A Porulation Study of Waterfowl on the Tetlin-Northway Area of Interior AK

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A POPULATION STUDY OF WATERFOWL ON THE TETLIN-NORTHWAY AREA OF INTERIOR ALASKA

By

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To the Resident Instructional Staff:

The members of the Committee appointed to examine the thesis of DONALD EDWARD McKNIGHT find it satisfactory and recommend that it be accepted.

Chairman

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CHAPTER I

INTRODUCTION

From 1955 to 1961 a combination production and banding study was conducted in the Tetlin-Northway area of east-central Alaska by the United States Bureau of Sport Fisheries and Wildlife. This 700-square mile area, a similar area near Minto, and another in the Copper River Delta have the highest waterfowl nesting densities in Alaska and thus constitute some of the most productive waterfowl breeding habitat north of the Canadian prairie provinces. The writer worked on this project in the summer of 1959 and was project leader in 1960 and 1961. All data except band returns and brood data prior to 1959 were obtained during the last three years of the study.

Figure 1 shows the main study area and the major lakes on which extensive banding was accomplished. During the summers of 1959, 1960, and 1961 a base camp was set up on the east shore of Tetlin Lake near the outlet of the Tetlin River. From this site the crew hiked, flew, and cruised with a boat to neighboring lakes and ponds.

Until 1958, banding operations and other studies in this area were largely unsuccessful and nonconclusive. In 1958, airplanes were utilized to increase the mobility of banding crews and this change combined with more efficient trapping

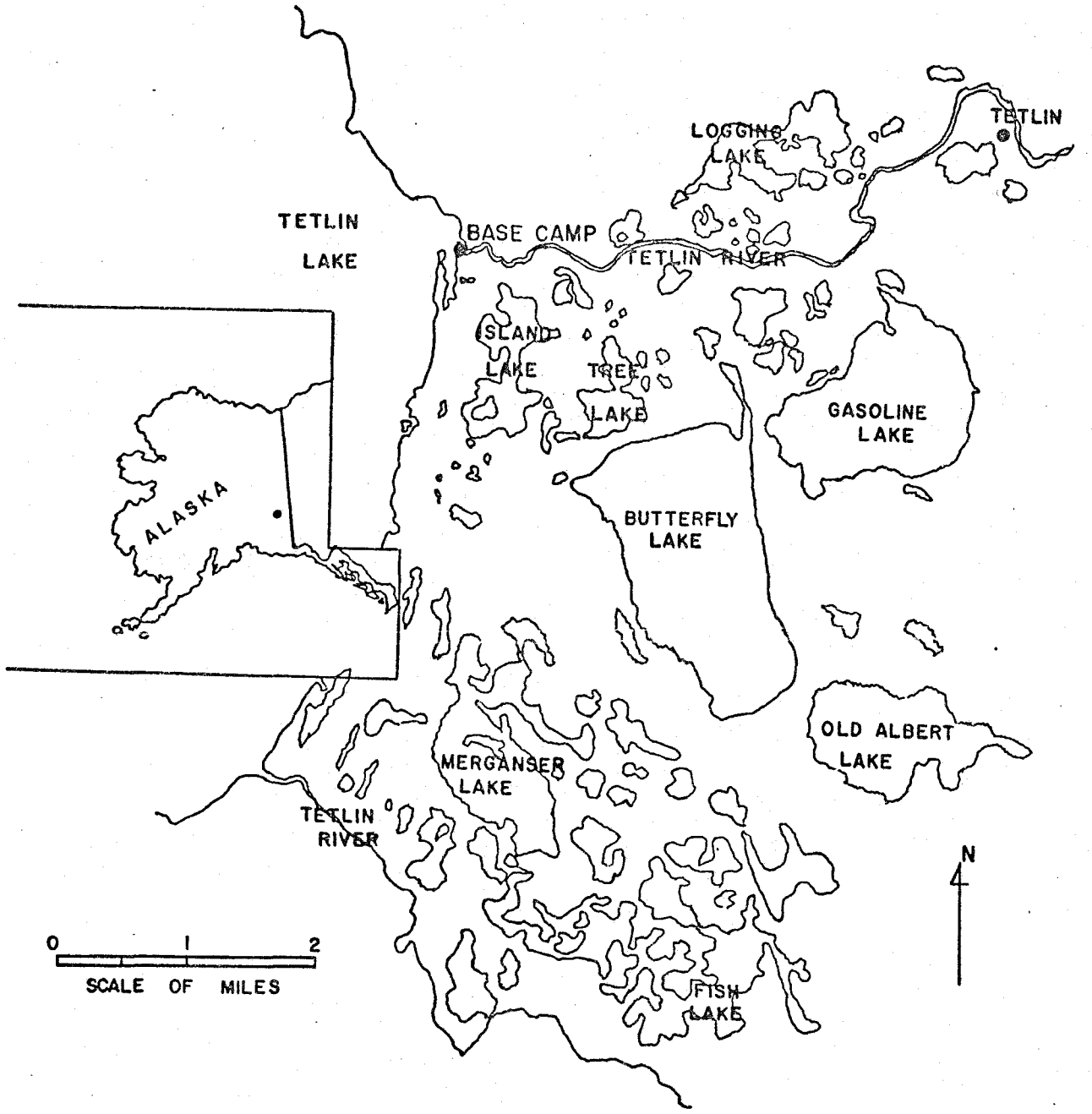

Fig. 1.--Tetlin Lake study area, showing lakes on which most waterfowl banding was accomplished.

techniques made possible the capture of large numbers of flightless adult diving ducks such as the lesser scaup, canvasback, and bufflehead. Consequently, the primary objective of this study, to band representative samples of the area's waterfowl for the purpose of obtaining information on migration, hunting pressure, and mortality rates, was fulfilled.

Since the months of July and August in each summer were utilized almost exclusively for banding operations, available time for ground studies was very limited. Nevertheless, these limited ground studies provided a great deal of information relative to waterfowl production under Arctic conditions.

Much of Interior Alaska has received very little biological investigation of any sort. The only mention of any ornithological work accomplished at the Tetlin area was a few notes by Murie in 1921 concerning the status of American goldeneyes in the region (Gabrielson, 1959). All new and significant (or important) bird records derived from the present study were sent to the University of Alaska where they are on file.

It is the purpose of this thesis to present the results of banding data from the Tetlin-Northway area of Alaska from 1955 to 1961, and to present additional data pertinent to waterfowl production which were derived from ground studies in 1959, 1960, and 1961.

CHAPTER II

DESCRIPTION OF THE TETLIN-NORTHWAY STUDY AREA

This region is comprised mainly of a broad, flat, alluvial plain of the TananaRiver, bounded on the north and east by the Tanana River and on the south and west by foothills of the Wrangel Mountains. The western portion of the study area, that from the Nebesna River westward, is drained mainly by the Nebesna, Kalutna, and Tetlin rivers of the Tanana River drainage. At one time, it is believed, this entire area was covered by a tremendous lake, but presently all that remains are numerous small lakes and ponds and only a few lakes which are over 1 mile in diameter. Tetlin Lake is the largest body of water in the area, being approximately 6 miles long and 5 miles wide. With very few exceptions the water depth of all these lakes and ponds rarely exceeds 10-15 ft and in most ponds water depths of 7-8 ft are maximum. On several occasions, moose were observed to walk entirely across Tetlin Lake without ever having to swim.

Climate

The interior of Alaska where the study area is located has a continental climate with very great extremes of temperature. During the winter months the region is characterized by high atmospheric pressure and cold, clear weather with little

or no wind, although Aleutian low pressure systems moving into the area may moderate temperatures and initiate precipitation accompanied by southerly winds. Occasionally as the Arctic high pressure system builds up over an extended period of time, unusually cold temperatures and strong northerly winds may develop. During the summer months low atmospheric pressure prevails as the great land mass of the Interior heats up under the influence of nearly continuous insolation. Then temperatures become warm or even hot and about one-third of the annual precipitation occurs in the form of localized convectional thundershowers. A typical June or July day would be clear and windless until about 11:00 A.M. when moderate westerly winds and localized convectional thundershowers would prevail until late evening.

During the summer of 1961 heavy rains produced flood conditions which were the most severe recorded since the early thirties. Although precipitation was normal through May, great Aleutian storm fronts in June and early July raised water levels to dangerous levels, causing destruction both to human contrivances and waterfowl nests.

The following tabulation taken from Lutz (1953) indicates general climatic conditions for the interior of Alaska north of the Alaska range and thus gives a good indication of weather conditions in the Tetlin-Northway study area:

Average annual precipitation	10-15 inches (one-half during May-Aug.)
Mean temperature, July	55° to 60°F
Mean temperature, January	-10° to -20°F
Temperature extremes	-78° to 100°F
Length of growing season	54 to 90 days

Vegetation

The general vegetational pattern of the study area appears from the air to be a complex mosaic of vegetational types. Forests are prevalent on high ground throughout the region. Small patches of mature white spruce (Picea glauca) forest are interspersed with areas of paper birch (Betula papyrifera), quaking aspen (Populus tremuloides), tacamahac poplar (Populus tacamahaca), and willow (Salix spp.). The complexity of the general pattern of vegetational types is caused chiefly by fires which have raced uncontrolled through the area many times in the past. Each pattern of the vegetational mosaic then is a successional stage and according to Lutz (1953) leads to a physiographic climax or terminal stage of white spruce forests on these fairly well-drained soils. Thus the small stands of mature white spruce forest scattered throughout the Tetlin-Northway area seem to comprise relict stands which were for some reason not destroyed by fire. Understory vegetation in these old-aged stands consists primarily of a thick moss carpet covered by bluejoint (Calamagrostis canadensis) and shrubby species such as the willows, bearberry (Arctostaphylos alpinus), rose (Rosa acicularis), cranberry (Vaccinium Vitis-idaea), and squash berry (Viburnum pauciflorum). This vegetational type is broken by more or less extensive areas of paper birch or quaking aspen and transitional types between these and white spruce. As stated previously, boundaries between these types are very distinct and generally mark the edges of fires. Quaking aspen and paper birch types and transitional zones have a wider

variety of associated grasses, probably resulting from more open canopies. Bent grass (Agrostis scabra) and fescue (Festuca altaica) are found associated with bluejoint. Forbs (non-grasslike herbaceous species) such as yarrow (Achillea borealis), fireweed (Epilobium angustifolium), bluebells (Mertensia paniculata), twin-flower (Linnaea borealis), lupine (Lupinus sp.), and rose form a dense understory on these areas.

The influences of permafrost or permanently frozen ground and the continuously changing river channels are also apparent in the vegetational pattern. Permafrost frequently results in poor drainage and also restricts the area available for root growth. Where this influence is extensive no forests are found and marshy areas of willow, low forbs, mosses, and lichens predominate. In low, moderately well-drained areas such as recently dried up ponds or old stream courses, sedge-willow-grass vegetation generally is prevalent. According to Lutz (1953), where extensive and repeated burnings have occurred on these areas the ultimate climax will be a fireweed-grass or shrub community.

Shoreline and submergent vegetation, water depths, and consequently waterfowl production of the numerous lakes and ponds of this area vary greatly. Many ponds have high banks and very little surrounding emergent vegetation. A sharp line of demarcation exists between the forest type adjacent to such a lake and the water's edge, with possibly a little grass, generally bluegrass (Poa spp.) or manna grass (Glyceria grandis), and a narrow fringe of willows bordering the water. Ponds and

lakes with high, steep banks and little emergent vegetation are generally rather deep and nonproductive. This type of water area seems to form very marginal habitat for waterfowl and is utilized to only a very slight extent by nesting or molting ducks. Such a pond may support a pair of nesting horned grebes or a brood of bufflehead or goldeneyes but is generally not utilized by other species.

Other ponds have much more gradually sloping shorelines and are bordered by a broad strip of beaked sedge (Carex rostrata), softstem bulrush (Scirpus validus), and grassy areas. It is these lakes which are most important to the nesting of diving ducks such as lesser scaup and canvasbacks and appear to be much more favorable for nesting and brood raising of all species.

A typical small pond of the latter type is shown in Figures 2 and 4. This pond was located only about 200 yards from the base camp on the east shore of Tetlin Lake and thus was very convenient for intensive study. In 1961 two lesser scaup nests were observed on the pond; and a bufflehead brood, a widgeon brood, and a green-winged teal brood were raised on it.

A 5-20 ft fringe of sedge and softstem bulrush extends along its complete shoreline. Grasses such as bluegrass, slough grass (Beckmannia Syzigachne), and brome (Bromus ridgidus) are intermixed with sedge further back from the shoreline with patches of rush (Juncus spp.) and one-bracted spikerush (Eleocharis uniglumis) interspersed throughout. Willow and rose form a narrow band between these sedge-grass meadows

on the poorly-drained soils adjacent to the ponds and forests of paper birch, quaking aspen, and white spruce surrounding the pond. Soil moisture probably determines the width of the sedge-grass area bordering such a pond. Submergent vegetation in a shallow pond such as Dumbbell Pond, which reaches a depth of only 1-2 ft and probably freezes solid most winters, is very restricted, consisting only of horned pondweed (Zannichellia palustris) draped with filamentous green algae and a sparse amount of duckweed (Lemna minor). In larger and deeper ponds which do not ordinarily freeze solid, submergent plants such as pondweeds (Potamogeton pectinatus and P. perfoliatus), mare's tail (Hippuris vulgaris), water persicaria (Polygonum amphibium), and water milfoil (Myriophyllum sp.) form an important source of waterfowl food.

Most of the larger lakes in the area possess shorelines consisting of both gradually sloping meadows and high banks with little emergent vegetation. Generally, deep lakes surrounded by high banks have very small amounts of both emergent and submergent vegetation and do not harbor large numbers of waterfowl. White-winged scoters, old squaws, and other species utilizing primarily animal foods (Cottam, 1939) are the most common ducks using such lakes.

Shallow lakes with wide margins of emergent vegetation and copious quantities of submergent plants were by far the most productive lakes in the area. For this reason, Tetlin, Merganser, Fish, and Gasoline lakes contained very large concentrations of broods and molting waterfowl. Gasoline Lake,

diagrammed in Figures 3 and 5, was chosen as a site for extensive vegetative analysis because it is undoubtedly the most productive lake in the Tetlin-Northway area. In 1959 the writer and Henry A. Hansen on July 20 counted 125 broods by traversing the approximately 6-mile long shoreline of this lake. In 1960 and 1961 the number of broods observed with a corresponding search were fewer but densities of birds were still high. An estimated 10,000 waterfowl including 200-300 canvasbacks molted on this lake each of the three summers. The shoreline of this lake is gradually receding and consequently broad meadows surround it on most of its circumference. The great complexity of its shoreline vegetation coupled with the dense weed beds which almost entirely cover it and the tremendous number of microcrustaceans, leeches, and other animals inhabiting it undoubtedly make this one of the most productive lakes in Alaska.

Except for about one-half of the southern shoreline which has only a very narrow fringe of sedge and willow, the shoreline is bordered by broad meadows of sedge and softstem bulrush interspersed with patches of one-bracted spike-rush and rush. In most places a 50-200 ft wide meadow of sedge intermixed with grasses such as bluegrass, brome, manna grass, and slough grass extends to a narrow band of willow or willow-rose and the adjacent forests. Near the northeastern and northern shorelines where high, relatively dry, hillocks have been recently burned, willow and fireweed form conspicuous islands in the sedge-grass meadows. During most summers when water levels drop in Gasoline Lake, most of the west shoreline is

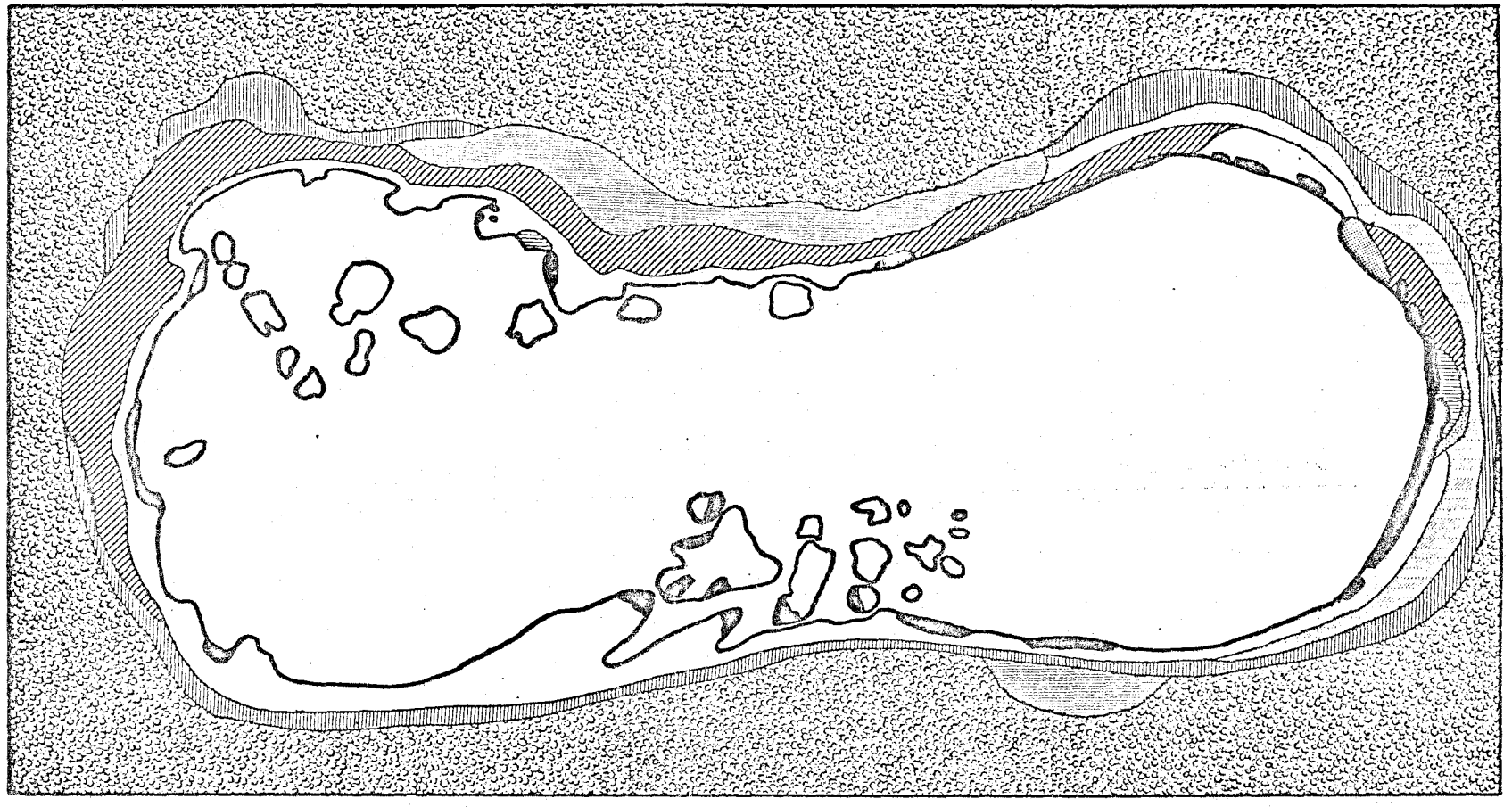

Fig. 2.--Vegetation map of 2-acre Dumbbell Pond located near main camp on Tetlin Lake.

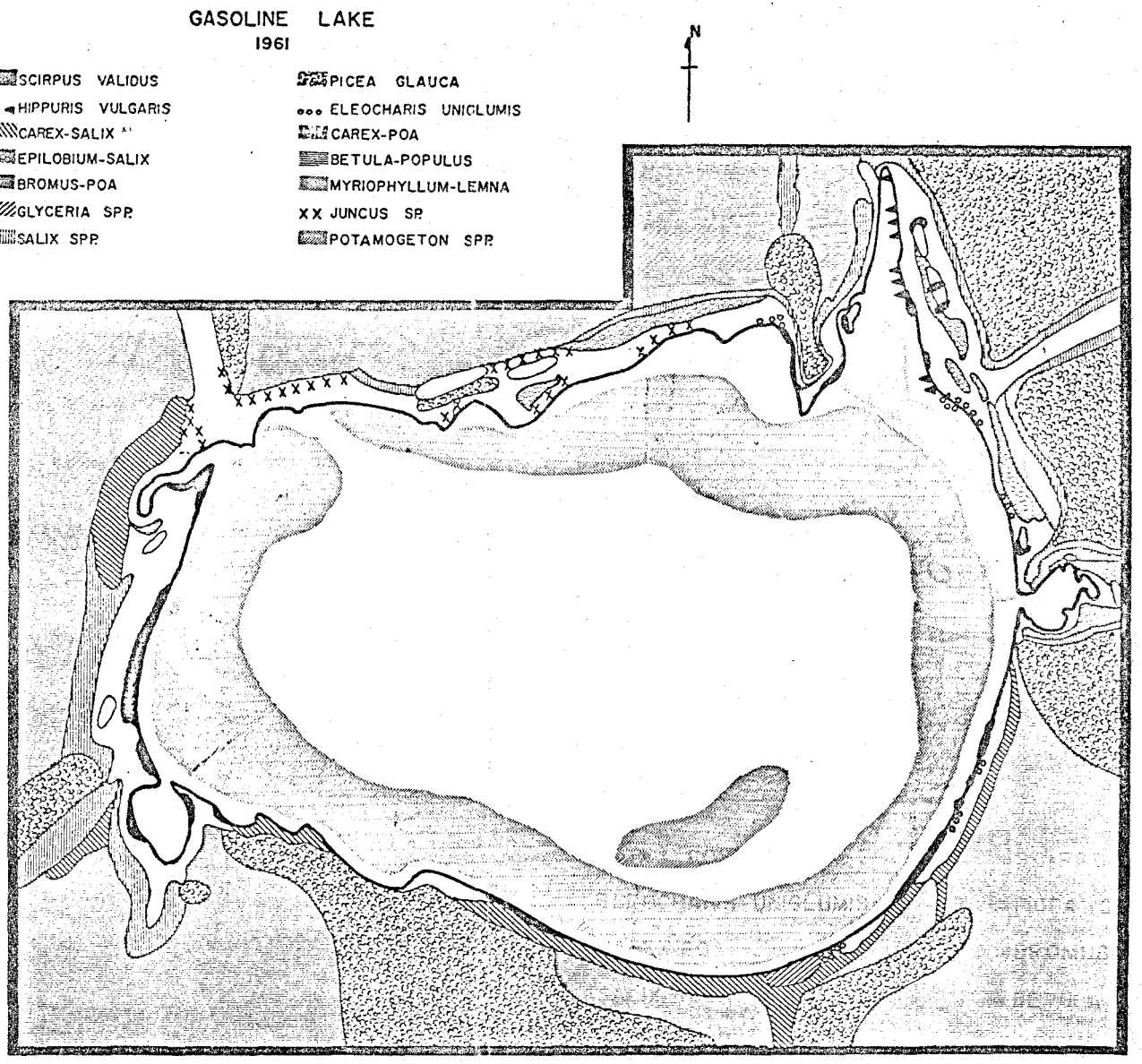

Fig. 3.--Vegetation map of Gasoline Lake, showing diversity of shoreline and submergent plant associations.

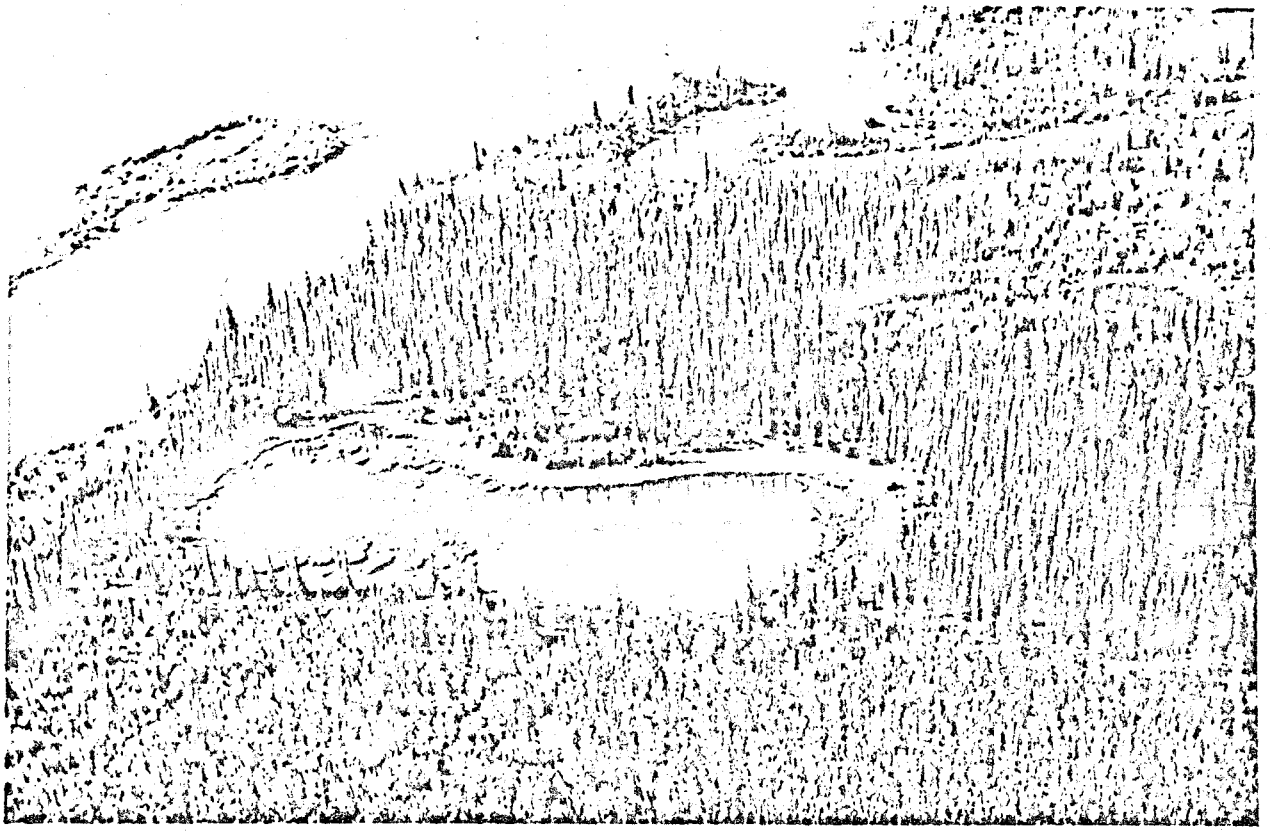

Fig. 4.--Aerial view of Dumbbell Pond and site of main camp

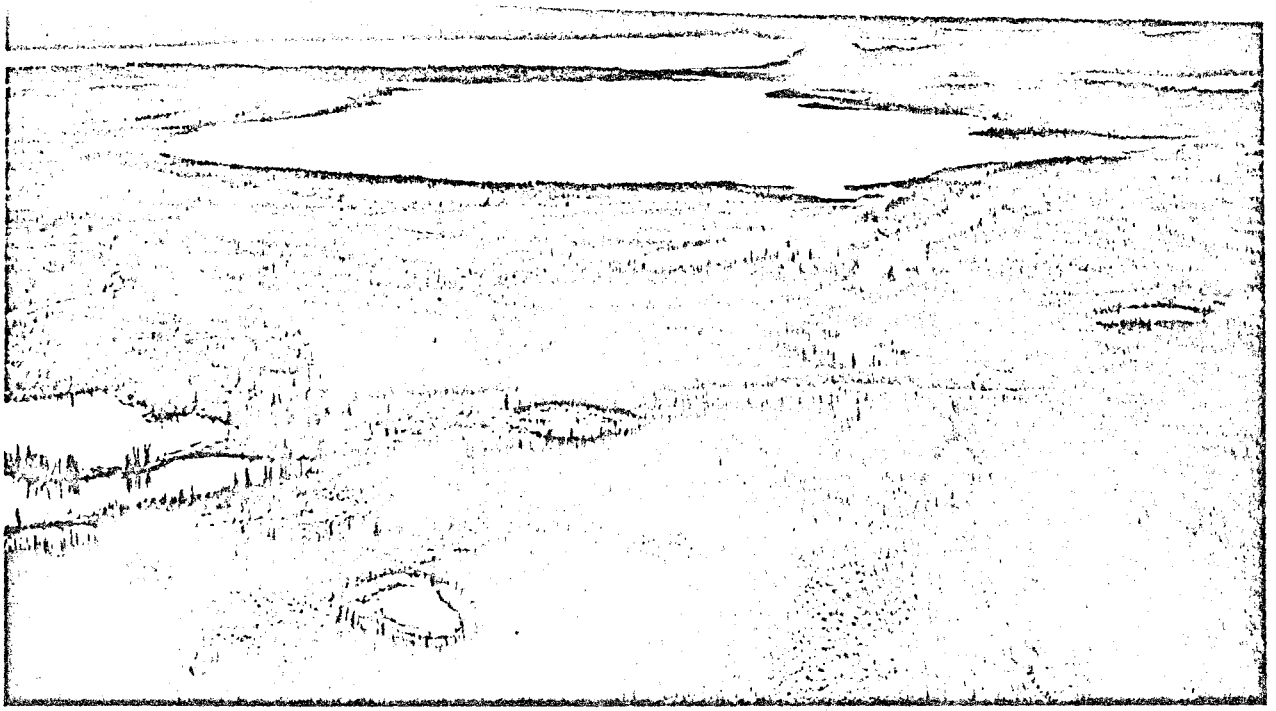

Fig. 5.--Aerial view of main study area, looking west across Gasoline, Butterfly, and Tetlin lakes. Note the complexity of vegetational mosaic.

covered by a dense "jungle" of ragwort (Senecio congestus) which often reaches a height of 5 to 6 ft. These dense stands of ragwort are utilized intensively as cover both by molting adult dabblers and broods. As one walks through such a growth, birds running ahead of him create a loud rustling sound and often 100-200 flightless ducks, particularly green-winged teal, may be driven from the 100-yard wide strip of vegetation.

Along the entire shoreline and in the shallow northeast corner, submergents such as mare's tail, duckweed (Lemna trisulca and L. minor), and water milfoil form extensive mats of vegetation. In slightly deeper water farther from shore, dense growths of pondweeds (Potamogeton pectinatus and P. perfoliatus) form weed beds which nearly cover the lake. In August, great numbers of migrating and resident ducks and horned grebes completely blacken some parts of the lake. The broad sedge-grass meadows and the surrounding forests form ideal nesting cover for all species of waterfowl, and the tremendously rich weed beds and shoreline vegetation provide copious quantities of food. The entire shoreline, particularly the east shore where sandy beaches caused by wave action are found, is used for resting by ducks.

Fauna

During the warm summer months the animal life in the Tetlin-Northway area is very lush. Many moose (Alces americana) and black bear (Euarctos americanus) inhabit the region and in 1960 and 1961 varying hares (Lepus americanus) were numerous

wherever suitable habitat existed. Common small carnivores in this area included red foxes (Vulpes fulva), short-tailed weasels (Mustela erminea), mink (Mustela vison), and lynx (Lynx canadensis). Beaver (Castor canadensis) and muskrats (Ondatra zibethica) are found in most ponds and lakes, and river otters (Lutra canadensis) are fairly common in the Tetlin and Tanana rivers. On high, drier habitats red-backed voles (Clethrionomys rutilus) and meadow jumping mice (Zapus hudsonius) were the most common small mammals, and in marshy areas the yellow-cheeked vole (Microtus xanthognathus) and masked shrew (Sorex cinereus) were abundant. Red squirrels (Tamiasciurus hudsonicus) were abundant wherever mature white spruce stands occurred.

As might be expected, the bird life of the area was particularly rich. Waterbirds such as arctic loons (Gavia arctica), red-necked grebes (Podiceps grisegena), and horned grebes (Podiceps auritus) nested on ponds and lakes throughout the region, and large numbers of ducks utilized the area. Common shorebirds nesting there were the common snipe (Capella gallinago), lesser yellowlegs (Totanus flavipes), solitary sandpiper (Tringa solitaria), spotted sandpiper (Actitis macularia), and northern phalarope (Lobipes lobatus). Bonaparte gulls (Larus philadelphia) and short-billed gulls (Larus canus) also nested in the area, and in August migrating Arctic terns (Sterna paradisaea) spent several weeks on some of the larger lakes. Ruffed grouse (Bonasa umbellus) and spruce grouse (Canachites canadensis) nested in the woods near lakes and occasionally sharp-tailed grouse (Pediocoetes phasianellus)

were observed. Large raptors commonly seen were the rough-legged hawk (Buteo lagopus), marsh hawk (Circus cyaneus), great horned owl (Bubo virginianus), and the osprey (Pandion halietus). A few bald eagles (Haliaeetus leucocephalus) nested in the area each summer. Swainson thrushes (Hylocichla ustulata), robins (Turdus migratorius), yellow warblers (Dendroica petechia), white-crowned sparrows (Zonotrichia leucophrys), and slate-colored juncos (Junco hyemalis) were the most common small birds nesting in the area.

Since little ornithological work has been done in the Tetlin-Northway area and this region is located only about 50 miles from the Canadian border many new sight and breeding records for Interior Alaska were derived from this study. New waterfowl breeding records for Alaska established at Tetlin were those for the redhead (Aythya americana), blue-winged teal (Anas discors), ring-necked duck (Aythya collaris), and the ruddy duck (Oxyura jamaicensis). The first sight records for the gadwall (Anas strepera) in Interior Alaska were at Tetlin and a specimen was collected in 1961. Other unusual sightings and collections include those for the red-winged blackbird (Agelaius phoeniceus), coot (Fulica americana), sora (Porzana carolina), and black brant (Branta bernicula).

CHAPTER III

STATUS OF WATERFOWL IN THE TETLIN-NORTHWAY AREA

The following is an annotated list of waterfowl and other large water birds which were seen in the study area during the summers of 1959, 1960, and 1961. Data concerned with new, significant, or unusual observations of other avian species have been sent to Dr. Brina Kessel, University of Alaska, for filing and reference purposes.

Arctic Loon (*Gavia arctica*)

This bird is a common summer resident of the area but no signs of breeding were noted. Pairs and small groups of from three to five birds were found scattered throughout ponds and large lakes every summer.

Red-throated Loon (*Gavia stellata*)

A rather uncommon bird seen only in the summer of 1961. An adult female was collected at Tetlin Lake on May 24 that year and several others were seen on Tetlin River and Butterfly Lake.

Red-necked Grebe (*Podiceps grisegena*)

A common summer resident and breeder on most of the area's large lakes. Adults and young were banded each summer.

Horned Grebe (Podiceps auritus)

A very common breeder in the Tetlin area; almost every small pond and lake had at least one nesting pair. On Butterfly and Tree lakes this bird nested in colonies of from 10 to 15 nests. Over 1,100 of these birds were banded from 1955 to 1961.

Whistling Swan (Cygnus columbianus)

A migrant and rare summer resident. Each summer several of these birds molted in the Tetlin area. In the spring of 1961 about 75-100 swans, probably this species, stayed on Tetlin and Butterfly lakes for about ten days, finally leaving in early June. An injured swan was caught on Tetlin River July 1, 1961. Its weight was 12½ lb and the length from nail to nostril was 43 mm, establishing it as C. columbianus.

Canada Goose (Branta canadensis)

Three Canada geese were observed on Tetlin Lake, May 21, 1961. Pairs were seen each summer on sand bars of the Tanana River, and they probably nested there. About mid-August, 1961, a flock of 20 Canada geese was seen on a sand bar on the Tanana River.

Black Brant (Branta nigricans)

A single brant probably of this species was observed during the summer of 1959 on Gasoline Lake, and on June 21, 1961, two were seen and an immature female was collected at the same place.

White-fronted Goose (Anser albifrons)

This species was commonly seen during migration in late August but few stayed long in the area. On June 17, 1961, a single goose of this species was observed on the west shore of Tetlin Lake, and on August 12, 1961, a flock of 40-50 birds flew low over the area in a southerly direction.

Snow Goose (Chen hyperborea)

This species was observed only once in the area; six birds were flushed from Tetlin Lake on May 26, 1961.

Mallard (Anas platyrhynchos)

A very common breeder in the Tetlin area. In 1961 the earliest nest, with seven eggs, was found on May 17. The first brood was observed on June 11 that year.

Gadwall (Anas strepera)

A rare summer visitor at the Tetlin area. One pair was seen each of the summers of 1959 and 1960, and an adult was observed May 19, 1961 on Island Lake. A molted adult male was caught in a banding trap July 12, 1961 and subsequently collected, and several weeks later another male was banded.

Pintail (Anas acuta)

A common breeder in the study area. This duck and the mallard are the earliest to nest at Tetlin. In 1959 and 1960 the first pintail brood was observed on June 15 and in 1961 it appeared on June 11.

Green-winged Teal (Anas carolinensis)

A common breeder in the Tetlin area, seeming to prefer small ponds and Tetlin River as brood habitat. Large numbers of adult males congregate on the north shore of Butterfly Lake to molt in early July each year.

Blue-winged Teal (Anas discors)

A common summer resident and uncommon breeder. In 1961 the first pair was observed on May 28, and in 1960 an immature male was shot on September 1 at Tetlin Lake. From four to six broods were seen each summer.

Baldpate (Mareca americana)

This species breeds abundantly in the area, with nearly every small pond as well as larger lakes producing broods. Large numbers of adult male baldpates molt in the Tetlin area and consequently nearly 2,000 have been banded in three summers.

Shoveler (Spatula clypeata)

A fairly common summer resident and breeder. Although large numbers of shovelers molt in the area each summer, only a few broods were observed. Beginning in mid-June, many large flocks consisting primarily of adult males become conspicuous around the larger lakes.

Redhead (Aythya americana)

A fairly common summer resident and occasional breeder in 1959, 1960, and 1961. Two redhead broods were observed in 1959, five in 1960, but none in 1961. Only ten redheads were

banded in 1961, and apparently they were not as common as in 1959 and 1960.

Ring-necked Duck (Aythya collaris)

An uncommon summer resident and breeder. In 1961 a single male of this species was seen on May 18 and another was seen May 19 in a different lake. Although about 5-15 ringnecks were banded each summer of 1959 and 1960, only two were banded in 1961. On July 21, 1960 a female with a brood of five young was observed on a small, wooded lake near Tetlin Lake.

Canvasback (Aythya valisineria)

A common breeder on the larger ponds and lakes of the area. On June 11, 1961 four nests were found on Gasoline Lake, containing 7, 10, 11, and 13 eggs, respectively. An estimated 400 to 500 canvasbacks molted on Butterfly Lake each summer, with several hundred more molting on Gasoline and Old Albert lakes.

Greater Scaup (Aythya marila)

A rare summer visitor. Formerly the scaup population in the Tetlin-Northway area was presumed to consist only of lesser scaup, but in 1961 four greater scaup were trapped and banded on Butterfly Lake.

Lesser Scaup (Aythya affinis)

An abundant breeder in the Tetlin area; this is decidedly the most numerous duck there. In 1961, 31 nests of this species were examined and 2,000 scaup were banded.

Common Goldeneye (Bucephala clangula)

An uncommon spring migrant and a rare summer resident. In 1961, 14 individuals were observed between May 17 and May 31, and two adult females were banded in August. In 1960 one adult male was observed in mid-June.

Barrow Goldeneye (Bucephala islandica)

A common summer resident and breeder. Although large numbers of this species molt in the Tetlin Lake area, only few broods were observed.

Bufflehead (Bucephala albeola)

This species is an abundant summer resident and breeder on the ponds and lakes of the area. Many large flocks of males and females molt on Tetlin Lake and the other large lakes each summer.

Oldsquaw (Clangula hyemalis)

An uncommon summer resident and migrant. A few scattered individuals and a flock of about 12-20 spent the summers of 1959, 1960, and 1961 on Island, Tree, and Butterfly lakes. In 1961 during the period May 19 to May 26 several hundred old squaws stayed on Tetlin Lake.

Harlequin Duck (Histrionicus histrionicus)

A rare summer visitor. No harlequins were observed until the summer of 1961 when on June 8 an adult male was seen on the Tanana River about 2 miles downstream from the mouth of the Tetlin River, and on June 16 when an adult male was

Red-breasted Merganser (*Mergus serrator*)

A rare visitor. The only observation of this species was on Tetlin Lake, May 16, 1961, when a pair was watched closely with a 20X spotting scope.

Common Coot (*Fulica americana*)

On August 8, 1960 an adult was observed closely and positively identified on Gasoline Lake by the writer and Galen McWilliams, student at the University of Alaska; in August, 1960 an adult coot, possibly the same one, was seen by Jim Branson, United States Game Management Agent, on Fish Lake.

CHAPTER IV

THE BREEDING SEASON

Territoriality and Courtship

This was a very general study, and little effort and time were devoted to behavioral aspects of waterfowl nesting in the Tetlin study area. Since the writer did not reach the study area until mid-June in 1959 and 1960, most nesting was already completed and very little territorial or courtship activity was observed. In 1961 the writer arrived at the study area in mid-May while courtship and defense flights were still in progress in some species. On numerous occasions adult male baldpate and green-winged teal were seen chasing other males in defense of territories. Other similar observations are excluded since they would merely be repetitions of past studies.

Although the work of Hochbaum (1944) in the Delta marsh of Manitoba indicates that lesser scaup defend a unit of the environment as a territory, it is believed by the writer that territorialism in this species is centered around defense of the female by the male rather than defense of a specific portion of the physical environment. On numerous occasions during June and July two or three pairs of scaup were seen occupying one loafing bar or log without any apparent manifestations of aggressive behavior. Small ponds only 100 ft in diameter

frequently contained several pairs, seemingly cohabiting harmoniously. Pairs also intermingled with large flocks of adult males without any signs of defensive behavior by the male, unless another male obviously pursued the female. Mendall (1958) describes a very precise spacing of pairs of ring-necked ducks on rivers and sloughs in Maine, and Hochbaum indicates that this spacing also occurs in lesser scaup at Delta. No such spacing seems to present itself in lesser scaup in the Tetlin area. For example, at about 10:00 A.M. on June 27, 1961 during a 6-mile trip down the Tetlin River to the village of Tetlin, 24 pairs and two lone males were recorded. At this time there were three known nests on this particular portion of river which probably accounts for the lone males. The birds were aggregated in groups of from one to four pairs and no spacing such as that described by Mendall and Hochbaum was noted.

On July 4, 1961 two lesser scaup nests which were only about 6 ft apart were discovered in a narrow fringe of sedge bordering a small lake. This seems to indicate that if defense of a segment of the environment does occur the nest is not part of the defended area. Another nest discovered July 20, 1961 contained 20 eggs, 12 of which hatched on July 28. The remaining seven eggs (one fell out of the nest July 26 when the female flushed) contained embryos of varying degrees of development. Near this nesting site was a loafing bar which was utilized simultaneously by three pairs of scaup. Apparently after one of these females had laid an egg in the nest, another of the females laid an egg in the same nest. According to numerous

workers, these "dump" nests are common in this species, but seldom does the opportunity to obtain a complete history of such a nest present itself.

Nesting and Production

In the Tetlin-Northway area, as in most breeding grounds in Interior Alaska, the waterfowl nesting density is so low that it would not be feasible to establish an extensive nesting study there. During the summers of 1959 and 1960 very few duck nests were found and these were located only by accident. Although no record of these nests were kept for the purpose of this thesis, records were sent to the University of Alaska Bird Nesting Scheme. In 1961 the writer and one assistant were in the study area about June 6, and even though no attempt was made to conduct a nesting study, 58 waterfowl nests were found. Data from these nests are recorded in Table 1.

Most dabbling duck nests were discovered while the writer and his assistant were hiking through the woods or cutting poles for duck traps. It was discovered, however, that many species preferred to nest on islands, probably to escape nest predation by foxes or bears. By systematically searching islands in the area, chances of finding nests were increased many-fold. In this region dragging ropes or using most methods applicable elsewhere is completely impractical. Only by systematically searching the woods with a large crew of men, or with the aid of dogs, could any appreciable number of dabbling duck nests be found. Scaup seemed to prefer the sedge-grass

meadows along lake and pond shorelines for nesting, and 29 nests were found by searching the shoreline vegetation. By following shorelines of lakes and Tetlin River closely with a boat, incubating females were flushed and their nests found.

TABLE 1

COMPILATION OF WATERFOWL NESTS LOCATED IN THE TETLIN LAKE AREA, 1961

Date Found	Clutch Size	Vegetation at Site	Approx. Distance from Water	Fate of Nest
		Mallard		
June 18	9	Labrador tea (Ledum) at edge of willow thicket	50 ft	?
May 17	7	Ground litter at the base of 40-ft spruce	50 ft	?
May 19	8	Grassy area at edge of 10-ft bank	10 ft	Destroyed by predator
May 26	7	Under pile of dead willow in grassy area	8 ft	Hatched
June 10	9	Base of 5-ft spruce in willow thicket	30 ft	?
June 11	4	Sedge-grass meadow	1 ft	Flooded
June 12	7	Base of small spruce in grass and lupine	35 yd	?
June 12	8	Base of small spruce in open willow-birch	20 ft	4 eggs missing on June 21; on June 22 other eggs hatched
June 13	10	Base of small spruce in lupine and Hortensia at edge of cut bank	10 ft	?

TABLE 1--Continued

Date Found	Clutch Size	Vegetation at Site	Approx. Dist. from Water	Fate of Nest
		Mallard--Continued		
June 14	8	Grassy area at edge of willow thicket	50 ft	Flooded
June 19	6	Moss in spruce forest, concealed by rose bushes	50 ft	?
May 31	9	Grassy area in willow thicket at edge of spruce forest	5 ft	Destroyed by predator
Av.	7.7			
		Pintail		
June 12	7	Grass clump at base of large spruce	1 ft	Flooded
		Green-winged Teal		
May 25	9	Litter at base of small spruce in aspen woods	35 ft	?
May 30	8	Grass at base of small spruce in open aspen woods	50 ft	?
June 10	9	Moss in stand of mature spruce	100 yd	?
June 26	8	Moss in stand of mature spruce	75 yd	Nest and hen destroyed by predator
Av.	8.5			
		Widgeon		
June 12	6	Open grassy area about 10 ft from willow and spruce thicket	75 ft	?

TABLE 1--Continued

Date Found	Clutch Size	Vegetation at Site	Approx. Dist. from Water	Fate of Nest
		Widgeon--Continued		
June 14	9	Grassy area at base of small spruce	30 ft	All eggs hatched
June 18	8	Base of small spruce in willow and birch stand	30 ft	?
June 18	10	Base of small spruce in fireweed-grass stand	25 ft	?
July 2	6	Open soil at base of leaning willow	8 ft	5 eggs hatched July 17
July 5	7	Base of small birch in fireweed-grass stand	30 ft	?
Av.	7.7			
		Canvasback		
June 11	8	On dead ragwort "reeds"	3 ft	Destroyed by predator
June 11	10	Bulrush clump in lake	0	?
June 11	11	Bulrush clump in lake	0	Flooded
June 11	13	Bulrush clump in lake	0	?
Av.	10.5			
		Lesser Scaup		
June 11	9	Sedge-grass meadow	10 ft	Destroyed by predator
June 19	9	Moss at base of willow	1 ft	?
June 20	10	Open grassy area in aspen woods	50 ft	?
June 20	10	Base of small spruce in open willow woods	50 ft	?

TABLE 1--Continued

Date Found	Clutch Size	Vegetation at Site	Approx. Dist. from Water	Fate of Nest
		Lesser Scaup--Continued		
June 21	7	Extensive sedge meadow	40 ft	Destroyed by predator
June 21	8	Sedge-grass meadow	60 ft	?
June 24	10	Grass clump at base of small spruce on vertical bank	25 ft	?
June 26	12	Sedge clump at lake edge	1 ft	Destroyed by predator
June 26	7	Clump of grass and lupine	6 in.	Destroyed by predator
June 26	10	Sedge clump at lake edge	4 in.	?
June 26	11	Sedge clump at lake edge	2 in.	Destroyed by predator
June 26	7	Sedge clump surrounded by water	0	?
June 26	10	Clump of grass at base of steep bank	3 ft	Destroyed by predator
June 27	10	Clump of grass at base of dead spruce	1 ft	Destroyed by predator
July 2	8	Sedge meadow	20 ft	?
July 2	10	Sedge clump at lake edge	2 in.	?
July 4	8	Sedge clump at lake edge	4 in.	Nest and hen destroyed by predator
July 4	7	Sedge clump at lake edge	4 in.	Deserted
July 4	8	Dead "reeds" of ragwort interspersed with grass	8 ft	Hen collected

TABLE 1--Continued

Date Found	Clutch Size	Vegetation at Site	Approx. Dist. from Water	Fate of Nest
		Lesser Scaup--Continued		
July 5	8	Base of leaning willow on vertical bank	1 ft	Destroyed by predator
July 5	6	Sedge clump at lake edge	6 in.	?
July 6	6	Sedge clump at lake edge	4 in.	?
July 6	7	Sedge clump at lake edge	4 in.	All eggs hatched
July 15	5	Grass meadow	20 ft	?
July 15	6	Sedge clump at lake edge	6 in.	?
July 20	8	Sedge clump at lake edge	4 in.	7 eggs hatched 1 dead young in nest
July 20	20	Clump of grass at edge of lake	2 ft	12 eggs hatched
July 21	9	Sedge clump in marshy area	40 ft	?
July 21	9	Sedge clump at lake edge	3 ft	?
July 27	8	Sedge clump at lake edge	4 in.	All eggs hatched
Aug. 3	7	Sedge-grass clump at pond edge	2 in.	?
Av.	8.7			

In 1961, 12 mallard nests were discovered. There seems to be no set pattern of nesting or of vegetational requirements in this species at the Tetlin area. It appears, however, that the ecotones of willow, paper birch, and spruce are chosen in most cases. Mallard nests were often placed under small spruce trees.

Nests of green-winged teal, like those of the mallard, are usually placed on high, dry land, but a specific plant community does not seem necessary. The four green-winged teal nests found in 1961, and those found during previous summers, were located a considerable distance from water and were very well hidden. Baldpate nesting appears to follow a more precise pattern than that of the other dabbling ducks. This species seems to require open grassy areas on high ground for nest sites. As was found in the mallard, most nests were located at the base of small spruce trees which probably offered concealment as well as protection from rain and wind.

More nests of lesser scaup were found than of any other species. This species appears to prefer a nest site as near water as possible and generally nests in sedge clumps or sedge-grass meadows (see Appendix, Fig. 12). Of 31 nests found, all but two were within 30 ft of open water, and most of these were at the water's edge.

Average clutch sizes in all species are comparable to those found in other regions (Bent, 1923). Although the sample of canvasback nests (4) was small, their average clutch size of 10.5 is very similar to the average of 10.0 found by Hochbaum

at Delta, Manitoba (1944). The low average brood size (6.8) in this species as compared to the relatively large number of eggs laid appears to indicate a high percentage of infertile eggs, since it seems that little mortality occurs to broods in this region. Data in Table 2 show that in this species 24 newly hatched broods in 1960 and 1961 averaged 5.8 young, whereas 11 three- to four-week-old broods averaged 5.7.

TABLE 2

BROOD SIZE AS AN INDICATION OF MORTALITY TO BROODS OF WATERFOWL, 1960 AND 1961

Species	Brood Size[a]		
	Class I[b]	Class II	Class III
Mallard	39 (7.41)	30 (7.17)	10 (7.1)
Pintail	15 (6.53)	21 (5.33)	8 (5.38)
Widgeon	102 (7.56)	55 (6.44)	.....
Green-winged Teal	48 (6.25)	28 (5.61)	12 (6.48)
Canvasback	24 (5.83)	11 (5.73)	.....
Lesser Scaup	53 (7.94)	20 (9.2)	.....
Bufflehead	52 (5.98)	15 (5.13)	.....

[a]Average size of broods in parentheses.

[b]Age classes as described by Gollop and Marshall (1954).

The Brood Season

Data in Figure 6 contrasts nesting phenologies from 1960 and 1961 at Tetlin with similar information for some species from Hochbaum's work at the Delta marshes in Manitoba

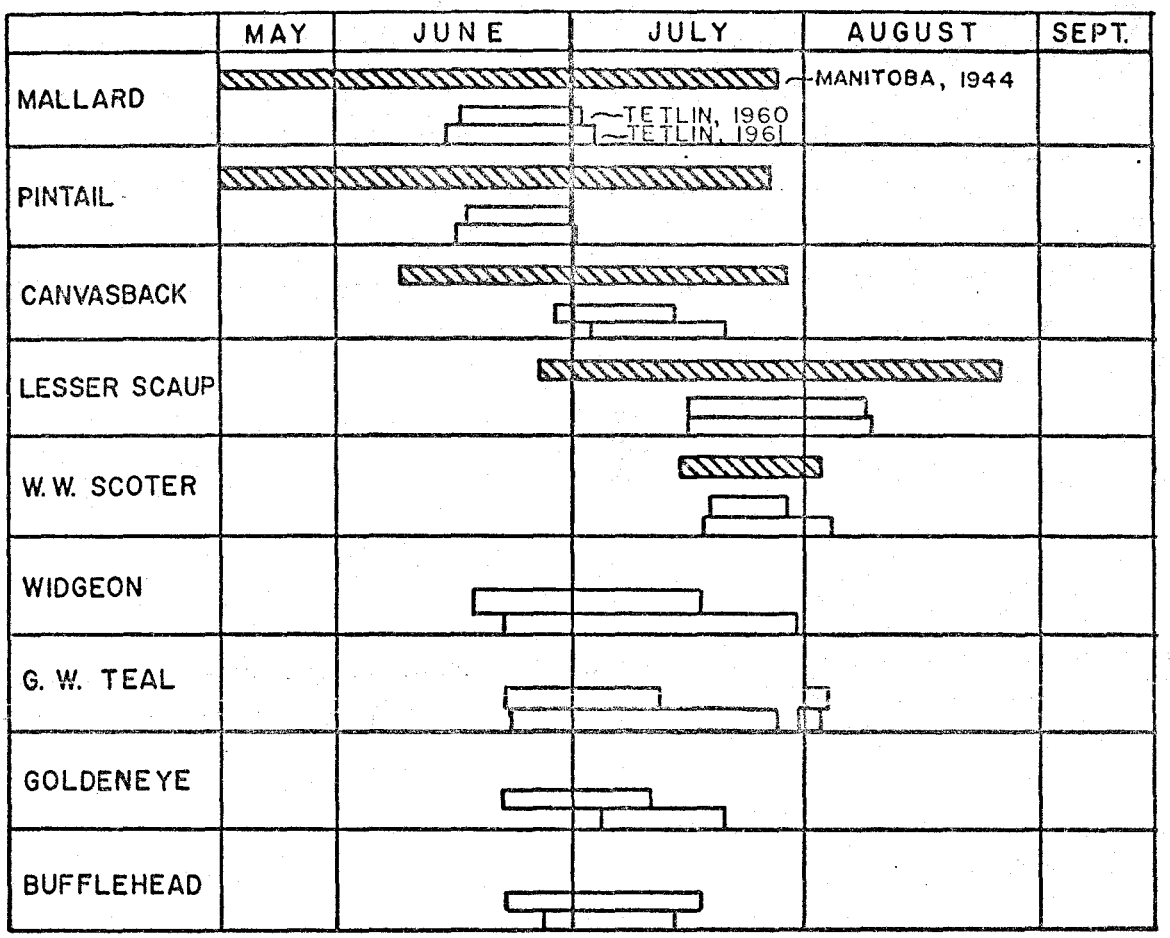

Fig. 6.--Total range of hatching dates for the Tetlin area in 1960 and 1961 compared to the hatching periods at Delta, Manitoba (Hochbaum, 1944). The period between first and last broods hatched at Tetlin is based on field observations of broods, whereas earliest dates in Manitoba are based on nest observations and late dates are based on brood observations.

(1944). All of the dates in the Alaska study were derived from brood observations, whereas in Hochbaum's study earliest hatching dates were based on nest observations, and data for latest hatchings were based on brood observations. By looking at this graphical comparison one may note several very important differences.

As would be expected, initiation of nesting and early hatching dates are earliest in southern areas. Also, the period between the first and last broods hatched is much shorter in Arctic areas than in the prairies to the south for species like the mallard, pintail, shoveler, and canvasback. This probably reflects the influence of several factors. Obviously, the fact that ducks do not arrive at northern breeding areas until about a month later than in the Prairies would shorten the nesting period appreciably. Also, in the prairie breeding areas the longer summer season and the presence of many nest predators are more apt to promote renesting. As studies by Hochbaum (1955) and Sowles (1945) indicate, two or three attempts at renesting are common. This of course lengthens the period between earliest and latest broods.

In Interior Alaska it is believed that no renesting occurs in these species, and this seems to be substantiated by the short interval between first and last brood hatchings. Where hatching is restricted to a two- or three-week period, the difference in dates would appear to result from differences in individual performances rather than renesting attempts.

Data indicating the period between first and last brood

hatchings for green-winged teal and baldpate, species which are generally recognized as chiefly Arctic nesters (Kortright, 1953), show a different pattern than those for the pintail, mallard, shoveler, and canvasback. The period in which newly hatched broods of green-winged teal and baldpate were observed extended about four to five weeks, whereas this same period for species generally conceded to be primarily prairie nesters was restricted to a two-week period. In the green-winged teal a distinctly two-segmented hatching period occurs. In 1960 newly hatched broods were observed from June 22 to July 12 and then none were observed until August 1. In 1961 the first newly hatched young were observed on June 23 and young broods were seen nearly every day until July 15. As in 1960, newly hatched broods were subsequently observed between July 27 and August 3.

The period for newly hatched broods in the baldpate was 29 days in 1960 and 35 days in 1961. Although there is no distinct segmentation of hatching dates as found in the green-winged teal, the wide variation in hatching dates probably suggests behavior other than individual variation in nest initiation. The longer period between first and last hatching dates in the baldpate in 1961 as compared to those of 1960 was possibly caused by flooding of nests during June in 1961. The same may be true for the extended hatching of green-winged teal in 1961. Brood data on these two species suggests that renesting occurs at least to some extent in the baldpate and green-winged teal in the Tetlin-Northway area.

Hatching dates in typically Arctic nesting birds such as

the bufflehead, goldeneye, and white-winged scoter show very little spread. In nesting of the white-winged scoter at Delta, first and last hatching dates correspond very closely to those at Tetlin. This suggests that in this species, even though the nesting period is longer and the opportunity and motivation for renesting is greater in the Prairies, renesting does not occur at Delta. These birds apparently do not begin to nest until late in the summer and have time for only one nesting attempt.

Hatching data for lesser scaup present a different pattern than in other ducks, but as in other species the peak of hatching in the Prairies occurs about two weeks prior to that in Interior Alaska. In 1960 the hatching period in this species extended over 27 days; in 1961 it extended over 28 days. The wide range of hatching dates may indicate renesting or individual variation in initiation of egg-laying. First egg dates for pheasants in Wisconsin (Buss, 1946) and Washington (Nagra and Buss, 1959) have been shown to have a range of approximately 30 days. The writer believes that individual variation causes this difference in lesser scaup hatching dates although only through a thorough renesting study could the cause of this variation be determined accurately.

Table 3 gives a 5-year summary of brood observations made in the study area. To some extent the number of broods observed each year merely reflects the time and effort spent observing broods. In some species like the blue-winged teal and shoveler these differences indicate increased breeding. The summer of 1959 obviously was the best production year for all species and particularly prairie nesting species.

TABLE 3

NUMBER AND AVERAGE SIZE OF BROODS OBSERVED IN THE TETLIN-NORTHWAY AREA, 1957-1961[a]

Species	1957	1958	1959	1960	1961	Total No. and Av. Size
Mallard	17 (6.5)	37 (8.0)	64 (6.1)	43 (7.9)	36 (6.7)	197 (7.0)
Pintail	10 (6.5)	23 (7.1)	64 (6.1)	17 (6.1)	26 (6.0)	140 (6.3)
Widgeon	17 (5.3)	42 (7.3)	65 (7.3)	59 (7.4)	104 (6.4)	287 (6.9)
Shoveler	.....	5 (7.6)	24 (8.5)	7 (6.8)	5 (6.6)	41 (7.9)
Green-winged Teal..	23 (6.7)	45 (7.2)	82 (7.1)	31 (6.6)	58 (5.9)	239 (6.7)
Blue-winged Teal...	.....	.....	12 (7.2)	3 (7.0)	4 (7.5)	19 (7.2)
Lesser Scaup	46 (8.7)	50 (7.4)	67 (8.9)	44 (8.1)	73 (8.3)	280 (8.3)
Canvasback	17 (7.5)	22 (7.1)	32 (7.3)	18 (6.1)	18 (5.5)	107 (6.8)
Redhead	.....	.....	1 (3.0)	6 (4.8)	.....	7 (4.6)
Ring-necked Duck ..	.....	.....	.....	1 (5.0)	.....	.....
Bufflehead	26 (6.9)	30 (7.0)	26 (7.0)	27 (5.4)	40 (6.1)	149 (6.5)
Goldeneye	10 (7.0)	5 (6.2)	7 (6.9)	10 (5.7)	10 (4.9)	42 (6.1)
White-winged Scoter	4 (11.3)	10 (12.6)	8 (12.8)	14 (10.6)	20 (10.7	56 (11.3)
Surf Scoter	2 (7.5)	7 (8.7)	1 (7.0)	.....	.....	10 (8.3)
Ruddy Duck	.....	.....	1 (5.0)	.....	.....	.....
Total	172 (7.3)	276 (7.5)	454 (7.3)	280 (7.2)	394 (6.8)	1576 (7.2)

[a]Average size of broods in parentheses.

Molting

The flightless period for all species is very comparable to that found at the Delta marsh by Hochbaum (1944). Mallards and pintails which are the earliest arrivals at Tetlin, as well as at Delta, begin to molt in mid-June and flightless males have been observed as early as June 20. The peak of the flightless period of all adult male dabbling ducks at Tetlin is from about July 10 to July 25. Although the molt of adult females extends into October at Delta, the latest molting female dabbling ducks at Tetlin are probably flying by August 20.

The molt period in adult male diving ducks at Tetlin begins about a week later than that in Manitoba and extends from mid-July to late August. Most adult females are flightless beginning in early August and by early September nearly all young and adult females can fly.

In the Tetlin-Northway area, as in other breeding areas of Interior Alaska and northern Canada, ponds and lakes often begin to freeze by the third week of September and they are completely frozen by October 1 in most years. It is possible then that early ice occurs before late hatched broods and molting females in species like the lesser scaup and white-winged scoter can leave their breeding areas. Although an early freeze-up would probably be fatal to some of these birds, most of them are flying before lakes freeze over and hence the number lost is probably of little consequence to continental duck populations.

Predation

In waterfowl marshes of Interior Alaska predation occurs chiefly as depredations to nests and incubating females. On several occasions predation of young ducks was observed; an American rough-legged hawk was seen catching a young mallard and on two different occasions short-billed gulls were observed catching a young horned grebe and a newly hatched mallard. Such predation seems to be of little consequence to waterfowl production. Probably a few ducks are killed by northern pike (Esox lucius), mink, marsh hawks, and other animals. Table 3 showing comparative data on different aged broods indicates that there is very little loss of ducklings in the Tetlin area.

Nest predation, particularly by black bears, appears to be cause for a substantial loss in waterfowl production in the study area. In this region, although there is no closed season on bears, there is little hunting and bear populations are relatively high. During June and July bears spend much time around waterfowl nesting lakes apparently seeking duck nests, muskrat dens, and other choice food items. Of the 16 lesser scaup nests which were rechecked, 9 were destroyed by predators, in most cases by bears. In most instances these nests may have been found by the predator because of disturbances caused by the writer and his assistant. However, three nests which were checked from a boat, and which were not disturbed or touched, were also destroyed. Other nest predators which probably destroy an appreciable number of nests and incubating females in the Tetlin area include the raven (Corvus corax), short-billed

CHAPTER V

TRAPPING AND BANDING

Trapping Techniques

Although a few of the ducks banded at Tetlin were young birds which were individually caught by hand, the great majority of the birds banded were flightless adults and young captured in drive traps consisting of corrals built of chicken wire and fish net. These traps are similar to those described by Cowan (1952) and used in British Columbia. Since James King, United States Bureau of Sport Fisheries and Wildlife, has described trapping techniques used in detail (Annual Waterfowl Report for Alaska, 1958), the description given here is very brief.

Essentially the drive traps utilized are built in the form of a fish trap, consisting of wings, a "heart," and a "pot" (see Appendix, Fig. 10). As in the case of a fish trap, long leads or wings are used to direct the birds to a central "pot" or holding pen. The trap itself consists of a semi-circular "heart" with a wide opening. The "heart" is connected to the holding pen by an opening approximately 4-6 inches wide. The trap normally is placed in from 3-4 ft of water, and the wings are extended into as much as 10 or 12 ft of water. Where

water depths exceeded 4 or 5 ft near the shore the trap was placed only 10-20 ft from the shoreline, but in lakes with gradually sloping shorelines traps were located as far as 100 yards from shore. The length of wings varied with the individual trap site and on large, shallow lakes often 100- to 200-ft wings were used. Poles for traps and wings were cut in forested areas adjacent to trap sites. Chicken wire with 2-inch mesh was used for trap construction and wings built in shallow water. Fine mesh fish net, weighted with segments of lead telegraph cable, was used for wings wherever water depths exceeded 5-6 ft.

Placement of traps is the most critical part of drive-trapping ducks, as traps must be built where diving ducks may be driven close to shore. Peninsulas of land extending into deep water, spaces between islands and the mainland, and narrow channels between lakes were found to be good trap sites. Lesser scaup and canvasbacks could be trapped only when driven in a direction and general area where they would ordinarily go to evade pursuers.

Waterfowl were driven towards the traps with the use of two native kayaks (rat canoes), a Grumman aluminum canoe with outboard motor, and an airplane. Once within the confines of the wings they were funneled towards the "heart" of the trap, where they milled around until they found the entrance to the "pot." Ducks entering the "pot" rarely found their way out again.

After the birds were driven into the "pot," the entrance was blocked with a gate, and they were immediately removed with a long-handled dip net and placed in burlap bags. It was found that waterfowl rapidly become wet and exhausted in the traps and mortality by shock is excessive if the birds are not taken out of the water as quickly as possible. Apparently heat generated by the ducks and the darkness of the burlap bags has the effect of both calming and drying the birds. By the time the ducks are removed from the bags to be banded their feathers are dry and fluffy and they are generally in excellent physical condition. Trapping mortality using this technique rarely exceeded 6% and generally was only 4% to 5%.

Although fair success in capturing diving ducks such as lesser scaup and goldeneyes has been achieved in other areas (Cowan, 1952; Cartwright, 1952), banding operations at Tetlin and Fort Yukon in Alaska have achieved a degree of success probably never before attained. In 1961 approximately 16,000 ducks, mostly divers, were banded at these two stations. Large concentrations of flightless birds, the great mobility of banding crews using airplanes, and good trapping methods contributed to this success.

Floatplanes (Cessna "180's" and Piper "Supercubs") were used extensively by banding crews (see Appendix, Fig. 11). Banding equipment, boats, and crews were transported to banding sites in these aircraft, and they were often used to help drive ducks into traps.

Results of Banding

In the years 1955 to 1960 approximately 10,320 ducks of 15 species were banded at the Tetlin-Northway study area. A total of 362 band recoveries (Table 4) gives much information on distribution, migration, and hunting mortality for the most important species, but for other ducks the number of recoveries is too small to give but a very generalized idea of migration routes and mortality. In the summer of 1961 at Tetlin, an additional 4,478 birds were banded; this will provide many additional data in following years.

For the purposes of this paper, the term "returns" designates ducks which were banded at Tetlin and their bands recovered when they were shot by hunters or killed in another way. "Retraps" are birds which were banded in sites other than the study area and were subsequently captured and released at the Tetlin area.

Returns and retraps for four species--redhead, canvasback, lesser scaup, and baldpate--have been plotted on outline maps of North America to show their respective distributions (Figs. 7-9). Where only a few returns for a species were made or where the migration route seems well defined, no such map was made but returns are mentioned in the discussion for that species. The discussion for each species follows.

TABLE 4

BAND RECOVERIES FROM WATERFOWL BANDED AT TETLIN, ALASKA, 1956-1960

Year Banded	Number Banded			Number of Recoveries										Total
				1956		1957		1958		1959		1960		
				M	F	M	F	M	F	M	F	M	F	
Baldpates														
1956	Adult	M	34	3		3								6
1957	Adult	M	1											0
	Local	M	2											
			3											
1958	Adult	M	64					3	1	4		3		11
	Adult	F	1											
	Local	M	7											
	Local	F	4											
			76											
1959	Adult	M	403							27	1	18	1	47
	Adult	F	8											
	Local	M	26											
	Local	F	21											
			458											
1960	Adult	M	1097									59	4	63
	Adult	F	24											
	Local	M	34											
	Local	F	33											
			1188											
Total			1759											127
Lesser Scaup														
1956	Adult	M	12											
	Adult	F	2											
	Local		0											
			14											
1957	Adult	M	42			3	1	1		1				6
	Adult	F	4											
	Local		42											
			88											

TABLE 4—Continued

Year Banded	Number Banded			Number of Recoveries										Total
				1956		1957		1958		1959		1960		
				M	F	M	F	M	F	M	F	M	F	
Lesser Scaup—Continued														
1958	Adult	M	339					12	3	10	2	2	1	29
	Adult	F	59											
	Local		137											
			535											
1959	Adult	M	619							27	1	5	3 (4?)	44
	Adult	F	239											
	Local		211											
			1069											
1960	Adult	M	531									5	3 (15?)	23
	Adult	F	336											
	Local		283											
			1150											
Total			2856											102
Canvasbacks														
1956	Adult	M	0	3	3			1						7
	Adult	F	1											
	Local	M	10											
	Local	F	11											
			22											
1957	Adult	M	2			1								1
	Adult	F	2											
	Local	M	6											
	Local	F	1											
			11											
1958	Adult	M	37					3		2		1		6
	Adult	F	6											
	Local	M	10											
	Local	F	7											
			60											
1959	Adult	M	174							7	9	2		18
	Adult	F	98											
	Local	M	11											
	Local	F	26											
			309											

TABLE 4--Continued

Year Banded	Number Banded			Number of Recoveries										Total
				1956		1957		1958		1959		1960		
				M	F	M	F	M	F	M	F	M	F	
Canvasbacks--Continued														
1960	Adult	M	96									2	3	5
	Adult	F	64											
	Local	M	24											
	Local	F	29											
			213											
Total			615											37
Pintails														
1956	Adult	M	1											
1957			0											
1958			0											
1959	Adult	M	161							6	5	4	2	17
	Adult	F	80											
	Local	M	23											
	Local	F	16											
			280											
1960	Adult	M	190									3		3
	Adult	F	34											
	Local	M	9											
	Local	F	10											
			243											
Total			524											20
Barrow Goldeneyes														
1955	?		172			1								1
1956	Adult	M	97	1		2	1		1	1				6
	Adult	F	105											
			202											
1957	Adult	M	32			1				1	1		1	4
	Adult	F	27											
	Local		1											
			60											

TABLE 4--Continued

Year Banded	Number Banded			Number of Recoveries										Total
				1956		1957		1958		1959		1960		
				M	F	M	F	M	F	M	F	M	F	
Barrow Goldeneyes--Continued														
1958	Adult	M	72					1				1		2
	Adult	F	104											
	Local		3											
			179											
1959	Adult	M	67							1	2		1	4
	Adult	F	301											
	Local		20											
			388											
1960	Adult	M	41									1	2	3
	Adult	F	212											
	Local		19											
			272											
Total			1273											20
Shovelers														
1958	Adult	M	3							1				1
	Adult	F	1											
			4											
1959	Adult	M	27									2		2
	Adult	F	5											
	Local	M	3											
	Local	F	3											
			38											
1960	Adult	M	135									13	1	14
	Adult	F	7											
	Local	M	2											
	Local	F	3											
			147											
Total			189											17

TABLE 4—Continued

Year Banded	Number Banded			Number of Recoveries										Total
				1956		1957		1958		1959		1960		
				M	F	M	F	M	F	M	F	M	F	
Green-winged Teal														
1957	Local	M	7			1								1
	Local	F	7											
			14											
1958	Local	F	1											
1959	Adult	M	156							8		1		9
	Adult	F	6											
	Local	M	2											
	Local	F	1											
			165											
1960	Adult	M	111									4	2	6
	Adult	F	12											
	Local	M	5											
	Local	F	5											
			133											
Total			313											16
Redheads														
1959	Adult	M	23							1	3		1	5
	Adult	F	41											
			64											
1960	Adult	M	4											
	Adult	F	4											
	Local		11											
			19											
Total			83											5

TABLE 4--Continued

Year Banded	Number Banded			Number of Recoveries										Total
				1956		1957		1958		1959		1960		
				M	F	M	F	M	F	M	F	M	F	
Bufflehead														
1956	Adult	M	204											
	Adult	F	44											
			248											
1957	Adult	M	126			2		1		1				4
	Adult	F	53											
	Local		4											
			183											
1958	Adult	M	249							1		1		2
	Adult	F	99											
			348											
1959	Adult	M	852							2	1	1		4
	Adult	F	191											
	Local		4											
			1047											
1960	Adult	M	281									2	2	4
	Adult	F	315											
	Local		3											
			599											
Total			2425											14

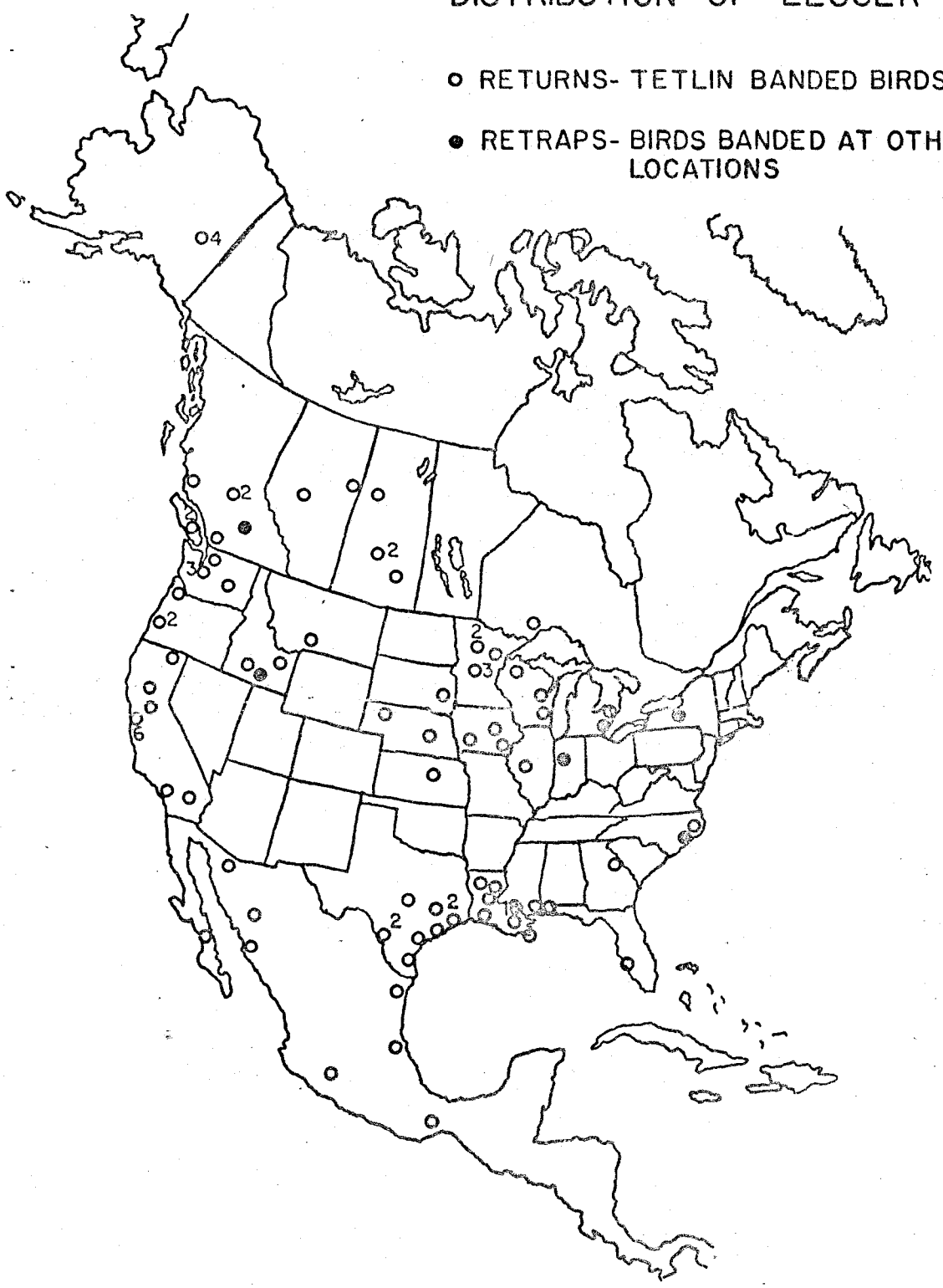

Fig. 7.--Recovery sites of lesser scaup banded at Tetlin, and locations of banding stations where birds retrapped at Tetlin were banded.

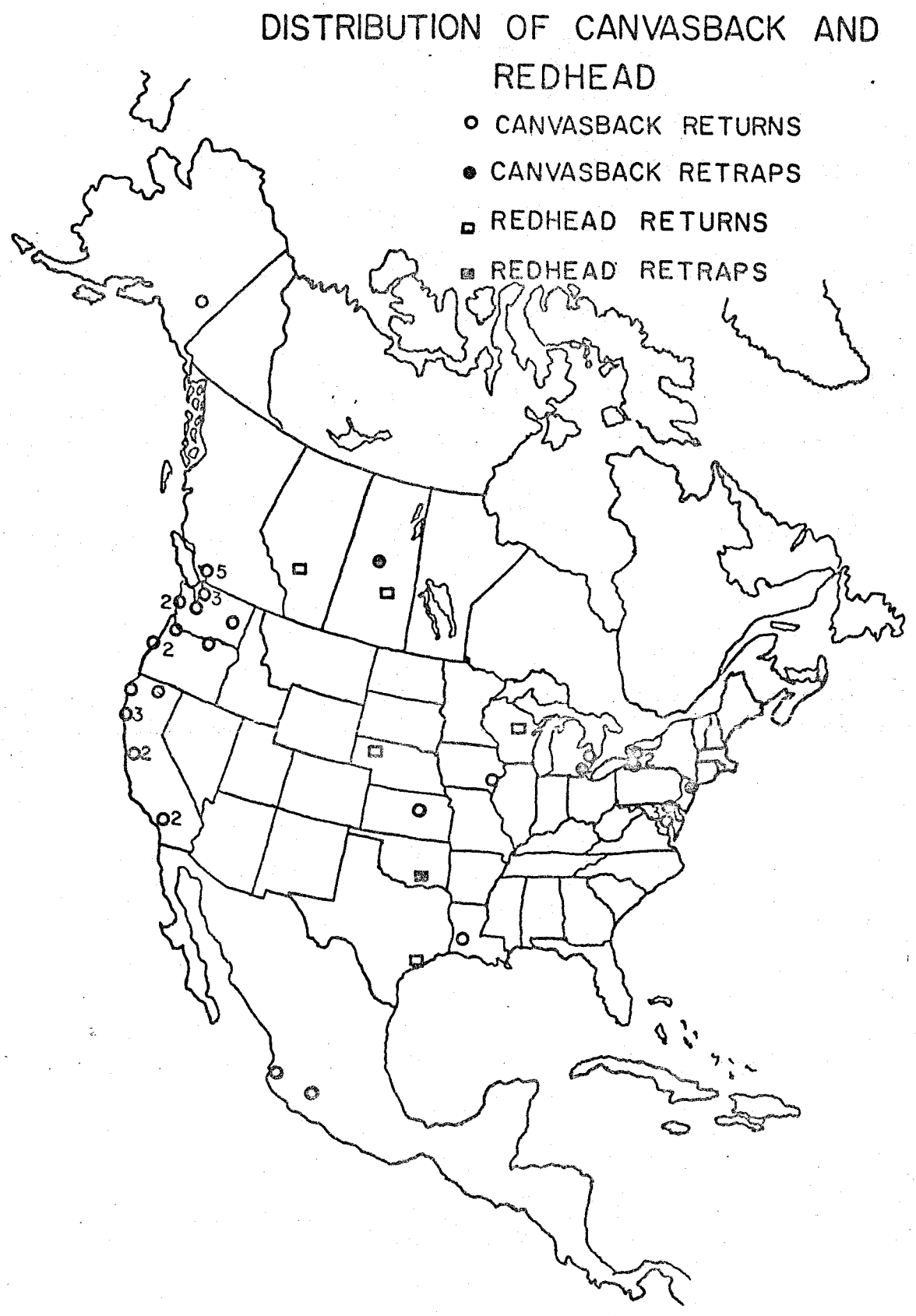

Fig. 8.--Recovery sites of canvasbacks and redheads banded at Tetlin, and locations of banding stations where birds retrapped at Tetlin were banded.

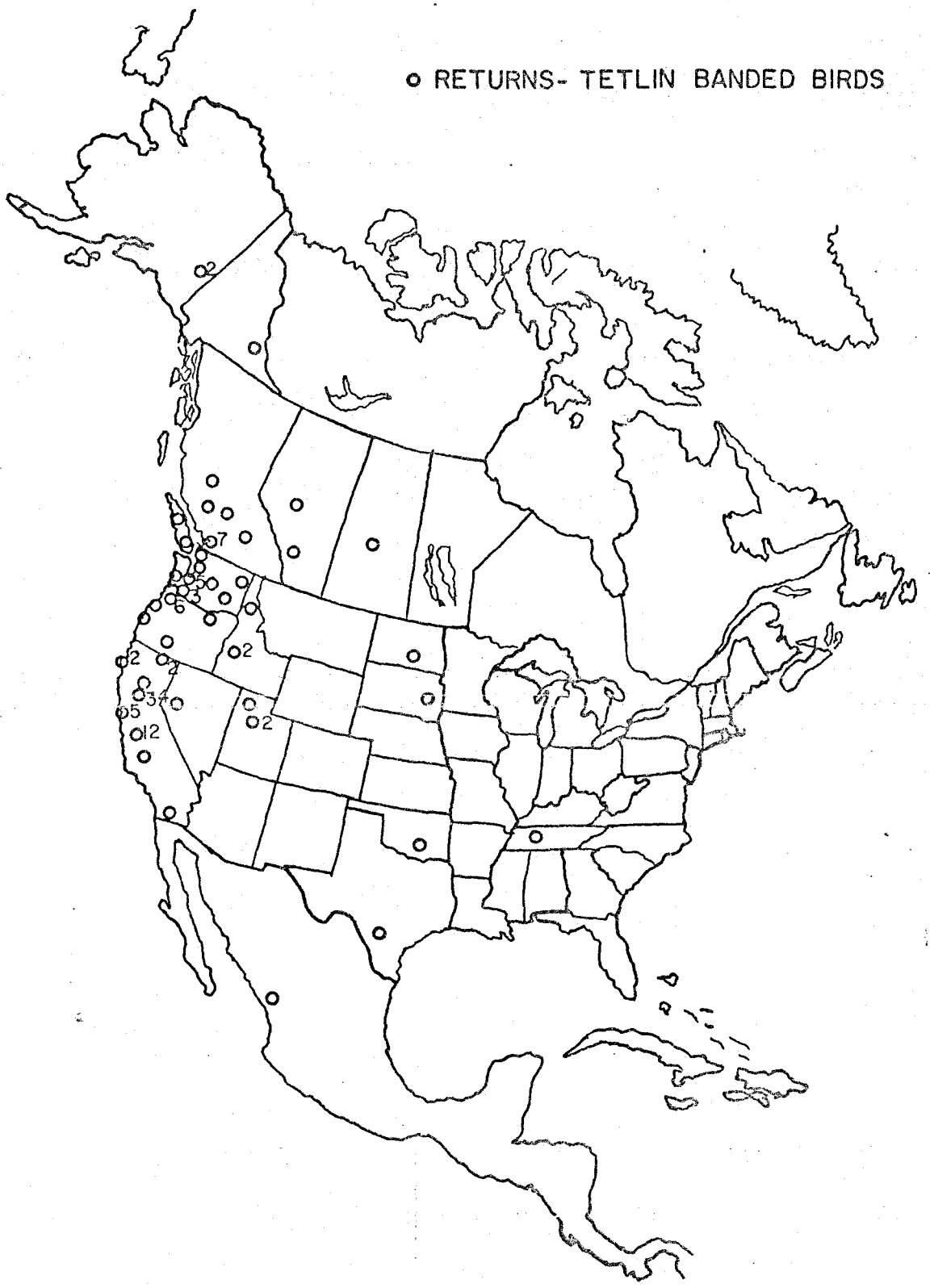

Fig. 9.--Recovery sites of baldpates banded at Tetlin

Lesser Scaup

Figure 7 shows the recovery sites of 102 returns for lesser scaup banded at Tetlin, and the locations of six banding stations where lesser scaup retrapped at Tetlin were banded. This species shows the greatest degree of dispersion of any waterfowl species breeding in the Tetlin area, with individuals being shot from California to Florida and from northern Alberta to Mexico. Although a portion of the Tetlin lesser scaup population seems to winter along the Pacific coast, about 71% of the returns are from other parts of North America. The most important wintering area appears to be the Gulf Coast states of Louisiana and Texas where 32 of the birds were taken. Apparently only a very small percentage of these birds winter along the Atlantic coast as only four returns are from that region.

One segment of the Tetlin lesser scaup population apparently migrates down the coasts of southeastern Alaska, British Columbia, and through Washington, Oregon, and California southward to the Pacific coast of Mexico. Probably the disparity of returns from Mexico indicates low hunting pressure there rather than the number of scaup wintering in the area. The largest segment of these birds apparently migrates through Alberta and Saskatchewan down the Mississippi and Central flyways to Texas and Louisiana. Possibly all the birds migrate this way as far south as the Prairie Provinces of Canada, then some of them swing westward to British Columbia before continuing south. The disparity in band returns from Canada and the northern United States probably indicates a rapid migration between Alaska and

the Gulf Coast wintering grounds. A small number of these birds also seem to migrate through the Prairie Provinces of Canada, thence southeasterly across the Great Lakes region, and to winter along the Atlantic Coast from New York southward.

The percentage of recoveries of Totlin banded lesser scaup (102 returns from 2,856 banded birds, or 3.6%) indicates a low rate of hunter harvest for this species.

Canvasback

Although the number of returns from canvasbacks banded at Totlin is small, the paths of migration seem fairly well established. Twenty-seven of 37 returns (75%) are from the Pacific Coast, three (9%) are from the Central and Mississippi flyways, and six (18%) indicate migration to the Atlantic Coast. Apparently most of these birds migrate down the coasts of British Columbia, Washington, Oregon, and California and winter at least to some extent in Mexico. A smaller segment migrates southeasterly through the Prairie Provinces of Canada along the Central and Mississippi flyways and finally winters on the Gulf Coast, while the third portion crosses Canada and the Great Lakes region to eventually winter along the coasts of New York, Delaware, and New Jersey. Possibly a portion of those birds that migrate down the Pacific flyway first cross Yukon Territory and the Prairie Provinces, then swing westward to the coasts of British Columbia and Washington before continuing southward. Band returns from canvasbacks banded in New York indicate that New York receives only those birds from prairie breeding grounds

(DeGraff et al., 1961), but two birds banded in New York and retrapped at Tetlin in 1961 and several recoveries of Tetlin banded birds in New York indicate that a portion of the ducks wintering in New York come from Alaska.

Since no hunting of this species was allowed in 1960, the five returns from that year will be discounted in calculations of hunting mortality. Banding of 402 birds previous to 1960 provided 32 returns or an 8% recovery rate. This indicates that a relatively high percentage of canvasbacks were harvested each year (Geis, 1959).

Redhead

Redheads banded at Tetlin were shot in Alberta, Saskatchewan, Nebraska, Wisconsin, and Texas, indicating that this species migrates through the Central and Mississippi flyways and winters in the Gulf Coast states. The only retrapped bird, an adult female banded in Oklahoma, occurred in this path of migration also.

Baldpate

Most baldpates from the Tetlin area go to the Pacific flyway, with only 11 of 123 (8%) band returns coming from other areas. Apparently most of these birds migrate southward along the Pacific coast of Southeastern Alaska and British Columbia into the Pacific States. There also appears to be a portion of the population migrating in a southeasterly direction through Yukon Territory and into Saskatchewan and Alberta where they then swing back to the Pacific Coast or scatter throughout the

Central and Mississippi flyways. Most of the returns were made in the San Joaquin and Sacramento valleys of California where the majority of these birds probably winter. The one Mexican return suggests that either a portion of these birds winter in Mexico or that there is round-about spring migration from either Texas or California wintering areas. It appears that at least a small percentage of Tetlin baldpates winter along the Gulf Coast.

Of the 1,759 baldpates banded from 1956 to 1960 at Tetlin, 127 (7.2%) of the bands were recovered, indicating a high rate of hunting mortality for this species.

Pintail

In the Tetlin area only 524 pintails were banded and 20 bands (4%) subsequently recovered. This seems to imply a rather low hunter kill for this species. Ten (50%) of the returns are from California and 16 (75%) are from the Pacific flyway. Two returns from Texas and one from Utah suggest that some Tetlin pintails winter along the Gulf Coast although most birds probably winter in California.

Shoveler

All returns for this species are from the Pacific flyway. Sixteen of the 17 recoveries are from California and one is from Summer Lake in southcentral Oregon. The lack of returns from areas between the Tetlin banding site and California probably reflects a very rapid and sustained migration to the wintering grounds.

The percentage of returns of 9% in this species indicates a high hunting mortality.

Green-winged Teal

Although the sample of returns is very small, it appears that green-winged teal from Tetlin have one segment which winters in California and another which migrates through the Central flyway and winters in Texas and Oklahoma. Eight of 16 returns are from California; another from Baja California. Three returns from Washington also indicate a migration path along the Pacific flyway. One return from Utah, one from Oklahoma, and two from Texas indicate that some of these birds migrate through the Central flyway and winter along the Gulf Coast.

Sixteen returns from 313 banded birds or a 5% recovery rate indicates a low hunter mortality to this species, and probably reflects the undesirability of this small duck to hunters.

Bufflehead

Of 2,425 buffleheads banded prior to 1961, only 13 band returns have been secured. This indicates a very low kill of this species by hunting. The low mortality possibly reflects the low regard most hunters hold for this species as well as the relative inaccessibility of its wintering areas. Only two of the band returns are from the Continental United States; one from northern California, and the other from Washington. Six returns came from Alaska--three from the southern coast of the mainland, two from the Juneau area, and one from near Ketchikan.

Two other recoveries were made in British Columbia, and one is from near Whitehorse, Yukon Territory. Apparently the majority of Tetlin bufflehead migrate to the coast of Alaska, wintering there or moving southward as far as the coast of California. Probably most of these birds winter along the coast of British Columbia and southeastern Alaska. The return from Yukon Territory might indicate a movement of some of these birds through the interior of Canada.

Barrow Goldeneye

Band returns for Barrow goldeneye indicate a very low rate of hunting mortality in this species. This reflects primarily the inaccessibility of wintering populations. Four of the 20 returns for this species were from birds collected at Tetlin. Two others were taken in Interior Alaska within 100 miles of the banding site, and another was killed in the spring of 1961 near Whitehorse, Yukon Territory, Canada. The 13 remaining returns were from the coast of Alaska, from Kodiac Island west to the Copper River area. Although Munro (1939) describes the southern coast of British Columbia as the major wintering area for this species, it appears that Alaska birds winter primarily along the southern coast of Alaska. Gabrielson (1959) recognizes the areas around Kodiac and Afognak Islands as areas with large wintering concentrations of this species.

Miscellaneous

The number of band recoveries for some species is too small to offer but a very general idea of distribution patterns. Table 5 contains recoveries of this type.

TABLE 5

MISCELLANEOUS BAND RECOVERIES

Species	Date Banded	Recovery Site	Date Shot
Mallard ...	July 29, 1957	Lake Terrell, Wash.	Dec. 2, 1957
Mallard ...	Aug. 1, 1959	Bridger, Montana	Nov. 26, 1959
Blue-winged Teal	July 28, 1959	Cameron Parish, La.	Dec. 23, 1959
Blue-winged Teal	Aug. 21, 1959	Washougal, Wash.	Oct. 16, 1959
Ring-necked Duck	Aug. 10, 1957	Trinidad, Calif.	Dec. 14, 1959

Ducks Banded and Retrapped at Tetlin

During duck banding operations at Tetlin many birds previously banded there were subsequently retrapped on following years. Two female white-winged scoters hatched in the Tetlin area returned there on following years and were trapped. Four female canvasbacks also returned to the Tetlin area where they were hatched. From 1956 to 1961 a total of 19 lesser scaup females banded as flightless young in the Tetlin area were retrapped there the following year. The proportionately high number of female white-winged scoters, canvasbacks, and lesser scaup returning to the Tetlin area (as indicated by the degree of chance involved in retrapping a banded bird) seems to indicate that a large percentage, if not all, of these birds return to their natal marsh to breed.

Retrap-data for lightly hunted species such as the Barrow goldeneye and bufflehead, and for the horned grebe and lesser scaup are shown in Table 6. At the end of six years, over 3% of the lightly hunted Barrow goldeneye were still being retrapped. Conversely, by the end of three years, retraps of

TABLE 6

NUMBER AND PERCENTAGE OF WATERFOWL BANDED AND RETRAPPED AT TETLIN

Year Banded	Number Banded	Number Retrapped (year following banding)					
		1st	2nd	3rd	4th	5th	6th
Lesser Scaup							
1955	3						
1956	13						
1957	88		3				
1958	535	1	2	1			
1959	1,069	13	12				
1960	1,173	35					
Total	2,881	49	17	1			
Percentage		1.7	1.0	0.2			
Bufflehead							
1955	23						
1956	248	1		3	2		
1957	183	7	6	1	3		
1958	348	17	9	4			
1959	1,047	27	24				
1960	601	26					
Total	2,450	78	39	8	5		
Percentage		3.2	2.1	1.0	1.1		

TABLE 6--Continued

Year Banded	Number Banded	Number Retrapped (year following banding)					
		1st	2nd	3rd	4th	5th	6th
Barrow Goldeneye							
1955	165	31	5	10	15	12	5
1956	202	2	13	19	10	4	
1957	60	4	11	4			
1958	181	16	9	9			
1959	388	85	36				
1960	277	27					
Total	1,273	165	74	42	25	16	5
Percentage		12.9	7.4	6.9	5.6	4.4	3.0
Horned Grebe							
1955	0						
1956	108	1	1	2	1		
1957	63	1	3	2			
1958	147	11	10				
1959	157	19					
1960	679[a]						
Total	475	32	14	4	1		
Percentage		6.7	4.4	2.3	0.9		

[a]Too little trapping effort expended on horned grebes in 1961 to make retraps from this year's class valid in the calculations.

a heavily hunted species, the lesser scaup, had dropped to less than 0.5% of the original banded population.

Evidence of Breeding in Yearling Female Lesser Scaup

For many years it has been believed by waterfowl workers that lesser scaup nest as yearlings, but evidence to support this belief was lacking. In 1960 and 1961 all retrapped female lesser scaup that had been banded the previous year at Tetlin as flightless ducklings were killed and their reproductive organs saved. In 1960, five of these known-aged yearling females were collected, and in 1961 eleven more were trapped and collected. The ovaries of these 16 birds and the oviducts of the 11 yearlings captured in 1961 were subsequently analyzed by the writer and Dr. Irven O. Buss, Professor of Wildlife Biology, Washington State University, to determine whether or not the birds had laid. The results of this ovarian analysis are summarized in Table 7.

Three of the five ovaries from birds collected in 1960 showed positive evidence of ovulation. Nine of the 11 birds taken in 1961 apparently had ovulated. The higher percentage of ovulation found in 1961 probably reflects the better breeding conditions present in the study area that year. Since 12 of the 16 ovaries of yearling lesser scaup represented in this study showed evidence of ovulation, it appears that a high proportion of these birds are physiologically capable of breeding in their first year. If these yearlings are physiologically

able to breed it is not unreasonable to assume that a large proportion of them do successfully lay and incubate eggs.

TABLE 7

OVULATION DATA FOR 16 YEARLING LESSER SCAUP COLLECTED IN JULY AND AUGUST, 1960 AND 1961

No.	Date Collected	No. of Ovulated Follicles	Remarks
	1960		
1	July 28	2-4	More ovulated follicles probably present
2	Aug. 19	6-8	
3	Aug. 21	none	Probably did not lay
4	Aug. 21	none	Ovary stimulation but no ovulation
5	Aug. 24	12-14	
	1961		
6	Aug. 4	6	Maximum number of ovulated follicles
7	Aug. 6	4-6	Definite evidence of laying
8	Aug. 6	4-6	Definite evidence of laying
9	Aug. 6	10	Definite evidence of laying
10	Aug. 10	none	Evidence of stimulation only
11	Aug. 10	none	Evidence of stimulation only
12	Aug. 10	6	Oviduct indicated laying also
13	Aug. 10	6	Oviduct indicated laying also
14	Aug. 19	3	Oviduct indicated laying also
15	Aug. 19	6	Oviduct indicated laying also
16	Aug. 20	?	Condition of ovary and oviduct indicate laying

CHAPTER VI

THE RELATIONSHIP BETWEEN THE TETLIN-NORTHWAY AREA AND DISPLACED PRAIRIE WATERFOWL

Immigrant Ducks

It is generally believed by waterfowl administrators in Canada and the United States that during years of drought in the prairies of Alberta, Saskatchewan, Manitoba, and the Dakotas, many ducks move farther north to breed. In 1957, prairie waterfowl breeding ranges were subjected to a drought which is presently restricting waterfowl breeding severely.

Aerial surveys of Canadian waterfowl breeding populations in 1958 and 1959 by John J. Lynch and Robert H. Smith (1959), biologists of the United States Bureau of Sport Fisheries and Wildlife, indicated that waterfowl populations in the great interior plains of Canada increased many-fold. This increase was particularly notable in northern Alberta, British Columbia, and the Slave River region of the Northwest Territories, where water levels in the innumerable ponds, lakes, and sloughs are more permanent. At the same time, populations in southern prairies dropped markedly as many water areas disappeared. As the increase in 1959 occurred in species like the lesser scaup and white-winged scoter which normally are Arctic nesters, as well as in the mallard and pintail, part of the

increase from 1958 to 1959 may be credited to an exceedingly favorable nesting year in 1958. However, the increase in prairie nesting species in the north, despite decreased continental populations, indicated movements to more northern areas.

It seems probable that if waterfowl immigrate to Arctic Canada in order to find suitable breeding habitat during drought years in the prairie areas, they could also wander into parts of Alaska. The Tetlin-Northway study area, located only about 50 miles from the Canadian border, would probably be the first major waterfowl breeding area in Alaska to receive these displaced or immigrant birds. Several observations seem to indicate that this displacement did occur beginning in 1959.

When the writer first reached the study area in June, 1959, it was apparent that ducks not ordinarily found in Arctic habitats had invaded the region. Redheads (Aythya americana), a species whose inclusion in the avifauna of Alaska was based on limited evidence only (one published record by Seale in 1898 and an unpublished record of a pair on Amukta Island, June 16, 1936 by Murie [Gabrielson, 1959]), were fairly common and 65 were banded that summer. A brood of three young of this species was also observed that summer, establishing a new Alaska breeding record. The blue-winged teal, a species considered only an uncommon summer resident in Alaska (Gabrielson, 1959) and seen only rarely in 1958 at Tetlin (King, unpublished report) was common in the area and 12 broods were recorded, also establishing a new breeding record. Ruddy ducks, recorded only once before from Alaska (Willett in 1921 reported a male taken by

Fred H. Gray, August 15, 1916 on Kupreanof Island [Gabrielson, 1959]), were observed on several occasions, specimens collected, and in August a brood of five young was seen and a duckling collected.

If the discovery of three new waterfowl breeding records for Alaska were not enough to indicate the influx of birds from other regions, populations of shovelers, canvasbacks, and other species which prefer a prairie pothole habitat for breeding, were seen at levels never recorded previously at Tetlin or any other area in Alaska or nearby Yukon Territory (Soper, 1954). Table 8 contains population indices taken from annual spring aerial surveys made by Henry A. Hansen of the United States Bureau of Sport Fisheries and Wildlife from 1957 to 1961.

TABLE 8

POPULATION INDICES FROM AERIAL SURVEYS OF THE TETLIN-NORTHWAY AREA, 1961[a]

Species	Year				
	1957	1958	1959	1960	1961
Pintail	2.6	4.1	3.1	1.9	4.3
Mallard	2.9	4.4	4.9	2.1	2.7
Shoveler	0	0	1.0	0	0.14
Canvasback ...	0.3	0.9	0.14	4.3	1.4
Lesser Scaup..	10.9	7.6	25.3	18.5	18.3

[a]Number of ducks per square mile.

Since Hansen had a different observer each year, only one-half of the transect data, or a sample of 14 square miles was utilized for comparative purposes. This sample size does not give a statistically valid estimation of the total waterfowl present, but the data do indicate changes in the yearly duck population.

The population indices for the shoveler indicate a fairly high density in 1959 although none were seen in 1957 and 1958. Ground observations and the number of broods observed seem to verify this increase. In 1957 no shoveler broods were seen, in 1958 five broods were recorded, and in 1959 twenty-four broods were observed.

Transect data for canvasback populations indicate a marked increase in 1960 and 1961, but no increase in 1959. Banding and ground observations in 1959 indicated very high densities in 1959 and possibly the late-migrating canvasbacks had not reached the study area by May 21 when the aerial survey was made.

High densities of lesser scaup indicated by aerial transect data obtained in 1959 possibly reflect an exceptionally good breeding year in 1958. However, the densities were probably inflated in part by birds displaced from drought stricken areas farther south. This seems to be substantiated by the fact that although 1959 was a very good production year for this species, the 1960 population density was less than that in 1959.

Although mallard and pintail populations in Arctic Canada showed a marked increase from 1957 to 1959 there was little change in these birds at the Tetlin area. The slight increase from 1957 to 1958 possibly reflects the influx of

prairie birds.

Populations of all species except the canvasback were reduced in 1960, probably reflecting a reduction in continental populations. The change in all species except pintails from 1960 to 1961 at Tetlin was inconsequential, indicating fairly stabilized conditions.

Even though observations at Tetlin and those of other biologists in different parts of Alaska (Peter E. K. Sheppard at Minto Lakes and James King at Fort Yukon, personal communication) indicated that drought had forced ducks into Alaska, proof of this was difficult to procure. Probably the best evidence was obtained when an adult female canvasback, banded in Cory, Saskatchewan, Canada, as a local or flightless juvenile on August 3, 1955, was retrapped at Tetlin on August 18, 1959. Although not enough work has been accomplished on diving ducks to prove conclusively that females return to their natal marsh to breed as do species like the mallard and pintail (Sowles, 1955; Lincoln, 1939), this seems to happen. Three female canvasbacks which were banded at Tetlin as locals were retrapped in the area the following year, and 19 female lesser scaup were also retrapped as returning yearlings. The proportionately high number of yearling female diving ducks returning to the Tetlin area, as indicated by the degree of change involved in retrapping a known-aged individual of a heavily hunted species, seems to indicate that these birds do return to breed to the area where they were hatched. If it could be assumed that canvasbacks normally do this, then it could also be assumed that this

female canvasback was a bird which normally would have nested in Saskatchewan and had been forced farther north by a lack of suitable water areas for nesting.

Similar data from band returns in other parts of Alaska seem to give at least circumstantial evidence of the movement of pintails to Alaska from breeding areas farther south, as shown in Table 9.

TABLE 9

LOCAL FEMALE PINTAILS BANDED IN OTHER AREAS AND SHOT IN ALASKA

Where Banded	When Banded	Where and When Taken in Alaska
Hughes Co., S.D.	July 25, 1957	Iliamna, Sept., 1959
Mound City, S.D.	Aug. 6, 1957	Minto Flats, Sept. 1, 1959
Long Lake, S.D.	July 4, 1957	Noatak Village, May, 1959
Brooks, Alberta	July 3, 1958	Cook Inlet, Sept. 26, 1959
Stettler, Alberta	July 3, 1958	Mountain Village, Summer, 1960

Productivity of Predominately Prairie Nesting Species

During the summers of 1959, 1960, and 1961 an effort was made at Tetlin to determine whether these displaced birds would breed successfully in the area. Findings indicated that these birds do nest and rear young in Arctic areas, but their success is breeding is much lower than under more optimal conditions.

Waterfowl nesting in Arctic regions is radically

different from that farther south in the Canadian Prairies. In the prairie nesting areas the most prominent species present are the mallard and pintail; both species begin nesting as soon as they reach the breeding marshes. On the Prairies many predators such as the badger (Taxidea taxus), skunk (Mephitis mephitis), crow (Corvus brachyrhynchos), and the magpie (Pica pica), which are persistent and accomplished egg robbers, exert pressure on nesting waterfowl (Sowles, 1955). It is this type of predation which is more apt to stimulate renesting, and an accurate assessment of renesting must be considered in determining productivity of prairie breeding areas. In Arctic areas, on the other hand, predators are the type which generally are more likely to kill the incubating female as well as to destroy the nest. Weather conditions in the far north are such that catastrophic destruction of nests by storms or chilling may occur at any time. Neither of these conditions are conducive to renesting. In addition, most Arctic nesting species do not nest until late in the season, resulting in little opportunity for renesting attempts. Consequently the assessment of productivity in Arctic areas need not be concerned with renesting, an important consideration farther south.

Nesting success is commonly used for ascertaining productivity in regions where nesting densities are high (Kendall, 1958; Sowles, 1955). This technique is not feasible in most parts of Alaska where nesting densities are very low. In Alaska, sex ratios of large flocks during late June and early July have been used in an attempt to determine nesting success.

In Arctic nesting species like the lesser scaup, males band together in mid-July to molt. In a good nesting year such flocks will contain only small numbers of females until early August when females which have been unsuccessful in nesting join these flocks. As the molt progresses through August, molting females comprise an increasingly higher percentage of the flightless birds in these flocks. A high percentage of "deserter" or unsuccessful females in these molting flocks during late June and early July indicates low productivity for the species. In the Tetlin area the nesting and molting chronology of lesser scaup, canvasbacks, and redheads is very similar, but as early as mid-July flocks of canvasbacks and redheads contain nearly as many females as males. This seems to indicate a very low degree of success in the canvasbacks and redheads inhabiting the area. The very low number of broods for these species also indicates low nesting success.

Whether the lower degree of success in these species is caused by climatic conditions, the much shorter summer period, hormonal disturbances caused by excessively long migration, variations in nesting habitat, or some other factor is unknown.

It appears that the species having the lowest degree of nesting success in Arctic habitats is the redhead, a bird which is classically unable to adapt to new surroundings. These ducks are very slovenly nesters; they lay eggs in other ducks' nests, scatter eggs throughout nesting marshes, and do not incubate until very late in the summer (Kortright, 1953; Bent, 1923). It is probably their failure to adapt to changing conditions

which accounts for their very low nesting success in Alaska and which may jeopardize the survival of this species.

Although the study at the Tetlin-Northway region has probably given the first true evidence of prairie nesting waterfowl moving into Alaskan marshes during times of drought in the Canadian prairies, there is no reason to believe that this is the first time it has occurred. A Tetlin native described to the writer a strange duck that his father shot in the Tetlin area in 1936 or 1937 and could not recognize. This bird was almost certainly an adult male redhead. The time of this event coincides with the period of drought of the 1930's which saw continental waterfowl populations at an all-time low.

Even though the nesting success of ducks displaced to Alaska appears to be much lower than in more suitable areas farther south, the importance of Arctic areas to displaced birds must not be underestimated. When Prairie Canada is plagued by drought, breeding areas in Arctic Canada and Alaska cannot produce enough ducks to maintain high populations of waterfowl, but enough ducks will be produced to assure the security of Prairie species. Thus, Arctic areas will serve as a "buffering zone" where populations of waterfowl like the canvasback and redhead may be retained at a low level until prairie habitats recover from drought conditions.

CHAPTER VII

AN ASSESSMENT OF THE TOTAL WATERFOWL POPULATION UTILIZING THE TETLIN-NORTHWAY STUDY AREA

An attempt has been made to assess as accurately as possible the actual number of waterfowl breeding in the 700-square mile Tetlin-Northway area. In 1955 aerial transects were established on the study area to give a population index by which annual changes in the spring breeding population could be determined statistically. It was believed that by utilizing data from these seven transects in conjunction with species composition data derived from ground counts made in May, 1961, a close approximation of actual numbers of waterfowl using the area in 1961 could be attained. This estimate of the breeding population combined with an evaluation of nesting success could then be utilized to obtain a measure of actual production for the area.

Although this system for estimating total population seems to be clearly defined and easy to use, it involves several important problems. Most important of these is the fact that although lesser scaup seemed to be the easiest species to observe from the air, an unknown percentage of this conspicuous duck was not seen in aerial counts.

During the summer of 1961 Calvin Lensink of the United

States Bureau of Sport Fisheries and Wildlife (personal communication) undertook to determine the percentage of lesser scaup not observed in aerial surveys of the Yukon River Flats near Fort Yukon, an area very similar to the Tetlin-Northway study area.

Four transect lines 4 miles in length and spaced at 1-mile intervals were flown in eight randomly selected areas on the Yukon Flats. The results of these aerial surveys were then compared to ground surveys of 4-square-mile plots located in the center of each air survey area. The same areas were covered by both ground and air surveys on the same days and results were directly comparable. From Lensink's air and ground surveys it was found that only 40% of male lesser scaup were seen from the air by him and his assistant. Since all aerial surveys at Tetlin have been conducted by Henry A. Hansen, the calculation of waterfowl density from Lensink's aerial surveys and those from Hansen's 1961 transect were compared and found to differ radically. Several possible reasons for Hansen's higher determinations are: (1) sampling variation, (2) counts made earlier in the spring when migrating birds not resident to the area may have inflated the count, and (3) more extensive experience as an aerial observer may have resulted in counts which are closer to true population figures. The aerial count by Hansen on lesser scaup equalled 82.1% of the ground count in the area. Therefore, the percentage of lesser scaup seen from the air would probably lie between 40% and 80%, but for the purposes of this paper the higher figure will be used. Until more compari-

sons of aerial and ground surveys can be made the degree of error will be great.

The percentage composition of waterfowl inhabiting the Tetlin area was determined by a ground survey which began May 17, 1961 and terminated June 1, 1961. By this time most migration was completed and resident birds were stabilized in the area. This ground survey consisted of traveling at random by boat and afoot through the study area, and recording by sex and species any waterfowl seen. It is felt by the writer that almost complete randomization was achieved; no area was covered twice, and no particular type of habitat was emphasized. The results of this survey are found in Table 10.

Routine aerial surveys of the study area were done May 18 in 1961. The number of lesser scaup seen on these seven transects was 9 single males, 50 pairs, and 140 of unknown sex seen in flocks. Using the methods for determining breeding population indices (Anonymous, 1957), the percentage of drakes unaccompanied by hens (9), of the total identified ducks (9 males to 50 pairs), is 8.2%. When this ratio of drakes to birds in pairs is applied to the total unidentified ducks (140) a total of 12 drakes is obtained. By using this technique, the following scaup population index is estimated:

The number of identified pairs doubled	= 100
The number of identified lone drakes doubled	= 18
The number of estimated lone drakes among the unidentified doubled	= 24
The remainder of birds unidentified	= 116
Total	258

TABLE 10

SPECIES COMPOSITION OF WATERFOWL BREEDING POPULATION, TETLIN, ALASKA, 1961[a]

Species	No. of Pairs	No. of Lone Males	No. of Lone Females	Total Ducks	Percentage of Population
Mallard	126	104	5	361	9.21
Pintail	87	83	5	262	6.68
Gadwall	..	1	..	1	Tr.
Baldpate	195	65	2	457	11.66
Green-winged Teal..	144	55	7	350	8.93
Blue-winged Teal...	5	..	..	10	Tr.
Shoveler	39	27	3	108	2.76
Canvasback	83	116	13	295	7.53
Lesser Scaup	399	277	19	1,094	27.91
Ring-necked Duck...	..	2	..	2	Tr.
Redhead	36	13	3	88	2.20
Barrow Goldeneye...	23	74	12	132	3.36
Common Goldeneye...	2	9	1	14	Tr.
Bufflehead	75	67	25	242	6.18
White-winged Scoter[b]	67	167	147	461	11.76
Surf Scoter	2	9	1	14	Tr.
Oldsquaw	3	7	15	28	Tr.
Total				3,919	100.00

[a]Ground counts made from May 17 to June 1.

[b]Unidentified White-winged Scoters and Oldsquaws listed under lone females.

Thus a total of 258 scaup were seen from the air on a sample of 14 square miles (Hansen's half of the 28-square-mile sample), and the calculated density of scaup per square mile is then 258 divided by 14 or 18.3 birds per square mile. The total number of scaup occupying the 700-square-mile area would then be the product of 18.3 and 700 or 12,810 multiplied by the conversion factor 1.2 since only 80% of the birds were seen from the air. The total calculated scaup population in the Tetlin-Northway area in 1961 was then 15,372. Although this is probably a very minimum figure, it at least gives some indication of the number of waterfowl using the area. Until other methods can be devised for use in Arctic habitats this census method will help determine the relative importance of Alaskan breeding areas.

Since lesser scaup comprise an estimated 27.91% of the total waterfowl population, it is possible to calculate the total population as 55,077 birds with the following species composition:

Lesser scaup	15,372
White-winged scoter	6,477
Baldpate	6,422
Mallard	5,073
Green-winged teal	4,918
Canvasback	4,147
Pintail	3,679
Bufflehead	3,404
Barrow goldeneye	1,851
Shoveler	1,520
Redhead	110
Miscellaneous (Ring-necked duck, Common goldeneye, Surf scoter, Gadwall, Blue-winged teal, and Oldsquaw)	2,102
Total	55,077

CHAPTER VIII

SUMMARY

A combination banding and production study of the waterfowl at the Tetlin-Northway region of east-central Alaska was initiated in 1955 by the United States Bureau of Sport Fisheries and Wildlife. In 1959 this study was intensified; large numbers of waterfowl were banded and ground production studies were expanded, providing a great deal of information relative to little known aspects of Arctic waterfowl breeding.

Observations of courtship and territorial behavior were very limited, but territorial behavior in the lesser scaup appeared to center around defense of the female by the male rather than defense of a specific portion of the environment. In 1961, 58 waterfowl nests were discovered on the study area although no extensive nesting study was established.

The period in which newly hatched broods were observed is much shorter at Tetlin than in areas farther south. This appears to result from late nest initiation and decreased renesting in Arctic habitats. It appears that renesting does occur in green-winged teal and baldpate on the study area.

The flightless period of waterfowl at Tetlin seems fairly comparable to that farther south, although it begins at a later date and terminates earlier in most species.

Predation occurs chiefly as depredations to nests at Tetlin; the black bear is apparently the most important nest predator there.

In 1959 a mass immigration of ducks from the drought stricken breeding grounds in Canada occurred in the study area. New Alaskan breeding records were established for the redhead, blue-winged teal, and ruddy duck that summer at Tetlin. Nesting success of ducks displaced into the Tetlin area was not as great as that achieved under more optimal conditions, but Arctic nesting areas probably can produce enough of these ducks to help assure their security.

Although most of the ducks from the study area winter in the Pacific flyway, many lesser scaup, canvasbacks, baldpates, pintails, and green-winged teal disperse to other parts of the United States and Mexico. Twenty-five female diving ducks hatched at the study area returned on following years, thus providing evidence that these birds return to their natal marsh to breed.

Twelve of 16 yearling female lesser scaup studied apparently had ovulated and probably laid and incubated eggs.

An attempt was made to assess the total number of waterfowl breeding in the Tetlin area. By using the method or a variation of the method used at Tetlin, a fairly accurate estimate of breeding populations probably can be attained.

APPENDIX

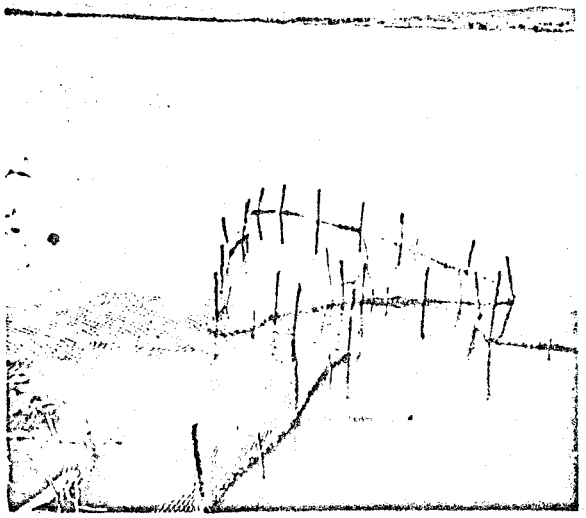

Fig. 10.--Duck trap on Old Albert Lake.

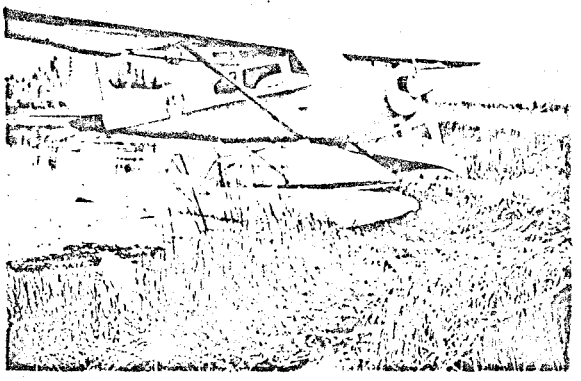

Fig. 11.--"Rat canoes" ready for transport to another lake.

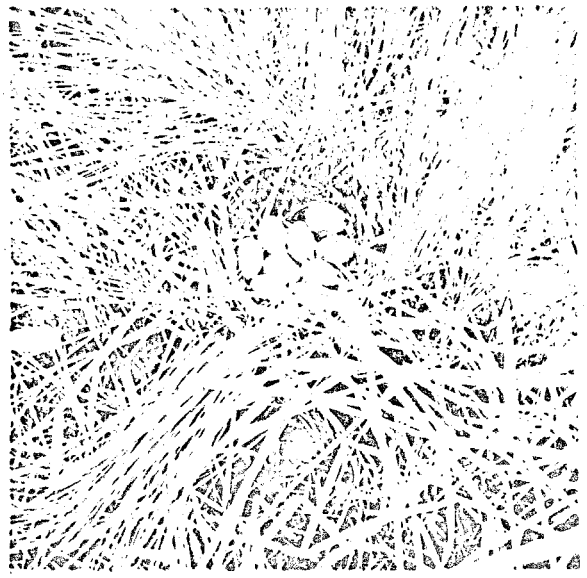

Fig. 12.--Lesser scaup nest in sedge clump.

Fig. 13.--Typical small pond in Tetlin study area.

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A POPULATION STUDY OF WATERFOWL ON THE TETLIN-NORTHWAY AREA OF INTERIOR ALASKA

ABSTRACT

by Donald Edward McKnight, M.S.
Washington State University, 1962

Chairman: Irven O. Buss

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