

COMPARATIVE BEHAVIOR AND ECOLOGY
OF ARCTIC AND RED-THROATED LOONS

PROGRESS REPORT

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BY

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INTRODUCTION

A literature review, description of the study area, methods of study, and discussion of objectives are detailed in the original proposal (February 1974, Frank M. Chapman Memorial Fund application for grant in support of Ornithological Research).

Briefly, the objectives of this research are to:

1. Compare the behavior of arctic (Gavia arctica), and the red-throated loons (Gavis stellata) during the breeding season.
2. Compare the habitat utilized by arctic and red-throated loons during the breeding season.
3. Compare the reproductive success and the factors influencing that success of arctic and red-throated loons.

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METHODS

Observations of loons were made from two observation towers (Figure 1) and two portable blinds using a 15x spotting scope. The 3 x 3 x 3 foot portable blinds were set up near ponds with nesting loons. Nesting arctic and red-throated loons were monitored using two time-lapse photography units set at 30 second intervals for five 30 hour periods. Incidental observations of foraging red-throated loons were made at the slough area adjacent to the field camp (Figure 1). Concentrations of arctic and red-throated loons were recorded when approached by boat.

In 1973, 134 of the 221 ponds on the study area were searched for arctic and red-throated loon young prior to fledging of the young. In 1974, 180 of 221 ponds on the study area were searched for nests prior to hatching, by walking the shore and islands of each pond. Each pond on the study area was examined for the presence of loon young and adults, and the vegetation and islands of each pond were described. Pond sizes were estimated from aerial photographs using a planimeter. Adult and young loons were marked with one and one-half inch diameter round patagial tags in both wings of each bird. Tags were of yellow plastic cattle ear tag material with either red or black numbers. The loons were captured by driving them into gill nets with unleaded or lightly leaded bottom lines.

Collections of adult arctic loons were made prior to nest initiation and at hatching of the first egg. Red-throated loons were collected prior to or following hatching of the first egg.

Samples of aquatic insects and fish were taken from five ponds on the study area on a weekly basis July 1, 1974 through September 3, 1974. Each sample site was near the shore in the areas where arctic loons had been observed foraging or at other similar areas. Collections were made using an insect net twelve inches in diameter in a one meter square area.

RESULTS

1. Spring phenology

The river and slough system on the study area was covered by a complete layer of ice on arrival May 3, 1974. Open leads and patches in the Chikchiok Slough and Kashunuk River (Figure 1) were apparent by May 7, 1974, and both had free flowing open water by May 26, 1974. Smaller sloughs (10 feet across and less) were ice free and full of water by May 5, 1974.

There was variation in the dates when various ponds on the study area began to become free of ice; e.g., on May 17, 1974, a 1.0 acre pond had a 100% ice cover, while a 5.0 acre pond had only an estimated 30% ice cover.

2. Arrival dates

I was present on the study area May 3 through September 17, 1974. The first red-throated loons were observed flying over the study area May 5, in the sloughs May 7, and on ponds May 10. An increase in the total number of red-throated loons became apparent May 9, and the numbers were variable throughout the prenesting period (Figure 2). Arctic loons were first observed flying over the study area May 18, and on ponds May 23.

3. Associations prior to incubation

Red-throated Loons - Associations of two breeding plumage birds flying together, landing together, foraging together, engaging in mutual displays, or any combination of those activities were considered mated pairs. Those breeding plumage loons observed as one bird only flying or foraging were categorized as singles, but actual status was unknown. Single birds were observed most frequently until ten days (May 15, 1974) after the arrival of the first red-throated loon (Figure 2). Pairs were first observed May 9, 1974 and became the most frequently observed association May 15 through May 26, 1974 (Figure 2). All observations were of loons seen throughout the day flying over or in the Chikchiok Slough foraging area. Individuals were unmarked, so there may be some duplication of numbers of individuals observed.

Arctic Loons - Arctic loons were first observed flying over the study area May 18, 1974. Arctic loons were most frequently observed as pairs (10 of 12 observations) prior to May 25, 1974, both in the ponds and flying over the study area.

4. Prenesting behavior

Red-throated Loons - Breeding plumage red-throated loons were observed in the open water portion of sloughs prior to the initiation of nesting. One area (Chikchiok Slough) was observed May 7, until May 26, 1974. Mutual displays described by Huxley (1922) were observed in the slough area and ponds.

The "plesiosaurus-race ceremony" (Figure 3) was observed between two birds, three birds and four birds. A pair of red-throated loons was observed in the "plesiosaurus-race ceremony" two times following a 10 minute separation of members of the pair due to an ice sheet.

Another pair of red-throated loons was observed in the "pleisioaurus-race ceremony" after repeated dives by both loons for 39 minutes. The "plesioaurus-race ceremony" was observed on three occasions when single breeding plumage red-throated loons landed near pairs of red-throated loons, and was followed by the single red-throated loons leaving the area. Two pair of loons were observed in the "plesioaurus-race ceremony" following the arrival of a second pair to the slough. Following the mutual display by all four birds, the last pair to land flew from the area.

The "snake-ceremony" (Figure 3) was observed May 16, 1974, between a pair of birds on the slough area when one red-throated loon flew over them. This mutual display was again observed between a pair on May 19, 1974 when a group of three red-throated loons flew over the pair.

One pair was observed landing in a pond at 1425 hours on May 10. The "plesiosaurus-race ceremony" was observed once before and twice after the "snake ceremony" during the first 59 minutes after the arrival of the birds to the pond. Both birds engaged in "looking into the water" (Figure 3), preening, and diving throughout the observation period. Three hours and eleven minutes after the arrival of the pair, one of the pair (the female- see below) was observed crawling onto a small wet island that was covered with dried sedges. It then began moving the dried sedges around its side and breast. The female was on and off islands in the pond three times more during the following 19 minutes. The adult in the water remained near the island "looking into the water" and preening. The last time the bird was on the small island, the bird in the water moved directly to the bird on the island and copulation occurred

on the island. There was no postcopulatory display, and both birds moved into aquatic vegetation and were last observed there. Red-throated loons did not nest on that pond.

A pre-flight head movement by red-throated loons was first observed prior to nesting, and was observed throughout the breeding season. Immediately prior to flight, the bird first to fly would give a rapid horizontal shake of its head. The pre-flight head movement was most prevalent between pairs of adults although single birds were occasionally observed doing a pre-flight head movement.

Red-throated loons observed flying were frequently heard giving single noted calls. Although groups of one and two individuals were frequently heard calling, there was a recognizable difference in the call between the two group sizes. The difference between the calls will be studied further.

Arctic Loons - Prenesting behavior of arctic loons was not observed.

5. Description of loon nests and nest area

Red-throated Loons - One red-throated loon nest was found in 1973 (before this study was initiated), and five nests were found in 1974 on the study area. Identification of species was established by the presence of adult red-throated loons prior to or during hatching. Nests were round to oval in shape, at or near the edge of the pond, and made of chunks of Sphagnum moss or mud. Most red-throated loon nests were on the shore, although one was on an island (Table 1).

The ponds with red-throated loon nests were small, averaging 1.1 acres (Table 2). A detailed analysis of the distribution of small ponds, and a detailed comparison of the characteristics of those ponds

is to be completed in the future.

Arctic Loons - Eighteen arctic loon nests were found and described on the study area prior to hatching. Nests were essentially identical to red-throated loon nests and were identified by the presence of adult arctic loons. Nests were round to oval in shape, and made of chunks of Sphagnum moss, chunks of mud, leaves of Carex spp., or other plant material. Ten (55.6%) of the nests were on islands, and eight (44.4%) of the nests were along shore lines (Table 1).

Ponds containing arctic loon nests averaged 4.5 acres (Table 2). A detailed analysis of the distribution, abundance and comparisons of ponds 1.0 acres and larger is to be completed later.

6. Clutch size, success, and chronology

Red-throated Loons - Of five red-throated loon nests, four nests contained eggs with an average clutch size of 1.75 (Table 3). The clutch of one egg was destroyed before hatching, and two nests with two eggs each hatched two young. One clutch of two eggs hatched one young and had one egg destroyed prior to hatching.

Dates of egg laying and the sequence of egg laying were not observed for red-throated loons. Backdating from the hatching date of the first hatched young of three clutches on June 19, 1974 by assuming a 27 day incubation period (Drury 1961), allowed an estimation of egg laying occurring May 23 through 26, 1974. No red-throated loon nests were found containing eggs on the study area after the observed hatching date, and no other young were found on the study area.

Arctic Loons - Clutch size of 12 of the 18 arctic loon nests could not be determined. The remaining six nests all contained 2 eggs (Table 3). One clutch of two eggs hatched one young, and the remaining five

clutched were destroyed prior to hatching.

Dates of egg laying were not observed for arctic loons. One nest was found containing only one egg on June 2, 1974, then contained two eggs on June 4, 1974. Since the nest was not examined on June 3, 1974, the dates of egg laying could not be precisely determined. One nest with unknown egg laying dates hatched one young on June 25, 1974. By assuming a 28 day incubation period for arctic loons (Palmer 1962), the egg laying on the study area is estimated to have occurred May 29 through June 4, 1974. No nests were found on the study area containing unhatched eggs after June 27, 1974, and no late developing young were found on the study area.

7. Incubation

Red-throated loons - Incubating red-throated loons were not observed from blinds.

Arctic Loons - One arctic loon nest was observed for 13.5 hours during the first seventeen days of incubation. One adult only was observed on the pond throughout each of four observation sessions of 2.5 to 4.0 hours each. Activity of the adult on the nest consisted of nest building motions while sitting on the eggs, or remaining motionless with its bill under its scapular feathers. On one occasion the incubating adult got off the nest and remained in the pond, diving in the area of the nest. The adult remained off the nest for 58 minutes before being disturbed.

Preliminary analysis of time-lapse photography movies indicated that both adults are on the nest pond at least once per day. Adults were not marked and determination of which adult incubated for what duration was not possible. Further analysis of activity at the nest is to be

completed in the future.

An incubating adult was not disturbed from the nest when a pomarine jaeger (Stercorarius pomarius) took an egg from a nearby mew gull (Larus canus) nest. Long-tailed jaegers (Stercorarius longicaudus), parasitic jaegers (S. parasiticus), glaucous gulls (Larus hyperboreus), and mew gulls were observed flying in the area, and did not cause the incubating adult loon to leave the nest.

An incubating arctic loon was observed to leave the nest for one to six minutes (average 3.25 minutes) four of five times when an airplane was observed. The adult loon dove off the nest when an airplane went over and returned to the nest without leaving the pond. On one occasion when an airplane went directly over the nest, the adult gave a sharp cry, splashed the water, and dove near the nest.

Arctic loons were never observed incubating during nest searching activities. Loons were frequently seen leaving the ponds when the observer was up to one-fourth mile away, and did not return to the pond until the observer was out of sight of the pond.

8. Nest predation

Red-throated Loons - One red-throated loon clutch containing one egg disappeared before hatching. No egg shell fragments were found in the nest or in the vicinity of the nest, and the egg had disappeared at least five days prior to the mean hatching date of red-throated loons on the study area. One apparent second egg of a clutch of two eggs was destroyed after the hatching of the first egg. On June 19, 1974, the first egg had hatched. On June 23, 1974 egg shell pieces of an unhatched egg were found five feet from the nest, and only one young was found in the pond. Human disturbance was probably influential in the egg des-

truction, but it was unknown if the embryo was alive and would have hatched normally.

Arctic Loons - Of eighteen nests found on the study area, only one nest hatched one egg. The remaining seventeen nests were found with no eggs or egg shell fragments, with egg shell fragments only, or had eggs destroyed after the nest was initially found (Table 4). Nests were considered to have been destroyed when large egg shell fragments were found on the tundra near the nest with no evidence of hatching, when small egg shell fragments were found in the nest, or when no eggs were found in the nest. All ponds with nests were searched for the presence of loon young which are easily found when the young are less than one week of age. Since copulation platforms are apparently not used by loons, and, in the common loon actual nest building begins on the day the first egg is laid (Sjöl^hander and Ågren 1972), nests without eggs when found probably contained eggs at one time. Nests that were known to be destroyed became indistinguishable from the surrounding area due to vegetation growth and wave action after two weeks of inactivity.

Of the five predated nests originally found with whole eggs, four (80.0%) were without egg shell fragments after destruction, and one (20.0%) contained egg shell fragments when found. Of twelve nests with unknown clutch sizes, seven (58.3%) were found without eggs or fragments and five (41.7%) contained egg shell fragments.

Nest searching activities began following nest initiation, and continued until the last egg laid should have hatched on the study area. Egg loss could have occurred at anytime prior to examination of the nest for those nests in which whole eggs were not found, and could

have occurred throughout incubation in those nests found with eggs.

For all but two nests on the study area, observations were not frequent enough to accurately determine when egg destruction occurred. For one nest, egg laying was estimated to have occurred June 2 to 4, 1974, and the eggs disappeared between June 19 and 24, 1974. For another nest, egg destruction occurred between June 20 and 27, 1974. More nests found the first two weeks in incubation contained whole eggs than those found the last two weeks of incubation (Table 4).

Red fox (Vulpes fulva), arctic fox (Alopex lagopus), glaucous gulls, mew gulls, parasitic jaegers, long-tailed jaegers, and ravens (Corvus corax) had been seen on the study area. I have no direct evidence of any of those species taking arctic or red-throated loon eggs from an undisturbed nest, but a long-tailed jaeger and a parasitic jaeger were observed taking eggs from one nest when human activity forced the loon to leave its nest (Raveling, pers. comm.).

9. Distribution and movement of broods

Red-throated loons - In 1973, 134 of 221 ponds of the study area were searched for loon young. The one red-throated loon young found, was hatched from a nest on an adjacent 2.8 acre pond, and was moved July 10, 1973 to a 0.8 acre pond where it fledged August 15, 1973 (Figure 5).

Two young from two separate clutches fledged from the study area in 1974 (Figures 4 and 5). One clutch hatched at a 1.0 acre pond, and the single surviving young moved to a pond one-fourth mile away at about two weeks of age. Due to low water levels exposing silt and mud edges, it was possible to follow the tracks of two loons into and out of two ponds between the hatching and fledging ponds. The

young fledged from the pond August 13, 1974 at 55 days of age. That same pond was the one the young fledged from in 1973. Two young were hatched at a 0.4 acre pond, and the single surviving young fledged at 58 days of age.

All young were banded with USFWS leg bands, and both 1974 young were marked with patagial tags. None of the marked young was observed on the study area after fledging. One unmarked young with two adults was observed in Chikchiok Slough August 16, 1973, and one unmarked young was observed in a 10 foot wide slough August 26, 1974.

Arctic Loons - Nine arctic loon broods fledged one young each from the study area in 1973, and two broods fledged one young each from the study area in 1974 (Figure 4). Nest locations of the 1973 birds are not known. Of the 1974 young, one hatched and fledged from a 3.2 acre pond. The nest size of the other young raised on the study area is not known, and the lake it fledged from was 247.0 acres in size at the edge of the study area. Only a 13 acre area of the pond was observed to be utilized by the family. Young were observed in ponds averaging 6.5 acres in 1973, and in ponds averaging 8.1 acres in 1974 (Table 5).

In both years only one young per brood fledged from a hypothetical clutch size of 2.0. No pond had young fledge from it in both years. Two ponds that fledged young in 1973 had arctic loon nests in 1974 with eggs, but both were predated prior to hatching.

One young was banded in 1973, and one young was marked with patagial tags in 1974. The marked young was not observed on the study area after leaving the pond when 57 to 64 days of age. One unmarked young was observed on the Kashunuk River portion of the study area September 1, 1974.

10. Adult-young interactions

Red-throated Loons - The larger member of a successful breeding pair of loons was marked on June 22, 1974, and last observed July 19, 1974, when the young was thirty days old. During the first thirty day period, one or both of the adults were observed on the pond with the young (7 observations). From thirty days of age until fledging only the unmarked adult was observed bringing fish to the pond and staying with the young (3 observations). Total continued observation time (17 minutes) of the marked adult was insufficient to determine its role in care of the young.

Neither bird of another successful breeding pair of red-throated loons was marked, and more than one adult was not observed with the young after seven days from hatching. Observations for each brood are insufficient for detailed comparisons. From June 26 to August 12, 1974 there was a difference in the attendance time between the two families, but adults were with the young more than 50.0% of the time during observation sessions between 0915 and 2205 hours (Table 6).

It appears that young red-throated loon may initiate flights by the adult from the pond to the foraging area. Immediately prior to an adult leaving the pond, the young swims close to the adult, and grasps and pulls the breast and flank feathers of the adult. "Nibbling" by the young occurred occasionally throughout the time the adult was with the young, and the intense occurrences preceded and followed each time the adult flew from the pond and returned with a fish. "Nibbling" was intense whenever an adult landed in the pond without a fish. The "nibbling" action was never observed between two adult red-throated

loons, and adults were never seen "nibbling" the young.

By assuming that the adult that left the pond was the one returning to the pond, foraging times were estimated (Table 7). Foraging times could only be accurately determined for either pair when the young were 21 to 46 days of age. Data are insufficient to indicate any relationship between tide stage, age of young, time of day and foraging time. Light rain or heavy fog occurred during each of the eleven observation sessions, so weather factors could not be compared. Winds up to 21 miles per hour with rain predominated one observation session of 3 hours 55 minutes in which one unsuccessful foraging trip of 17 minutes occurred. One unsuccessful foraging trip of 37 minutes occurred during another observation session following two and preceeding one successful foraging trip.

Species identification of the fish brought to the young was not possible. Fish were three to six inches in length, slender, and silver. Adults returning to the pond with fish, and young immediately after eating were not collected due to the small number of broods on the study area.

Arctic Loons - A pair of adult arctic loons with one young was observed from the time the young was an estimated five weeks of age until eight weeks of age. Observations were made between 1000 and 1825 hours, and ceased when rain made observations impossible. Both adults were observed with young 99.6% of the total time observed (15.9 hours). Neither of the adults was marked or had obvious plumage aberrations, but the body size difference was sufficient to distinguish between the birds. The larger bird was labeled A and the smaller bird

B. Neither of the birds were collected, and thus, the sex of either bird was not positively determined.

The pair of arctic loons collected food for the young by diving and brought the food to the young. Food items observed were small fish of undetermined species up to three inches long, but most food items could not be identified. The young followed diving bird B and remained on the surface of the water until an adult came to the young with a fish. Each adult presented the fish to the young differently. The larger bird (A) tended to hold his neck at a 45 degree angle and pointed its bill with the fish down towards the young, which then grasped the fish. The smaller adult (B) approached the young with its neck and head on the surface of the water, moving toward the young until the young grasped the fish.

No overt action by the young towards the adults was observed. The smaller adult (probably the female) fed the young more frequently, made more dives, and brought food items to the surface of the water more frequently than the larger adult (probably the male) (Table 8).

Feeding was not restricted to any time periods. The most efficient feeding times by the female averaged 27 minutes (range 8 to 82 minutes), and were characterized by a low capture time (Table 9). There was a marked increase in capture time just before feeding ended, before and after strange birds entered the area, and during rain (Table 9). The small adult spent an equivalent amount of time feeding the young (7.6 hours) as not feeding the young (7.0 hours), in feeding sessions averaging 16 minutes and non-feeding sessions averaging 16 minutes.

11. Reaction to disturbances

Red-throated Loons - Young red-throated loons would dive and then swim very low in the water into the emergent vegetation along the shore of the pond when sandhill cranes (Grus canadensis), parasitic jaegers, long-tailed jaegers, mew gulls, glaucous gulls, arctic loons, or red-throated loons flew over the pond area. None of those species of birds were observed killing young red-throated loons.

An adult with young was observed swimming with its head and neck very low to the water when arctic loons, red-throated loons, parasitic jaegers, or long-tailed jaegers were observed flying over the area. On two occasions an adult was observed flying towards parasitic jaegers that flew within six feet of the pond.

Since all adults raising young were not marked, individuals were considered to be adults of the young if they fed the young fish upon landing in the pond, or if the young swam to the adult and began "nibbling" the adult. On five occasions a breeding plumage red-throated loon landed in a pond without feeding the young and was not approached by the young. On three of those occasions an adult was already with the young in the pond. The breeding plumage red-throated loon immediately left the pond when the adult with the young swam toward the other bird. On one occasion when no adults were present, a breeding plumage red-throated loon was observed diving and swimming for 26 minutes in the pond while the young remained in some emergent vegetation along the shore of the pond. The breeding plumage loon left apparently without finding the young. On one other occasion, a breeding plumage red-throated loon was observed to land in a pond, swim to the edge of the vegetation where the young was, and for 8 minutes attempted to hit the young with its bill. The breeding plumage red-throated loon then swam around the

edge of the pond and left when another adult red-throated loon landed in the pond. The breeding plumage red-throated loon was in the pond a total of 24 minutes.

The reaction of young to human disturbance varied with the age of the young. When the young were less than one week old, they would dive and hide amongst the shore vegetation after the adult left the pond. After one week of age the young would sit in mid-pond. If an adult was with the young, the adult would leave the pond if the observer came within five feet of the shore or entered the water. The adult would then circle the pond calling. On one occasion the unmarked adult of the marked pair landed in the pond when I was in the pond setting up a net to capture the young.

Arctic Loons - Young arctic loons were observed to swim low in the water, dive to aquatic vegetation, then remain in the aquatic vegetation when other arctic loons were near when another species of bird was near, or when an airplane flew over the pond.

Arctic loons accompanying young were observed flying at a female greater scaup (Aythya marila) and a glaucous gull. Other species of birds were not observed flying over the pond or landing in the pond near adults and young arctic loons. Adult arctic loons were observed to splash dive only when an airplane flew directly over the pond.

Breeding plumage arctic loons other than the adults with young were observed being chased from a foraging area in the larger lake on seven separate occasions. The larger adult of the pair was observed chasing single breeding plumage arctic loons from the area on five separate occasions. The larger adult dove at two, flew at two, and swam at one arctic loon prior to the other arctic loons leaving the area. Both

adults were seen swimming at a group of three breeding plumage arctic loons and a single breeding plumage arctic loon immediately prior to their leaving the area. When swimming at the loon being chased, the pair assumed an attitude identical to that of loons in the "threat dance" (Sjölander 1968) (Figure 3).

On two occasions the larger adult of the pair with young was observed calling when a single breeding plumage arctic loon flew over the area. On both occasions the flying bird "flared" and left the area.

Arctic loon young of all ages would remain with the adult in mid-pond until the adult left the area due to human disturbance. The young would dive and hide along the shore until the observer was within twenty feet of the young. The young would then swim to mid-pond and remain sitting there. When the young were less than one week of age, one adult would stay with the young until the observer reached the shore of the pond. When the young was past one week of age, the adult would leave the pond when the observer was within 75 feet of the pond when walking directly to the pond. The adult would circle the pond one to three times calling before leaving the area.

12. Adult foraging and display areas

Red-throated Loons - Red-throated loons were observed diving in the wide slough regions of the study area May 7 through August 26, 1974. Loons were observed diving in deep slough areas, and at junction of the sloughs and the Kashunuk River. From one to five individuals in each group were observed with groups of one and two individuals being the most frequent (Table 10). Before nest initiation, groups of loons were observed most frequently at high tide on Chikchiok Slough. Red-

throated loons were observed catching fish and flying to the pond areas of the study area on two occasions. Groups of more than two breeding plumage adults were not observed on the ponds.

Red-throated loons were most commonly observed in the slough and river areas in May, with fewer loons in June and July, and no adults observed after fledging of the young in August. Singles and pairs were consistently seen foraging in two areas near ponds with loon young. Groups of birds were not observed in those areas following the initiation of nesting, and none were observed after the young fledged.

Arctic Loons - Groups of arctic loons were frequently encountered on the Kashunuk River, usually at bends, and at mouths of sloughs. Groups of arctic loons were not frequently observed until after hatching of the eggs should have occurred, followed by a sharp reduction of groups seen through August and September (Table 11).

Breeding plumage arctic loons were most frequently observed in dispersed groups of one or two birds in a large pond, either diving or sitting on the surface of the water. Groups of four to seven birds believed to be in the "threat dance" (Figure 3) were observed in open water regions nine times. Groups of displaying birds were composed of birds seen diving in the area as dispersed singles and pairs. Prior to formation of the group, a characteristic call was heard and the birds in the vicinity (i.e. up to one third mile away) would congregate in an open water area. Each individual in the group had its silver neck feathers raised, held its neck at a 90 degree angle and its bill horizontal. The birds would merge into a tight group and move in such a manner to suggest the group was rotating on an axis. The individuals

tended to remain perpendicular to each other facing toward the center of the group. Groups remained together one to five minutes before the individuals dispersed from the group by diving.

Breeding plumage arctic loons were observed giving a single horizontal rapid headshake immediately prior to flying. The head movement was observed frequently between a pair, and occasionally by a single bird.

13. Weights of adult loons

Red-throated Loons - One adult male was collected July 27, 1973 while foraging at the mouth of a slough. One adult was collected June 18, 1974 off the study area from a nest containing two eggs, and one adult female was collected June 23, 1974 from a nest hatched June 19, 1974. Both specimens are to be analysed for fat content, gonad development, food habits, and parasites. One adult loon believed to be a male was captured, marked, and weighed two days following the hatching of its young. Weights of the individuals are relatively uniform (Table 12).

Arctic Loons - One adult female was collected August 10, 1973 when flying from a pond with another bird. No young were found in the pond or immediate area. One adult male was collected while on the Kashunuk River August 31, 1973.

In 1974, three adult loons were collected during egg laying, and one adult female arctic loon was collected with a newly hatched young. Specimens are to be analysed for fat content, gonad development, food habits, and parasites. The weights (Table 12) indicate there may

be a significant difference in the weights of the adults during different times of the breeding season.

14. Aquatic insect and fish samples

Samples of aquatic insects and fish were taken from five ponds on the study area once per week July 1 through September 3, 1974. Arctic loons were observed in all ponds, and nesting on two ponds. One arctic loon young fledged from one pond. Eighty of eighty-one fish captured were nine-spine stickleback (Pungitius pungitius). One fish was a three inch sculpin (Cottidae). Aquatic insects have yet to be identified.

DISCUSSION

Due to accidental injury on May 15, 1974, observations were restricted to a single foraging area utilized by red-throated loons at the field camp until May 26, 1974. I was absent from the study area May 26 to June 1, 1974. Continuous observations of incubating red-throated loons were not possible, and observations of incubating arctic loons were infrequent. A complete search of the study area for nests prior to hatching was not possible. Observations of red-throated loon broods began when the young were one week old, and extended observations of an arctic loon brood began when the young was three weeks old.

1. Comparison of the behavior of arctic and red-throated loons on the study area

Red-throated loons arrived to the study area as singles or pairs. Since individuals were not marked, it could not be determined if the singles formed pairs and nested. Pairs were observed in the ponds

before nest initiation. Pair formation probably occurs prior to the birds arriving on the pond area. Red-throated loons utilized large ponds (i.e. greater than 1.4 acres) that were free of ice prior to nest initiation and the arrival of arctic loons.

Arctic loons were observed on the study area as pairs until nest initiation. Pairs were not marked and it could not be determined if the pairs first seen nested in the area. Single arctic loons and groups of arctic loons were frequently observed in July and August. Those individuals may be unsuccessful breeding birds or birds previously not paired.

Three mutual displays by red-throated loons were observed prior to nest initiation when the pair was alone, when other birds entered the area, or when other birds were observed flying over the area. The mutual displays appear to function as threat or territorial displays, as well as being important in synchronization and recognition within the pair (refer to Results Section, Pre-nesting Behavior).

For both arctic and red-throated loons, only the adult that is incubating is in the pond the majority of the time until hatching. After one week of age, young red-throated loons are fed fish that are caught in the slough area by one or more adults. Apparently both red-throated loon adults do not participate equally in bringing fish to the young, and the young are frequently left alone in the ponds.

After hatching, both adult arctic loons are with the young almost constantly. Fish or other food items are captured in the brood rearing pond by both adults and each item is fed singly to the young. The smaller bird (possibly the female) feeds the young the majority of the time, while the larger bird (possibly the male) chases other arctic

loons from the area. More observations of marked individuals of both species are necessary to more clearly define each adult's role in care of the young.

"Social gatherings" (Sjolander 1968) of breeding plumage arctic loons were observed. Birds participating were apparently non-breeding or unsuccessful breeding birds that were foraging in the pond. The function of the "threat dance" is not well understood. Elements observed in the display were observed when a pair chased another bird from the area. Adult loons were permanently displaced by the pair, but no permanent displacement occurred after the "threat dance". The adults with young in the same pond were never observed participating in the "social gatherings". Since individuals were not marked, it was not possible to determine the consistency of participation of an individual or pair in the "social gatherings" for extended periods of time.

2. Habitat utilization

The most obvious difference in the habitat utilized by arctic and red-throated loons is the size of the ponds used for nesting and brood rearing. Red-throated loons utilized ponds between 0.4 - 2.8 acres, whereas arctic loons utilized larger ponds between 1.0 and 19.4 acres. In areas where arctic loons are absent, red-throated loons still used ponds (Davis 1972). Arctic loons forage for food in the pond in which the young is raised, and may require a larger pond for a sufficient food source. After the first week, red-throated loons feed the young on fish brought from sloughs, and apparently do not require large ponds with an abundant food source. Red-throated loon young are susceptible to predation by avian predators when left alone in the pond while the

adult is foraging. It is possible that a young red-throated loon would be less conspicuous, and be able to more efficiently utilize escape cover in a small pond than in a large pond.

Arctic and red-throated loons utilized different areas in the slough and river system of the study area. Red-throated loons were most frequently observed foraging in the sloughs, and occasionally at the junctions of a slough and river. Arctic loons were most frequently observed at bends in the river and in the river near the mouth of a slough. Those differences could be due to a food preference by each species, or may reflect the need for a larger area for flying by arctic loons. More observations of foraging loons and samples of foraging loons are necessary to determine if there is a difference in food taken.

3. Factors influencing success

Red-throated loons on the study area hatched eggs in three (60.0%) of five nests, and fledged one young from each undestroyed nest. Sufficient observations were not made to compare the frequency of feeding between members of a brood, but size differences within the brood may indicate unequal feeding by the adults as well as age difference related to hatching time.

There were nine broods of arctic loons found on 60.6% of the study area in 1973. Assuming that a 50% survival of young as found by Davis (1972), and an equal loss of young and eggs as found by Lehtones (1970), there should have been about fifty arctic loon nests found on the total study area in 1974. Only eighteen arctic loon nests were found. The low numbers of pairs of arctic loons attempting to nest, along with a 5.6% success rate of those pairs nesting resulted in very

low production of arctic loon young on the study area.

The reasons for the low number of arctic loons attempting to nest are obscure. The ponds used for nesting were available prior to the arrival of arctic loons, and there were no freezing storms following the arrival of the loons. Factors such as the presence of food items in the pond prior to egg laying, and the condition of breeding and non-breeding adults were not adequately investigated. Factors influencing the condition of the birds before arrival on the breeding grounds is unknown and beyond the scope of this project.

Predation of arctic loon nests was the major factor influencing nest success. Seventeen of 18 (94.6%) nests were destroyed prior to hatching. Nests of arctic loons were identical in construction and general placement to red-throated loons, yet red-throated loons successfully hatched young. The two main differences in nesting between the two species were the size of the ponds, and the timing of nest initiation.

Red-throated loons were estimated to be laying eggs one week earlier than arctic loons, and hatched young one week prior to arctic loons. Red-throated loons and arctic loons initiated clutches on the study area fourteen days after the first pair of each species was observed. Red-throated loons were not observed prior to nest initiation, in ponds where nests were subsequently found, but were frequently observed in larger ponds until the arrival of arctic loons. Arctic loons were commonly observed in ponds before nesting where their nests were subsequently found.

The data (Table 2) appear to indicate that most nests were predated late in incubation. Accurate dates of predation on all but two nests were not established. More data are needed to determine the timing of predation and its implications on the reproductive success of arctic loons.

4. Plans for 1975

Observations of arctic and red-throated loons are to be made from observation towers and portable blinds from the arrival of the birds until fledging of the young. Observations will be supplemented with two time-lapse photography units during incubation of both species, and until the red-throated loon young fledge.

Up to twenty pair of arctic loons and ten pair of red-throated loons are to be collected throughout the breeding season in areas adjacent to the study area. Birds will be analysed for parasites, food habits, reproductive condition, and lipid content. Areas where breeding pairs are removed will be observed to determine if other birds utilize the area.

Samples of aquatic insects and fish will be taken in ponds utilized by both species of loons from the time the ponds become free of ice until fledging of the young. The foraging areas on the Kashunuk River and in the sloughs will be sampled to determine what fish are available to the different species of loons.

An assistant will be needed May 1 until July 15, 1975 to aid in a more extensive search of the study area for loon nests, and in capturing breeding pairs of arctic and red-throated loons for marking. It is anticipated that the assistant will be a student at the University of California, Davis Campus and will be doing a short term project while on the study area.

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ARCTIC AND RED-THROATED LOON STUDY AREA

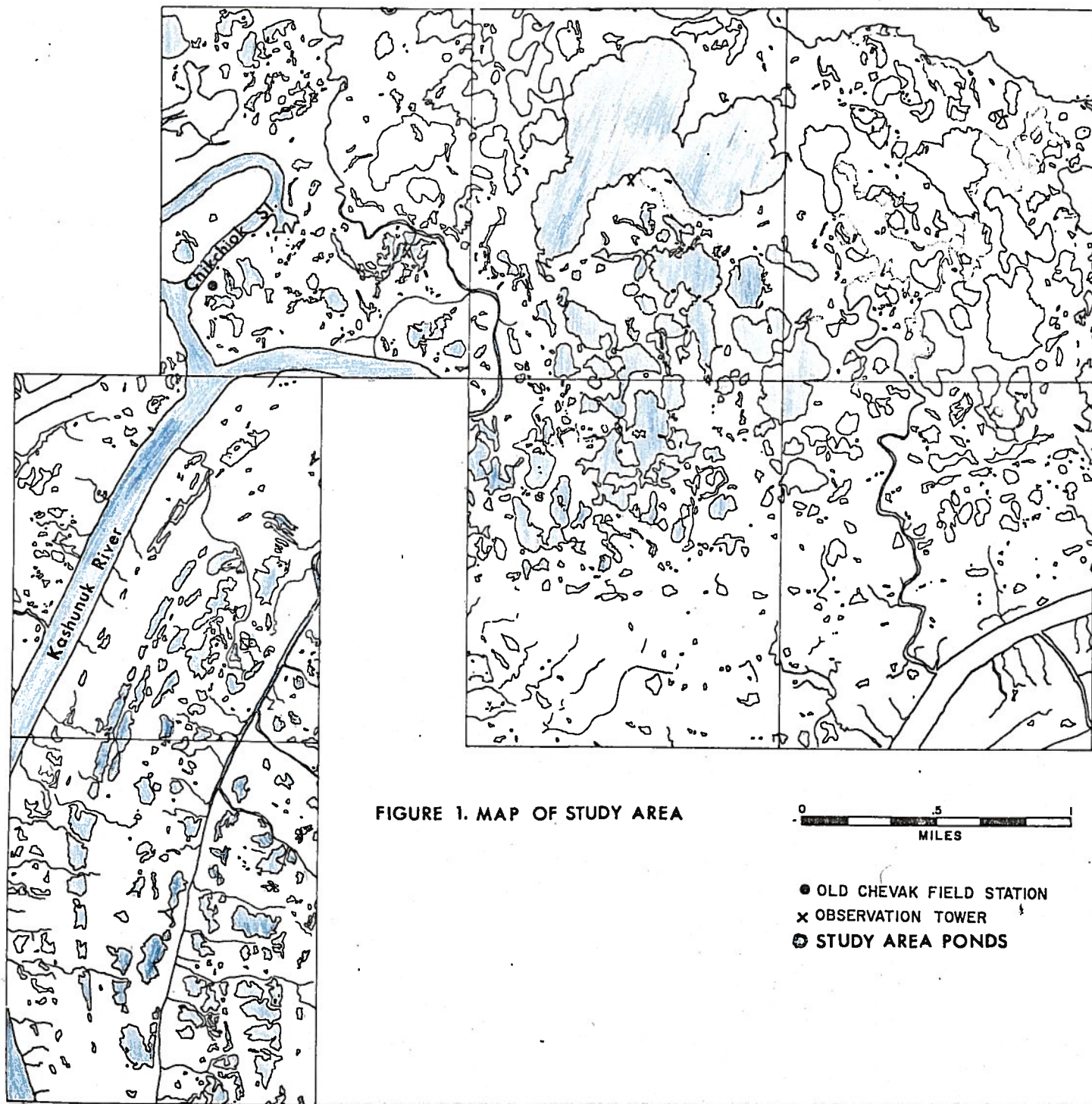


FIGURE 1. MAP OF STUDY AREA

0 .5 1
MILES

- OLD CHEVAK FIELD STATION
- x OBSERVATION TOWER
- ⊙ STUDY AREA PONDS

FIGURE 2.. FREQUENCY AND STATUS OF RED-THROATED LOONS OBSERVED
MAY 5- 26, 1974 AT THE CHIKCHIOK SLOUGH FORAGING AREA

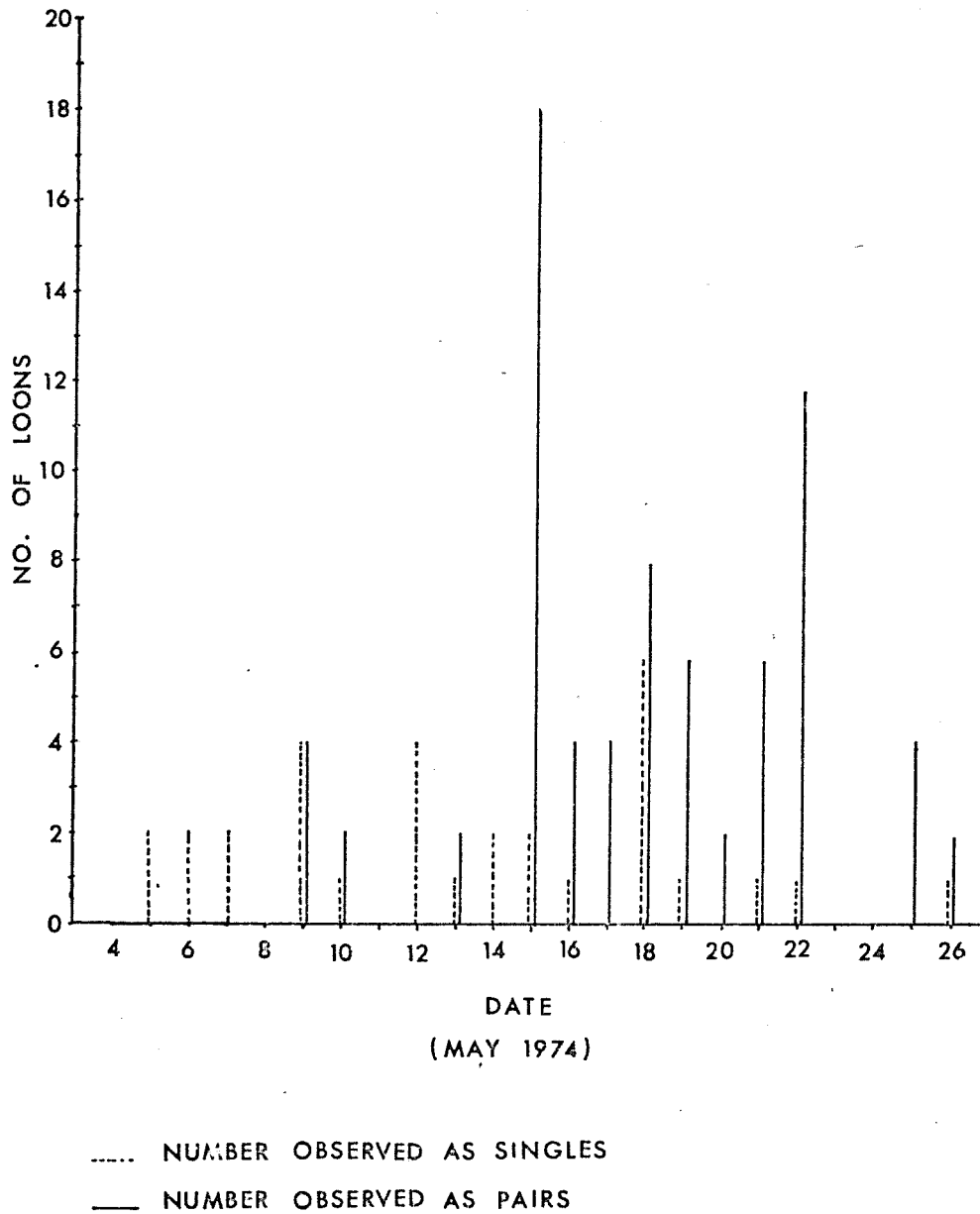
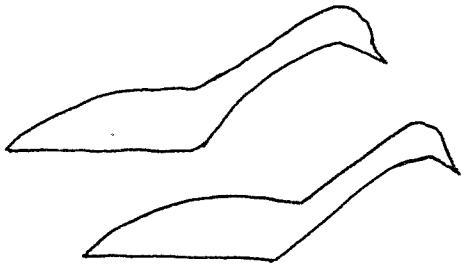
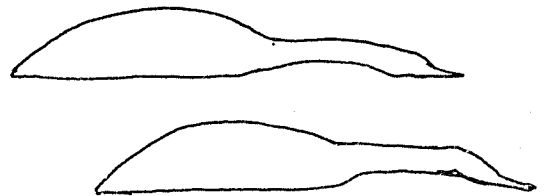


FIGURE 3. ARCTIC AND RED-THROATED LOON DISPLAYS



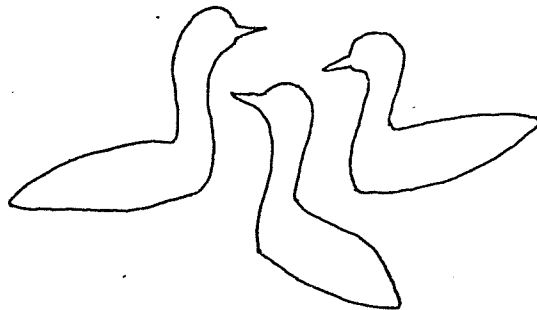
Red-throated Loon
Plesiosaurus-race ceremony



Red-throated Loon
Snake ceremony



Red-throated Loon
Looking into the water



Arctic Loon
Threat dance

ARCTIC AND RED-THROATED LOON STUDY AREA

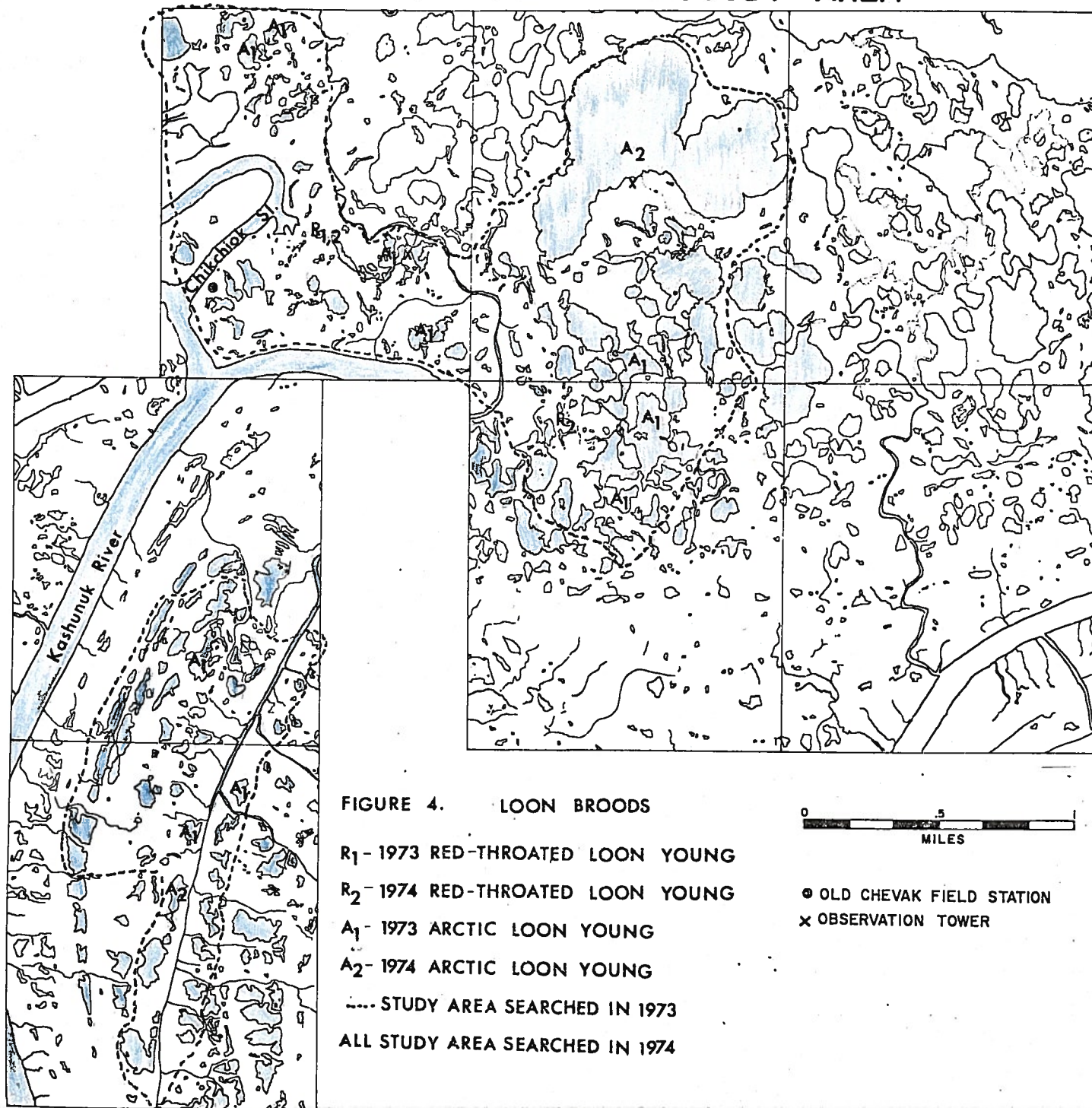


FIGURE 4. LOON BROODS

R₁ - 1973 RED-THROATED LOON YOUNG

R₂ - 1974 RED-THROATED LOON YOUNG

A₁ - 1973 ARCTIC LOON YOUNG

A₂ - 1974 ARCTIC LOON YOUNG

---- STUDY AREA SEARCHED IN 1973

ALL STUDY AREA SEARCHED IN 1974

0 5
MILES

● OLD CHEVAK FIELD STATION
X OBSERVATION TOWER

ARCTIC AND RED-THROATED LOON STUDY AREA

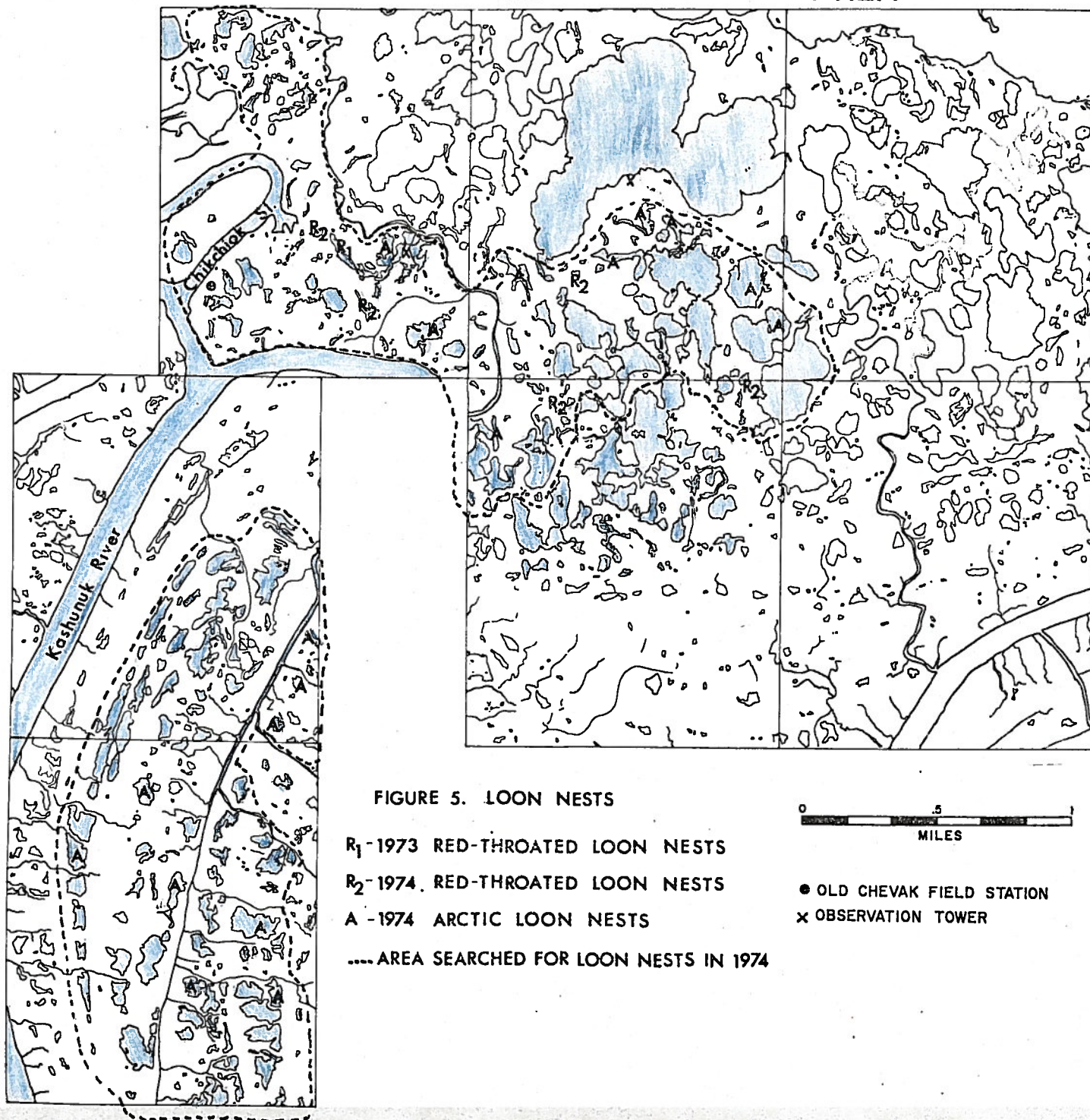


TABLE 1 LOON NEST SITES - 1974

<u>Species</u>	<u>Islands</u>	<u>Shore</u>	<u>Total</u>
Red-throated Loons	1 (20.0%)	4 (80.0%)	5
Arctic Loon	10 (55.6%)	8 (44.4%)	18

TABLE 2 SIZES OF NESTING PONDS

<u>Species</u>	<u>Year</u>	<u>No. of Ponds</u>	<u>Average Pond Size in Acres</u>	<u>Range of Pond Size in Acres</u>
Red-throated Loon	1973	1	2.8	--
	1974	5	0.8	0.4 - 1.0
Arctic Loon	1974	18	4.5	1.0 - 17.2

TABLE 3 CLUTCH SIZES OF LOON NESTS - 1974

<u>Species</u>	<u>No. of Nests With Unknown Clutch Sizes</u>	<u>No. of Nests With 1 egg</u>	<u>No. of Nests With 2 eggs</u>	<u>Total No. of Nests</u>	<u>Average Clutch Size¹</u>
Red-throated Loon	1 (20.0%)	1 (20.0%)	3 (60.0%)	5	1.75
Arctic Loon	12 (66.7%)	0	6 (33.3%)	18	2.00

¹Average clutch size of nests with a known number of eggs only

TABLE 4 CONDITION OF EGGS IN
ARCTIC LOON NESTS WHEN FIRST FOUND - 1974

<u>Date Nest First Found</u>	<u>No. With Whole Eggs</u>	<u>No. With Fragments Only</u>	<u>No. Without Eggs or Fragments</u>	<u>Total</u>
June 2 to June 17	5 (50.0%)	1 (10.0%)	4 (40.0%)	10
June 18 to July 4	1 (12.5%)	4 (50.0%)	3 (37.5%)	8

TABLE 5 DESCRIPTION OF PONDS WHERE
ARCTIC LOON YOUNG WERE OBSERVED

<u>Year</u>	<u>Total No. of Ponds Searched</u>	<u>No. of Ponds With Young</u>	<u>Average Pond Size in Acres</u>	<u>Range of Pond Sizes in Acres</u>
1973	134 (60.6%)	9	6.5	2.4 to 19.4
1974	221 (100.0%)	2	8.1	3.2 to 13.0 ¹

¹Total pond size was 247 acres, but only 13 acres were observed utilized by the young and adults

TABLE 6 PRESENCE OF ADULT RED-THROATED
LOONS WITH THE YOUNG - 1974

<u>Pair</u>	<u>Total Time Adult(s) With Young in Hours</u>	<u>Total Time Young Alone in Hours</u>	<u>Total Observation Time in Hours</u>
unmarked	18.82 (56.0%)	14.80 (44.0%)	33.62
marked	11.65 (62.1%)	7.12 (37.9%)	18.77
Total	30.47 (58.2%)	21.92 (41.8%)	52.49

TABLE 7 DURATION OF FORAGING TRIPS
BY ADULT RED-THROATED LOONS - 1974

Pair	No. of Succ. Trips ¹	Ave. Time In Minutes	No. of Unsucc. Trips	Ave. Time In Minutes	Total Succ. Trips	Total Uns. Trips
Unmarked	6	78 (15-232)	2	27 (17-37)	7 (70.0%)	3 (30.0%)
Marked ¹	3	111 (12-272)	0	0	6 (100.0%)	0 (0.0%)
Total	9	89 (12-272)	2	27 (17-37)	13 (81.2%)	3 (18.8%)

¹the Unmarked member of the pair only was observed bringing fish to the young

TABLE 8 DIVES OF ADULT ARCTIC LOONS WITH YOUNG - 1974

Adult	No. Unsucc. ¹ Dives	No. Succ. Dives and Fed Young	No. Succ. Dives and Adult Fed	No. Dives With Unknown Results	Total Dives Observed
A	49 (41.9%)	62 (53.0%)	5 (4.3%)	1 (0.8%)	117
B	75 (7.8%)	841 (87.0%)	47 (4.9%)	4 (0.4%)	967

¹

a dive was considered successful if the adult was seen with a food item after diving

TABLE 9 DURATION OF TIME IN MINUTES FOR AN ADULT ARCTIC LOON¹ TO CAPTURE AND FEED FOOD ITEMS TO THE YOUNG

Date	Normal Feeding	Before quit Feeding	Before and After Disturbance	During Rain
Aug. 2	0.31	0.66	0.39	--
Aug. 8	0.23	0.48	0.37	0.36
Aug. 17	-	-	-	0.81
Aug. 19	0.27	0.95	0.65	--
Aug. 22	-	-	-	1.10
Average	0.28	0.65	0.48	0.71

¹Small adult of a pair, believed to be the female

TABLE 10 GROUP SIZES OF RED-THROATED LOONS OBSERVED IN THE RIVER AND SLOUGH AREAS - 1974

Dates	Total Number	Group Sizes				
		1	2	3	4	5
May 7-26	39	16	21	1	0	1
June 1-30	4	2	2	0	0	0
July 1-31	13	5	6	1	0	1
Aug. 1-31	1	1	0	0	0	0
Total	57	24 (42.1%)	29 (50.9%)	2 (3.5%)	0	2 (3.5%)

TABLE 11 GROUP SIZES OF ARCTIC LOONS OBSERVED ON THE RIVER AND SLOUGH AREAS - 1974

<u>Date</u>	Total No. of Groups Observed	<u>Group Sizes</u>									
		1	2	3	4	5	6	7	8	14	18
June 1-30	12	3	2	2	4	0	1	0	0	0	0
July 1-31	41	9	4	10	4	4	2	5	1	1	1
Aug. 1-31	2	0	0	0	2	0	0	0	0	0	0
Sept. 1-18	3	1	0	0	2	0	0	0	0	0	0
<u>Total</u>	58	13 (22.4%)	6 (10.3%)	12 (20.7%)	12 (20.7%)	4 (6.9%)	3 (5.2%)	5 (8.6%)	1 (1.7%)	1 (1.7%)	1 (1.7%)

TABLE 12 WEIGHTS OF ADULT LOONS

<u>Species</u>	<u>Sex</u>	<u>Status</u>	<u>Date Collected</u>	<u>Weight in Grams</u>
Red-throated Loon	unknown ¹	within 3 days of hatching	June 18, 1974	1510
	male ²	3 days after hatching	June 22, 1974	1530
	male	foraging single	July 27, 1973	1640
	female	4 days after young hatch	June 23, 1974	1430
Arctic Loon	male	single	May 30, 1974	2350
	male	pair without eggs in nest	June 1, 1974	2550
	male	single on river	August 31, 1973	1990
	female	prior to egg laying	May 24, 1974	2320
	female	1 day after hatching	June 30, 1974	1810
	female	pair without young	August 10, 1973	1840

¹Frozen for subsequent analysis

²Bird banded and released, believed to be a male

1975 EXPENSESTravel Expenses

Airfare from San Francisco, California to Bethel, Alaska for two persons	\$ 480.00
Airfare from Bethel, Alaska to Old Chevak, Alaska	\$ 250.00
Airfare from Bethel, Alaska to San Francisco, California for two persons	\$ 480.00
Equipment shipping charges	\$ 35.00

Living Expenses

Food and lodging at Old Chevak, Alaska for 218 days at \$5.00 per day	\$1090.00
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Supplies and Equipment

Batteries for time-lapse photographic equipment	\$ 120.00
35mm film and developing at \$7.40 per roll for 10 rolls	\$ 74.00
Super 8mm movie film developing at \$2.84 per roll for 67 rolls plus 6% sales tax	\$ 201.69

<u>Total 1975 Expenses</u>	<u>\$2730.69</u>
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