant Lake	8	Experimental	5	7	Bathing, stretching and little preening.
Coym Lake	8	Control	36	10	Bathing, preening and oiling.
Penoski Lake	12	Both	6	17	Bathing, preening and oiling. Feathers being removed and floating on the water down wind.
Rocket Lake	12	Both	8	8	Bathing, preening and oiling.
Ham Lake	12	Control	18	9	Preening, feathers scattered around loafing area.
Penoski Lake	17	Both	7	15	Bathing, preening, feathers scattered down wind.
1970					
Duck Marsh	6	Experimental	10	0	No grooming.
Ashland Lake	6	Both	11	1	Preening.
Ashland Lake	7	Control	8	7	Bathing, preening and oiling.
Penoski Lake	6	Experimental	77	3	Bathing, cleaning nasal saddles, preening and oiling.
Penoski Lake	7	Experimental	3	8	Bathing, preening and oiling.
Curry Lake	7	Control	42	1	Escape dives, bathing, scratching.

TABLE XXXVII (Continued)

Location	Age[1] (weeks)	Type of Duck	Number of Ducks	Duration[2] (min)	Activity
Curry Lake	9	Control	41	18	Escape dives, bathing, preening and oiling.
Penoski Lake	9	Experimental	2	10	Preening, oiling, scratching about the head.
Brown Lake	13	Both	9	25	Bathing, preening, oiling.
<u>1971</u>					
Duck Marsh	6	Experimental	4	2	Preening and bathing.
Ashland Lake	7	Control	27	4	Escape dives and working water from feathers, oiling breast.
Lake 23	7	Control	14	8	Escape dives and splashing water over backs, preening.
Lake 58	9	Experimental	16	10	Bathing, preening and oiling.
Lake 4	9	Experimental	25	11	Bathing, preening and oiling.
Lake 39	11	Control	15	17	Bathing, working water from feathers.
Lake 51	12	Both	33	11	Oiling and working breast feathers.
Lake 4	12	Experimental	25	10	Bathing, preening and oiling.
Ashland Lake	14	Control	21	55	Preening and oiling.
Lake 4	14	Experimental	6	22	Preening abdomen, chest, wings.

[1]Age is included to illustrate the difference in duration of grooming between younger and older birds.

[2]These ducklings had several short grooming periods. Times listed in this column were the longest observed for each group.

influenced preening, but the exact effect of each factor is undetermined.

Experimental birds on Penoski Lake in 1970 commonly concentrated biting and scratching movements on certain parts of the head and body. Ectoparasites were found on all birds collected on Penoski Lake. Feeding drive in experimental birds at Chalfant Lake in 1969, at Penoski Lake in 1970, and in control ducks on Rocket Lake in 1970 appeared to shorten preening and oiling periods. Individual birds left the water for periods of only 1 min or less to preen and oil before re-entering the water.

Molting appeared to extend the grooming period. In September of 1969 and 1970, the few birds remaining on the release lakes began their first prenuptial molt. Preening periods during molting often lasted 20 min or more. Many feathers drifting on the water surface downwind from a preening duck indicated that molt was underway. Loose feathers were removed by the bill and washed away by splashing the bill in water.

As mentioned previously, escape dives associated with escape runs by Weidmann (1956) were always performed by MMWF ducklings during bathing prior to grooming activities. Bathing varied in intensity and duration, but it was always associated with preening and oiling.

Premovement Gestures

Weidmann (1956) described premovement gestures and vocalization in the mallard duck. The MMWF ducklings performed similarly to Weidmann's (1956) description except in two cases. First, thrusting-the-head-upward (Weidmann's term), designated as a preflight gesture, was executed by one or more MMWF birds in connection with these actions: prior to leaving the loafing site; prior to getting out of the water onto a loafing site; during the approach of an animal moving on land at distances over 100 m; and prior to flight. Among the MMWF mallards, the thrusting-the-head-upward or the down-up occurred as general premovement gestures rather than strictly as preflight gestures.

Second, the following series of movements were performed by most ducks prior to leaving a perch located on a stump or on the bank at 30 to 60 cm above water: the neck was stretched out and down and the bill was extended toward the water. The bill was dipped into the water if the bird was close enough and the head was then brought back up. Ducks were either in a sitting or standing position, and the gesture was repeated usually two or three times with as many as nine repetitions being observed. After the gestures were completed, the bird got off the perch and entered the water. Quite often, birds nearby were observed repeating the movements performed by the first bird. Movements by surrounding birds were less vigorous, and they did not always leave their loafing places. Lone birds seldom performed the neck-stretching-out-and-down movement prior to leaving a perch. This was performed mostly by members of a group. The only distinction that can be made between experimental and control ducks is that the latter remained in large groups and were more influenced by group behavior than were the former. Evidently the neck-stretching-out-and-down is a behavior that serves a communicative function regardless of rearing condition.

Flight

Sustained movement of flightless birds was confined to travel between feeding and loafing sites. Direct travel such as this usually took less than 5 min. Gaining the ability to fly changed the daily routine movements about the lakes only slightly. On most lakes ducks flew only when they were disturbed or were escaping. First flight observed in released ducklings is recorded in Table XV.

After ducks reached flight age there were two activities associated with flight that occurred irregularly and had no apparent external stimulation.

The first activity occurred in control birds 9 weeks of age in 1969 and 1970, and in both experimental and control birds 8 to 10 weeks of age in 1971. This activity was wing exercise and trial-flight practice. It began with a group of ducks swimming rapidly into open water and, as a unit, they rushed over the water beating their wings. There were varying degrees of successful flight, the longest being about 200 m. Flight practice was repeated several times lasting up to 30 min.

The second activity was observed in both experimental and control birds after they were capable of longer flights. Small groups occasionally flew up, circled the lake six to eight times, then landed. This was seen regularly only in 1971 where supplemental food was available. In 1969 and 1970 most birds appeared to leave the area after their flying strength and ability improved.

Behavior Associated with Nasal Saddles

Ducklings released in 1970 and 1971 were fitted with colored plastic nasal saddles prior to shipment to Oklahoma. In 1970, orange saddles were placed on experimental birds and black saddles were placed on control birds. In 1971, white saddles were placed on experimental ducklings and green was used to mark control ducklings. This form of marking greatly improved the identification of released birds. Ducklings could be identified at 500 m with a 20X spotting scope.

Young birds were neglectful in keeping strands of submergent vegetation off their nasal saddles. This was very evident for the first 2 to 3 weeks after release. The suspended vegetation did not noticeably affect their feeding behavior because they continued feeding regardless of the buildup of material on the saddle. It seemed to take very little effort to free the saddles of the plant materials. If the load became too great, there were three methods used to remove the vegetation:

1. They scratched the saddles vigorously with their feet.
2. They put their heads below water and shook vigorously.
3. They rolled their heads over their backs and rubbed their bills on their back feathers.

Quite often the vegetation was pulled off by other ducks feeding beside them. If a large mass became entangled, they merely lowered their heads and backed out of it. The possible effect of light colored markers in attracting predators is unknown.

As the birds grew older, they became more diligent in keeping the markers free of plant materials. Birds leaving the loafing site to feed never had an accumulation on the saddles and even feeding birds kept them free of vegetation.

The external nares of six birds collected at Penoski Lake and Curry Lake in 1970 were slightly enlarged by the nasal saddles but had no signs of infection, irritation, or irregular tissue growth. The markers were attached to the birds for 5.5 weeks prior to collection.

As a result of these observations, nasal saddles described by Sugden and Poston (1968) are recommended as an excellent method of marking ducks. Because of lack of contrast, against the bill, black is not recommended unless it is used in combination with another color.

Behavior of Ducklings at Feeder Sites

Experimental and control ducklings had similar behavior at feeder sites in 1971. There was little aggressive behavior shown by the birds while feeding even though two or three birds were feeding from the same feeder opening. If grain were spilled from the feeder openings, ducklings tipped up to get grain from the lake bottom below the feeder. If other animals were near the feeders or if the feeders were plugged with wet grain, ducklings swam about, seemingly agitated, in deep water. They did not approach the feeders if other animals were nearby.

As mentioned earlier, ducklings averaged six 6-min visits per day at feeders. Little adverse behavior affected ducklings during their short trips to the feeders.

The only significant behavioral problem was associated with filling feeders. At this time, ducklings that normally swam away or flew during human approach swam to within 3 to 6 m of the person filling the feeders. This degree of human tolerance is not desirable. If feeders still had grain in them and if the birds did not appear hungry, 12-to-14-week-old birds were less apt than younger birds to approach the feeders as they were being filled.

Comparisons of approach distances of birds with and without supplemental food will be made later.

Fall Grouping

Because this project was terminated at the end of August in 1971, fall grouping data are available only from the 1969 and 1970 releases.

Ducks remaining on the release lakes in late August, September, October, and November of 1969 and 1970 showed signs of pairing (Table XXXVIII). Although no courtship behavior was observed, the birds were definitely orientated in pairs of multiples of two. This mild form of pairing was observed in both experimental and control birds in 1969 and 1970. Pairing among experimental birds in 1970 occurred 2 to 3 weeks ahead of pairing in the control birds (Table XXXVIII).

TABLE XXXVIII

SIGNS OF FALL PAIRING BY MAX MCGRAW WILDLIFE FOUNDATION MALLARDS

Location	Date	Type of Duck	Grouping
1969			
Penoski Lake	9-19	Both	1 pair-total 8
Rocket Lake	9-27	Both	1 pair, 1 pair plus 1 drake-total 29
Duck Marsh	9-27	Both	3 pairs-total 18
1970			
Penoski Lake	8-27	Experimental	4 to 11 pairs-total 62
Duck Marsh	9-5	Experimental	1 pair-total 2
Brown Lake	10-10	Both	2 pairs-total 9
Curry Lake	10-11	Control	3 pairs-total 26

Pairing seemed to withstand considerable mixing and moving among the remaining birds. The sex of a few of the pairs was identifiable although most birds were still in juvenile plumage. Pairs in which the first prenuptial molt had begun and sexes were evident, a male and a female were pair partners.

Reproductive, Nesting and Brooding Behavior

Normal courtship and pairing behavior described by Lorenz (1941), Weidmann (1956), Johnsgard (1960, 1965), Collias (1962), Raitasuo (1964) and McKinney (1965, 1969) was observed in the majority of MMWF mallards during the spring months 1 yr after their release. Also, the majority of pair mates were birds of the same release group from the previous year, and pairing between experimental and control birds was common. A small number of males and females of both experimental and control ducks appeared not to form pair bonds. Instead, these birds congregated in small groups of from four to six birds in which courtship displays were absent even though both sexes were present. Each lake having a large spring mallard population had a small group of nonreproductive birds.

Paired ducks were not tolerant of other mallards at feeding sites. There was considerable pecking, chasing and attempted rapes of hens by paired drakes. Some pairs flew to the general area where food was available but did not feed, while other mallard pairs, using lakes nearby, did not come to the feeding area at all. After incubation started, only drakes came for food and aggressive behavior subsided at the feeding sites.

Scattered courtship display was observed as early as January, and three-bird flights were in progress by mid February. Egg laying and incubation occurred mostly in March and April, and broods were present in April and May (Table XXVII). Reproductive success is discussed in Chapter VI.

There were 15 occasions of trio-bond formation. Trios are formed when three mutually accepted ducks are involved in ritual courtship display which continues throughout the breeding season. Raitasuo (1964) describes trio formation as follows:

> Even in winter one occasionally sees two drakes making approaches to one female, which perhaps has previously courted alternately both of these drakes; typically the females often change their objects of courting in the beginning of the pair formation period, as already described in section 4.21. They may result in a rival fight between the drakes. If both drakes nevertheless still follow the same duck (cf. Lorenz 1935), the fights may become less and less frequent. The phenomenon may at first be a result of prolonged intense strife, the internal motivation for fighting is reduced to a minimum, and it takes a certain time for it to increase to a level of release. At the same time apparently mutual habituation also results so that both parties gradually adjust to a situation originally quite intolerable. Gradually also the mutual female accepts both drakes at the same time without encouraging one or the other to attack the competitor.

> The regular preponderance of drakes in the mallard flocks overwintering in the Helsinki area may also to some extent contribute to the existence of such trios. As, however, each spring a number of females remain unpaired in spite of the excess of drakes and since there are always more of such females than of trios, the formation of the latter cannot be caused by a force of circumstances of any kind.
>
> Trios are thus quite rare, yet rather regularly recurring phenomena.
>
> So far I have not been able to obtain information concerning the nesting success of trios. Copulation usually appears unsuccessful: as the female and one of the drakes initiate the introductory ceremonies, the other drake turns aggressive, and the chain of activities breaks up.

Trios observed by Raitasuo (1964) involved two drakes and one hen and copulation was incomplete. Also, trios were formed even though unattached hens were present. In the MMWF mallards, where unpaired hens were also present, nine trios with two drakes and one hen were detected and six trios with one drake and two hens were detected. Two trios were interspecific involving, in one case, a wood duck drake and two mallard hens and in the second case, one mallard drake and hen and a wood duck hen.

Two copulations were observed in trios with one drake and two hens and one copulation was observed in trios with two drakes and one hen. One brood of 9 ducklings was reared by a trio of one drake and two hens and another brood of seven is believed to result from a one-drake-two-hen trio. A third brood of five is suspected as coming from a two-drake-one-hen trio.

In all trios, one drake was dominant, and he was responsible for driving away other ducks. In one-drake-two-hen trios with broods, both hens attended the brood. One hen led while the second hen kept her position between the brood and any drakes in the area.

Beside the trios that included wood ducks mentioned above, an additional interspecific pair formed between a drake gadwall and a hen mallard. Also one mallard drake became paired with a domestic hen hybrid at the Zink Ranch.

There were mixed results from released-mallard nesting behavior (Table XXVII). Hens had various degrees of success from nests in nest boxes, other birds chose poor nest sites on the ground and their nests were abandoned or destroyed, while others had successful nests that were never found. In situations where hens were incubating in nest boxes, most drakes were protective of the area surrounding the nest box and vigorously repelled intruding ducks. In other cases drakes did not remain with incubating hens. Judging by the number of eggs dropped at feeding sites and on loafing areas, some young hens were either reluctant to start nests or their timing was incorrect. This could be attributed to the lack of a nest experience as hatchlings, or to "apathy" (if apathy exists in ducks), or it could be attributed to failing to coordinate nesting instinct and physiological change associated with egg laying.

There were also mixed behavioral patterns associated with brood care. At two separate lakes two broods were present on the same lake at the same time. In both cases the broods were joined and one hen took over the leadership of the combined broods. In two instances where trios were involved, two hens, in each case, were observed in charge of one brood. On one lake where a hen and a drake were both watching a brood, the brood number dwindled from five to none. The drake was observed pecking at the last duckling while the hen was trying to force her way between the drake and the ducklings. At another lake a hen and a drake were successful in rearing a brood of nine ducklings. Occasionally the drake took over the responsibility of the brood when the hen left to feed. The drake kept the brood away from other ducks and away from people. In both cases where this was observed the hen was gone more than an hour.

In normal situations where hens cared for the broods, broods were kept together and were kept away from the feeding areas, while they were downy young, until the other ducks had gone. Although hens often led the broods across open water, they were usually found in emergent vegetation in shallow water. Also, hens were known to lead ducklings overland to different lakes.

Even though released mallards exhibited some unusual reproductive behaviors, some birds performed the task of reproduction in a manner typical of the species, and they reared broods to flight age in Oklahoma.

Intestinal Parasites and Behavior

Six experimental ducks collected at Penoski Lake in 1970 were necropsied. All six birds harbored large numbers of cestodes. Three control birds taken from Curry Lake on the same day were free of intestinal parasites.

The majority of the tapeworms were identified as *Diorchis bulbodes* which was first described by Mayhew in 1929. There was an average of 42.7 scolices of *Diorchis bulbodes* in the small intestines of the six birds examined. After fixing, dehydrating, and staining, a mature tapeworm of this species was about 4.5 cm in length. The remainder of the tapeworms found in the small intestine of the six birds were *Hymenolepis* spp., which averaged 16.3 scolices per bird. The longest *Hymenolepis* spp. was 9.3 cm in length. According to Wardle and McCleod (1952) there are 17 species of *Hymenolepis* occurring in wild ducks.

Both of the genera, *Diorchis* and *Hymenolepis* belong to the subfamily Hymenolepididae. Olson (1974) names the intermediate host of this subfamily as aquatic invertebrates: "In the case of other species of hymenolepiids occurring in birds and mammals living in an aquatic environment, aquatic invertebrates are most likely to serve as the intermediate hosts, with microcrustaceans being predominant in this role." The parasite infection of experimental birds on Penoski Lake was evidently contracted from wild ducks (which were common on this lake) by way of infected intermediate invertebrate hosts consumed by the ducklings. There were no records of parasite infections at the Max McGraw Wildlife Foundation hatchery. This condition was evidenced further by an examination of digestive tracts of birds that died in transit from Illinois to Oklahoma in 1971, all of which were free of parasites.

It is possible that the cestode infection at Penoski Lake in 1971 had altered feeding and loafing behavior in the ducklings released there. The extent of the infection is unknown; however, a relatively large percentage of the population was assumed to be infected.

Many of the experimental birds on Penoski Lake in 1970 had long feeding periods. Three ducklings fed continuously for nearly 3.5 hr and after a 10-min preening and oiling period the three birds resumed feeding. In two separate observations, two ducklings fed for such a long period they were beginning to lose buoyancy. Only their heads and necks and the top of their backs were out of water. These birds had failed to stop feeding long enough to work water out of their abdominal plumage and to oil; consequently they were starting to sink. Water ran from their plumage after they went on land at one of the loafing sites.

Reactions and Adaptations

Human Activity

During fair weather in the spring, most bodies of water used as release sites were used considerably by fishermen. Fishing was particularly heavy during vacations and week-ends, but during the hotter parts of June, July, August, and September it diminished somewhat. Because of the lack of set time intervals of observation at each lake, comparisons of human use between release lakes cannot be made; however, observations were made of changes in duckling behavior indicating an adaptation to humans using the lake.

During their first day in the new habitat, young birds usually ran along the shore rather than enter the water when people approached on foot. Table XXXIX illustrates the change in escape behavior as birds grew older. Older birds that had established ranges always moved into water when they were approached by people. If the people got too close, the birds flew. In most cases approach distance increased with increase of age in the ducklings. Solitary birds or small groups of birds with less than 10 members were often approached more closely than were larger groups of birds. At comparable ages in 1969 and 1970 (Table XXXIX), experimental ducklings released on Penoski Lake had a greater approach distance than did control birds released on Curry Lake.

Approach distances and reactions of ducklings depend on several factors including: (1) habitat type, (2) influence of escape activities of other animals, (3) duckling activity at the time of disturbance, (4) time interval from last disturbance, (5) visibility, (6) time of day and time

TABLE XXXIX

REACTIONS OF MAX MCGRAW WILDLIFE FOUNDATION MALLARDS TO PEOPLE ON FOOT

Location	Age (weeks)	Type of Duck	Number of Ducks	Approach Distance (m)	Reaction
1969					
Penoski Lake	4	Both	21	15	Paid little attention to us.
	8	Both	15	15	Escape-ran into deep water.
	12	Both	12	8	Flew-circled and landed in deep water.
	17	Both	8	30	Flew-circled and landed in deep water.
Grassy Lake	4	Both	18	4	Slowly swam away.
Curry Lake	4	Both	7	5	Ran into weed cover.
	8	Both	14	75	Escape-ran into aquatic cover.
	12	Both	5	13	Flew into deep water.
Duck Marsh	4	Both	37	2	Escape-ran into water.
	7	Both	2	7	Sat on stump surrounded by water.
	12	Both	5	25	Flew to heavy cover.
	17	Both	7	60	Swam toward deep water.
Rocket Lake	7	Both	25	20	Slowly swam toward islands.
	12	Both	5	18	3 flew, 2 swam toward islands.
	17	Both	25	30	Flew toward deep water.
Canton Res.	4	Experimental	60	3	Crowded together under bush.
	12	Experimental	21	15	Flew toward deep water.
Taylor Lake	4	Experimental	47	12	Escape-ran into the water.
	8	Experimental	1	2	Escape-ran into the water.

TABLE XXXIX (Continued)

Location	Age (weeks)	Type of Duck	Number of Ducks	Approach Distance (m)	Reaction
Chalfant Lake	4	Experimental	58	3	Escape-ran into cover.
	8	Experimental	32	100	Slowly swam away from fishermen.
	11	Experimental	1	30	Flew down the beach-landed out of water.
Coym Lake	4	Control	100	23	Swam into deep water.
	8	Control	36	10	Swam away as rocks were thrown at them.
	11	Control	3	40	Flew with wild ducks.
Ham Lake	12	Control	18	20	Walked into water from loafing area.
<u>1970</u>					
Brown Lake	5	Control	38	5	Entered water from loafing area.
	7	Both	37	20	Swam into heavy cover.
	11	Both	39	20	Swam into heavy cover.
Rocket Lake	5	Control	42	20	Entered water from loafing area.
	6	Control	35	25	Swam toward islands.
	11	Control	8	150	Swam toward islands.
	13	Control	9	25	Swam slowly toward islands.
Duck Marsh	5	Experimental	7	13	Ran down dike.
	6	Experimental	17	7	Swam away from loafing area.
	11	Experimental	4	35	Swam into heavy cover.
	13	Experimental	2	50	No reaction.
Ashland Lake	6	Both	16	17	Swam into heavy cover.
	8	Both	7	31	Swam toward deep water.

TABLE XXXIX (Continued)

Location	Age (weeks)	Type of Duck	Number of Ducks	Approach Distance (m)	Reaction
Penoski Lake	6	Experimental	77	17	Swam toward deep water.
	8	Experimental	11	35	Flew to deep water.
	13	Experimental	10	60	Flew to opposite side of lake.
Curry Lake	6	Control	45	13	Escape-ran into heavy cover.
	8	Control	60	15	Rushed into water from loafing area.
	13	Control	67	30	Flew and rushed into heavy cover.
Zink Ranch	4	Both	32	25	Rushed across pond.
	7	Both	23	30	Swam across pond.
	12	Both	28	37	Swam into deep water.
1971					
Lake 52	5	Control	31	5	Slowly swam off.
	6	Control	10	15	Swam away from loafing area.
	7	Control	22	20	Swam away.
	8	Control	1	10	Slowly swam away.
Lake 6	5	Experimental	31	30	Swam away from loafing area.
	6	Experimental	3	30	Swam away from loafing area.
	7	Experimental	7	40	Swam to deep water.
Lake 3	5	Control	31	60	Swam away from loafing area.
	6	Control	21	18	Swam to deep water.
	7	Control	2	70	Swam to deep water.
Lake 2	5	Experimental	31	6	Did not move.
	6	Experimental	22	45	Swam away from loafing area.
	7	Experimental	7	30	Swam to deep water.

TABLE XXXIX (Continued)

Location	Age (weeks)	Type of Duck	Number of Ducks	Approach Distance (m)	Reaction
Lake 45	5	Control	31	30	Rushed to deep water.
	6	Control	15	25	Ran down a car path to release lake.
Lake 66[1] (Ashland)	5	Control	3	2	Hid in weeds.
	6	Control	17	5	Rushed to deep water.
	7	Control	28	50	Swam away in a close group.
	8	Control	27	15	Swam to deep water.
	9	Control	26	15	Rushed and flew to deep water.
	10	Control	26	40	Swam into cover vegetation.
	11	Control	26	25	Flew.
	12	Control	25	60	Flew.
Lake 4[1]	5	Experimental	31	30	Rushed and swam to deep water.
	6	Experimental	22	15	Rushed away; one tried to fly.
	7	Experimental	24	40	Swam to deep water.
	8	Experimental	25	50	Swam to deep water.
	9	Experimental	25	25	Swam and flew to deep water.
	10	Experimental	25	35	Swam to deep water.
	11	Experimental	25	25	Swam to far side.
	12	Experimental	25	25	Swam to far side.
Lake 39[1]	5	Control	30	5	Swam slowly into cover plants.
	6	Control	8	5	Swam to deep water.
	7	Control	25	10	Rushed to deep water.
	8	Control	17	none	Feeder was plugged; birds swam to the feeder.
	9	Control	14	20	Swam into cover plants.
	10	Control	15	none	Swam to feeder.
	11	Control	15	20	Swam to deep water.
	12	Control	15	20	Swam to deep water.

TABLE XXXIX (Continued)

Location	Age (weeks	Type of Duck	Number of Ducks	Approach Distance (m)	Reaction
Lake 58[1]	5	Experimental	31	25	Swam to deep water.
	7	Experimental	23	20	Swam to deep water.
	8	Experimental	21	22	Rushed to deep water; tried to fly.
	9	Experimental	21	40	Swam to deep water.
	10	Experimental	21	20	Swam to deep water.
	11	Experimental	21	60	Swam to deep water.
	12	Experimental	20	60	Swam to deep water.
Lake 51[1]	5	Control	31	35	Swam to deep water.
	6	Both	44	20	Ran down a spillway canal.
	7	Both	44	10	Swam to deep water.
	8	Both	32	--	Ran overland through a herd of cattle toward the lake; feeder was plugged.
	9	Both	33	10	Swam to deep water.
	10	Both	33	25	Rushed and flew to deep water.
	11	Both	33	65	Flew.
	12	Both	33	75	Flew.
Lake 7[1]	5	Experimental	31	40	Rushed into water.
	8	Both	7	15	Rushed into deep water.
	9	Both	7	20	Swam to deep water.
	10	Both	7	40	Swam to deep water.
	11	Both	7	40	Swam to deep water.
	12	Both	7	45	Flew.

TABLE XXXIX (Continued)

Location	Age (weeks)	Type of Duck	Number of Ducks	Approach Distance (m)	Reaction
Lake 23[1]	5	Control	31	5	Swam along the lake edge.
	6	Control	19	5	Rushed into deep water.
	7	Control	26	60	Swam to deep water.
	8	Control	26	40	Swam to deep water.
	9	Control	25	10	Swam to deep water.
	10	Control	21	20	Swam to deep water.
	11	Control	20	25	Swam to deep water.
	12	Control	20	20	Swam to deep water.
Lake 50[1]	5	Experimental	31	60	Swam to deep water.
	6	Experimental	31	60	Swam to deep water.
	8	Experimental	24	60	Swam to deep water.
	9	Experimental	24	30	Swam to deep water.
	10	Experimental	24	50	Swam and flew to deep water.
	11	Experimental	24	35	Flew.
	12	Experimental	24	40	Flew.

[1]Release lakes with supplemental food.

of year, (7) temperature, (8) number of birds and (9) manner of human approach. The dependability of approach distance as criteria for comparing experimental, control and wild ducks may be questioned.

Escape runs associated with human disturbances were usually under 50 m. Escape flights were usually direct flight to deep water and they were usually under 200 m in length. Only twice were birds observed to circle before landing. After the disturbance passed and ducks became more settled, they always began feeding.

The reaction of ducklings to people in boats and automobiles was much less fearful than their reaction to people on foot (Table XXXX). Occasionally ducklings did not flee when they were approached by a vehicle, and at Canton Reservoir in 1969 and Curry Lake in 1970, control ducklings were attracted to boats rather than repelled by them. Reaction to human vehicles generally improved by the time birds reached flying age.

Reaction to Predators

There was evidence around each release lake indicating considerable traffic by land-oriented and air-oriented predators. The most commonly observed tracks belonged to coyotes, raccoons, striped skunks, and bobcats. The most commonly observed signs of avian predators belonged to barred owls and great horned owls. Other observations included the remains of partially or completely eaten

TABLE XXXX

REACTION OF MAX MCGRAW WILDLIFE FOUNDATION MALLARDS TO BOATS AND AUTOMOBILES

Location	Age (weeks)	Type of Duck	Number of Ducks	Vehicle	Approach Distance (m)	Reaction
1969						
Grassy Lake	4	Both	21	Truck	1	Sat in the weeds by edge of asphalt road.
Rocket Lake	4	Both	55	Car	3	Ran for the water.
	4	Both	22	Boat	5	Swam slowly into cover.
Canton Res.	4	Control	40	Boat	3	Swam by boat slowly.
	7	Control	42	Boat	1	Being fed from boats.
	9	Both	11	Boat	25	5 flew, 6 swam for cover.
	9	Control	2	Boat	20	Loafed on a beach.
	12	Experimental	3	Truck	17	Flew when truck stopped.
Coym Lake	8	Control	6	Truck	30	Flew; truck stopped.
	8	Control	36	Truck	1	Loafed in shade of truck.
Penoski Lake	12	Both	12	Truck	8	Entered water from loafing area.
1970						
Ashland Lake	6	Control	1	Truck	1	Fed on grass seed.
	6	Both	3	Truck	25	Fed on grass seed.
Brown Lake	9	Both	39	Boat	5	Slowly swam into heavy cover.
	13	Both	9	Boat	15	Slowly swam away.
Curry Lake	13	Control	82	Boat	10	Remained on loafing area.

TABLE XXXX (Continued)

Location	Age (weeks)	Type of Duck	Number of Ducks	Vehicle	Approach Distance (m)	Reaction
1971						
Lake 3	5	Control	31	Truck	60	Swam from loafing site into deep water.
Red Bird Lake	6	Experimental	75	Boat	5	Swam toward land.
Lake 23	7	Control	26	Car	60	Swam into deep water.
Lake 4	7	Experimental	24	Car	40	Swam into deep water.
Lake 51	9	Both	33	Car	5	Showed no fear.
Lake 50	9	Experimental	24	Truck	30	Swam to deep water.
Lake 51	10	Both	33	Truck	25	Rushed and flew to deep water.
Lake 7	10	Both	7	Truck	40	Swam to deep water.
Lake 4	10	Experimental	25	Truck	35	Swam to deep water.
Lake 66 (Ashland)	12	Control	25	Truck	60	Flew.
Lake 51	12	Both	33	Truck	75	Flew.

ducklings. It was not possible, however, to determine whether birds were killed by predators or were found dead and then eaten. Most predation due to underwater predators such as fish and turtles was not detected. Only one attack on a duckling by a large mouth bass was observed, and a snapping turtle and a pond slider were detected as they fed on the body of a floating dead duck. Except for the fact that ducklings were often aware of underwater movement and would avoid some areas, aquatic predation went unnoticed. Reactions of ducklings to predators are listed in Table XXXXI.

The most commonly observed avian predators were red-tailed hawks. In general, hawks paid little attention to the ducks on the release lakes and the ducks did little more than watch the hawks as they flew over. However, one red-tailed hawk was observed feeding on a freshly killed duck that wandered away from its release lake on the Zink Ranch.

In 1969, 2.4 percent of the released birds were recorded as mortalities at the edge of their release lakes. In 1970, 4 percent of released birds were found dead, and in 1971, 3.7 percent were mortalities. The observed number of mortalities represents a small proportion of the total release. Unfortunately, the exact effect of predation is difficult to determine because losses due to fish and turtles are undetected unless the predator is observed in action, and some adult predators take dead birds away from

TABLE XXXXI

REACTION OF MAX MCGRAW WILDLIFE FOUNDATION MALLARDS TO PREDATORS

Location	Age (weeks)	Type of Duck	Stimulus Animal	Distance (m)	Reaction of Ducks
1969					
Canton Res.	9	Control	Dog	30	Entered water and swam away.
Chalfant Lake	8	Experimental	2 Red-tailed Hawks	7	No reaction; kept feeding.
Coym Lake	8	Control	Unknown; under water	0	Duck jumped and rushed away.
Penoski Lake	12	Both	Coyotes	200	Paid no attention to howling.
Penoski Lake	12	Both	Owl	20	Flew to loafing area under trees.
Duck Marsh	12	Both	Red-shouldered Hawk	30	No reaction.
Duck Marsh	12	Both	2 Red-tailed Hawks	15	No reaction.
Duck Marsh	12	Both	Barred Owl	50	No reaction to hoots.
Taylor Lake	11	Control	Mississippi Kite	25	Stopped feeding and watched the kite.
Coym Lake	11	Control	Mississippi Kite	7	Rushed away from low flying kite.
1970					
Ashland Lake	6	Both	Barred Owl	10	In heavy cover, no reaction.
Duck Marsh	6	Experimental	Raccoon	3	Approached the swimming animal.
Rocket Lake	6	Control	Red-tailed Hawk	40	No reaction.
Rocket Lake	7	Control	Raccoon	60	No reaction.
Ashland Lake	7	Both	Turkey Vulture	5	Rushed into water.

TABLE XXXXI (Continued)

Location	Age (weeks)	Type of Duck	Stimulus Animal	Distance (m)	Reaction of Ducks
Penoski Lake	6	Experimental	Swainson's Hawk	15	Watched hawk closely and quacked considerably.
Penoski Lake	6	Experimental	Unknown; under water	0	Jumped and rushed away as something broke surface from below.
Capart Pond	2	?	Largemouth Bass	0	Downy young pulled under water by fish.
Curry Lake	7	Control	4 Dogs	100	Entered water from loafing area.
Duck Marsh	12	Experimental	Red-shouldered Hawk	30	No reaction.
Curry Lake	9	Experimental	Coyote	20	Slowly swam away from approaching coyote; 3 quacks given.
Duck Marsh	16	Experimental	Osprey	60	Watched as osprey flew over.
Curry Lake	17	Control	Marsh Hawk	10	Swam out of the way of approaching hawk.
1971					
Duck Marsh	30	Both	Bald Eagle	35	Both released ducks and wild ducks scattered.
Rocket Lake	32	Control	Raccoon	5	Watchful but feeding.
Curry Lake	33	Control	Marsh Hawk	15	Both released ducks and wild ducks scattered; some by flying, some by diving. Released birds were first to fly.

TABLE XXXXI (Continued)

Location	Age (weeks)	Type of Duck	Stimulus Animal	Distance (m)	Reaction of Ducks
Lake 4	8	Experimental	Unknown	10	Birds would not go to feeder because some animal was in the trees near feeder.
Lake 23	9	Control	Raccoon	5	Birds would not go to feeder because the raccoon was trying to get grain at the feeder.
All Lakes	5-10	Both	Unknown; under water	0	Birds avoided some areas and often jumped and rushed away from something under water.

the locations where kills were made and feed on them in seclusion.

Trappers had taken an unknown number of raccoons, coyotes, bobcats and opossums in the area of Curry Lake, and 13 large snapping turtles were trapped in the fall of 1970 at Sangre Lake. Predator control was exercised on the U.S. Naval Ammunition Depot. In the last 6 months of 1969, the depot trapper removed 59 coyotes and 11 bobcats. In 1969 and 1970, 96 coyotes and 19 bobcats were trapped each year. During January and February of 1971, 29 coyotes and two bobcats were removed. About 70 raccoons and four to six striped skunks were taken yearly. Raccoons were trapped only when they became a problem to deer trapping activities.

It appears that if food conditions on any release lake are good, predation will not influence the success or failure of a stocking project. If food conditions are poor and ducklings have to leave the protection of the water, they suffer heavy losses to predators.

CHAPTER IX

STATISTICAL COMPARISONS BETWEEN EXPERIMENTAL AND CONTROL DUCKS

The chi-square statistic, as described by Snedecor and Cochran (1968), was used to measure comparable observations of experimental and control MMWF mallards released in Oklahoma. The null hypothesis is that there is no difference between experimental and control ducks. There is enough significant difference at the P=0.25 level or greater to question the null hypothesis. Experimental and control ducks are compared in Table XXXXII.

Experimental rearing techniques at the Max McGraw Wildlife Foundation produced heavier ducklings that were less vulnerable to release-lake hazards than were control ducks, although survival to flight age and migration appeared to be similar. Experimental birds had a higher first season hunting mortality than did control birds, and they were more apt to be found in flocks with wild mallards. Where birds could be identified, experimental birds returned in larger numbers than did control birds. It also appears that survival on release lakes with supplemental food favors experimental ducks over control ducks.

TABLE XXXXII

STATISTICAL COMPARISONS OF EXPERIMENTAL AND CONTROL MAX MCGRAW WILDLIFE FOUNDATION MALLARDS RELEASED IN OKLAHOMA

Characteristic	Experimental Ducks	Control Ducks	Conclusion
Rearing mortality (1970, 1971)	17.9/100	8.3/100	Significant Difference (P=0.05)
Shipping mortality (1970, 1971)	20	8	Significant Difference (P=0.05)
Duckling weight (1970, 1971)	Table VIII		Significant Difference (P=0.05)
Total mortality at release lakes (1969, 1970, 1971)	47	66	Significant Difference (P=0.10)
Possible predator-killed birds (1969, 1970, 1971)	29	49	Significant Difference (P=0.05)
Survival to flight age (1970, 1971)	376	388	Not Significant
Survival to flight age (1970)	175	209	Significant Difference (P=0.25)
Survival to flight age (1971)	201	179	Significant Difference (P=0.25)
First season hunting mortality (1969, 1970, 1971)	27	19	Significant Difference (P=0.25)
Ducks killed in Oklahoma (1969, 1970, 1971)	26	22	Not Significant
Ducks killed in other states (1969, 1970, 1971)	15	17	Not Significant

TABLE XXXXII (Continued)

Characteristic	Experimental Ducks	Control Ducks	Conclusion
Ducks killed less than 160 km from release lake (1969, 1970, 1971)	25	22	Not Significant
Ducks killed more than 200 km from release lake (1969, 1970, 1971)	16	17	Not Significant
Average flock size from which ducks were killed (1969, 1970, 1971)	14	6	Significant Difference (P=0.10)
Ratio of experimental and wild ducks killed during the same hunting period (1969, 1970, 1971)	27/69		Chi-square=18.38[1]
Ratio of control and wild ducks killed during the same hunting period (1969, 1970, 1971)		21/47	Chi-square= 9.94[1]
Identified ducks returning to release lake	51	30	Significant Difference (P=0.05)
Ducks surviving on lakes with supplemental food (1971)	91	80	Significant only at P=0.50
Mortality of ducks on lakes with supplemental food (1971)	1	8	Significant Difference (P=0.05)

[1]These numbers are both significant at the P=0.01 level. The Chi-square numbers are included to illustrate the difference in kill ratios between experimental and control mallards each compared with wild mallards. This indicates a greater association of experimental mallards than control mallards with wild mallards or at least a greater use of wild mallard habitat by experimental mallards.

CHAPTER X

CONCLUSIONS AND SUGGESTIONS

Conclusions

Conclusions based on field observations of experimental and control MMWF mallards released in Oklahoma are made in reference to the questions stated in the project hypotheses and to the project objectives.

The first question was: "will immature mallards survive, migrate, and return to Oklahoma release areas?" Released ducklings did survive, migrate, and return to Oklahoma release areas. During the 3 yrs ducklings were released in Oklahoma, there was little significant difference between experimental and control ducklings in total survival to flight age, migration, and total hunter harvest. However, survival to flight age in 1970 favored control ducklings whereas survival to flight age in 1971 favored experimental ducklings. Also, more of the experimental than the control ducklings were taken during their first hunting season. This comparison was reversed during the second and third hunting seasons. There appeared to be more experimental than control birds returning in the spring 1 yr after release.

The second question was: "how do behavioral patterns of released mallard ducklings affect survivorship?" Two patterns of behavior appeared to be critical to survival of ducklings on Oklahoma release lakes. The first and most critical behavior pattern was the habit of ducklings wandering overland away from their release lakes during the exploratory phase of behavior. This was observed in experimental ducklings in 1969 and 1970, and in experimental and control ducklings in 1971. This behavior pattern may be associated with the lack of a familiar food at release lakes. Ducklings were observed walking away from lakes with good supplies of natural food plants in 1969, 1970 and 1971; however, ducklings on release lakes having supplemental food in 1971 returned in large numbers to their release lakes and were seldom observed away from water after they were established. Numbers of ducklings on release lakes were always lower after the exploratory behavioral phase, during which most overland movement away from water was observed. Even at lakes with supplemental food there was some movement away from water, but the influence of this behavior upon population numbers was less drastic. At one lake with a poor natural food supply and no supplemental food, ducklings were often observed feeding on grass seed heads several meters from water. Similar behavior was not observed on the same lake when supplemental food was added the following year.

The second critical behavior pattern observed in ducklings released in Oklahoma was associated with their tolerance to human approach. Experimental ducklings had a greater approach distance to humans than did control ducks, although both groups should be considered more tolerant of humans than wild mallards. In both experimental and control ducklings that were not domesticated by property owners, approach distances increased as duckling age increased.

In general ducklings reacted appropriately to predators. Evidence of predation at release lakes was low and well within limits observed in mallard releases in other areas.

Following release, experimental birds gathered in smaller groups than did control birds, and experimental birds were less dominated by group behavior. Experimental birds flew at an earlier age and were more apt than control birds to be associated with wild mallards.

The third question was: "can breeding, imprinting, and rearing techniques designed to develop hardier ducklings improve survival of hand-reared ducklings?" If proper release methods are employed and if losses during rearing and shipping can be reduced, it appears that experimental rearing techniques can produce ducklings having a significant advantage over control ducklings in most characteristics deemed necessary for survival. Experimental ducklings were equal to or better than control ducklings in all categories but two. There was a greater tendency for experimental ducklings to wander away from release lakes (which may be corrected by improved release methods), and there were more experimental ducks than control ducks killed during their first hunting season. Some authorities would consider the latter to be a favorable characteristic for experimental birds.

The fourth question was: "how does survival of mallards released in Oklahoma compare with survival of mallards released in other areas?" A comparison between average percentages in five categories of successful and unsuccessful mallard releases reported in the literature, compared with Oklahoma releases, reveals major differences in the categories of ducklings "unaccounted for" and ducklings "reaching flight age." Among released birds reported in the literature, 31.8 percent were unaccounted for; in Oklahoma 57.6 percent were unaccounted for. In the literature 56.0 percent of released birds were said to reach flight age, whereas 39.1 percent of released birds reached flight age in Oklahoma. Percentage of nonhunting mortalities from the literature was similar to that observed in Oklahoma. First season (direct) band returns from the birds released in Oklahoma was 1.6 percent compared with 6.9 percent reported in other projects. Spring return of released birds was stated to be 14.9 percent in the literature whereas there was a trend toward higher numbers of returning birds each year birds were released in

Oklahoma. There was 0.9 percent return from the 1969 release, 7.6 percent return from the 1970 release, and 16.6 percent return from the 1971 release.

The fifth question was: "will mature ducks return to reproduce in release areas?" Although there were some odd spring pairings and some poor nest-site choices, there were 51 incidences of reproduction or attempted reproduction observed in the areas of duckling release. This indicates that Oklahoma is within the tolerance range for mallard reproduction. Because the majority of these birds received supplemental food, a question is raised concerning natural food supply and the ability of many Oklahoma lakes to attract breeding birds. It appears that quantity, quality, and availability of food are major limiting factors for the establishment of a population of breeding ducks.

The first hypothesis of the investigation was: "a breeding population of mallards will develop in areas where ducklings are released." This hypothesis is not rejected provided that habitat quality for duck reproduction, food in particular, is adequate and the birds are relatively free from human disturbance.

The second hypothesis was: "experimentally reared ducklings will exhibit greater survival than will control ducklings." If only the total numbers of experimental and control ducklings surviving to flight age are compared, the second hypothesis is rejected. However, in most cases where observations could be restricted either to experimental or to control birds during which the behavior of one group had no effect on the behavior of the other, these characteristics were evident to support the second hypothesis:

1. Experimental birds were heavier than control birds in 1970 and 1971.

2. On lakes where large numbers of birds were released, control birds congregated in larger groups than did experimental birds.

3. The exploration behavioral phase lasted longer in experimental ducks than in control ducks.

4. In 1969 and 1970, experimental ducklings outnumbered control ducklings in walking away from release lakes. However, mortality was greater among control than among experimental ducklings at release lakes.

5. Experimental birds flew at an earlier age than did control ducklings.

6. Approach distances were usually greater among experimental ducklings than among control ducklings.

7. Control ducks were generally less disturbed than were experimental birds when humans were using the release lakes.

8. Control birds remained longer than did experimental birds on release lakes.

9. Experimental ducks exceeded control birds in hunter kills during the first hunting season.

10. Although not statistically significant because of the small sample size, more experimental than control ducks were killed in Oklahoma and more control than experimental birds were killed in other states.

11. Experimental ducks returning in the next spring outnumbered returning control ducks.

12. Experimental ducklings had greater survival and fewer mortalities on release lakes with supplemental food than did control ducklings.

The third hypothesis was: "rearing techniques can eliminate the "taming" effect of artificial production." This hypothesis is not rejected. Although taming due to artificial production was not completely eliminated by isolation and hardening, it is reduced as is demonstrated by greater approach distances observed in experimental birds. Improper use of supplemental food and high human disturbance reduces the influence of experimental rearing techniques on duckling behavior.

The mallard ducklings used in this study appeared to be flexible birds that adapted behaviorally to the variables in their environment after they were established on release lakes. "Poor behavior" exhibited by released ducklings might be traced, in part, to release techniques and observational methods. Hand-reared birds can hardly be expected to know the difference between humans feeding them and humans hunting them until they are confronted with both situations. Ducklings appear to react to environmental stimuli and to learn from their experiences even though they are without the benefit of vicarious learning experiences provided by a mother bird. It appears that ducklings can be trained, during artificial propagation, to show fearful behavior toward humans. This may help to improve learning experiences of hand-reared birds released in natural areas without the guidance of a mother duck. One of the problems with this type of training program is that it must be contained within budgetary limits of the producers.

It should be noted that as both experimental and control ducklings grew older and more experienced, the following trends occurred: (1) the number of periods and the duration of each period in which ducklings were involved in grooming activities both increased; (2) in general, approach distances increased; (3) whether due to decreased hunting pressure or learning or both, the number of birds killed each month declined steadily following the first month of duck hunting season each year; (4) as suggested by Col. Howard Jarrell, Stillwater, Oklahoma, reproductive behavior, particularly choice of nest location, improved in older, more experienced birds. There were general improvements in duckling behavior varying according to the length of time birds were in a new habitat.

Suggested Release Procedures

The following critical points have various degrees of influence on duckling behavior and on the success of an introduction project:

1. A prerelease analysis of release lakes should include evaluations of water quality, food and cover plants, macroinvertebrates, vertebrates, protected loafing sites, use by cattle, and use by humans.

2. Carrying capacity for each release lake should be measured.

3. If a follow-up, postrelease study is planned, smaller lakes should be used because of the difficulty in locating ducklings during the exploration behavioral phase.

4. Avoid lakes with routes, such as roads or cattle trails, that provide easy overland movement by released ducklings going away from release sites.

Avoid lakes with intensive human use because young ducklings are easily tamed by food handouts and may be caught easily. This behavior declines after a time if birds remain at release lakes free of human interference.

Avoid lakes at which shoreline vegetation is damaged by cattle; such habitat deterioration can be expected to worsen during dry months.

Avoid lakes where grass is mowed near the edge of the lake. This attracts ducklings to feed on grass away from the protection of the water.

Avoid lakes that may have large seasonal changes in water level. Shallow lakes subject to high late-summer evaporation loss and lakes used for irrigation are examples.

5. Improved, isolated, and hardened mallard ducklings appear to be superior to standard game-farm mallards.

6. Gentle release is suggested. If gentle release is not possible, ducklings scheduled for release should be kept overnight in a holding pen having water to swim in prior to release. This improves postrelease behavior in birds shipped long distances.

7. Supplemental food, in a form familiar to the ducklings, should be present on the release lake prior to release and careful feeding should continue for 7 to 10 days following release. This improves duckling attraction to release lake and apparently reduces bird loss during the exploration period. Supplemental feeding need not be continued for established birds on lakes having good natural food supplies.

8. Expected loss due to predation is between 3 and 4 percent. This does not warrant predator control. If ducklings remain on water at release lakes, they apparently have the ability to evade most predators.

9. Over-water nesting structures may be used with hand-reared mallards if release lakes have poor nesting habitat. Hand-reared mallards are known to take advantage of such nesting locations.

Suggestions for Additional Research

The first question to arise is how would pure wild ducklings, reared by hens in natural surroundings for 5 weeks, compare with experimental and control ducklings if they were released, without the hens, on the lakes used in the Oklahoma project. A project of this nature should give some insight into the behavioral differences gained during the first 5 weeks of life under the direction of the parent bird. If little difference is detected in survival and behavior between pure-wild ducklings and hand-reared ducklings, it would suggest that game-farm producers provide adequate rearing conditions for ducklings used in stocking programs. If there are significant differences in survival and behavior between pure-wild ducklings and hand-reared ducklings, then inexpensive duckling training programs could possibly be developed, at game farms, to improve survival and desired behavior patterns. Isolation and hardening are examples of present-day thinking along these lines.

Because of the possibility that stimuli that release behavior patterns or open learning pathways in wild birds may be lacking in the hatchery environment, it may be helpful to understand the differences in learning ability, if they exist, between pure-wild, experimental, and control ducklings. Such things as learning rate, learning type, and retention may be influenced by the learning experiences of different rearing conditions and by quality and quantity of different foods. Some ideas concerning behavior and food are discussed by Howes (1970).

There appears to be a need for controlled experiments to disclose and measure the reactions of pure-wild, experimental, and control ducklings to humans and to predators. It was very difficult in this study to distinguish the influences of the physical and biological components of the environment when evaluating differences in reaction.

Finally, it appears possible that a set of conditioned reflexes eliciting desirable behavior might be developed in hand-reared birds. On hardening lakes, rewarding birds with food when proper behavior is performed should strengthen desired behavior, and punishing the birds with a loud noise or other stressor should inhibit undesired behavior. The experimental design of such a project would require considerable planning.

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APPENDIX

TABLE XXXXIII

LOCATIONS OF RELEASE LAKES FOR MAX MCGRAW WILDLIFE FOUNDATION MALLARDS IN OKLAHOMA

Release Lake	Latitude	Longitude	Range	Township	Section Number	County	Distance and Direction from Nearest Town
Coym	35°47'N	99°53'W	R25W	T15N	18	Roger Mills	26.6 miles NW Cheyenne
Chalfant	35°35'N	99°49'N	R25W	T13N	14	Roger Mills	14.2 miles W Cheyenne
Taylor	35°31'N	99°37'W	R23W	T12N	15	Roger Mills	12.8 miles SSE Cheyenne
Canton Reservoir	36°8'N	98°38'W	R14W	T19N	2	Blaine and Dewey	3 miles NW Canton
Sangre	36°5'N	97°6'W	R2E	T19N	29	Payne	1.5 miles SSW Stillwater
Ham	36°6'N	97°11'W	R1E	T19N	22	Payne	11 miles W Stillwater
Zink Ranch	36°23'N	96°10'W	R11E	T22N	--	Osage	9 miles W Skiatook
Red Bird	35°30'N	96°26'W	R8E	T12N	15	Okfuskee	2 miles NE Boley
Curry	35°30'N	96°26'W	R8E	T12N	14	Okfuskee	1.9 miles NE Boley
Penoski	35°21'N	96°19'W	R9E	T11N	1	Okfuskee	2 miles NNW Okemah

TABLE XXXXIII (Continued)

Release Lake	Latitude	Longitude	Range	Township	Section Number	County	Distance and Direction from Nearest Town
Grassy	35°12'N	96°11'W	R11E	T10N	6	Okfuskee	13.8 miles SE Okemah
NAD[1]	34°48'N	95°57'W	R13E	T3N	--	Pittsburg	10 miles SW McAlester
Capart Farm	34°47'N	96°4'W	R12E	T4N	--	Pittsburg	2 miles North Ashland
Vogel Farm	34°47'N	96°5'W	R12E	T4N	--	Pittsburg	2 miles North Ashland
Blue Stem	34°28'N	96°3'W	R12E	T1N	--	Atoka	4 miles North Stringtown

[1]United States Naval Ammunition Depot, McAlester, Oklahoma

TABLE XXXXIV

AVERAGE MONTHLY TEMPERATURES (FAHRENHEIT) FOR OKLAHOMA STATE DIVISIONS[1] WHERE MAX MCGRAW WILDLIFE FOUNDATION DUCKLINGS WERE RELEASED, 1969-1971

Division	J	F	M	A	M	J	J	A	S	O	N	D	Annual
1969													(1969)
Northeast	36.2	41.7	42.1	61.3	68.8	74.1	84.1	79.9	73.4	59.0	47.8	39.1	59.0
West Central	39.6	42.2	41.2	60.8	68.7	76.6	85.9	81.4	73.1	57.1	49.4	40.9	59.7
Central	39.1	43.2	43.0	61.7	69.4	76.0	85.6	81.2	74.5	59.5	49.6	41.4	60.4
East Central	39.8	42.9	44.7	62.4	69.8	75.4	84.6	80.7	74.5	61.6	50.0	41.6	60.7
1970													(1970)
Northeast	29.8	41.5	44.5	60.5	69.9	75.5	80.9	83.4	74.3	58.1	46.1	43.0	59.0
West Central	33.0	44.8	44.7	60.0	71.2	78.2	83.7	83.7	74.0	58.8	47.0	43.6	60.2
Central	32.4	43.8	46.4	61.3	70.9	77.0	82.1	83.8	75.7	59.7	47.4	45.1	60.5
East Central	33.2	43.2	46.8	62.5	70.5	76.1	81.1	83.4	75.9	59.8	48.2	45.8	60.5
1971													(1971)
Northeast	35.7	37.4	48.0	60.7	66.0	78.5	78.7	77.4	72.6	64.5	49.9	43.8	59.4
West Central	37.0	39.4	50.5	61.5	68.9	79.7	82.6	77.4	72.6	62.9	49.9	40.3	60.2
Central	37.5	39.9	50.0	61.6	67.9	79.0	81.8	77.9	73.5	64.8	50.6	43.3	60.7
East Central	38.7	41.1	49.6	61.0	66.5	78.4	79.9	77.1	73.8	66.3	51.7	46.4	60.9

[1]Divisions are according to the Climatological Data listings by the U.S. Department of Commerce, 1969, 1970, and 1971.

TABLE XXXXV

AVERAGE ANNUAL PRECIPITATION (INCHES) FOR OKLAHOMA STATE DIVISIONS WHERE MAX MCGRAW WILDLIFE FOUNDATION DUCKLINGS WERE RELEASED

Division	1969	1970	1971
Northeast	36.51	35.87	40.87
West Central	25.15	17.41	24.88
Central	29.17	33.12	32.51
East Central	43.61	45.00	45.57

TABLE XXXXVI

TOTAL EVAPORATION (INCHES) DURING THE GROWING SEASON (APRIL THROUGH OCTOBER) FROM A RECORDING STATION WITHIN STATE DIVISIONS WHERE MAX MCGRAW WILDLIFE FOUNDATION DUCKLINGS WERE RELEASED

Division	1969	1970	1971
Northeast			
Keystone Dam	50.76	53.79	52.31
West Central			
Canton Dam	55.40	65.32	63.30
Central			
Stillwater	51.99	57.04[1]	54.33[1]
East Central			
Eufaula Reservoir	55.89	43.71[2]	50.46

[1]April data missing.

[2]September and October data missing--1970 at Fort Gibson Dam total evaporation was 54.14 inches.

TABLE XXXXVII

AVERAGE MONTHLY WIND SPEED (MILES PER HOUR) AND RELATIVE HUMIDITY[1] (PERCENT) AT OKLAHOMA CITY AND TULSA WEATHER STATIONS[2]

Locations	J	F	M	A	M	J	J	A	S	O	N	D
1969												
Oklahoma City												
Wind	10.3	9.6	9.9	11.8	--	12.0	9.8	9.5	8.1	11.4	11.2	9.2
Relative Humidity	65	69	55	58	--	57	47	53	59	57	42	61
Tulsa												
Wind	10.6	10.2	10.2	11.1	--	11.3	8.6	7.7	7.8	9.7	8.2	8.3
Relative Humidity	62	57	48	56	--	62	49	53	54	55	52	63
1970												
Oklahoma City												
Wind	8.6	9.8	10.5	11.8	12.0	12.0	12.0	--	13.9	12.7	14.9	12.2
Relative Humidity	69	54	64	51	54	55	45	--	54	58	52	49
Tulsa												
Wind	8.9	9.3	9.0	10.8	10.1	9.6	9.2	--	9.7	9.3	11.2	9.6
Relative Humidity	64	56	63	55	54	59	46	--	62	62	57	57
1971												
Oklahoma City												
Wind	11.5	14.3	15.8	14.2	13.5	11.7	10.9	8.6	11.4	10.4	12.0	11.4
Relative Humidity	54	53	39	44	49	54	48	54	53	58	56	77
Tulsa												
Wind	9.3	11.8	13.9	11.5	11.8	10.5	9.8	7.7	11.2	10.2	11.3	9.0
Relative Humidity	56	58	41	49	54	60	59	52	62	59	55	75

[1]The noon average relative humidity readings are used in this table.

[2]Oklahoma City and Tulsa are the only stations recording wind and relative humidity data.

TABLE XXXXVIII

WATER CHARACTERISTICS OF SELECTED OKLAHOMA LAKES USED AS RELEASE SITES FOR MAX MCGRAW WILDLIFE FOUNDATION DUCKLINGS

Location	Average (ppm) Total Alkalinity	Average pH	Average % Light Transmission
Curry Lake	49	7.6	65
Red Bird Lake	24	7.9	92
Grassy Lake	22	6.9	81
Ham Lake	95	8.8	89
Sangre Lake	98	9.0	82
Zink Ranch	91	8.2	76
Canton Reservoir	164	8.4	88
Coym Lake	343	8.6	52
Taylor Lake	169	8.2	80
Chalfant Lake	275	8.5	66

TABLE XXXXIX

VEGETATION CHARACTERISTICS OF SELECTED OKLAHOMA LAKES RECEIVING MAX MCGRAW WILDLIFE FOUNDATION MALLARDS

Scientific Name	Common Name	Habitat Form							
		Submersed	Floating	Emersed	Paludal	Grass	Forb	Shrub	Tree
Alisma plantage-aquatica L.	Water Plantain			X	X		X		
Alopecurus aequalis Sobol.	Foxtail				X	X			
Ambrosia psilostachya DC.	Western Ragweed						X		
Ambrosia trifida L.	Giant Ragweed						X		
Ammannia auriculata Willd.	Wright's Ammannia				X		X		
Amorpha fruticosa L.	Bastard Indigo							X	
Andropogon Gerardii Vitman	Big Bluestem					X			
Andropogon scoparius Michx.	Little Bluestem					X			
Aristida oligantha Michx.	Annual Threeawn					X			
Arundinaria gigantea (Walt.) Chapm.	Giant Cane					X			
Aster spp.	Aster						X		
Azolla caroliniana Willd.	Water Velvet		X						
Bacopa rotundifolia (Michx.) Wettst.	Water Hyssop			X	X		X		
Bidens spp.	Bur Marigold			X	X		X		
Bromus japonicus Thunb.	Japanese Brome Grass					X			
Callitriche heterophylla Pursh	Water Starwort		X		X		X		
Carex sp.	Sedge			X	X		X		
Carex Frankii Kunth.	Frank's Sedge			X	X		X		
Carex lupuliformis Sartwell	Large Sedge			X	X		X		
Carex vulpinoidea Michx.	Sedge			X	X		X		

TABLE XXXXIX (Continued)

Scientific Name	Common Name	Submersed	Floating	Emersed	Plaudal	Grass	Forb	Shrub	Tree
Cephalanthus occidentalis L.	Buttonbush			X	X			X	
Ceratophyllum demersum L.	Coontail	X							
Cercis canadensis L	Redbud								X
Chara spp.	Muskgrass	X							
Cicuta maculata L.	Water Hemlock				X		X		
Commelina communis L.	Asiatic Dayflower						X		
Cornus Drummondi Meyer	Rough Leaf Dogwood				X			X	
Cynodon dactylon (L.) Pers.	Bermudagrass					X			
Cyperus sp.	Sedge			X	X		X		
Cyperus acuminatus Torr. & Hook.	Short-Pointed Cyperus			X	X		X		
Cyperus erythrorhizos Muhl.	Red-Rooted Cyperus			X	X		X		
Cyperus globulosus Aubl.	Globular Umbrella Sedge			X	X		X		
Cyperus strigosus Aubl.	Umbrella Sedge			X	X		X		
Desmanthus illinoensis (Michx.) MacM.	Illinois Bundleflower						X		
Desmodium sessilifolium (Torr.) T.&G.	Tickclover						X		
Echinochloa crusgalli (L.) Beauv.	Barnyard Grass					X			
Echinodorus cordifolius (L.) Griseb.	Burhead			X	X		X		
Eleocharis macrostachya Britt.	Pale Spike Rush			X	X		X		
Eleocharis obtusa (Willd.) Schuttes	Blunt Spike Rush			X	X		X		
Eleocharis parvula (R.&S.) Link.	Spike Rush			X	X		X		
Eleocharis quadrangulata (Michx.) R.&S.	Square Stem Spike Rush			X	X		X		
Elephantopus carolinianus Willd.	Leafy Elephant foot						X		
Elymus canadensis L.	Canada Wildrye					X			
Elymus virginicus L.	Virginia Wildrye					X			
Eragrostis spp.	Lovegrass					X			

TABLE XXXXIX (Continued)

Scientific Name	Common Name	Submersed	Floating	Emersed	Plaudal	Grass	Forb	Shrub	Tree
Eupatorium serotinum Michx.	Late-Flowering Thoroughwort						X		
Fimbristylis dichotoma (L.) Vahl	Sedge				X		X		
Fimbristylis Vahlii (Lam.) Link	Sedge				X		X		
Fraxinus pennsylvanica Marsh.	Red Ash				X				X
Haplopappus ciliatus (Nutt.) DC.	Prionopsis						X		
Hibiscus militaris Cau.	Marsh Mallow				X		X		
Hydrolea ovata Nutt.	Hydrolea			X	X		X		
Juncus acuminatus Michx.	Sharp-Fruited Rush			X	X		X		
Juncus crassifolius Buch.	Rush			X	X		X		
Juncus diffusissimus Buckl.	Diffuse Rush			X	X		X		
Juncus effusus L.	Soft Rush			X	X		X		
Juncus marginatus Rostk.	Grass-Leaved Rush			X	X		X		
Juncus repens Michx.	Creeping Rush			X	X		X		
Juncus scirpoides Lam.	Scirpus-Like Rush			X	X		X		
Juncus secundus Beauv.	Secund Rush			X	X		X		
Juncus Torreyi Coville	Torrey's Rush			X	X		X		
Juniperus virginiana L.	Eastern Redcedar								X
Jussiaea decurrens (Walt.) DC.	Annual Water Primrose			X	X		X		
Jussiaea peploides (HBK.) Raven	Primrose Willow			X	X		X		
Justicia americana (L.) Vahl.	Water Willow			X			X		
Leersia oryzoides (L.) Sw.	Rice Cutgrass				X	X			
Lemna valdiviana Phil.	Duckweed		X						
Lespedeza capitata Michx.	Roundhead Lespedeza						X		
Lespedeza virginica (L.) Britt.	Slender Lespedeza						X		

TABLE XXXXIX (Continued)

Scientific Name	Common Name	Habitat Form: Submersed	Floating	Emersed	Plaudal	Grass	Forb	Shrub	Tree
Liatris punctata Hooker	Dotted Gayfeather						X		
Lindernia anagallidea (Michx.) Pennell	False Pimpernel						X		
Ludwigia palustris (L.) Ell.	False Loosestrife				X		X		
Lysimachia lanceolata Walter	Lance-Leaved Loosestrife				X		X		
Mentha sp.	Mint						X		
Myriophyllum heterophyllum Michx.	Various-Leaved Water Milfoil	X		X					
Myriophyllum pinnatum (Walt.) BSP.	Pinnate Water Milfoil	X		X					
Najas guadalupensis (Spreng.) Magnus	Naiad	X							
Nasturtium officinale R.Br.	Water Cress			X	X		X		
Nelumbo lutea (Willd.) Pers.	American Lotus		X	X					
Nuphar advena (Ait.) Ait. f.	Spatterdock		X	X					
Nymphaea odorata Ait.	Fragrant Water Lily		X						
Panicum spp.	Panicum					X			
Panicum agrostoides Spreng.	Red-Top Panic				X	X			
Panicum virgatum L.	Switchgrass					X			
Paspalum sp.	Paspalum					X			
Paspalum floridanum Michx.	Dallisgrass					X			
Paspalum setaceum Michx.	Paspalum					X			
Polygonum spp.	Smartweed				X		X		
Polygonum coccinium Muhl.	Smartweed				X		X		
Polygonum lapathifolium L.	Dock-Leaved Smartweed				X		X		
Polygonum punctatum Ell.	Water Smartweed				X		X		
Pontederia cordata L.	Pickerelweed			X	X		X		
Populus deltoides Marsh.	Eastern Cottonwood								X
Potamogeton crispus L.	Pondweed	X							

TABLE XXXXIX (Continued)

Scientific Name	Common Name	Submersed	Floating	Emersed	Plaudal	Grass	Forb	Shrub	Tree
		Habitat				Form			
Potamogeton diversifolius Raf.	Diverse-Leaved Pondweed	X	X						
Potamogeton foliosus Raf.	Small Pondweed	X							
Potamogeton nodosus Poiret	Knotty Pondweed	X	X						
Potamogeton pectinatus L.	Sago Pondweed	X							
Prunus angustifolia Marsh.	Sand Plum							X	
Quercus marilandica Muenchh.	Blackjack Oak								X
Quercus stellata Wang.	Post Oak								X
Ranunculus spp.	Crowfoot				X		X		
Rhus copallina L.	Winged Sumac							X	
Rhus glabra L.	Smooth Sumac							X	
Rhynchospora macrostachya Torrey	Horned Rush				X		X		
Rotala ramosior (L.) Koehne.	Rotala			X	X				
Rubus spp.	Blackberry							X	
Rumex crispus L.	Yellow Dock				X				
Sagittaria graminea Michx.	Arrowhead			X	X				
Sagittaria latifolia Willd.	Arrowhead			X	X				
Salix spp.	Willow				X				X
Scirpus sp.	Bulrush			X	X				
Scirpus americanus Pers.	Three-Square Bulrush			X	X		X		
Scirpus californicus (C. Meyer) Stevd.	Hard-Stem Bulrush			X			X		
Scirpus sylvaticus L.	Bulrush			X	X		X		
Setaria lutescens (Wiegel) F.T. Hubb.	Yellow Foxtail					X			
Solanum elaegnifolium Cau.	Silverleaf-Nightshade						X		
Solidago missouriensis Nutt.	Missouri Goldenrod						X		

TABLE XXXXIX (Continued)

Scientific Name	Common Name	Submersed	Floating	Emersed	Plaudal	Grass	Forb	Shrub	Tree
Sorghastrum nutans (L.) Nash	Indiangrass					X			
Sorghum halepense (L.) Pers.	Johnson Grass					X			
Spirodela polyrhiza (L.) Schleiden	Big Duckweed		X						
Sporobolus asper (Michx.) Junth	Tall Dropseed					X			
Tamarix galica L.	Salt Cedar				X				X
Taxodium distichum (L.) Richard	Bald Cypress			X	X				X
Thalia dealbata Roscoe	Thalia			X					
Tridens strictus (Nutt.) Nash	Tridens					X			
Typha angustifolia L.	Narrowleaved Cattail			X					
Typha latifolia L.	Broadleaved Cattail			X					
Ulmus americana L.	American Elm								X
Uniola latifolia Michx.	Spikegrass					X			
Utricularia sp.	Bladderwort	X							
Utricularia gibba L.	Humped Bladderwort	X							
Wolffia columbiana Karst.	Watermeal		X						

Habitat Form: Submersed, Floating, Emersed, Plaudal, Grass, Forb, Shrub, Tree

TABLE L

VEGETATION RATINGS[1] OF RELEASE LAKES FOR MAX MCGRAW WILDLIFE FOUNDATION MALLARDS IN OKLAHOMA

Plants[2]	Release Lakes																																
	Duck Marsh[3] (69)	Rocket[3] (67)	Brown (68)	Ashland (66)	NAD 2	NAD 3	NAD 4	NAD 23	NAD 58	NAD 39	NAD 6	NAD 52	NAD 7	NAD 51	NAD 48	NAD 45	NAD 50	Red Bird	Penoski	Curry	Grassy	Zink 1	Zink 2	Zink 3	Blue Stem	Vogel	Capart	Canton	Taylor	Chalfant	Coym	Ham	Sangre
<u>Alisma</u> <u>plantago-aquatica</u>	P	P	X	X	1					X	X	1	X		X	X			X		X												
<u>Alopecurus</u> <u>aequalis</u>	P	P	X	X	X					X						X					X												
<u>Ambrosia</u> <u>psilostachya</u>	P	P	X	X	X	X	X	X	X	X	1	1	X	X	X	X	X	X	X	1	X	2		1	X	1	2	X	X	X	X	X	X
<u>Ambrosia</u> <u>trifida</u>	P	P	X	X	X			X	X	X						X		X	1	X	X	X						X	X	X	X	X	X
<u>Ammannia</u> <u>auriculata</u>			X	X				X																						X		X	
<u>Amorpha</u> <u>fruticosa</u>	P		X	2					X																								
<u>Andropogon</u> <u>Gerardii</u>	P	P	X	X	X	X	X	X	X	X						X		X	1	X		X			X	X	X					X	X
<u>Andropogon</u> <u>scoparius</u>	P	P	2	2	1	2	1	3	2	1	1	1	1	1	2	3	1	3	3	1	2	2	X	X	X	1	1	X				1	2
<u>Aristida</u> <u>oligantha</u>				X							X	X	X	X	X		X			X		X			X	X	X	X	X	X	X	X	
<u>Arundinaria</u> <u>gigantea</u>			X																X														
<u>Aster</u> app.	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<u>Azolla</u> <u>caroliniana</u>																					X												
<u>Bacopa</u> <u>rotundifolia</u>			X																														
<u>Bidens</u> spp.																												X		X			
<u>Bromus</u> <u>japonicus</u>	P	P	X	X	X	X			X	X						X		X	X						X						X	X	X
<u>Callitriche</u> <u>heterophylla</u>	P	P	X	X						X		X	X	X	X		X		X		X				X	X							
<u>Carex</u> sp.	P	P	X		X	X										X												X					
<u>Carex</u> <u>Frankii</u>	P	P	X		X					X					X	X					X												
<u>Carex</u> <u>lupuliformis</u>	P		X		X		X								X	X		X	X		X										X		
<u>Carex</u> <u>vulpinoidea</u>	P	P	X		X	X												X	X														X
<u>Cephalanthus</u> <u>occidentalis</u>	P	P	X	3	X	X			X	X						X					X	X			X								
<u>Ceratophyllum</u> <u>demersum</u>	P	P			1	X			X	1				X		X		X	4	X	2	X									X	1	X

TABLE L (Continued)

Plants[2]	Release Lakes																																
	Duck Marsh[3] (69)	Rocket[3] (67)	Drown (68)	Ashland (66)	NAD 2	NAD 3	NAD 4	NAD 23	NAD 58	NAD 39	NAD 6	NAD 52	NAD 7	NAD 51	NAD 48	NAD 45	NAD 50	Red Bird	Penoski	Curry	Grassy	Zink 1	Zink 2	Zink 3	Blue Stem	Vogel	Capart	Canton	Taylor	Chalfant	Coym	Ham	Sangre
Cercis canadensis			X																X														X
Chara spp.	P	P	X		X	X												X	2	X	X				X							X	X
Cicuta maculata	P	P		X						X																							
Commelina communis			X													X																	
Cornus Drummondi	P	P	X	X			X											X							X			X				X	X
Cynodon dactylon			X																X	X						X	X						X
Cyperus sp.	P	P	X	X	X	X			X	X						X			X	X	X					X	X						
Cyperus acuminatus			X																X														
Cyperus erythrorhizos	P	P	1	1	X	X	X		X	X	X	X	X	X	X	1	X	X	X	X	X	X		X	X	X					X	X	X
Cyperus globulosus	P		X		X		X							X		X				X													
Cyperus strigosus		P			X	X					X																						
Desmanthus illinoensis	P	P		X	X	X	X		X	X	X				X	X	X	X	X	X	X	X			X	X		X	X	X	X	X	X
Desmodium sessilifolium	P	P		X	X	X	X	X			X				X	X		X	X	X		X			X	X	X	X				X	X
Echinochloa crusgalli	P	P	X	X			X				X	X			X		X	X	X	X								X					X
Echinodorus cordifolius	P	P			X							X									X												
Eleocharis macrostachya	P	P	1	1	X	1	X		X	X	X	X	X	X	X	X		1	1	X	X	X			X	X	X	X			X		X
Eleocharis obtusa	P	P	X	X	X	1	X		X	X	X	X	X	X	X	X		X	X		X	X			X	X	X	X					
Eleocharis parvula	P	P	X	X	X	X			X	X					X	X		X	X														
Eleocharis quadrangulata	P	P	1	X	2	2	X	X	1	2	1	1	1	1	2	2	X	1	5	X	2	X	X	X	X	1	X	X	X	X	1	X	1
Elephantopus carolinianus	P	P	X	X	X		X					X							X			X			X		X						
Elymus canadensis	P	P	X	X	X				X	X		X						X	X	X					X			X				X	X
Elymus virginicus	P	P	X	X					X	X							X	X	X							X		X				X	X
Eragrostis spp.	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eupatorium serotinum	P	P	X		X				X	X								X	X	X	X	X			X								
Fimbristylis dichotoma	P	P	1	1	X	X			X	X			X	X	X				X	X	X			X								X	X

TABLE L (Continued)

Plants[2]	Duck Marsh[3] (69)	Rocket[3] (67)	Brown (68)	Ashland (66)	NAD 2	NAD 3	NAD 4	NAD 23	NAD 58	NAD 39	NAD 6	NAD 52	NAD 7	NAD 51	NAD 48	NAD 45	NAD 50	Red Bird	Penoski	Curry	Grassy	Zink 1	Zink 2	Zink 3	Blue Stem	Vogel	Capart	Canton	Taylor	Chalfant	Coym	Ham	Sangre
	Release Lakes																																
Fimbristylis Vahlii	P	P	1	X	X	X			X	X		X		X	X	X			X	X	X			X		X						X	X
Fraxinus pennsylvanica	P		X																X			X			X			X					
Haplopappus ciliatus	P			X							X	X	X	X	X		X			X		X					X		X	X	X	X	
Hibiscus militaris	P																																
Hydrolea ovata	P	P	1	X	1	1	X		X	1	X	X	X	1	X	1	X					X		X									
Juncus acuminatus	P	P	X		X	X			X	1	X	X	X	X	X	X	X	X	X	X	X	X			X	X					X	X	X
Juncus crassifolius																X																	
Juncus diffusissimus		P		X	X	X				X						1		1	1	2	X												
Juncus effusus	P	P	2	3	3	1	1	X	1	2	X	X	X	X	X	1	X	X	1	1	2	X	X	X	1	X						X	X
Juncus marginatus	P	P	X	X	X	X	X			X					X	X	X	X	X	X	X	X				X						X	X
Juncus repens																					X												
Juncus scirpoides	P	P	X	X	X	X	X		X	X			X	X	X	X	X	X	X		X					X							X
Juncus secundus																		X	1	X	X												
Juncus Torreyi	P	P	X	X	X	X				X						X			X		X												
Juniperus virginiana	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Jussiaea decurrens	P	P	X	3	2	1	X		X	1	X	1	1	2	X	1	X	X	2	X	2	2	X	X	X	1	X					X	X
Jussiaea peploides		P		X										X					X														
Justicia americana			5	X		X																X		2		X							
Leersia oryzoides	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X
Lemna valdiviana	P	P	X	X	X					1			X	X		X			1		1							X				X	X
Lespedeza capitata		P		X		X	X		X	X								X	X						X			X				X	X
Lespedeza virginica	P	P		X	X	X	X	X	X	X			X	X		X		X	X	X		X		X	X	X		X	X		X	X	X
Liatris punctata		P		X		X			X	X	X	X	X	X	X		X	X	X	X		X				X		X	X	X	X	X	
Lindernia anagallidea				X				X							X		X																
Ludwigia palustris	P	P	X	1		X	X			X	X	X	X	X	X		X	X	X	X				X		X	X						

TABLE L (Continued)

Plants[2]	Duck Marsh[3] (69)	Rocket[3] (67)	Brown (68)	Ashland (66)	NAD 2	NAD 3	NAD 4	NAD 23	NAD 58	NAD 39	NAD 6	NAD 52	NAD 7	NAD 51	NAD 48	NAD 45	NAD 50	Red Bird	Penoski	Curry	Grassy	Zink 1	Zink 2	Zink 3	Blue Stem	Vogel	Capart	Canton	Taylor	Chalfant	Coym	Ham	Sangre
	Release Lakes																																
Lysimachia lanceolata	P			X								X		X			X																
Mentha sp.			X	1						X									X											X	X		
Myriophyllum heterophyllum																			X		3												
Myriophyllum pinnatum	P	P			1	X				X				1																			
Najas guadalupensis	P																	X	X	X											X		
Nasturtium officinale																															X		
Nelumbo lutea	P	P	1		X					X	X	X	X	X		X					2				X	X							1
Nuphar advena	P																				X												
Nymphaea odorata	P															X																	
Panicum spp.	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Panicum agrostoides	P	P	X	X	X	X		X	X	X						X		X	X		X	X			X	X					X	X	X
Panicum virgatum	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X					X	X
Paspalum sp.	P	P	X	X	X	X			X	X						X	X																
Paspalum floridanum			X													X		X	X		X							X			X	X	X
Paspalum setaceum	P	P	X	X	X					X						X										X							
Polygonum spp.	P	P	1	X	1	1		X	1	1	X	X	X	X	X	1	X	X	2	1	2	X		X	X	X		X			X	X	X
Polygonum coccinium	P		X		X					1						X					X							X			3		
Polygonum lapathifolium	P	P	2	X	2	X	X			2			X	X		X			2	X	X					X							X
Polygonum punctatum	P	P	X	X	X	X	X			X			X	X		X			X	X	X					X					X		
Pontederia cordata																					2												
Populus deltoides	P	P	X	X	X		X	X		X			X	X	X	X	X	X	X	X	X	X			X			X	X	X	X	X	X
Potamogeton crispus																														1			
Potamogeton diversifolius	P	P	X	X	1	1	1		X	X	1	1	X	X	1	1	X	X	X	1		1				X			X				X
Potamogeton foliosus	P	P			X					X	X				X	X			2							X			X		2	2	X
Potamogeton nodosus	P	P	X		X		X				2	X		X		X		1	2	1										X	1	X	1

TABLE L (Continued)

Plants[2]	Release Lakes																																
	Duck Marsh[3] (69)	Rocket[3] (67)	Brown (68)	Ashland (66)	NAD 2	NAD 3	NAD 4	NAD 23	NAD 58	NAD 39	NAD 6	NAD 52	NAD 7	NAD 51	NAD 48	NAD 45	NAD 50	Red Bird	Penoski	Curry	Grassy	Zink 1	Zink 2	Zink 3	Blue Stem	Vogel	Capart	Canton	Taylor	Chalfant	Coym	Ham	Sangre
Potamogeton pectinatus	P																																
Prunus angustifolia	P	P	X	X	X	X							X				X	X	X	X		X						X	X	X	X		
Quercus marilandica	P	P	3	1	2	X	1	X	X	X	1	2	X	X	X	X	1	2	1	X	2	2	2	X	4		X	2	1	X	X	2	2
Quercus stellata	P	P	3	1	2	X	1	X	X	X	1	2	X	X	X	X	1	2	1	X	2	2	2	X	4		X	2	1	X	X	2	2
Ranunculus spp.																													X	X	X		
Rhus copallina / Rhus glabra	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X	X
Rhynchospora macrostachya	P	P	1	1	2	X	X	X	X	2	X	X	X	X	1	2	X	X	1	X	1	X		X	X	1	X	X			X	X	X
Rotala ramosior				X			X						X				X	X		X								X				X	X
Rubus spp.	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X		X		X		X	X
Rumex crispus	P	P	X		X					1						X			X		X										1		X
Sagittaria graminea	P	P	X		X	X				X									X		1												
Sagittaria latifolia	P	P	X		X													X	X		1										1		
Salix spp.	P	P	1	2	2	X	2	2	X	X	X	1	X	X	X	1	1	1	3	1	2	1	X	1	1	X	1	2	X	X	1	1	1
Scirpus sp.				X												X			X														
Scirpus americanus		P			X										X				X										2		X		1
Scirpus californicus	P		2	X			X			X						X	1	X	2	2	3	X		X	X			X					
Scirpus sylvaticus			X																X														
Setaria lutescens	P	P	X	X	X	X	X	X		X					X	X	X	X	X	X	X	X				X					X	X	X
Solanum elaegnifolium	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
Solidago missouriensis	P	P		X			X	X			X	X	X	X	X		X	X	X	X		X		X	X	X	X	X	X	X	X	X	X
Sorghastrum nutans	P	P	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	1	X	X	X	X		X		X	X					X	X
Sorghum halepense	P	P	X	X	X	X	X	X	X	X							X	X	1	X	1	1		X		X	X	X	X	X	X	X	X
Spirodela polyrhiza	P																																
Sporobolus asper	P	P	X	X	X	X		X	X	X						X		X	X			X											

TABLE L (Continued)

Plants[2]	Duck Marsh[3] (69)	Rocket[3] (67)	Brown (68)	Ashland (66)	NAD 2	NAD 3	NAD 4	NAD 23	NAD 58	NAD 39	NAD 6	NAD 52	NAD 7	NAD 51	NAD 48	NAD 45	NAD 50	Red Bird	Penoski	Curry	Grassy	Zink 1	Zink 2	Zink 3	Blue Stem	Vogel	Capart	Canton	Taylor	Chalfant	Coym	Ham	Sangre
	Release Lakes																																
Tamarix galica			X	X															1		X							X					
Taxodium distichum			X																														X
Thalia dealbata																					3												
Tridens strictus		P		X		X				X						X		X	X		X												
Typha angustifolia																						1	X	X									
Typha latifolia	P	P	1	1	X		X		X	X				X		X	X	X	X	4	3				X	X		2	3	3	1	1	2
Ulmus americana	P	P	X	X														X	X						X								X
Uniola latifolia	P	P	X	X	X		X	X		X	X	X				X	X	X	X		X	X			X			X			X	X	X
Utricularia sp.																			1		3												
Utricularia gibba	P	P	X		1	X				1		X	X	2		X										X							
Wolffia columbiana	P																				X												

[1]Ratings are based on the Total Estimate Scale similar to that of Smith (1966) abundance plus coverage equal total estimate.
X=Rare, small coverage; 1=Plentiful, small coverage; 2=Occasional, 5% to 25% coverage; 3=Frequent, 25% to 50% coverage; 4=Numerous, 50% to 75% coverage; 5=Abundant, 75% to 100% coverage; P=Present, no rating indicated.

[2]Identification references; Waterfall (1969), Muenscher (1967), Fassett (1969), Britton and Brown (1913), and Fernald (1950).

[3]The plants of Rocket Lake and Duck Marsh were studied by Mr. Stephen Nesbitt and evaluations of these lakes will be presented in his M.S. thesis.

TABLE LI

AQUATIC MACROINVERTEBRATES AT SELECTED OKLAHOMA RELEASE LAKES FOR MAX MCGRAW WILDLIFE FOUNDATION MALLARDS IN MAY 1971

Location	Classification[1]	Common Name	Life Cycle Phase	Average Number In Three Samples[2]
Rocket Lake	Phylum-Arthropoda			
	Class-Insecta			
	Order-Ephemeroptera	Mayfly	Nymph	7
	Order-Collembola	Springtail	Adult	200[3]
	Order-Coleoptera	Beetle	Larva	5
			Adult	1
	Order-Diptera	Fly	Larva	78
	Order-Odonata			
	Suborder-Zygoptera	Damselfly	Nymph	8
	Suborder-Anisoptera	Dragonfly	Nymph	1
	Order-Hemiptera			
	Family-Notonectidae	Backswimmer	Adult	2
	Family-Corixidae	Water Boatman	Adult	1
	Family-Nepidae	Water Scorpion	Adult	1
	Class-Crustacea			
	Order-Amphipoda	Scud	Adult	270[3]
	Order-Eucopepoda	Copepod	Adult	1000[3]
	Order-Cladocera	Water Flea	Adult	1000[3]
	Order-Podocopa	Seed Shrimp	Adult	40[3]
	Class-Arachnoidea			
	Order-Araneae			
	Family-Pisauridae	Surface Spider	Adult	1
	Order-Hydracarina	Water Mite	Adult	200[3]
	Phylum-Mollusca			
	Class-Gastropoda	Snail	Adult	20

TABLE LI (Continued)

Location	Classification[1]	Common Name	Life Cycle Phase	Average Number in Three Samples[2]
Rocket Lake	Phylum-Annelida			
	Class-Oligochaeta	Bristle Worm	Adult	11
	Phylum-Nematoda	Round Worm	Adult	28
	Phylum-Platyhelminthes			
	Class-Turbellaria	Planarian	Adult	4
Ashland Lake	Phylum-Arthropoda			
	Class-Insecta			
	Order-Diptera	Fly	Larva	20
	Order-Coleoptera	Beetle	Adult	1
	Order-Ephemeroptera	Mayfly	Nymph	1
	Order-Odonata			
	Suborder-Zygoptera	Damselfly	Nymph	1
	Class-Crustacea			
	Order-Amphipoda	Scud	Adult	7
	Order-Eucopepoda	Copepod	Adult	10
	Order-Cladocera	Water Flea	Adult	10
	Order-Podocopa	Seed Shrimp	Adult	4
	Class-Arachnoidea			
	Order-Hydracarina	Water Mite	Adult	7
	Phylum-Nematoda	Round Worm	Adult	2
Duck Marsh	Phylum-Arthropoda			
	Class-Insecta			
	Order-Ephemeroptera	Mayfly	Nymph	2
	Order-Collembola	Springtail	Adult	200[3]
	Order-Coleoptera	Beetle	Larva	1
			Adult	10
	Order-Diptera	Fly	Larva	67

TABLE LI (Continued)

Location	Classification[1]	Common Name	Life Cycle Phase	Average Number In Three Samples[2]
Duck Marsh	Order-Odonata			
	Suborder-Zygoptera	Damselfly	Nymph	8
	Suborder-Anisoptera	Dragonfly	Nymph	3
	Order-Hemiptera			
	Family-Corixidae	Water Boatman	Adult-Nymph	118
	Family-Nepidae	Water Scorpion	Nymph	1
	Family-Gerridae	Water Strider	Adult	1
	Class-Crustacea			
	Order-Amphipoda	Scud	Adult	246
	Order-Eucopepoda	Copepod	Adult	1000[3]
	Order-Cladocera	Water Flea	Adult	1000[3]
	Order-Podocopa	Seed Shrimp	Adult	70
	Class-Arachnoidea			
	Order-Araneae			
	Family-Pisauridae	Surface Spider	Adult	1
	Order-Hydracarina	Water Mite	Adult	730[3]
	Phylum-Mollusca			
	Class-Gastropoda	Snail	Adult	81
	Phylum-Nematoda	Round Worm	Adult	13
Brown Lake	Phylum-Arthropoda			
	Class-Insecta			
	Order-Ephemeroptera	Mayfly	Larva	2
	Order-Diptera	Fly	Larva	43
	Order-Odonata			
	Suborder-Zygoptera	Damselfly	Larva	1
	Suborder-Anisoptera	Dragonfly	Larva	1
	Class-Crustacea			
	Order-Amphipoda	Scud	Adult	1000[3]

TABLE LI (Continued)

Location	Classification[1]	Common Name	Life Cycle Phase	Average Number In Three Samples[2]
Brown Lake	Order-Eucopepoda	Copepod	Adult	100[3]
	Order-Cladocera	Water Flea	Adult	100[3]
	Order-Podocopa	Seed Shrimp	Adult	100[3]
	Class-Arachnoidea			
	Order-Hydracarina	Water Mite	Adult	33
	Phylum-Mollusca			
	Class-Gastropoda	Snail	Adult	27
	Phylum-Nematoda	Round Worm	Adult	14
Penoski Lake	Phylum-Arthropoda			
	Class-Insecta			
	Order-Ephemeroptera	Mayfly	Nymph	1
	Order-Collembola	Springtail	Adult	4
	Order-Diptera	Fly	Larva	27
	Order-Odonata			
	Suborder-Zygoptera	Damselfly	Nymph	9
	Order-Hemiptera			
	Family-Corixidae	Water Boatman	Adult	18
	Family-Gerridae	Water Strider	Adult-Nymph	17
	Class-Crustacea			
	Order-Amphipoda	Scud	Adult	27
	Order-Eucopepoda	Copepod	Adult	270[3]
	Order-Cladocera	Water Flea	Adult	270[3]
	Order-Podocopa	Seed Shrimp	Adult	200[3]
	Class-Arachnoidea			
	Order-Araneae			
	Family-Pisauridae	Surface Spider	Adult	1
	Order-Hydracarina	Water Mite	Adult	48

TABLE LI (Continued)

Location	Classification[1]	Common Name	Life Cycle Phase	Average Number In Three Samples[2]
Penoski Lake	Phylum-Mollusca			
	Class-Gastropoda	Snail	Adult	23
	Phylum-Nematoda	Round Worm	Adult	1
Red Bird Lake	Phylum-Arthropoda			
	Class-Insecta			
	Order-Ephemeroptera	Mayfly	Nymph	1
	Order-Collembola	Springtail	Adult	133
	Order-Coleoptera	Beetle	Larva	1
	Order-Diptera	Fly	Larva	83
	Order-Odonata			
	Suborder-Zygoptera	Damselfly	Nymph	3
	Suborder-Anisoptera	Dragonfly	Nymph	1
	Order-Hemiptera			
	Family-Corixidae	Water Boatman	Adult-Nymph	6
	Family-Nepidae	Water Scorpion	Adult	1
	Family-Gerridae	Water Strider	Adult	37
	Class-Crustacea			
	Order-Amphipoda	Scud	Adult	165
	Order-Eucopepoda	Copepod	Adult	180[3]
	Order-Cladocera	Water Flea	Adult	180[3]
	Order-Podocopa	Seed Shrimp	Adult	100[3]
	Class-Arachnoidea			
	Order-Araneae			
	Family-Pisauridea	Surface Spider	Adult	1
	Order-Hydracarina	Water Mite	Adult	2

TABLE LI (Continued)

Location	Classification[1]	Common Name	Life Cycle Phase	Average Number In Three Samples[2]
Red Bird Lake	Phylum-Mollusca			
	Class-Gastropoda	Snail	Adult	9
	Phylum-Annelida			
	Class-Oligochaeta	Bristle Worm	Adult	19
	Phylum-Nematoda	Round Worm	Adult	1

[1]Pennak (1953) was used to classify the aquatic macroinvertebrates.

[2]The numbers in this column are averages of three samples rounded to the next highest number.

[3]Because of large numbers, small size, and mobility of some invertebrates, their population numbers were estimated in those samples taken after the first two samples. In the first two samples all invertebrates were counted for comparison purposes.

TABLE LII

SPECIES[1] LIST OF VERTEBRATE ANIMALS OBSERVED ON OR NEAR SELECTED OKLAHOMA LAKES RECEIVING MAX MCGRAW WILDLIFE FOUNDATION MALLARDS

Common Name	Scientific Name[2]	Occurrence[3]
Birds		
Avocet	*Recurvirostra americana* Gmelin	U
Bittern, American	*Botaurus lentiginosus* Montagu	U
Least	*Ixobrychus exilis* Gmelin	O
Blackbird, Red-winged	*Agelaius phoeniceus* Linnaeus	C
Bobwhite	*Colinus virginianus* Linnaeus	C
Coot, American	*Fulica americana* Gmelin	A
Cormorant, Double-crested	*Phalacrocorax auritus* Lesson	U
Cowbird, Brown-headed	*Molothrus ater* Boddaert	C
Crow	*Corvus brachyrhynchos* Brehm	C
Dove, Mourning	*Zenaidura macroura* Linnaeus	C
Duck, American Golden-eye	*Bucephala (Glaucionetta) clangula* Bonaparte	U
American Widgeon	*Mareca americana* Gmelin	A
Blue-winged Teal	*Anas (Querquedula) discors* Linnaeus	A
Bufflehead	*Bucephala (Charitonetta) albeola* Linnaeus	U
Canvasback	*Aythya (Nyroca) valisineria* Wilson	O
Gadwall	*Anas (Chaulelasmus) strepera* Linnaeus	A
Greater Scaup	*Aythya (Nyroca) marila* Linnaeus	U
Green-winged Teal	*Anas (Nettion) carolinensis* Gmelin	A
Lesser Scaup	*Aythya (Nyroca) affinis* Eyton	A
Mallard	*Anas platyrhynchos* Linnaeus	A
Mottled	*Anas fulvigula maculosa* Sennett	R
Pintail	*Anas (Dafila) acuta* Vieillot	C
Redhead	*Aythya (Nyroca) americana* Eyton	O
Ring-necked	*Aythya (Nyroca) collaris* Donovan	O
Ruddy	*Oxyura (Erismatura) jamaicensis* Wilson	O

TABLE LII (Continued)

Common Name	Scientific Name[2]	Occurrence[3]
Duck, Shoveler	Spatula clypeata Linnaeus	O
Wood	Aix sponsa Linnaeus	C
Eagle, Bald	Haliaeetus leucocephalus Linnaeus	U
Egret, American	Casmerodius albus Gmelin	R
Snowy	Leucophoyx (Egretta) thula Molina	R
Flicker, Yellow-shafted	Colaptes auratus Linnaeus	C
Flycatcher, Scissor-tailed	Muscivora forficata Gmelin	C
Gallinule, Purple	Porphyrula (Ionornis) martinica Linnaeus	R
Godwit, Hudsonian	Limosa haemastica Linnaeus	U
Goose, Canada	Branta canadensis Linnaeus	C
Grackle, Boat-tailed	Cassidix mexicanus Vieillot	O
Grebe, Eared	Colymbus nigricollis Heermann	O
Horned	Colymbus auritus Linnaeus	O
Pied-billed	Podilymbus podiceps Linnaeus	C
Gull, Franklin's	Larus pipixcan Wagler	A
Ring-billed	Larus delawarensis Ord	A
Hawk, Cooper's	Accipiter cooperii Bonaparte	O
Ferruginous	Buteo regalis Gray	O
Marsh	Circus cyaneus Linnaeus	O
Red-shouldered	Buteo lineatus Gmelin	O
Red-tailed	Buteo jamaicensis Gmelin	C
Rough-legged	Buteo lagopus Johannis (Gmelin)	O
Sparrow	Falco sparverius Linnaeus	C
Swainson's	Buteo swainsoni Bonaparte	O
Heron, Black-crowned Night	Nycticorax nycticorax Hoactli (Gmelin)	U
Great Blue	Ardea herodias Linnaeus	O
Green	Butorides virescens Linnaeus	C
Little Blue	Florida caerulea Linnaeus	C
Louisiana	Hydranassa tricolor Gosse	R
Hummingbird, Ruby-throated	Archilochus colubris Linnaeus	U
Killdeer	Charadrius (Oxyechus) voiciferus Linnaeus	C

TABLE LII (Continued)

Common Name	Scientific Name[2]	Occurrence[3]
Kingbird, Eastern	Tyrannus tyrannus Linnaeus	C
Kingfisher, Belted	Megaceryle alcyon Linnaeus	C
Kite, Mississippi	Ictinia misisippiensis Wilson	C
Martin, Purple	Progne subis Linnaeus	C
Merganser, American	Mergus merganser Cassin	A
Hooded	Lophodytes cucullatus Linnaeus	U
Mockingbird	Mimus polyglottos Linnaeus	C
Nighthawk	Chordeiles minor J. R. Forster	C
Osprey	Pandion haliaetus Gmelin	U
Owl, Barred	Strix varia Barton	C
Great Horned	Bubo virginianus Gmelin	O
Pelican, White	Pelecanus erythrorhynchos Gmelin	R
Phalarope, Wilson's	Steganopus tricolor Vieillot	R
Plover, Black-bellied	Squatarola squatarola Linnaeus	U
Rail, Virginia	Rallus limicola Vieillot	U
Sandpiper, Least	Erolia (Pisobia) minutilla Vieillot	O
Spotted	Actitis macularis Linnaeus	O
Shrike, Loggerhead	Lanius ludovicianus Linnaeus	O
Snipe, Wilson's	Capella gallinago Ord	U
Sora	Porzana carolina Linnaeus	O
Swallow, Bank	Riparia riparia Linnaeus	C
Barn	Hirundo rustica Boddaert	C
Tree	Iridoprocne bicolor Vieillot	C
Tern, Common	Sterna hirundo Linnaeus	U
Black	Chlidonias nigra Gmelin	U
Turkey	Meleagris gallopavo Vieillot	C
Vulture, Turkey	Cathartes aura Wied	C
Willet	Catoptrophorus semipalmatus Gmelin	U
Woodpecker, Pileated	Hylatomus (Ceophloeus) pileatus Linnaeus	U
Wren, Long-billed Marsh	Telmatodytes palustris Wilson	R

TABLE LII (Continued)

Common Name	Scientific Name[2]	Occurrence[3]
Mammals		
Armadillo	*Dasypus novemcinctus* Linnaeus	C
Beaver	*Castor canadensis* Kuhl	O
Bobcat	*Lynx rufus* Schreber	U
Cottontail, Eastern	*Sylvilagus floridanus* J. A. Allen	C
Coyote	*Canis latrans* Say	C
Deer, White-tail	*Odocoileus virginianus* Boddaert	C
Domestic Cattle	*Bos taurus*	A
Domestic Dog	*Canis familiaris*	C
Mink	*Mustela vison* Schreber	O
Muskrat	*Ondatra Zibethica* Linnaeus	C
Opossum	*Didelphis marsupialis* Linnaeus	C
Raccoon	*Procyon lotor* Linnaeus	C
Skunk, Striped	*Mephitis mephitis* Schreber	O
Reptiles		
Snake, Bull	*Pituophis melanoleucus* Daudin	O
Common Garter	*Thamnophis ordinatus* Linnaeus	C
Cottonmouth	*Ancistrodon piscivorus* Lacepede	R
Kingsnake	*Lampropeitis* spp.	U
Rat	*Elaphe* spp.	U
Ribbon	*Thamnophis sauritus* Linnaeus	U
Water	*Natrix* spp.	C
Turtle, Mud	*Kinosternon subrubrum* Gray	C
Pond Slider	*Pseudemys scripta* Schoepff	C
Snapping	*Chelydra serpentina* Linnaeus	C
Softshell	*Amyda* spp.	C
Amphibians		
Bullfrog	*Rana catesbeiana* Shaw	C
Frog, Cricket	*Acris crepitans* Baird	C
Leopard	*Rana pipiens* Schreber	C

TABLE LII (Continued)

Common Name	Scientific Name[2]	Occurrence[3]
Frog, Treefrog	Hyla spp.	C
Fish		
Bass, Largemouth	Micropterus salmoides Lacepede	C
Carp	Cyprinus carpio Linnaeus	C
Catfish	Ictalurus spp.	C
Crappies	Pomoxis spp.	C
Gar	Lepisosteus spp.	O
Sunfish	Lepomis spp.	C

[1]Identification references: Smith (1950), Pough (1951), Burt and Grossenheider (1952), Murie (1954), Einarsen (1956), Seton (1958), Robbins, Bruun, and Zim (1966), Sutton (1967), and Kortright (1967).

[2]Genera names that are included parenthetically are old genera names.

[3]Code:

R=Rare: Only one observation of the species was made.

U=Uncommon: Few of the species were observed, or they were present for a short period of time or both. Mobility of species may make observations highly variable.

O=Occasional: The species is seldom found in large numbers and they may or may not spend a considerable time in the area.

C=Common: Several of the species are present for long periods of time. Species reproducing here could fit into this category.

A=Abundant: Large numbers of the species are observed for variable time periods. Migrating and wintering species could fit into this category.

TABLE LIII

USE OF SELECTED RELEASE LAKES FOR MAX MCGRAW WILDLIFE FOUNDATION MALLARDS BY WILD WATERFOWL[1]

Lakes and Months	None[2]	Geese, Canada	Ducks:	Mallard	Blue-Winged Teal	Green-Winged Teal	Lesser Scaup	Gadwall	American Widgeon	Ring-Necked	Shoveler	Pintail	Canvasback	Redhead	Wood	Ruddy	Greater Scaup	Bufflehead	Merganser, Common	Coot, American
Brown Lake (7-15-70 to 7-29-71)																				
July	0																			
August	0																			
September	0																			
October	0																			
November	X																			
December				26		2		15	6											
January		85[3]																		
February		30		9	2			28		2		1		12						14
March	X																			
April		28		10																16
May		13		9	4			3	2						1	7				4
June	0																			
July	0																			
Ashland Lake[4] (7-14-70 to 7-29-71)																				
July																				1
August																5				
September	0																			
October	0																			

TABLE LIII (Continued)

Lakes and Months	None[2]	Geese, Canada	Ducks:	Mallard	Blue-Winged Teal	Green-Winged Teal	Lesser Scaup	Gadwall	American Widgeon	Ring-Necked	Shoveler	Pintail	Canvasback	Redhead	Wood	Ruddy	Greater Scaup	Bufflehead	Merganser, Common	Coot, American
November	X																			
December				5																
January				19																
February						1														
March	X																			
April																				3
May																				2
June	0																			
July	0																			
Rocket Lake (6-25-69 to 7-29-71)																				
June				1																
July	0																			
August					8															
September					10															1
October							38													
November	X																			
December				2		13	6	44												
January				8				1												
February		2		9	2	9					7	3								
March	X																			
April		2		2											2					
May				2																

TABLE LIII (Continued)

Lakes and Months	None[2]	Geese, Canada	Ducks:	Mallard	Blue-Winged Teal	Green-Winged Teal	Lesser Scaup	Gadwall	American Widgeon	Ring-Necked	Shoveler	Pintail	Canvasback	Redhead	Wood	Ruddy	Greater Scaup	Bufflehead	Merganser, Common	Coot, American
Duck Marsh (6-25-69 to 7-29-71)																				
June	0																			
July															2					
August					3										2					
September				1	18	2				5					8					19
October					26			14	31			2								350
November	X																			
December				1100			95	400	150											200
January				55				225				24								175
February				9			6	128	2	16				5						237
March	X																			
April					19						11				1					64
May					2						2									24
Penoski Lake (6-18-69 to 7-30-71)																				
June																				1
July	0																			
August					15										1					1
September				6	6				2											5
October				1	1				14	2										54
November	X																			
December				42			4	32	197		2	4					4			
January				4		3		14	54	3		1								
February				11				31	40	18				70						8

TABLE LIII (Continued)

Lakes and Months	None[2]	Geese, Canada	Ducks:	Mallard	Blue-Winged Teal	Green-Winged Teal	Lesser Scaup	Gadwall	American Widgeon	Ring-Necked	Shoveler	Pintail	Canvasback	Redhead	Wood	Ruddy	Greater Scaup	Bufflehead	Merganser, Common	Coot, American
March								10	53	1		1								11
April				3	12			6	1		1				1		3			4
May					3															4
Curry Lake[5] (6-18-69 to 2-27-71)																				
June	0																			
July	0																			
August	0																			
September											1									1
October					3			8	4		2									22
November	X																			
December																				5
January	0																			
February	0																			
March										8						2				34
April					4						4									12
May					4						6									6
Taylor Lake (7-9-69 to 6-16-70)																				
July	0																			
August	0																			
September	0																			
October	0																			
November	X																			

TABLE LIII (Continued)

Lakes and Months	None[2]	Geese, Canada	Ducks:	Mallard	Blue-Winged Teal	Green-Winged Teal	Lesser Scaup	Gadwall	American Widgeon	Ring-Necked	Shoveler	Pintail	Canvasback	Redhead	Wood	Ruddy	Greater Scaup	Bufflehead	Merganser, Common	Coot, American
December	0																			
January	X																			
February	X																			
March						6				2		2		4				2		127
April				24		8	36	6			4		21					3		130
May																				33
June	0																			
Chalfant Lake (7-9-69 to 6-16-70)																				
July	0																			
August	0																			
September	0																			
October	0																			
November	X																			
December							10													
January	X																			
February	X																			
March						27	49						12					4		94
April				1			6				2					6		2		13
May						6														29
June							2			3					3			2		1
Coym Lake (7-9-69 to 6-16-70																				
July	0																			
August					2							2								4

TABLE LIII (Continued)

Lakes and Months	None[2]	Geese, Canada	Ducks:	Mallard	Blue-Winged Teal	Green-Winged Teal	Lesser Scaup	Gadwall	American Widgeon	Ring-Necked	Shoveler	Pintail	Canvasback	Redhead	Wood	Ruddy	Greater Scaup	Bufflehead	Merganser, Common	Coot, American
September	0																			
October					3				29	24	2	2								112
November	X																			
December				21	33			8				18								12
January	X																			
February	X																			
March				4		8	30	45			2					9			2	46
April				2	15			6			9									2
May				2							4									16
June				3							2									

[1]Because some of the release lakes were rejected for further use and because other lakes were used as release lakes later, continuous observations were not made at all lakes. Therefore, the waterfowl numbers listed above are averages of the number of waterfowl per month observed on the designated lake during the period indicated below the name of the lake.

[2]0=no wild waterfowl observed.
X=no observations were made.

[3]Brown Lake has a resident flock of 55 Canada Geese.

[4]An exceptionally large quantity of feathers was observed around the shore line of Ashland Lake. The feathers were from Mallard, Gadwall and Green-Winged Teal. Shafts of all feathers examined were not damaged. This lake must have been used by molting birds.

[5]In December 1970, the water level of Curry Lake was lowered and waterfowl ceased using the lake.

TABLE LIV

WEEKLY WILD WATERFOWL USE OF HAM LAKE AND SANGRE LAKE
1970 AND 1971[1]

	None	Geese, Canada	Ducks:	Mallard	Blue-Winged Teal	Green-Winged Teal	Lesser Scaup	Gadwall	American Widgeon	Ring-Necked	Shoveler	Pintail	Canvasback	Redhead	Ruddy	Greater Scaup	Bufflehead	Common Goldeneye	Merganser:	Common	Hooded	Coot, American
Ham Lake																						
1970																						
8-x	0																					
9-3				8	77																	
9-9				12	121							2										
9-15					164	75		12	7													
9-25				30	386	34		25	6		2	35										20
9-30					416	7		76	75	3		22										27
10-9				25	330	100	50	125	175			160										30
10-14		36			85	15	60	45	110	125		26	14	50								24
10-21					35	15	250	41	14	75	2	19	4	275		15						6
10-30				20			50			50		10	100	175	15							5
11-4					25		60	25	20	10		5	28	75	6							
11-13				15	2		150	5		50		3	21	45	2							
11-20							40	2		30		4	16	30	21							2
11-27				75			125			30		6	29		16							
12-5							36						8									
12-12							22		5				19	4								
12-19							8															
12-25				4			26						12	2								

TABLE LIV (Continued)

	None	Geese, Canada	Ducks:	Mallard	Blue-Winged Teal	Green-Winged Teal	Lesser Scaup	Gadwall	American Widgeon	Ring-Necked	Shoveler	Pintail	Canvasback	Redhead	Ruddy	Greater Scaup	Bufflehead	Common Goldeneye	Merganser:	Common	Hooded	Coot, American
1971																						
1-14								46		19		46	55					2				
1-20				14				130		50		125	75					4				
1-29						31		14	21	55		36						4				
2-6						6	20			14		21	33									
2-20				4		6		4		21		16	35									5
2-25				9						11							6			15		
3-5							25										8					
3-12						9	8	3	2	6							15				2	
3-18				2				8		20							2					
3-26						4		8		25	3	2			2		6					
4-2				2	18	21		40	25	8		2			13		8					
4-8				2	31	17	3	40	59	3	6			1			3					
4-15					60	25	15	75	40	2	31	5			9							6
4-26					12										2							2
5-3					14			27	2													2
5-11	0																					
5-18	0																					
5-24	0																					
6-x	0																					
7-x	0																					

TABLE LIV (Continued)

	None	Geese, Canada	Ducks: Mallard	Blue-Winged Teal	Green-Winged Teal	Lesser Scaup	Gadwall	American Widgeon	Ring-Necked	Shoveler	Pintail	Canvasback	Redhead	Ruddy	Greater Scaup	Bufflehead	Common Goldeneye	Merganser: Common	Hooded	Coot, American
Sangre Lake																				
1970																				
8-x	0																			
9-3			8																	
9-9			5																	
9-15			5																	
9-25			11																	
9-30			15																	
10-9			6																	
10-14	0																			
10-21			16																	
10-30			31																	
11-4			39	2																
11-13			46																	
11-20			26																	
11-27			21																	
12-5			42																	
12-12			50																	
12-19			52																	
12-25			56																	
1971																				
1-14			56																	
1-20			113																	
1-29			62																	

TABLE LIV (Continued)

	None	Geese, Canada	Ducks:	Mallard	Blue-Winged Teal	Green-Winged Teal	Lesser Scaup	Gadwall	American Widgeon	Ring-Necked	Shoveler	Pintail	Canvasback	Redhead	Ruddy	Greater Scaup	Bufflehead	Common Goldeneye	Merganser:	Common	Hooded	Coot, American
2-6				65																		
2-20				33										106								
2-25				55										34								1
3-5				42						1				36								1
3-12				2						7				9								2
3-18				4						3												2
3-26				8						4				1								5
4-2				7																		9
4-8				7																		6
4-15				3																		2
4-26				18					1													
5-3				32	1																	
5-11				18																		
5-18				6																		
5-24				6																		
6-x				12																		
7-x				6																		

[1]Ham Lake and Sangre Lake are located in the Stillwater, Oklahoma area. Ham Lake had considerable hunting pressure during the 1970 fall hunting season and Sangre Lake has houses around the edge.

TABLE LV

MORTALITY RECORD OF MAX MCGRAW WILDLIFE FOUNDATION MALLARDS AT RELEASE LAKES IN OKLAHOMA IN 1969, 1970, 1971, AND 1972

Location	Date	Age (weeks)	Type of Duck	Federal Band Number	Color Marker	Condition of Remains
1969						
Grassy Lake	6-19	4	?	none	none	Badly cut up, legs and head missing
Curry Lake	6-18	4	?	none	none	Body partly eaten
	6-27	5	Exp.	867-06072	Red Leg Band	Body eaten, feathers remained
	6-27	5	Control	867-06206	Red Leg Band	Body undamaged
	6-27	5	Control	867-06178	Red Leg Band	Body undamaged
	6-27	5	Exp.	867-06049	Red Leg Band	Feathers remained
	6-27	5	Control	867-06161	Red Leg Band	Feathers remained
	6-27	5	Control	867-06126	?	Feathers remained
	6-27	5	Exp.	867-06106	Red Leg Band	Body undamaged
	6-27	5	Exp.	867-06082	Red Leg Band	Body undamaged
	6-27	5	?	none	none	Feathers remained

TABLE LV (Continued)

Location	Date	Age (weeks)	Type of Duck	Federal Band Number	Color Marker	Condition of Remains
Curry Lake	6-27	5	?	none	none	Body uneaten, wings and legs gone
	6-27	5	?	none	none	Feathers remained
	6-27	5	?	none	none	Feathers remained
	7-17	8	?	none	none	Feathers, bones remained
Duck Marsh	7-17	7	?	none	none	Feathers remained
	7-17	7	?	none	none	Feathers remained
	8-4	10	Exp.	867-0627-	none	Reported by Game Ranger
Rocket Lake	7-16	7	?	none	none	Feathers remained
Canton Res.	8-11	10	Control	?	?	Reported by Game Ranger
	8-11	10	Control	?	?	Reported by Game Ranger
	8-22	11	Exp.	none	none	Body eaten, feathers, wing, bones remained
Taylor Lake	7-10	4	Exp.	867-06770	Green Leg Band	Body undamaged
	7-10	4	Exp.	867-06855	Green Leg Band	Feathers remained
	7-10	4	Exp.	867-06788	Green Leg Band	Body partially eaten
Chalfant Lake	7-10	4	Exp.	867-06763	Green Leg Band	Feathers remained

TABLE LV (Continued)

Location	Date	Age (weeks)	Type of Duck	Federal Band Number	Color Marker	Condition of Remains
Chalfant Lake	8-27	11	Exp.	867-06790	Green Leg Band	Body undamaged
Coym Lake	7-12	5	Control	867-06937	Yellow Leg Band	Partially eaten
Ham Lake	9-28	15	Control	807-90337	Blue Leg Band	Body undamaged
<u>1970</u>						
Sangre Lake	-	-	-	-	-	-
Brown Lake	7-13	5	Control	937-35587	Black	Body undamaged
	7-13	5	Exp.	937-35891	Orange	Body undamaged
	7-14	5	Exp.	937-35790	Orange	Killed by a car
	7-14	5	Control	937-35956	Black	Body undamaged
	7-22	6	Control	937-35729	Black	Body undamaged
Duck Marsh	7-10	5	Exp.	none	Orange	Body eaten, feathers, wing remained
	7-14	5	Exp.	937-35782	Orange	Body partially eaten
	7-22	6	Exp.	none	none	Body partially eaten, feathers, wing remained
	7-22	6	Exp.	937-35932	Orange	Body eaten, feathers, wings, legs, bill remained
	8-7	8	Exp.	937-35937	Orange	Feathers, leg remained

TABLE LV (Continued)

Location	Date	Age (weeks)	Type of Duck	Federal Band Number	Color Marker	Condition of Remains
Duck Marsh	9-5	12	Control	none	Black	Feathers, wings, bill remained
Rocket Lake	7-22	6	Control	937-35523	Black	Body partially eaten
	7-22	6	Control	none	Black	Feathers, bill remained
	8-7	8	Control	none	Black	Feathers remained
Ashland Lake	7-14	5	Exp.	937-35958	Orange	Feathers, leg, bill remained
	7-14	5	Control	937-35524	Black	Feathers remained
	7-14	5	Control	937-35600	none	Feathers remained
	7-14	5	Control	937-35662	Black	Feathers remained
	7-14	5	Control	937-35645	Black	Feathers, leg remained
	7-22	7	?	none	none	Feathers remained
	7-22	7	?	none	none	Feathers remained
	7-22	7	Exp.	none	Orange	Feathers remained
	7-22	7	Control	937-35502	none	Feathers, wing, feet remained
	7-22	7	Exp.	937-35831	Orange	Feathers, wing, feet remained
	7-22	7	Exp.	none	Orange	Feathers, part of head remained
	7-22	7	Control	937-35673	Black	Killed by a car
	8-1	8	?	none	none	Feathers remained

TABLE LV (Continued)

Location	Date	Age (weeks)	Type of Duck	Federal Band Number	Color Marker	Condition of Remains
Ashland Lake	8-1	8	?	none	none	Feathers, bones remained
	8-1	8	Control	937-35864	Black	Feathers remained
	8-1	8	?	none	none	Feathers remained
	8-7	9	Control	none	Black	Feathers remained
	8-7	9	Control	937-35650	none	Feathers remained
	8-11	10	Control	937-35795	Black	Feathers remained
	8-11	10	?	none	none	Feathers remained
Penoski Lake	8-21	8	Exp.	937-36621	Orange	Body undamaged
	8-21	8	Exp.	937-36734	Orange	Body undamaged, head eaten
	8-21	8	Exp.	none	Orange	Feathers, back, wings, leg remained
	8-27	9	Exp.	none	Orange	Feathers, wing, remained
	8-27	9	Exp.	937-36591	Orange	Body undamaged, head eaten
	9-21	13	Exp.	937-36638	Orange	Body undamaged, neck eaten
	9-21	13	Exp.	not returned	?	Killed by a car
	9-21	13	Exp.	not returned	?	Killed by a car
	9-21	13	Exp.	not returned	?	Killed by a car
	9-21	13	Exp.	not returned	?	Killed by a car
	9-21	13	Exp.	not returned	?	Killed by a farm dog
	9-21	13	Exp.	not returned	?	Killed by a farm dog

TABLE LV (Continued)

Location	Date	Age (weeks)	Type of Duck	Federal Band Number	Color Marker	Condition of Remains
Curry Lake	8-5	6	Control	937-36448	Black	Body slightly damaged, uneaten
	8-5	6	Control	937-36299	Black	Body undamaged
	8-5	6	Control	937-36356	Black	Body undamaged; head, foot gone
	8-5	6	Control	937-36358	Black	Body partially eaten
	8-14	7	?	none	none	Body undamaged
	8-14	7	Control	none	Black	Feathers remained
	8-14	7	Control	937-36326	Black	Feathers, wing, foot remained
	8-26	9	Control	none	Black	Feathers remained
	10-24	17	Control	none	none	Feathers, wings remained
	11-7	19	Control	937-36349	none	Feathers, wing remained
Zink Ranch	8-28	9	Control	937-36439	Black	Drowned in fish cage
	8-28	9	?	none	none	Drowned in fish cage
<u>1971</u>						
Penoski Lake	6-11	5	Control	967-52506	Green	Feathers, leg remained
	6-11	5	Control	967-52773	Green	Feathers, legs remained
	6-16	6	Control	967-52959	Green	Body undamaged
Red Bird Lake	6-17	6	Exp.	none	none	Feathers remained
	6-17	6	Exp.	967-53295	White	Caught in fish net; eaten by turtles

TABLE LV (Continued)

Location	Date	Age (weeks)	Type of Duck	Federal Band Number	Color Marker	Condition of Remains
Red Bird Lake	7-5	9	Exp.	967-53079	White	Feathers, head, wings, legs remained
Zink Ranch	6-20	7	Control	none	Green	Feathers, head remained
	6-20	7	Exp.	none	White	Feathers, head remained
	7-4	9	Control	967-52927	Green	Being eaten by Red-Tailed Hawk
Duck Marsh	6-13	6	Exp.	none	none	Feathers remained
	6-23	8	Exp.	none	none	Feathers remained
	7-3	10	Exp.	967-52235	White	Feathers, wings, legs remained
Rocket Lake	6-17	6	Control	none	none	Feathers, bones remained
	6-17	6	Control	none	none	Feathers remained
	6-17	6	Control	none	none	Feathers remained
	6-23	8	Control	967-52599	Green	Body undamaged; neck, head chewed up
	6-23	8	Control	967-52678	Green	Body eaten, feathers, wings, legs, head remained
	6-23	8	Control	none	none	Feathers remained
	6-23	8	Control	none	none	Feathers, bones, wings remained
	7-1	10	Control	967-52975	Green	Feathers, wings, legs remained

TABLE LV (Continued)

Location	Date	Age (weeks)	Type of Duck	Federal Band Number	Color Marker	Condition of Remains
Ashland Lake	6-20	7	Control	967-52883	Green	Feathers, wings, bill, leg bones remained
	6-25	7	Control	967-52694	Green	Feathers, leg, bill remained
Lake 48	6-12	6	Exp.	none	none	Feathers remained
Lake 45	6-16	6	Control	967-52525	Green	Feathers, wings, legs, bill remained
	6-16	6	Control	967-52836	Green	Body undamaged except for head
	6-16	6	Control	967-52623	Green	Feathers, bones, intestines remained; flesh eaten
	6-20	7	Control	none	none	Feathers remained
	6-20	7	Control	967-52909	Green	Feathers, wings, one leg, intestines remained
	6-26	8	Control	967-52695	Green	Feathers, legs, wings, bill, intestines remained
Lake 51	6-16	6	Control	967-52662	Green	Body undamaged
	6-18	7	Control	none	none	Feathers remained
Lake 23	6-18	7	Control	967-52849	Green	Feathers, legs, bill remained
	6-18	7	Control	967-52616	Green	Feathers, legs, bill remained
	7-14	11	Control	none	none	Feathers remained

TABLE LV (Continued)

Location	Date	Age (weeks)	Type of Duck	Federal Band Number	Color Marker	Condition of Remains
Lake 3	6-22	7	Control	967-52938	Green	Feathers, wings, legs, bill remained
	6-26	8	Control	967-52716	Green	Feathers, leg, bill remained
Lake 4	6-22	7	Exp.	967-53357	White	Feathers, legs, wings, bill remained
Lake 2	6-26	8	Exp.	none	none	Feathers remained
Lake 6	6-26	8	Exp.	967-53019	White	Partly eaten by turtles; bill was badly damaged
Vogel Pond	6-25	8	Exp.	none	none	Feathers remained
	6-25	8	Exp.	none	none	Feathers remained
Lake 52	7-6	9	Control	967-52556	none	Feathers remained
Lake 39	7-8	10	Control	none	none	Feathers remained
Capart Pond	7-10	10	Control	none	none	Feathers, wings remained
1972						
Ashland Lake	2-15	41	Control	967-52964	none	Reported by fisherman
Brown Lake	5-15	-	Control	937-35577	none	Killed by a car
	5-15	-	Control	937-35689	none	Killed by a car

TABLE LVI

REPORTED HUNTING MORTALITIES OF MAX MCGRAW WILDLIFE FOUNDATION MALLARDS RELEASED IN OKLAHOMA IN 1969, 1970, AND 1971

Release Location and Year	Date of Kill	Age (weeks)	Duckling Type	Sex	Recovery State	Distance Traveled (km)	Direction
Canton Res.-1969	10-25-69	20	Experimental	F	Oklahoma	0	0
	10-25-69	20	Control	M	Oklahoma	0	0
	10-25-69	20	Control	F	Oklahoma	0	0
	10-25-69	20	Control	M	Oklahoma	0	0
	10-26-69	20	Experimental	F	Oklahoma	0	0
	10-26-69	20	Experimental	F	Oklahoma	0	0
	10-26-69	20	Experimental	M	Oklahoma	0	0
	10-26-69	20	Experimental	M	Oklahoma	0	0
	10-26-69	20	Control	M	Oklahoma	0	0
	10-26-69	20	Experimental	M	Kansas	260	North
	10-30-69	21	Control	F	Oklahoma	0	0
	11-xx-69	24	Experimental	F	Oklahoma	0	0
	12-12-70	79	Control	M	Oklahoma	0	0
	12-12-70	79	Control	M	Oklahoma	0	0
	1-06-71	83	Experimental	M	Oklahoma	80	North
	12-26-71	134	Experimental	F	Oklahoma	80	Northeast
	12-29-71	134	Control	M	Texas	480	South
	9-29-72	174	Experimental	M	Saskatchewan, Canada	2000	Northwest
Chalfant Lake-1969	11-12-70	74	Experimental	M	Kansas	420	Northeast
	12-xx-71	131	Experimental	F	Kansas	240	Northeast
Taylor Lake-1969	11-25-71	128	Experimental	M	Texas	225	South

TABLE LVI (Continued)

Release Location and Year	Date of Kill	Age (weeks)	Duckling Type	Sex	Recovery State	Distance Traveled (km)	Direction
Coym Lake-1969	10-16-70	70	Control	F	North Dakota	1200	North
	11-xx-70	74	Control	M	Kansas	270	Northeast
	10-21-71	123	Control	F	Alberta, Canada	2000	Northwest
Ham Lake-1969	11-02-69	20	Control	M	Oklahoma	0	0
	11-15-69	22	Control	F	Louisiana	520	Southeast
	11-14-70	74	Control	M	Kansas	425	Northwest
	1-10-71	82	Control	M	Arkansas	590	East
	10-07-72	121	Control	M	North Dakota	1400	North
Curry Lake-1969	10-08-70	72	Control	M	South Dakota	1120	North
	10-11-70	72	Experimental	F	South Dakota	1120	North
	1-14-73	191	Control	M	Oklahoma	120	East
Duck Marsh-1969	11-xx-69	24	Experimental	M	Kansas	410	North
	12-05-69	27	Experimental	M	Arkansas	290	Northeast
	10-03-70	70	Experimental	F	Minnesota	1010	North
Rocket Lake-1969	11-02-69	23	Control	F	Oklahoma	50	West
	11-02-69	23	Experimental	F	Oklahoma	50	West
	11-09-69	24	Experimental	F	Oklahoma	50	West
	11-03-70	70	Experimental	F	Minnesota	1010	North
	11-27-70	78	Experimental	F	Texas	270	South
Zink Ranch-1970	11-02-70	19	Control	?	Oklahoma	0	0
	10-xx-71	68	Control	F	Nebraska	560	North
	10-14-72	120	Experimental	F	Nebraska	550	North
	10-21-72	121	Control	M	Oklahoma	0	0

TABLE LVI (Continued)

Release Location and Year	Date of Kill	Age (weeks)	Duckling Type	Sex	Recovery State	Distance Traveled (km)	Direction
Curry Lake-1970	10-31-70	18	Control	M	Kansas	400	North
	10-16-71	68	Control	F	Kansas	400	Northeast
	10-31-71	70	Control	M	Nebraska	655	North
	--	About 120	Control	M	North Dakota	1340	North
	10-28-72	122	Control	F	Kansas	240	Northeast
Penoski Lake-1970	11-12-70	20	Experimental	M	Oklahoma	105	Northwest
	10-16-71	68	Experimental	F	Kansas	400	North
	12-11-71	76	Experimental	M	Oklahoma	210	North
Rocket Lake-1970	10-17-70	19	Control	M	Oklahoma	90	Northwest
Brown Lake-1970	9-xx-70	14	Experimental	M	Oklahoma	135	Southwest
	10-18-70	19	Control	M	Oklahoma	105	North
	11-xx-70	23	Experimental	M	Oklahoma	145	Southwest
	12-12-70	27	Experimental	F	Oklahoma	90	North
	10-16-71	71	Control	M	Kansas	305	North
Penoski Lake-1971	10-17-71	24	Control	M	Kansas	255	North
	10-17-71	24	Control	M	Oklahoma	55	Southeast
	12-30-71	33	Control	M	Oklahoma	70	Northeast
	10-26-72	77	Control	M	Oklahoma	90	Northeast
Capart Farm-1971	11-05-71	26	Control	M	Oklahoma	0	0
	11-xx-71	26	Experimental	F	Oklahoma	0	0
Lake 51-1971	11-21-71	29	Control	F	Oklahoma	160	North
	11-21-71	29	Control	F	Oklahoma	160	North
	11-21-71	29	Control	F	Oklahoma	160	North

TABLE LVI (Continued)

Release Location and Year	Date of Kill	Age (weeks)	Duckling Type	Sex	Recovery State	Distance Traveled (km)	Direction
Lake 58-1971	10-16-71	24	Experimental	M	Oklahoma	135	North
	10-16-71	24	Experimental	M	Oklahoma	135	North
	10-16-71	24	Experimental	F	Oklahoma	135	North
	10-16-71	24	Experimental	M	Oklahoma	135	North
Lake 6-1971	12-xx-71	33	Experimental	M	Louisiana	540	Southeast
Lake 4-1971	10-17-71	24	Experimental	F	Oklahoma	130	Northeast
	10-24-71	25	Experimental	M	Oklahoma	70	North
	10-22-72	77	Experimental	F	Oklahoma	90	Northeast
Lake 48-1971	10-16-71	24	Experimental	M	Oklahoma	110	Northeast
	11-06-71	27	Experimental	M	Missouri	400	Northeast
Lake 7-1971	10-16-71	24	Experimental	M	Oklahoma	65	North
Lake 66-1971 (Ashland)	10-24-71	25	Control	M	Oklahoma	135	North
Lake 50-1971	11-25-71	29	Experimental	F	Oklahoma	120	Northeast
Blue Stem Lake-1971	11-xx-72	80	Control	F	Oklahoma	0	0
Penoski Lake-1970[1]	9-06-70	10	Experimental	M	Oklahoma	0	0
	9-06-70	10	Experimental	M	Oklahoma	0	0
	9-06-70	10	Experimental	F	Oklahoma	0	0

TABLE LVI (Continued)

Release Location and Year	Date of Kill	Age (weeks)	Duckling Type	Sex	Recovery State	Distance Traveled (km)	Direction
Curry Lake-1970[1]	9-06-70	10	Control	F	Oklahoma	0	0
	9-06-70	10	Control	F	Oklahoma	0	0
	9-06-70	10	Control	F	Oklahoma	0	0
Penoski Lake-1970[2]	9-21-70	13	Experimental	?	Oklahoma	0	0
	9-21-70	13	Experimental	?	Oklahoma	0	0
	9-21-70	13	Experimental	?	Oklahoma	0	0

[1]Three ducklings were collected for necropsy at each of the two lakes indicated.

[2]Two boys were caught poaching at Penoski Lake by a Game Ranger. Birds shot by the boys were given to me for necropsy.

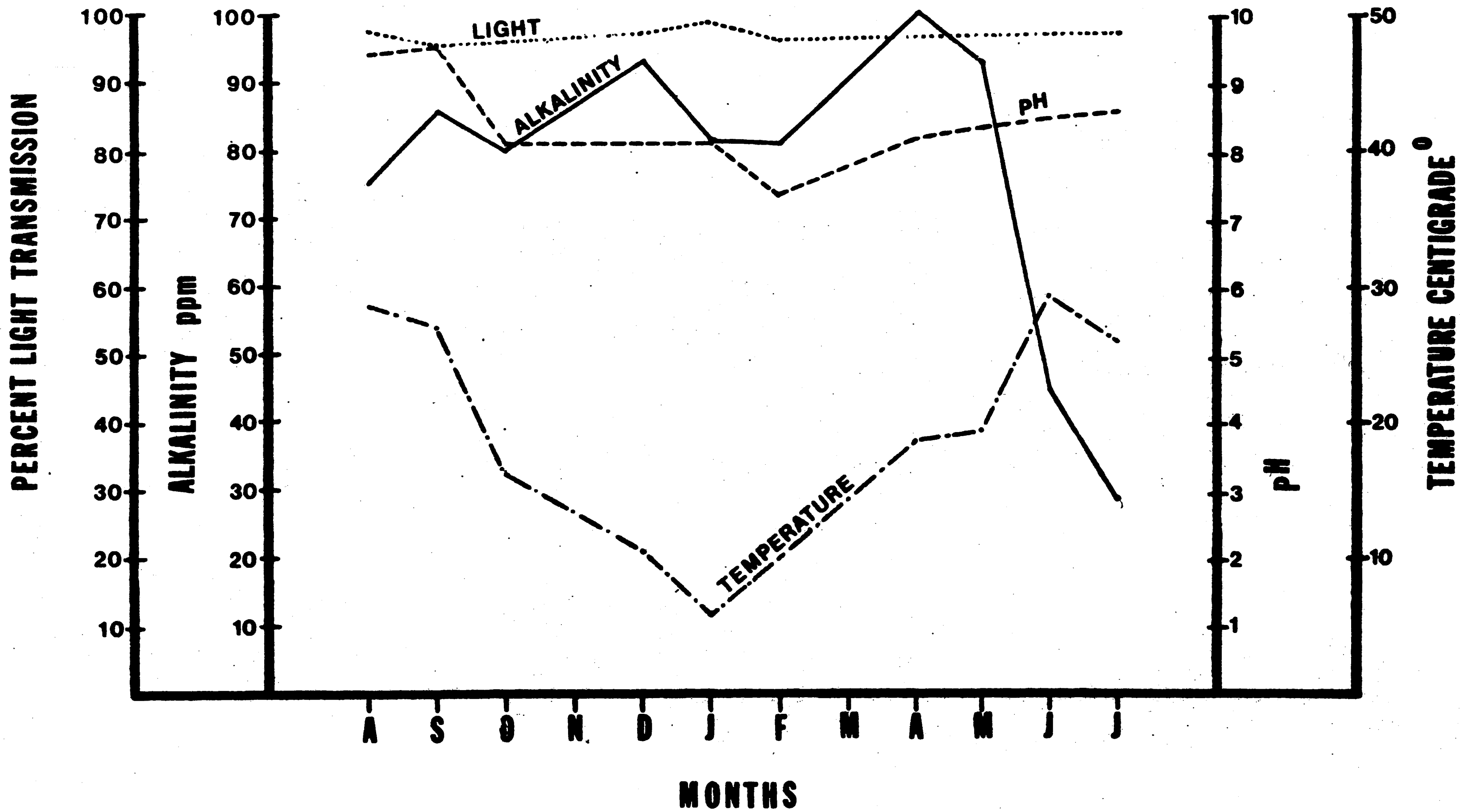

Figure 14. Water Quality Variables at Penoski Lake in 1970 and 1971

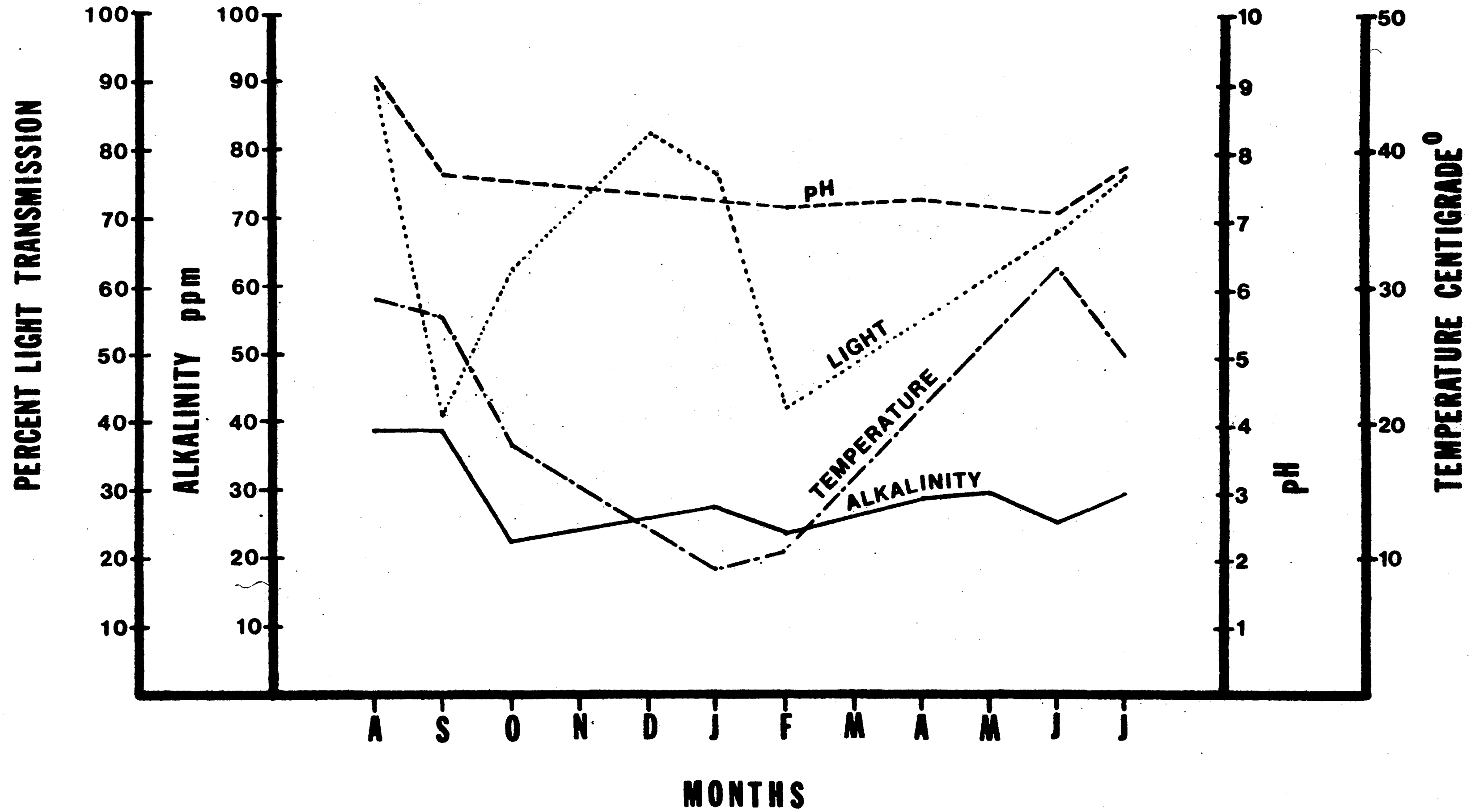

Figure 15. Water Quality Variables at Rocket Lake in 1970 and 1971

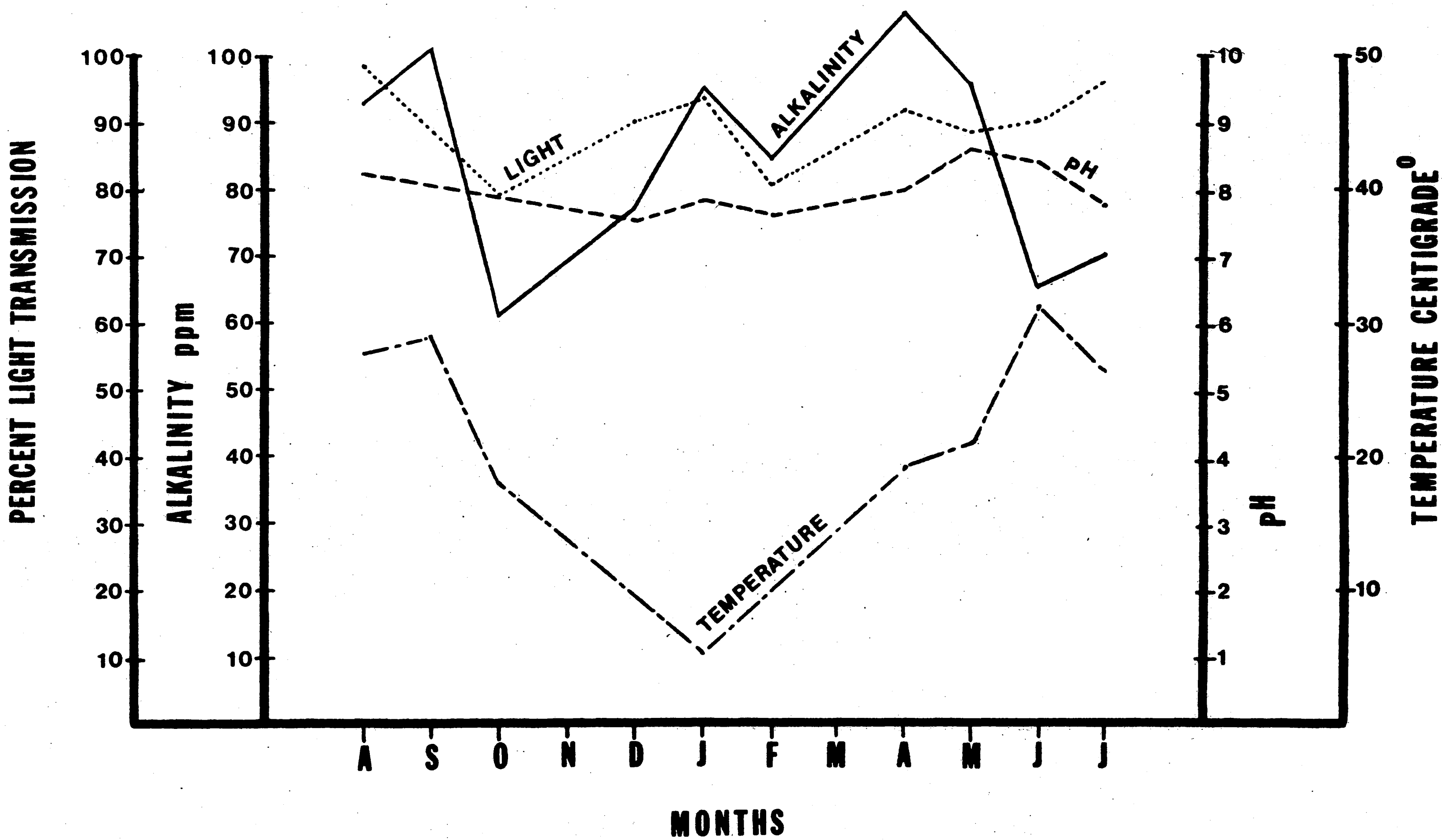

Figure 16. Water Quality Variables at the Duck Marsh in 1970 and 1971

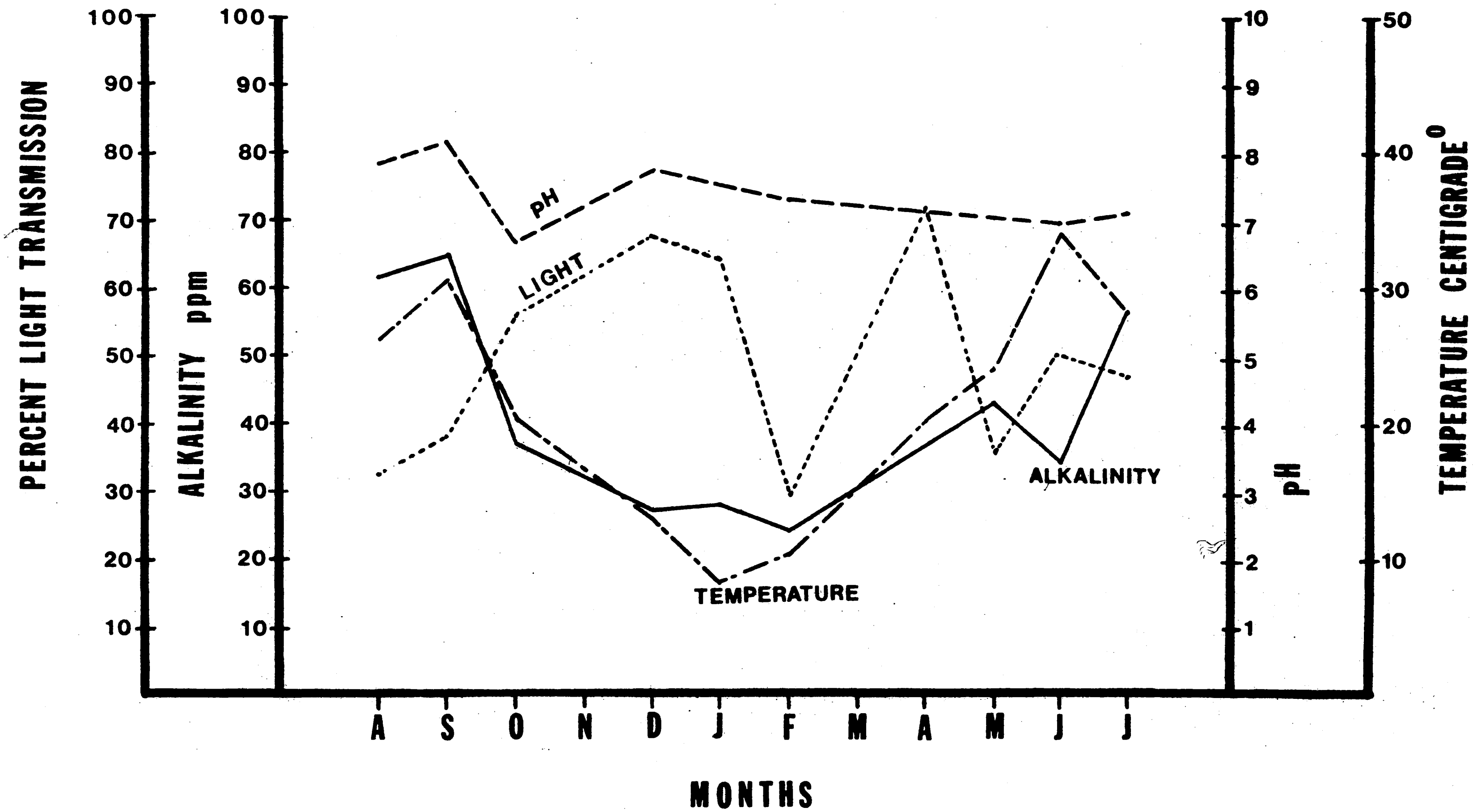

Figure 17. Water Quality Variables at Ashland Lake in 1970 and 1971

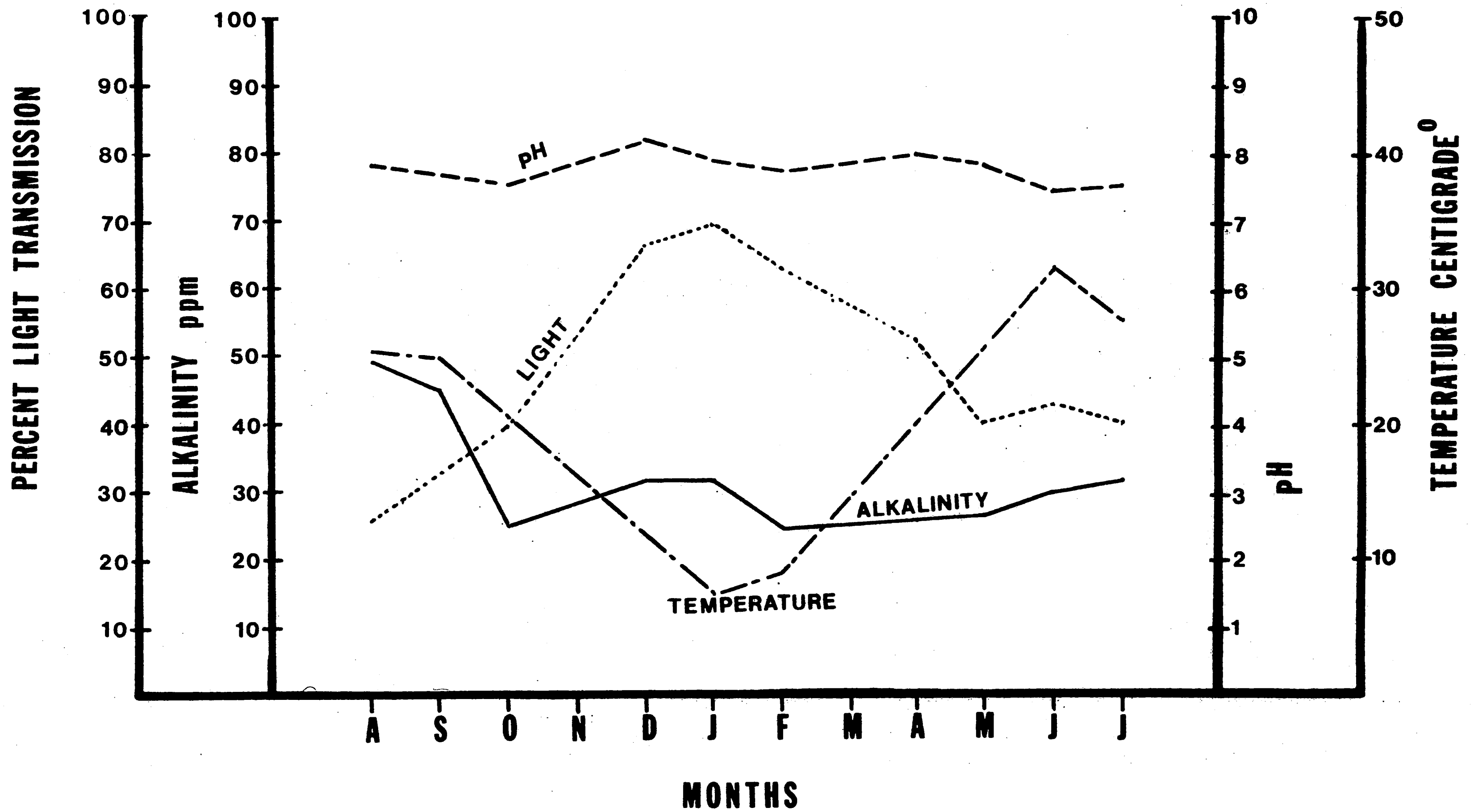

Figure 18. Water Quality Variables at Brown Lake in 1970 and 1971

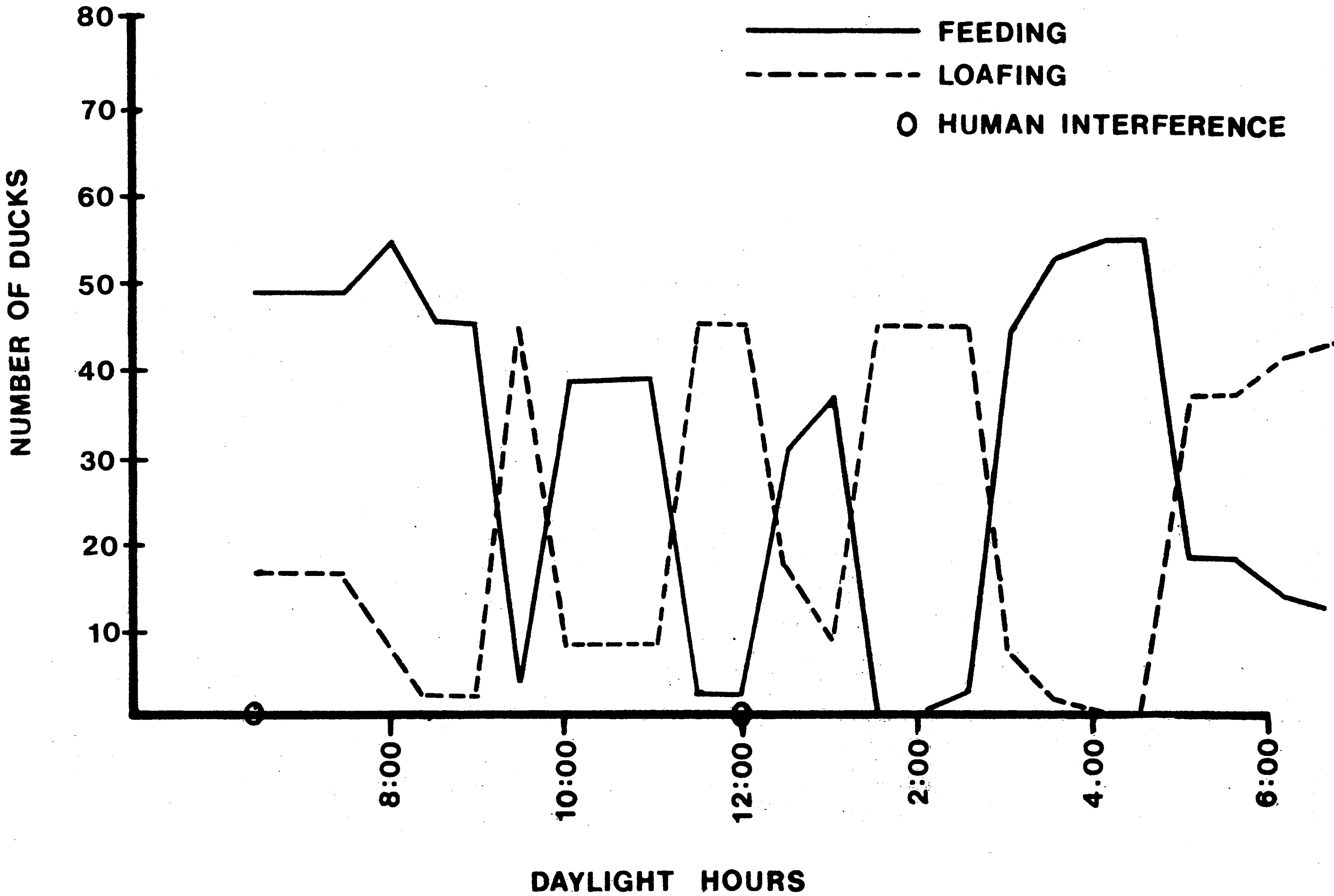

Figure 19. Feeding and Loafing Periods in Control Max McGraw Wildlife Foundation Mallards, Coym Lake, August 8, 1969

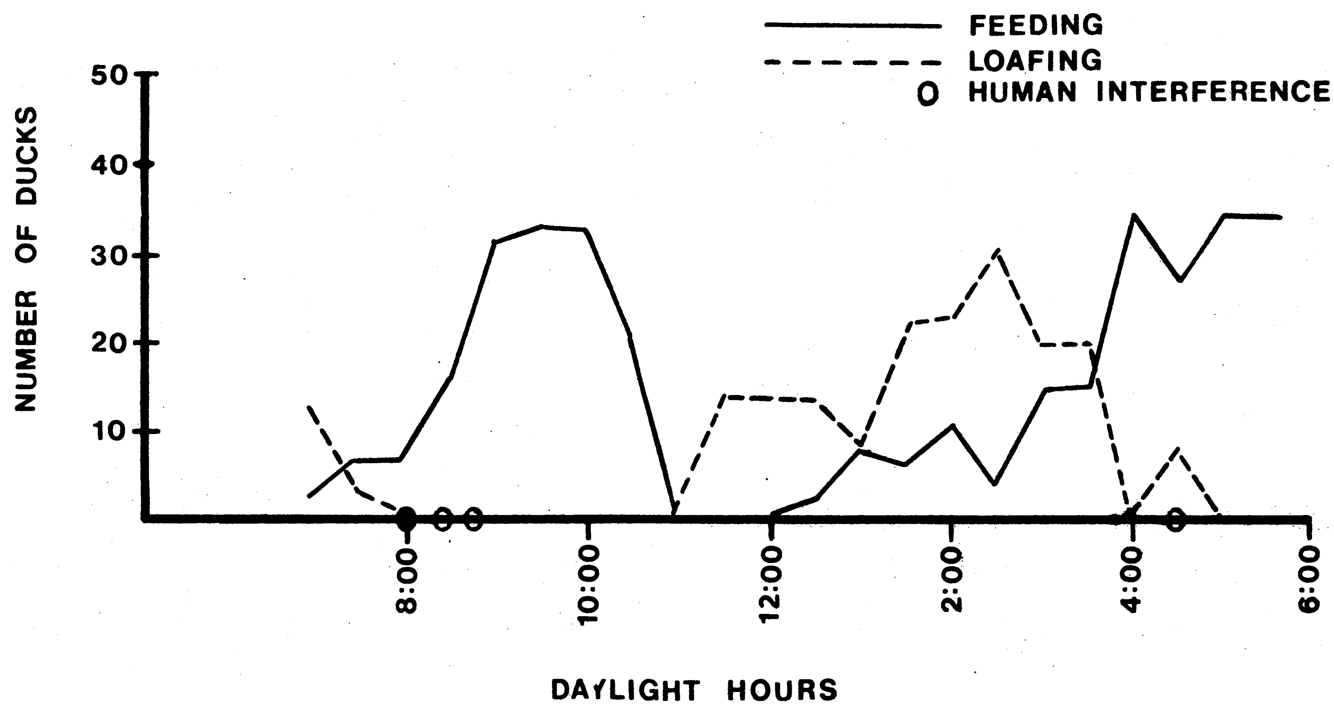

Figure 20. Feeding and Loafing Periods in Experimental Max McGraw Wildlife Foundation Mallards, Chalfant Lake, August 7, 1969

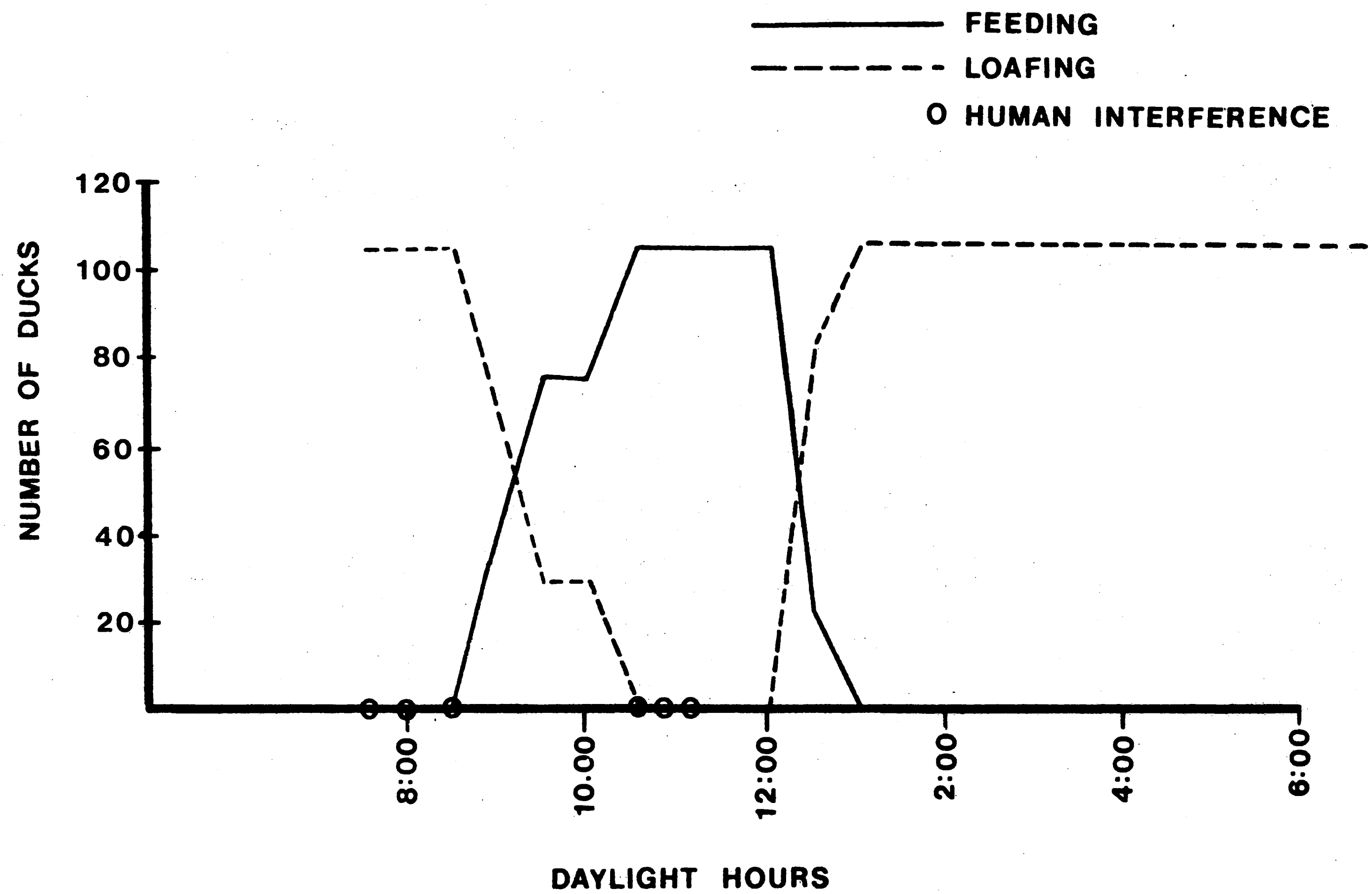

Figure 21. Feeding and Loafing Periods in Control Max McGraw Wildlife Foundation Mallards, Curry Lake, August 26, 1970

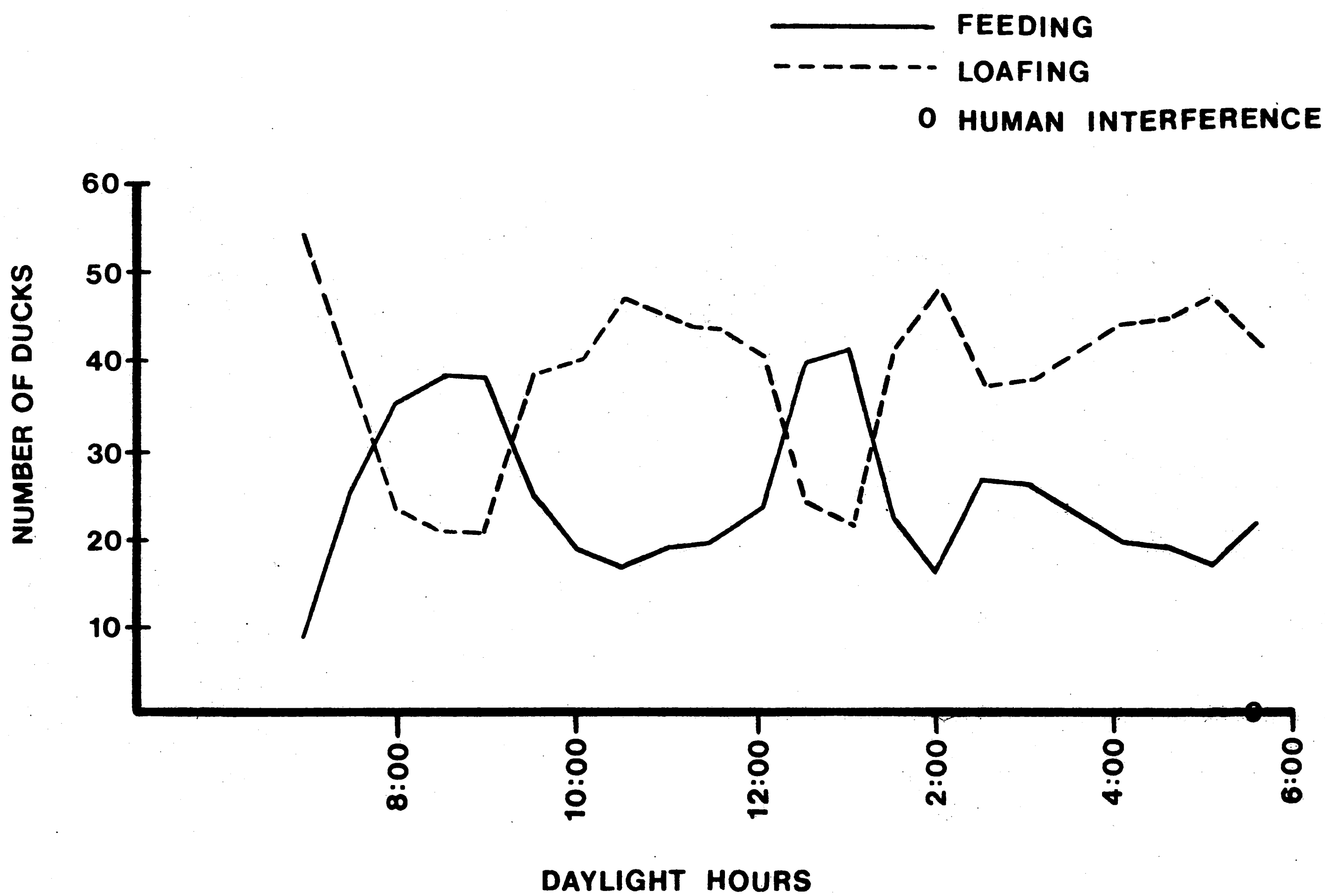

Figure 22. Feeding and Loafing Periods in Experimental Max McGraw Wildlife Foundation Mallards, Penoski Lake, August 27, 1970

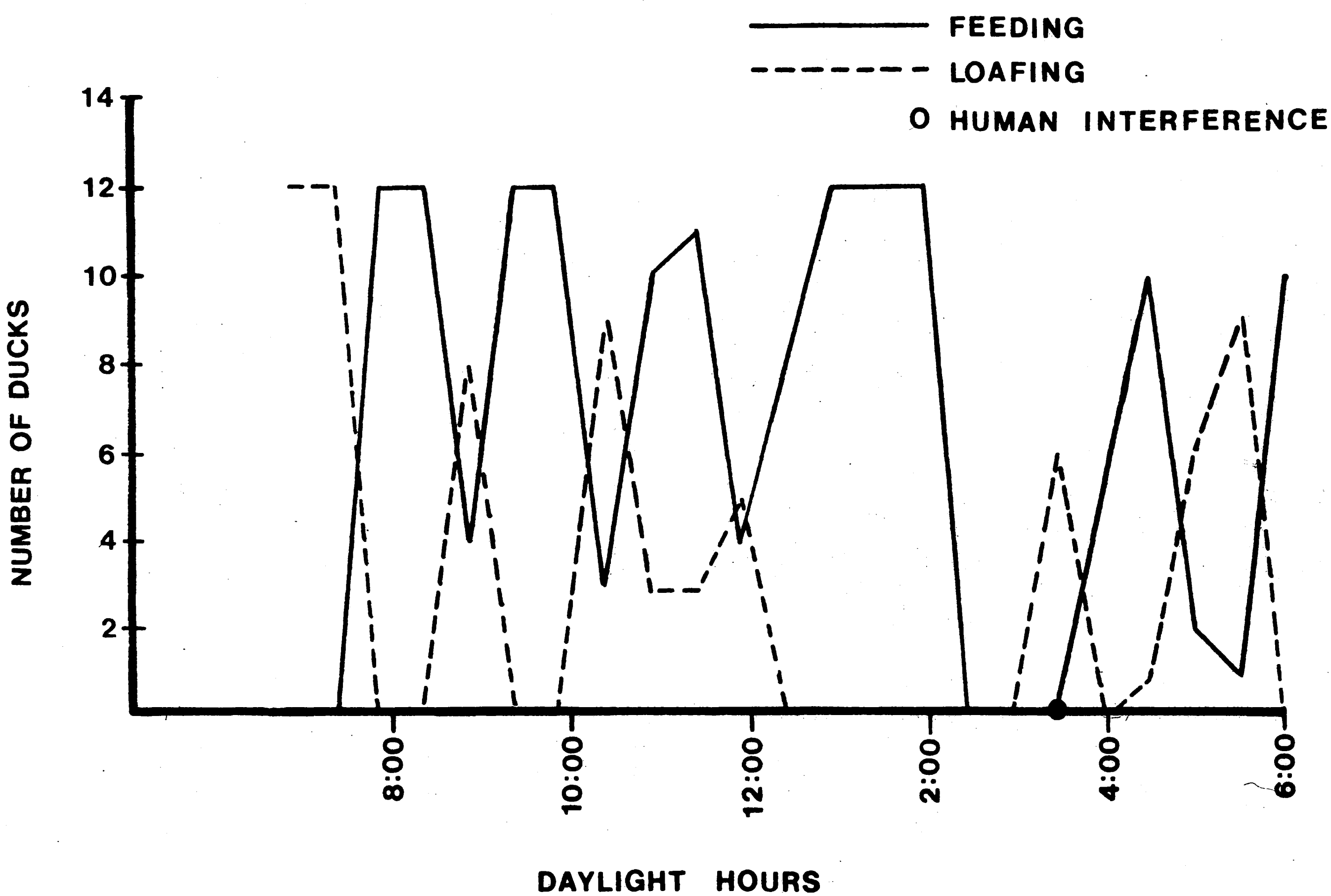

Figure 23. Feeding and Loafing Periods in Experimental and Control Max McGraw Wildlife Foundation Mallards, Ashland Lake, July 23, 1970

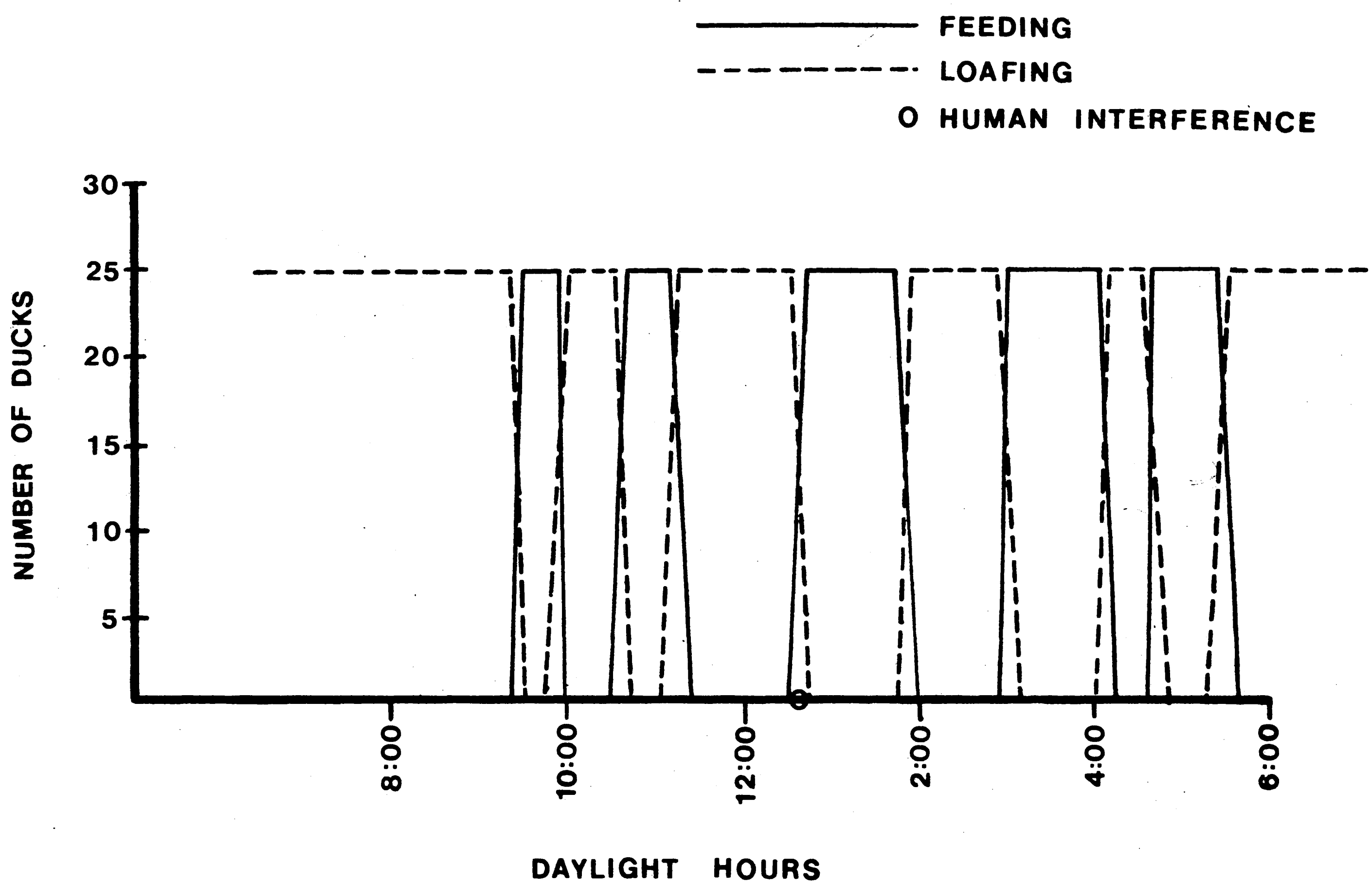

Figure 24. Feeding and Loafing Periods in Control Max McGraw Wildlife Foundation Mallards, Lake 39, June 25, 1971

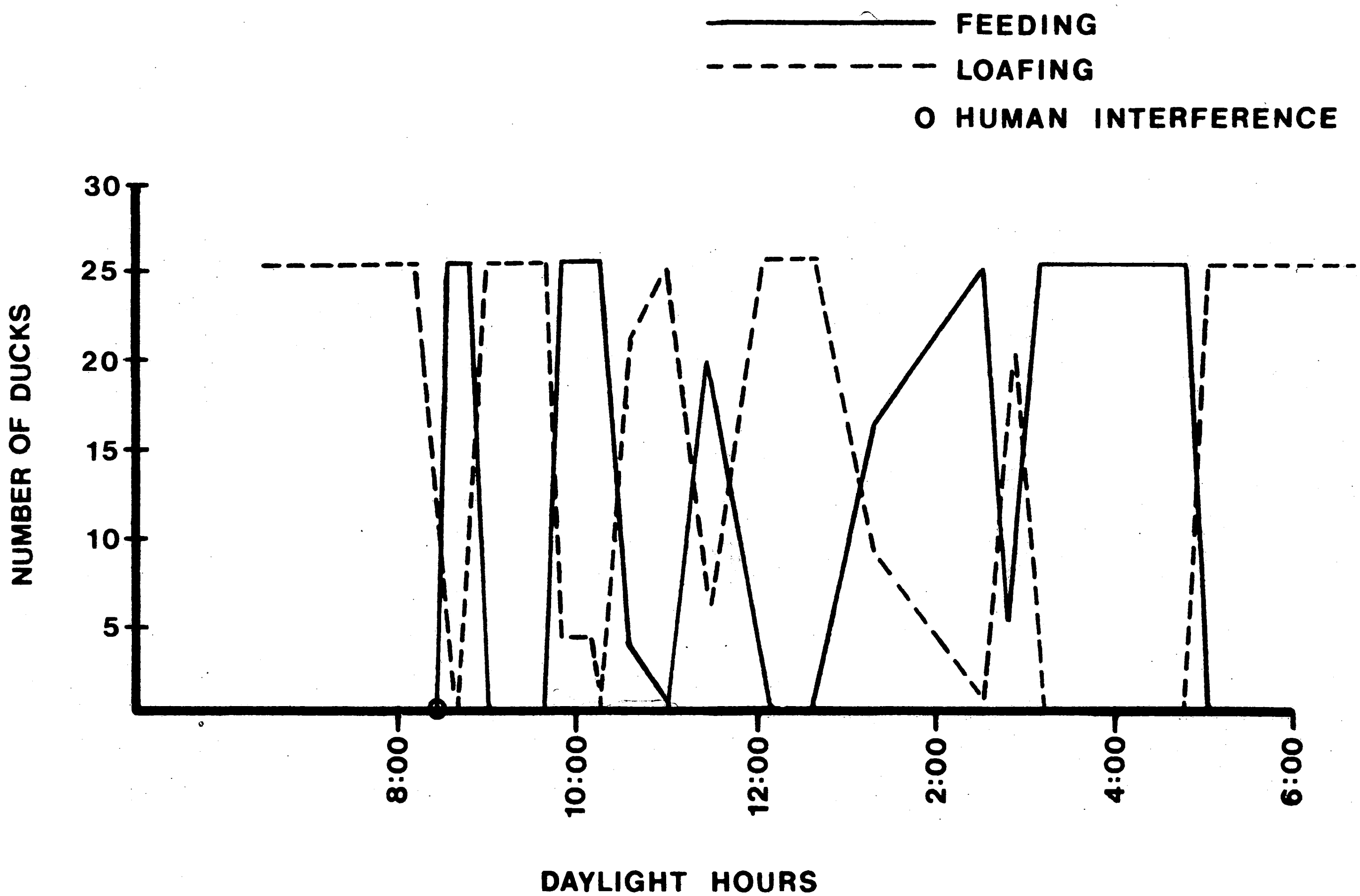

Figure 25. Feeding and Loafing Periods in Experimental Max McGraw Wildlife Foundation Mallards, Lake 4, July 11, 1971

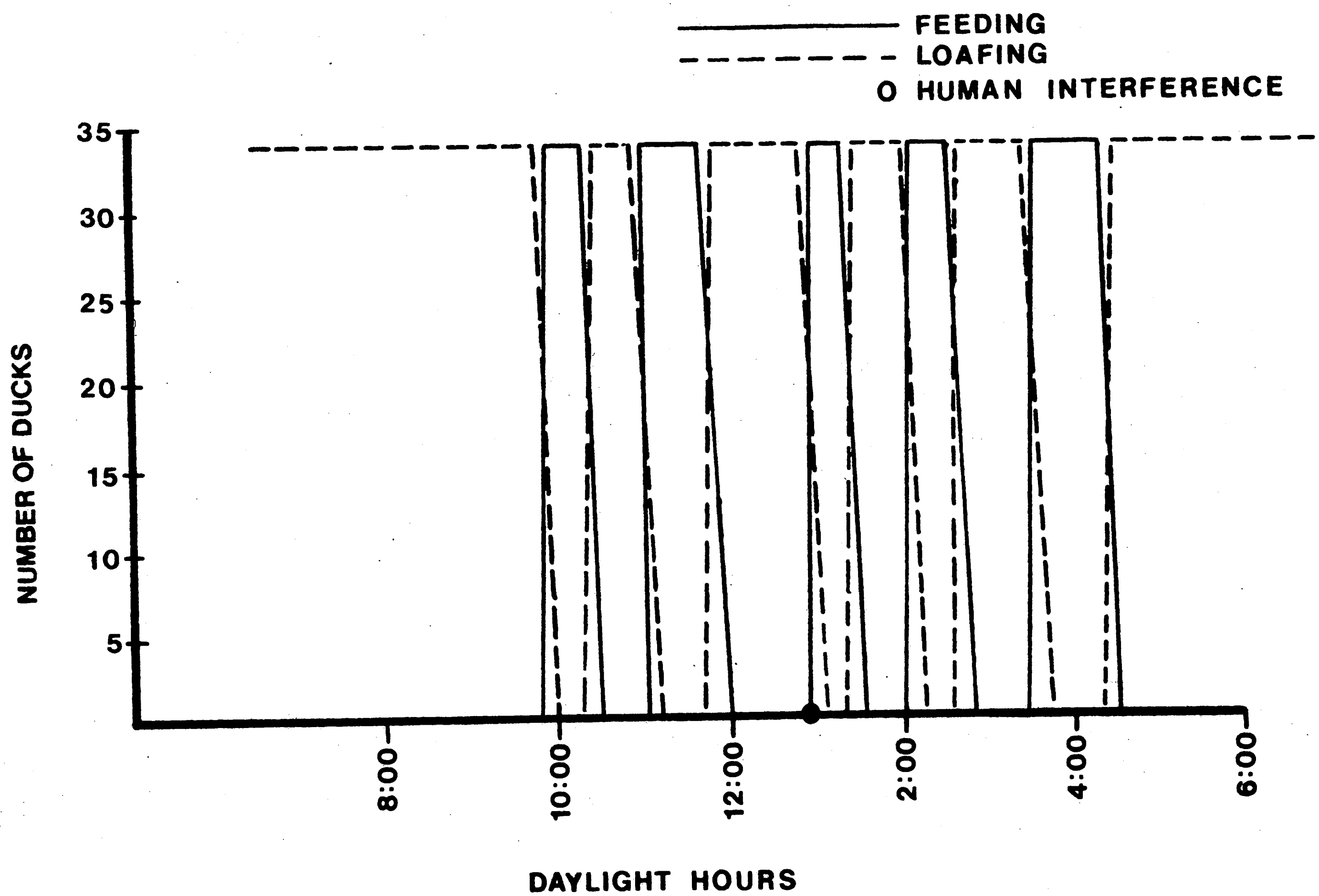

Figure 26. Feeding and Loafing Periods in Experimental and Control Max McGraw Wildlife Foundation Mallards, Lake 51, July 31, 1971

LITERATURE ANALYSIS

1. Lincoln, Fredrick C. 1934.
    a. Project Date: 1930-1931
    b. Location: Pennsylvania, New York, Connecticut and California
    c. Species, Numbers, and Ages:
        (1) Mallard 3556 (Adult)
        (2) Black Duck 815 (Adult)
    d. Treatment: standard game farm.
    e. Release Method: unknown
    f. Comments:
        (1) Objectives: restocking marshes with hand-reared ducks.
        (2) Evaluation: band returns (it was not understood what the band returns for released birds should be.)
        (3) Success: failure because band returns were far below that recorded for wild birds.

2. Pirnie, M. D. 1935.
    a. Project Date: 1929
    b. Location: Michigan
    c. Species, Numbers, and Ages:
        (1) Mallard 100 (Flight age--fall and spring)
    d. Treatment: standard game farm.
    e. Release Method: direct
    f. Comments:
        (1) Objectives: stocking project
        (2) Evaluation: band returns
        (3) Success: birds showed migrational behavior similar to wild mallards.
        (4) Behavior: some information included.

3. Errington, Paul L. and W. E. Albert, Jr. 1936.
    a. Project Date: 1932-1933
    b. Location: Iowa
    c. Species, Numbers, and Ages:
        (1) Mallard 350 (Ducklings)
    d. Treatment:
        (1) Improved: possible
        (2) Isolated: unknown
        (3) Hardened: yes
        (4) Standard: yes
    e. Release Method: free hatched
    f. Comments:
        (1) Objectives: trapped and banded offspring of ducks liberated from a game farm.
        (2) Evaluation: habits and survival were determined by banding and recapturing.

(3) Success: nearly 27 percent of the banded birds were in the area in the second summer after banding. The entire population was not caught and banded. Considered a failure because of lack of migration and low band returns.
(4) Behavior: some information included.
(5) Feeding: provided corn.

4. Benson, Dirck. 1939.
   a. Project Date: 1938
   b. Location: New York
   c. Species, Numbers, and Ages:
      (1) Mallard 70 (3, 5 and 7 weeks)
      (2) Mallard 50 (Adults)
   d. Treatment: standard game farm
   e. Release Method: direct
   f. Comments:
      (1) Objectives: restocking by liberation of breeders in the spring and by liberation of different age group ducklings during the summer.
      (2) Evaluation: field observation
      (3) Success: survival to flight age was good and breeders produced clutches.
      (4) Behavior: good descriptions included.
      (5) Habitat characteristics: described
      (6) Control: some wild black ducks and wood ducks nested on release lakes.

5. Williams, C. S. and E. R. Kalmbach. 1943.
   a. Project Date: 1938-1939
   b. Location: Manitoba, Canada; Maryland, Oregon, and North Dakota, U.S.A.
   c. Species, Numbers and Ages:
      (1) Pintails 120 (4 to 8 weeks)
      (2) Mallard 11 (4 to 8 weeks)
      (3) Gadwalls 14 (4 to 8 weeks)
      (4) Redheads 1 (4 to 8 weeks)
      (5) Shoveler 1 (4 to 8 weeks)
      (6) Blue-winged Teal 58 (4 to 8 weeks)
      (7) Widgeon 1 (4 to 8 weeks)
      (8) Cinnamon Teal 7 (4 to 8 weeks)
   d. Treatment: improved, all from eggs of wild birds.
   e. Release Methods: probably direct
   f. Comments:
      (1) Objectives: to study ancestral attachment to flyways. Birds were transported and reared in flyways other than flyway of origin.
      (2) Evaluation: band return and recaptures.
      (3) Success: birds became adapted to the flyway in which they were released.

6. McCabe, Robert A. 1947.
   a. Project Date: 1943-1944
   b. Location: Wisconsin
   c. Species, Numbers, and Ages:
      (1) Wood Ducks 100 (3 to 5 weeks)
   d. Treatment: improved, from eggs of wild birds.
   e. Release Methods: direct and gentle
   f. Comments:
      (1) Objective: to establish a wood duck colony.
      (2) Evaluation: field observation.
      (3) Success: reproduction occurred in the spring after release.
      (4) Behavior: some information included.

7. Wells, R. A. 1951.
   a. Project Date: 1946-1949
   b. Location: New York
   c. Species, Numbers, and Ages:
      (1) Mallard 5,344 (age unknown)
   d. Treatment: standard game farm
   e. Release Methods: probably direct
   f. Comments:
      (1) Objectives: restocking.
      (2) Evaluation: band returns.
      (3) Success: hand-reared birds are compared with wild birds.
      (4) Behavior: some information included

8. Hickey, Joseph J. 1952.
   a. Project Date: Analysis of band data through 1938.
   b. Location: North America
   c. Species, Numbers, and Ages:
      (1) Mallards 448 (age unknown)
   d. Treatments: some standard, some improved from wild parents.
   e. Release Methods: unknown
   f. Comments:
      (1) Evaluation: band returns.
      (2) Life tables were developed for the mallard.

9. Brakhage, George K. 1953.
   a. Project Date: 1932-1951
   b. Location: Manitoba, Canada
   c. Species, Numbers, and Ages:
      (1) Mallard 2,007 (6 to 8 weeks)
      (2) Pintail 2,617 (6 to 8 weeks)
      (3) Redhead 1,035 (6 to 8 weeks)
      (4) Canvasback 962 (6 to 8 weeks)
   d. Treatment: improved, from eggs of wild birds.
   e. Release Methods: direct and gentle.

f. Comments:
   (1) Objectives: to force renesting and increase duck populations; to compare migration, hunting vulnerability, speed, homing and local hunting pressure on wild ducks and ducks hand reared from wild parents.
   (2) Evaluation: band return data.
   (3) Success: incompletely assessed.
   (4) Behavior: several trends are indicated.

10. Foley, Donald. 1954 (2 publications).
   a. Project Date: 1952-1953
   b. Location: New York
   c. Species, Numbers, and Ages:
      (1) 3 Strains of Mallard 801 (5 weeks)
      (2) Pintail 72 (5 weeks)
      (3) Redhead 50 (5 weeks)
      (4) Canvasback 20 (5 weeks)
      (5) Blue-winged Teal 10 (5 weeks)
      (6) Shoveller 10 (5 weeks)
   d. Treatment:
      (1) Improved: some from eggs of wild birds and some mixed.
      (2) Standard: some
   e. Release Method: direct
   f. Comments:
      (1) Objectives: to study the survival of released ducks; to establish a breeding population.
      (2) Evaluation: field observations and band returns.
      (3) Success: breeding birds were established.
      (4) Habitat influence and nonhunting mortality were studied.

11. Sowls, Lyle K. 1955.
   a. Project Date: 1948-1949
   b. Location: Manitoba, Canada
   c. Species, Numbers, and Ages:
      (1) Mallard 33 (5 to 6 weeks)
      (2) Pintail 247 (5 to 6 weeks)
      (3) Gadwall 17 (5 to 6 weeks)
      (4) Shoveller 24 (5 to 6 weeks)
      (5) Blue-winged Teal 49 (5 to 6 weeks)
   d. Treatment: improved, from eggs of wild birds.
   e. Release Methods: gentle
   f. Comments:
      (1) Objectives: to measure the return of juvenile birds.
      (2) Evaluation: marking released birds and field observations.

(3) Success: there was a greater tendency for adults than for young to return to the same nesting area.
(4) Behavior: some information included
(5) Food: provided with gentle release.

12. Browne, Stephen. (no date).
    a. Project Date: 1934-1954
    b. Location: New York
    c. Species, Numbers, and Ages (specific projects and years - about 33,000 total, all species.)
        (1) 1939 to 1941, Mallard 252 (Adults)
        (2) 1957 to 1963, Redhead 1,911 (Adults)
        (3) 1957 to 1963, Redhead 1,972 (Juveniles)
    d. Treatment:
        (1) Standard: yes
        (2) Improved: unknown
    e. Release Methods: direct as adults.
    f. Comments:
        (1) Objectives: to establish breeding species in empty habitat.
        (2) Evaluation: field observations and band returns.
        (3) Success: the best return was associated with the best habitat. Birds did return to reproduce.

13. Hunt, Richard A., Laurence R. Jahn, Ralph C. Hopkins, and George H. Amelong. 1958.
    a. Project Date: 1949-1953
    b. Location: Wisconsin
    c. Species, Numbers, and Ages:
        (1) Mallard 10,731 (4 to 5 weeks)
        (2) Mallard 677 (Adult hens)
    d. Treatment:
        (1) Improved
        (2) Wild mallards were banded as a control.
    e. Release Method: direct
    f. Comments:
        (1) Objectives: to develop methods of duck production; to select suitable release sites; to check hunter bags on public hunting areas where birds were released; to make field observations; to determine costs, to test refuges as release sites; to determine the effect of a hormone on released mallards.
        (2) Success: not clear. They discuss maximum benefit in terms of maximum hunter kill only. Stocking to the gun was not a stated objective and the cost of putting a bird in a hunter's bag was not a stated objective

although the production cost per bird was. Stocking to the gun and the cost of increasing the hunter harvest were major topics in the conclusions.
(3) Evaluation: Hunter check and band returns.
(4) Control Group: wild mallards were banded for comparison.
(5) Properly stated objectives determine failure or success of waterfowl introduction experiments.

14. Boyer, George F. 1959.
a. Project Date: 1953-1955
b. Location: New Brunswick and Nova Scotia, Canada.
c. Species, Numbers, and Ages:
(1) Mallard 164 (5 to 8 weeks)
(2) Mallard 62 (Adults)
d. Treatment:
(1) Standard
(2) Hardened
e. Release: gentle and direct.
f. Comments:
(1) Objective: to release hand-reared mallards at the northeastern edge of their territory.
(2) Success: birds returned to nest and a few were taken by hunters.
(3) Evaluation: band returns and field observations.
(4) Behavior: some observations included

15. Weller, Milton W. and Peter Ward. 1959.
a. Project Date: 1952-1954 (1956-57)
b. Location: Manitoba, Canada.
c. Species, Numbers, and Ages:
(1) Redheads 1138 (5 to 8 weeks)
d. Treatment:
(1) Improved
(2) Hardened
e. Release Method: gentle.
f. Comments:
(1) Objectives: to re-evaluate previous work; to follow migration and mortality of improved hand-reared ducklings removed from natal marshes; to appraise the value of hand-reared birds in stocking.
(2) Evaluation: band return.
(3) Behavior: some observations included

16. Foley, Donald D., Dirck Benson, Lee W. DeGraff, and Earl R. Holm. 1961.
a. Project Date: 1934-1954
b. Location: New York

c. Species, Numbers, and Ages:
   (1) Mallard 19,423 (3-5-7 weeks)
   (2) Mallard 3,724 (Adults)
d. Treatment:
   (1) Standard - some
   (2) Improved - some
e. Release: direct
f. Comments:
   (1) Objectives: to evaluate the New York mallard releases for the establishment of breeding populations of mallard.
   (2) Success: breeding populations established.
   (3) Evaluation: field observations and band returns.
   (4) Behavior: some observations included.
   (5) Habitat: some habitat observations.

17. Britt, Ralph E. 1962.
   a. Project Date: 1951-1962.
   b. Location: Pennsylvania.
   c. Species, Numbers, and Ages:
      (1) Mallard 93,000 (5 weeks)
   d. Treatment:
      (1) Improved
      (2) Hardened
   e. Release Methods: direct
   f. Comments:
      (1) Objectives: not reported.
      (2) Success: not reported.
      (3) Evaluation: band returns.
      (4) This was a summary review from a popular magazine.

18. Fog, Jorgen. 1964.
   a. Project Date: 1950-1960
   b. Location: Denmark
   c. Species, Numbers, and Ages:
      (1) Mallard 4,676 (Ducklings)
      (2) Mallard 339 (Adults)
      (3) Mallard 221 (unknown age)
   d. Treatment: standard game farm
   e. Release Method: unknown.
   f. Comments:
      (1) Objective: to evaluate band returns of hand-reared mallards.
      (2) Success: good records on hunting mortality, movements and life span.
      (3) Evaluation: band returns.

19. Harrison, James, Jeffery Harrison, and Angus Meikle. 1964-65.
    a. Project Date: 1958-1964
    b. Location: British Isles
    c. Species, Numbers and Ages:
       (1) Mallards 604 (Young adults)
    d. Treatment: standard game farm
    e. Method of Release: gentle.
    f. Comments:
       (1) Objectives: to establish a winter population of mallard; to encourage breeding; to encourage use of the area by other birds.
       (2) Success: the objectives were met.
       (3) Evaluation: field observation and band return.
       (4) Habitat: habitat improvement.

20. Lee, F. B. and H. K. Nelson. 1965.
    a. History of the propagation and release of wood ducks. Early release numbers were uncertain; however, several release attempts were unsuccessful.

21. Fog, Jorgen. 1965.
    a. Project Date: 1953-1961
    b. Location: Denmark.
    c. Species, Numbers, and Ages:
       (1) Mallard 323 (Ducklings)
       (2) Mallard 30 (Adult)
    d. Treatment: standard game farm.
    e. Release Method: gentle - young were reared by the mother hen.
    f. Comments:
       (1) Objectives: to determine the fate of hen-reared ducklings in artificial surroundings.
       (2) Success: ducklings were reared to flight age.
       (3) Evaluation: band returns.

22. Bednarik, Karl E. and Charles L. Hanson. 1965.
    a. Project Date: 1959-1963
    b. Location: Ohio
    c. Species, Numbers, and Ages:
       (1) Mallard 1,372 (Adults) 12,218 (4-7 weeks)
       (2) Black Duck 37 (Adults) 1,267 (4-7 weeks)
       (3) Wood Duck 85 (Adults) 1,854 (4-7 weeks)
       (4) Redhead 150 (Adults)
    d. Treatment:
       (1) Standard
       (2) Improved
    e. Release Method: direct
    f. Comments: Three publications in Game Research In Ohio.

(1) Objectives: to establish new nesting populations in unoccupied nesting range in Ohio.
(2) Evaluation: band returns, colored markers, and field observation.
(3) Success: poor.
(4) Historical review: good.
(5) Behavior: observations were good.
(6) Rearing techniques were discussed.
(7) About 68 marked birds were known to have returned.

23. Dietz, Reuben H. 1965.
  a. Project Date: 1962-1965
  b. Location: Utah
  c. Species, Numbers, and Ages:
    (1) Black Ducks.

24. Reid, Brian. 1966.
  a. Project Date: 1954 to 1963
  b. Location: New Zealand
  c. Species, Numbers, and Ages:
    (1) Mallard 8,195 (6,109 birds 5 to 12 weeks old were used in this study)
  d. Treatment: standard game farm.
  e. Release Method: direct
  f. Comments:
    (1) Objectives: data analysis of birds released for improvement of sport shooting.
    (2) Evaluation: band returns - good analysis.
    (3) Success: breeding populations were established.

25. Ordal, Norman J. 1966. (Progress Report)
  a. Project Date: 1963
  b. Location: Minnesota
  c. Species, Numbers, and Ages:
    (1) Mallard 2,198 (4 to 5 weeks)
  d. Treatment:
    (1) Standard
    (2) Improved
  e. Release Method: direct
  f. Comments:
    (1) Objectives: to evaluate the practice of releasing hand-reared mallards by private organizations.
    (2) Evaluation: band returns, hunter bag checks, landowners and field observations.
    (3) Success: some birds returned to nest.
    (4) Behavior: good observations.

26. Borden, Richard and H. Albert Hochbaum. 1966.
   a. Project Date: 1957
   b. Location: Massachusetts
   c. Species, Numbers, and Ages:
      (1) Gadwall 76 (Adult)
   d. Treatment:
      (1) Improved
      (2) Hardened
   e. Release Method: gentle
   f. Comments:
      (1) Objectives: to establish a breeding population of gadwall ducks.
      (2) Evaluation: field observation.
      (3) Success: a breeding population was established where no breeding occurred in the past.
      (4) Behavior: some observations.

27. Marinaccio, James. 1968.
   a. Project Date: 1967
   b. Location: Connecticut
   c. Species, Numbers, and Ages:
      (1) Mallard 99 (5 weeks)
   d. Treatment: standard game farm
   e. Release Method: direct
   f. Comments:
      (1) Objectives: to identify postrelease mortality; to study survival; to observe daily activity and behavior.
      (2) Evaluation: daily field observation.
      (3) Success: incomplete because of time limitations; however, objectives were met.
      (4) Historical review: good.
      (5) Behavior: good observations.

28. Coulter, Malcolm W. and William R. Miller. 1968.
   a. Project Date: 1956 to 1961 (Resulted from a renesting study which was a major objective of this research).
   b. Location: Maine and Vermont
   c. Species, Numbers, and Ages:
      (1) Black Duck (6 to 10 weeks)
      (2) Mallards (6 to 10 weeks)
      (3) Ring-Neck Ducks (6 to 10 weeks)
   d. Treatment: improved.
   e. Release Method: gentle and direct.
   f. Comments: These birds were obtained from eggs salvaged in renesting studies. Data is available in Bulletin No. 68-2, Vermont Fish and Game Dep.

29. Benson, Dirck and Stephen D. Browne. 1969. (updated 1972)
   a. Project Date: 1952 to 1963.
   b. Location: New York
   c. Species, Numbers, and Ages:
      (1) Redhead 1,911 (Adult); 1,972 (5 weeks)
   d. Treatment: improved
   e. Release Methods: direct
   f. Comments:
      (1) Objectives: to establish breeding colonies of redheads.
      (2) Evaluation: band returns and field observations.
      (3) Success: new breeding colonies were established.
      (4) Behavior: some observations.

30. Bevill, William V. (Jr.). 1969.
   a. Project Date: 1967 to 1969
   b. Location: New Mexico
   c. Species, Numbers, and Ages:
      (1) Mexican Duck 115 (Adult)
   d. Treatment: improved
   e. Release Method: gentle
   f. Comments:
      (1) Objectives: restoration of species; evaluate management practices.
      (2) Evaluation: field observation.
      (3) Success: breeding birds were established.
      (4) Habitat evaluation and management practice evaluation: good.
      (5) Prerelease and postrelease duck evaluations were made.
      (6) Behavior: some observations.

31. Zohrer, James J. 1969.
   a. Project Date: 1968 to 1969
   b. Location: Wisconsin
   c. Species, Numbers, and Ages:
      (1) Mallards 50 (Adult); 301 (4-5 weeks)
   d. Treatment: improved
   e. Release Method: direct
   f. Comments:
      (1) Objectives: to establish a breeding population.
      (2) Evaluation: band returns and field observations.
      (3) Success: birds returned to reproduce.
      (4) Behavior: some observations.

32. Schladweiler, John L. 1969.
    a. Project Date: 1968
    b. Location: Minnesota
    c. Species, Numbers, and Ages:
       (1) Mallard 179 (6 weeks)
    d. Treatment:
       (1) Standard
       (2) Improved
    e. Release Method: direct
    f. Comments:
       (1) Objectives: to test survival between two different strains of hand-reared ducks; to study the effect of habitat quality on survival.
       (2) Evaluation: field observation, radio tracking, and band returns.
       (3) Success: survival was tested - second year returns were not included. No habitat analysis was included.
       (4) History: good
       (5) Behavior: comments were made.

33. Harrison, James, Jeffery Harrison and David Harrison. 1968-69.
    a. Project Date: 1965 to 1968
    b. Location: Great Britain.
    c. Species, Numbers, and Ages:
       (1) Gadwall 94 (10 to 12 weeks)
    d. Treatment:
       (1) unknown
    e. Release Method: direct
    f. Comments:
       (1) Objectives: to release a common native breeding species.
       (2) Evaluation: field observation and band returns.
       (3) Success: birds migrated.
       (4) Band return analysis: good.

34. Kiel, W. H. (Jr.). 1970.
    a. Project Date: 1962 to 1967
    b. Location: Texas
    c. Species, Numbers, and Ages:
       (1) Mallard 3,071 (5 to 6 weeks)
    d. Treatment: standard game farm.
    e. Release Method: direct.
    f. Comments:
       (1) Objectives: to study survival and reproduction of released game farm ducks in south Texas.
       (2) Evaluation: field observation and band returns.

(3) Success: reproduction occurred for several years following the release.
(4) Food was provided because of drought period following the release.

35. Brakhage, George K. 1971.
a. Project Date: 1963 to 1970
b. Location: Minnesota (FFA Program)
c. Species, Numbers, and Ages:
(1) Mallards (mostly 5 weeks - some adults)
d. Treatment:
(1) Standard
(2) Improved
e. Release Methods: direct
f. Comments:
(1) Objectives: to improve local hunting; to enlarge breeding populations of mallards; to increase interest and improve educational opportunities; to increase habitat awareness; and to improve farmer-hunter relations.
(2) Evaluation: variable
(3) Success: variable but the objectives are good.
(4) The Minnesota Department of Conservation has published "A Minnesota Guide to Raising and Releasing Mallards" for this FFA program.

36. Fog, Jorgen. 1971.
a. Project Date: 1963 to 1968
b. Location: Denmark
c. Species, Numbers, and Ages:
(1) Mallards 1,539 (5 to 10 weeks)
d. Treatment:
(1) Improved
(2) Hardened
e. Release Method: direct
f. Comments:
(1) Objectives: evaluate the release of hand-reared birds for shooting.
(2) Evaluation: band returns.
(3) Success: band returns from hunting area were about 100 percent of banded birds shot.
(4) Band return analysis - good.

37. Norman, F. I. 1971.
a. Project Date: 1964 to 1969
b. Location: Australia
c. Species, Numbers, and Ages:
(1) Chestnut Teal 1,976 (5 to 7 weeks)
d. Treatment: improved
e. Release Method: direct

f. Comments:
   (1) Objectives: to extend the species range by releasing hand-reared wild birds.
   (2) Evaluation: field observation and band returns.
   (3) Success: some birds remained in the release area to reproduce - hunting pressure was heavy.

38. McGilvrey, Frank B. 1971a.
   a. Project Date: 1967 to 1969
   b. Location: Maryland
   c. Species, Numbers, and Ages:
      (1) Black Duck 567 (year old birds)
   d. Treatment: standard game farm
   e. Release Method: direct
   f. Comment:
      (1) Objectives: to condition ducks to use artificial nesting structures.
      (2) Evaluation: field observation.
      (3) Success: reproduction followed the release.
      (4) The main objective was not stocking but stocking resulted from other research objectives.

39. McGilvrey, Frank B. 1971b.
   a. Project Date: 1967 to 1969.
   b. Location: Maryland
   c. Species, Numbers, and Ages:
      (1) Wood Duck 67 (Adult hens)
   d. Treatment: standard game farm.
   e. Release Method: direct
   f. Comments:
      (1) Objectives: to increase population to carrying capacity of habitat by releasing hand-reared birds.
      (2) Evaluation: field observation.
      (3) Success: reproduction followed release.
      (4) Greatest loss occurred immediately after release.

40. Webster, Clark G., E. Hugh Galbreath and Arthur E. L. Dierker. 1971.
   a. Project Date: 1968 to 1970
   b. Location: near Chesapeake Bay
   c. Species, Numbers, and Ages:
      (1) Mallard 20,000 (5 weeks)
   d. Treatment:
      (1) Improved or Standard
      (2) Hardened (after 5 weeks)
   e. Release Method: direct at 5 weeks of age but food was provided at release sites.

f. Comments:
 (1) Objectives: to release hand-reared birds for hunting visitors at Remington Farms.
 (2) Evaluation: field observation, band returns.
 (3) Success: only 14.9 percent of the released birds were taken during their first season. About 1,000 mallards remain on the farm each spring.
 (4) Good evaluation of stocking a hunted area.
 (5) Behavior: some observations.

41. Stotts, Vernon D., Aelred D. Geis and George V. Burger. 1971.
 a. Project Date: 1967 to 1970
 b. Location: Maryland
 c. Species, Numbers, and Ages:
 (1) Mallards (4 to 6 weeks)
 d. Treatment:
 (1) Standard
 (2) Improved
 (3) Isolated
 (4) Hardened
 e. Release Method: unknown
 f. Comments:
 (1) Objectives: to compare harvest and survival of different hand-reared mallards; to evaluate contribution to harvest and to local production; to evaluate cost.
 (2) This is a progress report and data evaluation is not complete.

42. Sellers, Richard A. 1971.
 a. Project Date: 1969 to 1970
 b. Location: Manitoba, Canada
 c. Species, Numbers, and Ages:
 (1) Mallards 1,474 (4 to 5 weeks old hens only)
 d. Treatment:
 (1) Improved
 (2) Hardened
 e. Release Methods; direct
 f. Comments:
 (1) Objectives: to increase breeding populations on occupied range; to study overland movements; to study liberation age.
 (2) Evaluation: field observation and band returns.
 (3) Success: overland movement was common, reproduction increased in the release area.
 (4) Behavior: good observations.
 (5) This project had prerelease and postrelease observations and a natural control area for comparison.

43. Thomforde, Lawrence L. 1971.
    a. Project Date: 1965 to 1967
    b. Location: Minnesota
    c. Species, Numbers, and Ages:
       (1) Mallards 900 (5 weeks)
    d. Treatment: standard game farm.
    e. Release Method: direct
    f. Comments:
       (1) Objectives: to study survival of hand-reared ducks on artificial farm ponds in an unpopulated area.
       (2) Evaluation: field observation and band reports.
       (3) Success: objectives were met.
       (4) Behavior: observations were good.
       (5) Shows the influence of extensive grazing.

44. Emmons, J. C. 1971.
    a. Project Date: 1968 to 1969.
    b. Location: Florida
    c. Species, Numbers, and Ages:
       (1) Gadwall 429 (4 to 8 weeks)
    d. Treatment:
       (1) Improved
       (2) Hardened (wing clipped and fed)
    e. Release Method: gentle
    f. Comments:
       (1) Objectives: to introduce the species into new territory.
       (2) Evaluation: field observation.
       (3) Success: some reproduction attempts were made but reproduction was not very successful.
       (4) Observation on climate comparisons: good.
       (5) Behavior: good observations.

45. Belden, Mason S. 1972.
    a. Project Date: 1954 to 1970
    b. Location: Connecticut
    c. Species, Numbers, and Ages:
       (1) Mallards 38,253 (5 to 6 weeks)
    d. Treatment:
       (1) Improved
       (2) Hardened
    e. Release Method: direct
    f. Comments:
       (1) Objectives: to increase mallard populations.
       (2) Evaluation: pre- and postrelease field observations.
       (3) Success: mallard populations have increased.
       (4) Production: good (cost records).

46. Kear, Janet. 1972.
    a. Project Date: 1960 to 1970
    b. Location: Hawaii
    c. Species, Numbers, and Ages:
       (1) Nene (Hawaiian Goose) 899 (young adults)
    d. Treatment:
       (1) Standard
       (2) Hardened
    e. Release Method: gentle
    f. Comments:
       (1) Objectives: restoration of endangered species.
       (2) Evaluation: field observation.
       (3) Success: the species is increasing in number in the wild and captive flocks will keep the species from extinction.
       (4) Excellent review of the restoration project.

47. Doty, Harold A. and Arnold D. Kruse. 1972.
    a. Project Date: 1968 to 1970
    b. Location: North Dakota
    c. Species, Numbers, and Ages:
       (1) Wood Duck 280 (9 to 16 days)
    d. Treatment:
       (1) Improved
       (2) Hardened
    e. Release Method: gentle
    f. Comments:
       (1) Objectives: to release wood ducks into uninhabited area to develop a breeding population.
       (2) Evaluation: field observation, band returns.
       (3) Success: a reproducing colony was established.
       (4) Artificial nesting structures were evaluated.

48. Wardell, John, Jeffery Harrison, A. R. Snead and C. Swan. 1964 to 1972.
    a. Project Date: 1954 to 1972
    b. Location: The Wildfowler's Association of Great Britain and Ireland (W.A.G.B.I.)
    c. Species, Numbers, and Ages:
       (1) Mallards - from 110 in 1954 to 17,241 in 1970. (total in 1971-72 Report was 159,597 mallards).
       (2) Several species of ducks, geese and swans.
    d. Treatment:
       (1) Standard
       (2) Hardened
       (3) Improved
    e. Release Method: varied

f. Comments:
   (1) Objectives: to establish methods of production; scientific investigation of wildfowl biology; to provide a protected area for both rare and abundant wildfowl; to increase populations; and others.
   (2) Evaluation: field observations, band returns.
   (3) Success: very successful in meeting the objectives and in production of wildfowl.
   (4) Information and data for several books by different authors came (at least in part) from W.A.G.B.I. and Wildfowl Trust.
   (5) Excellent records concerning mallard releases, movements and survival were kept and reported in the W.A.G.B.I. Annual Report and Yearbooks.

49. Lee, Forrest B. and Arnold D. Kruse. 1973.
   a. Project Date: 1970 to 1971.
   b. Location: North Dakota
   c. Species, Numbers, and Ages:
      (1) Mallard 648 (25 to 45 days)
   d. Treatment:
      (1) Improved
      (2) Hardened
   e. Release Method: gentle
   f. Comments:
      (1) Objectives: to test gentle release method; to assess migration, homing and nesting.
      (2) Evaluation: field observation, band returns.
      (3) Success: objectives were met and reproduction followed the release.
      (4) Behavior: good observations.
      (5) Gentle release: effective (but the pen may not be needed if birds are held in place with food - my comment).

50. Flickinger, Edward L., Kirke A. King and Oliver Heyland. 1973.
   a. Project Date: 1969 to 1970
   b. Location: Texas
   c. Species, Numbers, and Ages:
      (1) Fulvous Tree Duck 165 (3.5 months old)
   d. Treatment: improved.
   e. Release Method: direct.
   f. Comments:
      (1) Objectives: release of pen-reared birds to study movements.
      (2) Evaluation: band returns.
      (3) Success: movements indicate long migrations.

VITA

Joe Wesley Allen

Candidate for the Degree of

Doctor of Education

Thesis: INTRODUCTION OF MAX MCGRAW WILDLIFE FOUNDATION MALLARD DUCKS INTO OKLAHOMA AND EVALUATION OF THEIR SURVIVAL AND ADAPTATION

Major Field: Higher Education Minor Field: Zoology

Biographical:

Personal Data: Born in Elsie, Nebraska, July 16, 1936, the son of W. W. and Ruth Allen.

Education: Graduated from Madrid High School, Madrid, Nebraska in 1954; received the Bachelor of Arts degree, Kearney State College, Kearney, Nebraska in 1961, with majors in Zoology and Physical Science; received the Master of Science degree, Omaha University, Omaha, Nebraska in 1966, with a major in Biology; completed requirements for the Doctor of Education degree at Oklahoma State University in May, 1975.

Professional Experience: General Science Teacher, Kearney, Nebraska, 1962-1964; General Science Teacher, Seward, Nebraska, 1964-1965; General Biology Instructor, Omaha University, 1966-1967; Graduate Teaching Assistant, Iowa State University, 1967-1969; Graduate Teaching Assistant, Oklahoma State University, 1971-1972; Biological Science Instructor, Cleveland State Community College, 1972-1975.

Member: The Wildlife Society, The Wildfowl Trust.