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Breeding Biology of Red-throated Loons in the Canadian Beaufort Sea Region

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ABSTRACT. The breeding biology of the red-throated loon in the Canadian Beaufort Sea region was investigated from 1985 to 1989. Five study plots were established with a total area of 276 km^2 and over 200 pairs of loons on territory each breeding season. Loon densities ranged from 0.6 pairs·km^{-2} on the Yukon coast to 1.8 pairs·km^{-2} at Toker Point on the Tuktoyaktuk Peninsula. An average of 73% of the pairs on territory nested each year. Productivity averaged 0.63 young·nesting $pair^{-1}$. The median date of egg laying ranged from 19 to 24 June in four years, but was 3 July in a year when spring thaw was late. The chicks fledged a mean of 47 d after hatch (n = 10), the first clutch chicks leaving the nesting pond in late August to mid-September.

In all but one year, the mortality rate was higher for eggs than chicks, with egg losses peaking in the second half of incubation. Most (82%) chick losses occurred within three weeks of hatch (n = 61).

Just 13% of the ponds were occupied in all five years of the study, while 39% were used in only one year. At two of the study plots, ponds with pairs that successfully reared at least one chick had a greater tendency to be occupied the following year than did ponds with unsuccessful pairs. At the other three plots, reuse of ponds was independent of breeding success the previous year.

Key words: red-throated loon (*Gavia stellata*), breeding biology, Beaufort Sea

RÉSUMÉ. On a étudié la reproduction du huart à gorge rousse dans la partie canadienne de la mer de Beaufort de 1985 à 1989. À chacune des périodes de reproduction, on a observé plus de 200 couples de huarts territoriaux répartis dans cinq zones expérimentales couvrant une superficie totale de 276 km^2. La densité des huarts a varié de 0.6 couple par km^2 sur la côte du Yukon à 1.8 couple par km^2 à Toker Point sur la péninsule de Tuktoyaktuk. Le nombre moyen annuel de couples nicheurs territoriaux s'est élevé à 73%. La productivité moyenne a été de 0.63 oisillon par couple nicheur. La date médiane de ponte s'est située du 19 au 24 juin pour quatre des cinq années; l'autre année la date médiane de ponte a été le 3 juillet à cause d'un dégel printanier tardif. Le premier vol des oisillons a eu lieu en moyenne 47 jours après l'éclosion (n = 10), la première couvée quittant l'étang de nidification entre la fin août et la mi-septembre.

À l'exception d'une année, le taux de mortalité a toujours été plus élevé dans le cas des oeufs que dans celui des oisillons et a été maximal pendant la deuxième moitié de l'incubation. La mortalité des oisillons a particulièrement été forte (82%) au cours des trois premières semaines suivant l'éclosion (n = 61).

Seuls 13% des étangs ont été utilisés pendant les cinq années de l'étude alors que 39% l'ont été pendant seulement une année. Le succès de la reproduction n'a eu un effet sur la réutilisation d'un étang l'année suivante que dans deux des cinq zones expérimentales.

Mots clés: huart à gorge rousse (*Gavia stellata*), reproduction, mer de Beaufort

INTRODUCTION

Recent discoveries of oil and gas in the Canadian Beaufort Sea region have raised concerns about the effect that offshore oil and gas production might have on regional bird populations. Thus in 1985, the Canadian Wildlife Service initiated a long-term monitoring program using the red-throated loon as an indicator species. The red-throated loon was selected as the indicator due to its vulnerability to the proposed development, its abundance throughout the Beaufort Sea region and its conspicuous nature making it relatively easy to survey. The abundance and productivity of the red-throated loon were monitored for five years to establish a pre-development data base for future comparison. Additional information on the breeding biology and ecology of the red-throated loon was collected to ensure that the design of the monitoring program was adequate and to improve our ability to interpret the results of the monitoring program, particularly during the post-development phase. This paper examines several aspects of red-throated loon breeding biology, including breeding effort and success, nesting phenology, mortality of eggs and chicks and nest site fidelity. For an analysis of the natural environmental and biological factors that affected annual productivity and for an evaluation of the effectiveness of the monitoring program, refer to Dickson (1992).

Several general investigations of the seasonal distribution and abundance of birds in the eastern Beaufort Sea have included information on the red-throated loon. These data are summarized in Alexander *et al.* (1988a) and Johnson and Herter (1989). However, no previous study in the region has focused specifically on the red-throated loon. Elsewhere in its circumpolar breeding range, there have been several recent studies of red-throated loon breeding biology: in Canada on the Queen Charlotte Islands (Reimchen and Douglas, 1984; Douglas and Reimchen, 1988) and on the west side of Hudson Bay (Davis, 1972); in the United States on the Alaskan Beaufort Sea coast (Bergman and Derksen, 1977); in Scotland on the Shetland Islands (Bundy, 1976, 1978; Furness, 1983; Gomersall *et al.*, 1984; Gomersall, 1986) and in Orkney (Booth, 1982); and in southern Finland (Lokki and Eklöf, 1984).

STUDY AREA

The study area consists of Tuktoyaktuk Peninsula, Northwest Territories (70°N, 131°W) and the coastal plain of northern Yukon (69°N, 138°W) (Fig. 1). The region is characterized by wet lowland tundra interspersed by dry ridges. Shallow lakes, ponds, low and high-centred polygons and pingos are all common features of the landscape. Permafrost is continuous; hence much of the area is poorly drained, with moist to wet cryosolic soils (Wiken, 1986). Summers are short and cool, with a mean daily temperature in July of 10°C at Tuktoyaktuk (Atmospheric Environment Service, 1982).

There is a continuous cover of low-arctic tundra vegetation, most of which is less than 0.5 m high. Wet lowlands are dominated by sedges (*Carex* spp.) and willows (*Salix* spp.), while dry uplands feature willows, birch (*Betula* spp.) and several ericaceous species. Tussock-forming cottongrass (*Eriophorum vaginatum*) covers moist, gentle slopes. Better-drained protected slopes and creek valleys have patches of taller (>0.5 m) willows.

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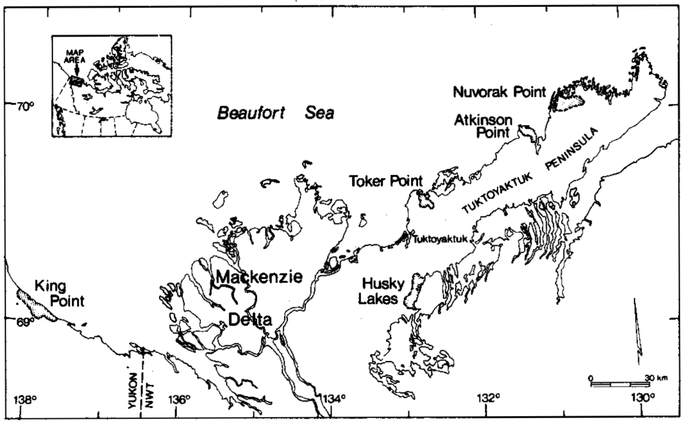

FIG. 1. Location of the five study plots selected for monitoring the abundance and productivity of the red-throated loon.

METHODS

Five study plots were established, four at sites along the Beaufort Sea coastline that would be affected to varying degrees by offshore oil and gas development and one control located inland on Husky Lakes (Fig. 1). Each plot was large enough to support a minimum of 20 pairs of red-throated loons. The plot boundaries were all within 7 km of either the coast or Husky Lakes, because the density of nesting red-throated loons and their reproductive success tend to be highest close to where they feed (Davis, 1972). The boundaries were further defined by the ridges separating the wetlands to eliminate the problem of a red-throated loon nesting territory straddling a boundary. The total area of the plots was 276 km^2.

From 1985 to 1989, all of the wetlands in each study plot were surveyed twice during the incubation period and once just prior to the chicks fledging. The objectives of the surveys were to determine the number of red-throated loon pairs on territories, their breeding effort and their breeding success. The surveys were conducted by two observers in a Bell 206B Jet Ranger helicopter. To locate incubating birds, the helicopter was flown at 20-25 m above ground and at 50-100 $km \cdot h^{-1}$. If a loon was sighted on a water body, the shoreline was checked for a nest by hovering at about 8 m above ground and slowly moving sideways around the edge of the pond. When searching for chicks, all wetlands were surveyed at approximately 50 $km \cdot h^{-1}$ and 30 m above ground. Ponds known to be active nesting territories were double checked with a slow low-level pass, followed by hovering at 90 m above the pond for about 1 min to see if any young loons surfaced from under water.

A more intensive field study was done at the Toker Point study plot. Ground observers checked each red-throated loon nesting territory every three to five days from mid-June to early September. During the first three years of the study (1985-87), the observers approached nests with incubating loons to record the number of eggs. During egg laying and just prior to hatch the nests were checked daily. In 1988 and 1989, nest checks and visits more frequent than every third day were discontinued, to reduce the likelihood of observer-induced predation of loon eggs and newly hatched chicks. Instead, the nesting status of each pair of loons was determined by observations taken from a concealed place, usually 200-300 m away, and by checking for eggs during the two helicopter surveys.

The location of each pond occupied by red-throated loons was marked on a 1:50 000 scale topographical map. At Toker Point, we also sketched a map of each nesting territory showing all the ponds within the territory and the location of the nest.

Data on the timing of melt and freeze-up of the shallow ponds used by the red-throated loons for nesting were obtained from the renewable resources officers stationed in Tuktoyaktuk. The timing of the melt of ice covering the marine nearshore loon feeding areas was also recorded.

The mortality rate for loon eggs and chicks was calculated by dividing the number of eggs or chicks lost during a 7 d period by the number available at the beginning of that period. Addled or infertile eggs and eggs of unknown age were excluded from the analysis.

Loon nesting territories were classified as either occupied or active. A territory was occupied if a loon was present during at least one survey, it was suitable loon nesting habitat and it was unlikely part of a nearby loon territory. An active territory was one where we found evidence of nesting (eggs, chicks, fresh egg remains or a dead chick). A resident pair was a pair of loons that occupied a territory; a breeding pair was one that laid eggs; and a successful pair was one with young near fledging. A fledged young was one that could fly well enough that it vacated the nesting territory.

RESULTS

Density and Breeding Success

The density of resident pairs of red-throated loons occupying a nesting territory ranged from 0.6 $pairs \cdot km^{-2}$ along the Yukon coast to 1.8 $pairs \cdot km^{-2}$ at Toker Point on the Tuktoyaktuk Peninsula (Table 1). The average density for all five study plots for the five-year period was 1.1 $pairs \cdot km^{-2}$.

An average of 73% of the resident pairs laid eggs each year (Table 1). Most (75%; n = 777 clutches) were two-egg clutches,

TABLE 1. Mean density and breeding success of red-throated loon, 1985-89

Study plot	Plot size (km^2)	Resident $pairs \cdot km^{-2}$ Mean	(Range)	% of pairs nesting	Clutch size	Young near fledging per nesting pair	% breeding success[1]
Toker	26	1.8	(1.6-1.9)	80	1.8	0.38	31
Atkinson	33	1.3	(1.1-1.4)	74	1.8	0.77	58
Nuvorak	65	0.9	(0.7-1.1)	69	1.7	0.52	41
Husky	56	0.7	(0.6-0.8)	75	1.7	0.67	56
King	96	0.6	(0.5-0.7)	66	1.7	0.81	63
All plots	276	1.1	(0.5-1.9)	73	1.7	0.63	50

[1]Percentage of nesting pairs with at least 1 chick near fledging.

and none had more than two eggs. Production averaged 0.63 young near fledging per nesting pair. The percentage of nesting pairs that were successful at raising at least one chick to near fledging ranged from 31% to 63% across the study area. For an analysis of the five-year variation in the number of resident pairs and breeding success, refer to Dickson (1992).

The surveys by foot every 3-5 d at Toker Point indicated that an average of 29% of the pairs of red-throated loons that lost their first clutch laid a second clutch (five-year range: 18-42%, n = 149). No replacement clutches were laid for chicks lost. The size of replacement clutches was similar to that of first clutches: 79% of replacement clutches had two eggs (n = 33), compared to 86% of first clutches (n = 186). Production of fledged chicks from replacement clutches tended to be low. Assuming chicks died if their nesting pond froze before they reached 40 d old, breeding success was an average of 0.15 young per nesting pair (five-year range: 0-0.38, n = 41 pairs). Even if unfledged chicks survived by moving to a larger unfrozen water body, breeding success was only 0.35 young per nesting pair.

Nesting Phenology

In the two years that the field study started prior to spring thaw, arrival of red-throated loons on the nesting ponds occurred within a day of the ice on the ponds melting. A period of 16-21 d elapsed between arrival and the median date of onset of egg laying at Toker Point (Fig. 2). Thus, in three years when spring thaw was early, the median date of egg laying was 19-20 June, whereas in 1986, when spring thaw was late, the medium date of egg laying was 3 July. The interval for egg laying ranged between 16-28 d over the five years. The most protracted laying period occurred in 1988, when spring thaw was earliest (Fig. 2).

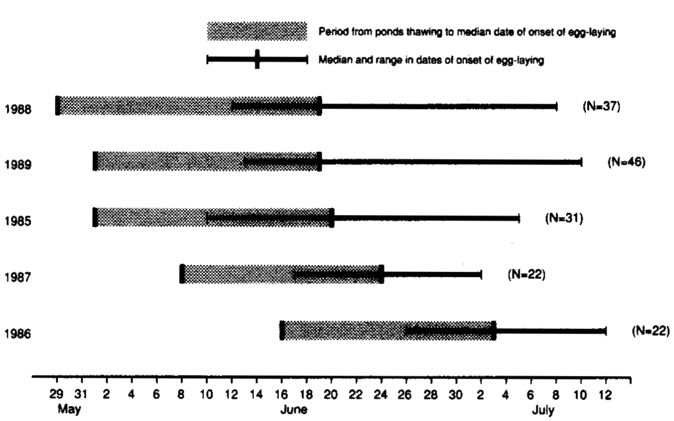

FIG. 2. The timing of nest initiation by the red-throated loon at Toker Point in relation to spring thaw.

The two eggs within a clutch were always laid two or more days apart (n = 26). The exact date of lay of both eggs was known for four clutches. The eggs were laid 2 d apart in three clutches and 3 d apart in the fourth.

Replacement clutches were laid an average of 11 d after loss of the first clutch (range: 6-18 d, n = 15). In all five years at Toker Point, no replacement clutches were laid after 23 July, nor were any replacement clutches laid for nests where the eggs were lost after 13 July.

The first egg laid in a clutch was incubated 26 d (range: 25-27 d, n = 7), while the second egg was incubated 25 d (range: 24-25 d, n = 6). The eggs within a clutch hatched 1-3 d apart (1 d apart in four clutches, 2 d apart in two clutches and 3 d apart in one clutch).

Red-throated loon chicks fledged an average of 47 d after hatch (range: 43-52 d, n = 10). Time of fledging for chicks from first clutches was late August to mid-September (n = 35), except in 1986, the year of the late spring thaw, when chicks fledged as late as 22 September. Chicks from replacement clutches reached fledging age from mid-September to early October (n = 15).

Mortality of Eggs and Chicks

Most years at Toker Point, the mortality rate was higher for eggs than for chicks (Fig. 3). The exception was 1988, when 32% of chicks less than one week old died. Egg losses peaked in the second half of incubation each year. Most (82%) chick losses occurred within three weeks of hatch (n = 61). Of the chick losses after three weeks of age, only 5% were confirmed. I assumed the other 13% died, since the chicks were <40 d old when their nesting ponds froze.

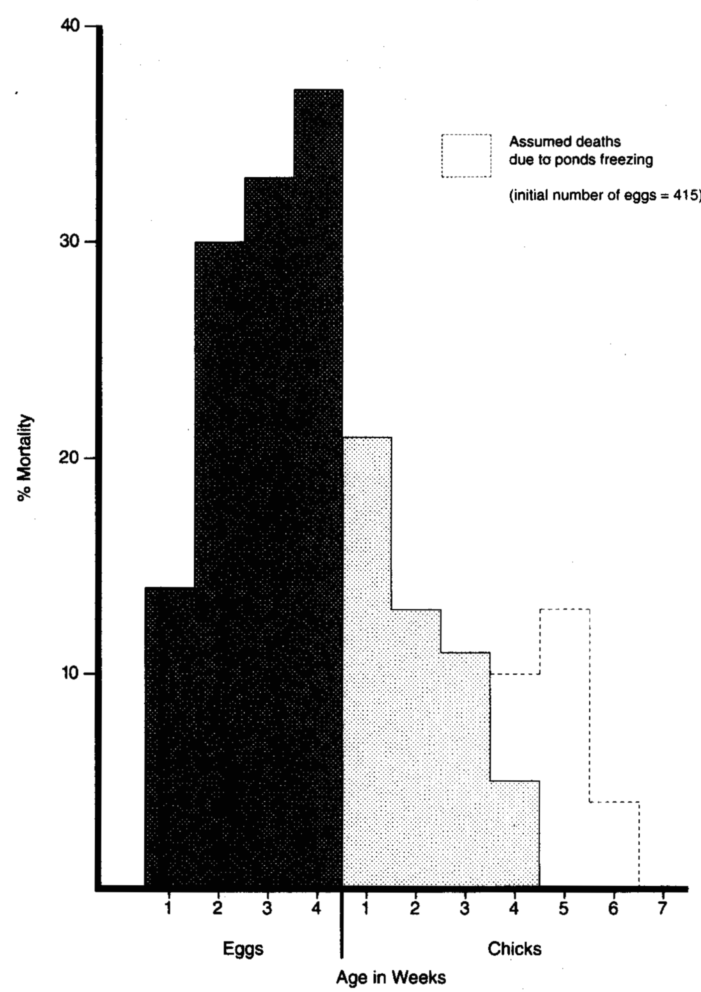

FIG. 3. Five-year average mortality rate for red-throated loon eggs and chicks at Toker Point.

Most eggs and chicks disappeared with no sign of what happened. Predator tracks were seldom visible due to the type of substrate surrounding most nests: peat on the land and unstable organic material on the bottom of ponds. However, the parasitic jaeger (*Stercorarius parasiticus*), glaucous gull (*Larus hyperboreus*) and arctic fox (*Alopex lagopus*) were each seen taking loon eggs on several occasions. An ermine (*Mustela erminea*) was the suspected predator of one loon egg, because its feces was found in the nest when the egg disappeared. The glaucous gull was the only species seen taking loon chicks. Although parasitic jaegers tried to take fish from loons in flight, none was seen preying on a loon chick.

There were no red-throated loon eggs lost due to flooding of the nest, which has been identified as a source of mortality in other areas (Gomersall, 1986; Lokki and Eklöf, 1984; Cyrus, 1975; Douglas and Reimchen, 1988). Only 3% of the eggs (n = 301) over the five years failed to hatch because they were addled or infertile. A minimum of two nests were abandoned, and at least one egg did not hatch because it was abandoned after the first egg hatched. Eggs were found knocked out of the nest on one occasion.

Nest Site Fidelity

At Toker Point, approximately half of the nesting territories used by red-throated loons (52%, n = 65) were occupied in all five years of the study. Assuming the same pair returns to a pond each year, as banding evidence from Shetland suggests (Furness, 1983), neither hatching success nor fledging success affected whether the nesting territory was reoccupied the following year at Toker Point (X^2 tests, 1 df, $p > 0.05$). Ninety-six percent of the territories where at least one egg had hatched were reoccupied the following year (n = 68), compared to an 88% reoccupancy at sites where none hatched (n = 93). Similarly, there was 96% reoccupancy of territories where young had fledged (n = 49), compared to 89% reoccupancy following an unsuccessful year (n = 112).

Reuse rates for the nesting territories at the other study sites could not be determined, since it was not possible to assess which ponds were within a particular territory in three brief visits by helicopter. Instead, frequency of use of ponds has been presented (Table 2). These data show a lower reuse rate than would data on reoccupancy of nesting territories, since many territories (43% at Toker Point) in the study area included more than one pond. However, frequency of use of ponds provides a means for comparison between study plots. The proportion of ponds that were occupied in all five years ranged from 26% at Toker Point to 5% at Nuvorak Point.

TABLE 2. Frequency of use of nesting ponds by red-throated loons

	Percentage of ponds occupied					
Study plot	1 yr	2 yr	3 yr	4 yr	5 yr	Number of ponds
Toker	33	16	11	14	26	88
Atkinson	44	18	9	11	18	89
Nuvorak	44	22	17	12	5	138
Husky	39	20	13	20	7	83
King	35	21	20	14	10	115
All plots	39	20	14	14	13	513

At three of the five study plots, breeding success had no effect on whether a pond was reused the following year (Table 3). However, at Husky Lakes and Nuvorak Point, ponds with pairs that successfully reared at least one chick were more likely to be occupied the following year than were ponds that supported unsuccessful pairs (X^2 tests, 1 df, $p < 0.05$).

At Toker Point, most pairs (86%, n = 36) that laid a replacement clutch following loss of the first clutch either built or renovated another nest rather than using the same platform. However, they usually renested on the same pond (76%, n = 41) and always within the same nesting territory (n = 41).

DISCUSSION

Density and Productivity

The highest densities of nesting red-throated loons in the Beaufort Sea region occurred at Toker Point and Atkinson Point on the northwest shore of the Tuktoyaktuk Peninsula. Densities declined towards the eastern tip of the Tuktoyaktuk Peninsula, on the south side of the peninsula and along the Yukon coast. The densities of 0.6-0.8 pairs·km^{-2} found at Storkersen Point on the Alaskan Beaufort Sea coast (Bergman and Derksen, 1977) were similar to what we recorded along the Yukon coast.

All of the red-throated loons observed in the study area during the nesting season had mature breeding (definitive alternate) plumage, were in pairs and were on territories. There were no groups of nonbreeding birds that regularly congregated on the freshwater lakes during June and July, such as Reimchem and Douglas (1980) found on the Queen Charlotte Islands at the southern limit of the breeding range. However, in most years during this study 20-30% of the red-throated loon pairs did not nest. Some of these nonbreeding pairs may have been immature birds that were establishing a territory but were not ready to breed. Selecting a territory the year before breeding might reduce the pre-laying period, which would be advantageous to the loons, given the short arctic breeding season.

The productivity of the red-throated loon averaged 0.63 young per nesting pair during the five-year study. This productivity was higher than what has usually been found on the Shetland Islands (0.35-0.65 young per nesting pair) (Bundy, 1976, 1978; Furness, 1983; Gomersall, 1986). However, it was lower than the reproductive rates reported for either the Queen Charlotte Islands (0.86 young per nesting pair) (Douglas and Reimchen, 1988) or the Orkney Islands, Scotland (0.79 young per nesting pair) (Booth, 1982).

TABLE 3. Effect of breeding success on occupancy of the same pond the following year[1]

	Ponds with successful pairs		Ponds with unsuccessful pairs			
Study plot	Number	% occupied the following year	Number	% occupied the following year	Chi square	P
Toker	48	85	113	74	2.38	0.12
Atkinson	84	75	43	67	0.81	0.37
Nuvorak	64	70	98	50	6.56	0.01
Husky	64	72	55	49	6.48	0.01
King	96	68	48	67	0.02	0.90

[1]Includes loon pairs that occupied a pond but did not lay eggs.

Breeding success of the red-throated loon will vary from one location to another depending on numerous factors: climatic conditions; species and abundance of predators; availability of fish close to the nesting territory; prevalence of parasites and diseases; quality of nesting habitat (e.g., nest cover, stable water levels); and the amount and type of human activity. About 73% of the eggs at Toker Point failed to hatch, most of which were taken by predators. This suggests that a prime factor limiting breeding success at Toker Point was the abundance of egg predators. The high density of loon nests may have further contributed to predation of eggs. The short open water season also likely affected breeding success, especially the survival of chicks from replacement clutches. The influence of man on loon productivity in the Beaufort Sea region was likely minimal, due to the low level of human activity in recent years.

Nesting Phenology

The red-throated loon arrives in the Beaufort Sea region in late May and early June (Johnson and Herter, 1989). Before their nesting ponds thaw, they occupy the offshore leads of open water, particularly west of Tuktoyaktuk (Barry *et al.*, 1981; Barry and Barry, 1982; Alexander *et al.*, 1988b), as well as any nearshore open water, such as the Kugaluk River mouth (P. Voudrach, pers. comm. 1986). In years when there is very little open water in the Beaufort Sea, thousands of red-throated loons stage on the Mackenzie River over 200 km upstream from the coast (T. Barry, pers. comm. 1986). Regardless of the timing of spring thaw, most loons arrived on the nesting ponds within a day of the ponds' thawing. Bergman and Derksen (1977) likewise noted that the red-throated loon arrived at Storkersen Point, Alaska, concurrently with thawing of the nesting ponds.

The timing of egg laying was directly related to the timing of melt of the nesting ponds. The later the spring thaw occurred, the later the median date of egg laying. Although day length determines whether the reproductive system of most temperate birds is in an active state, the female needs additional stimuli for the final stages of ovarian development (Loft and Murton, 1968; Silver and Ball, 1989). These stimuli may include territorial behaviour, a nest site and nest material, which for loons would not occur until the nesting pond thawed (Yonge, 1981).

Delays in nest initiation due to social behaviour associated with pair formation and finding and defending a nesting territory would be minimal for the red-throated loon, since it likely pairs for life (Cramp and Simmons, 1977) and returns to the same nesting territory each year (Davis, 1972; Furness, 1983; Douglas and Reimchen, 1988). By minimizing the length of time required to lay their eggs, the red-throated loon is better adapted to nesting in areas such as the Beaufort Sea region, where the nesting ponds are ice free for only a short period of time.

In regions where the open water season is much longer than at Toker Point, the period between arrival and nesting is longer (Table 4). An average of 18 d elapsed between arrival of the loons on the nesting ponds and peak nest initiation at Toker Point. In comparison, on the Queen Charlotte Islands, although the loons arrived in mid-April, egg laying did not occur until 10 May to 20 July (Douglas and Reimchen, 1988). On the Shetland Islands, loon pairs arrived in the breeding area at least two months before clutch initiation (Bundy, 1976).

The earlier the nesting ponds thawed at Toker Point, the longer the period of egg laying. The period of egg laying is even more protracted at the southern limits of the red-throated loon's breeding range (Table 4). On the Shetland Islands, eggs were laid over a 38 d period (2 yr average) (Bundy, 1976), compared to a 23 d period (5 yr average) at Toker Point. Similarly, on the Queen Charlotte Islands, egg laying occurred over twice the length of time that it did at Toker Point.

Eggs were incubated for a minimum of 24 d at Toker Point, although some eggs took up to 3 d longer to hatch. The same minimum incubation period of 24 d has been recorded elsewhere for the red-throated loon (Bundy, 1976; Furness, 1983; Douglas and Reimchen, 1988). However, the maximum recorded is 31 d (Douglas and Reimchen, 1988) (Table 4). Factors that contribute to a longer period of incubation in some species are the age and experience of the breeding pair (Ryder, 1980). Interrupted incubation due to human disturbance may also extend the incubation period (Pierce and Simons, 1986).

The time required for chicks to fledge at Toker Point ranged from 43 to 52 d (n = 10). In comparison, chicks on the Shetland Islands have fledged in as few as 38 d (Bundy, 1976) (Table 4). The variation in the number of days required for the loon chick to develop may be partly due to the amount of food each chick receives. Slower growth rates in red-throated loon chicks not receiving adequate food have been reported by Davis (1972). Interrupted feedings due to storms lasting several days, such as the four-day storm that occurred at Toker Point in 1988, might also slow the growth rate of loon chicks. Such has been documented for common terns (Dunn, 1975).

Length of incubation and period from hatch to fledging appears to be unaffected by the length of the ice-free season. On the Queen Charlotte Islands, where the ice-free period is at least 170 d, young red-throated loons fledged an average of 75 d after the onset of clutch initiation. In comparison, it took 74 d for the young to fledge at Toker Point, where there were only 108 ice-free days on average during the five-year study (range: 100-118 d).

TABLE 4. Comparative red-throated loon nesting phenology for Toker Point and two sites with a longer open water season

Region (latitude, longitude)	Date: Peak arrival on ponds	Date: Nest initiation	Number of days: Period between arrival and peak nest initiation	Period of egg laying	Period of incubation	Period from hatch to fledging	Reference
Toker Point (70°N,133°W)	early June	10 June-12 July	18 (5 yr $\bar{X}$)	23 (5 yr $\bar{X}$)	24-27 (n = 13)	43-52 (n = 10)	This study
Unst, Shetland (61°N, 1°W)	mid-March	19 May - 2 July	~ 80	38 (2 yr $\bar{X}$)	24-29 (n = 19)	38-48 (n = 27)	Bundy, 1976
Queen Charlotte Islands (53°N,132°W)	mid-April	10 May -20 July	~ 60	71 (in 10 yr)[1]	24-31 (n = 11)	46-50 (n = 5)	Douglas and Reimchen, 1988

[1]During 10 years, egg laying occurred over a 71 d period, compared to a 23 d period in 5 years at Toker Point.

Mortality

The most common predators of loon eggs at Toker Point were the arctic fox, parasitic jaeger and glaucous gull. The sandhill crane (*Grus canadensis*), several of which nested in the Toker Point study plot each year, probably also took loon eggs. Cranes are known predators of eggs (Reynolds, 1985; Harvey *et al.*, 1968), including red-throated loon eggs (Davis, 1972), and were often seen feeding in the wetlands in the vicinity of loon nests at Toker Point. Although less abundant, the common raven (*Corvus corax*) may have taken some loon eggs (Marquiss and Booth, 1986).

The loon chicks that glaucous gulls were seen taking were all < 10 d old. During the first few days following hatch, young loons are particularly vulnerable to avian predators due to their inability to escape by diving.

Many of the chick losses in the first three weeks may have been due to starvation of the youngest chick in the brood. Braun *et al.* (1968), Davis (1972) and Bergman and Derksen (1977) all found that the youngest chick usually died within two weeks of hatch. Davis (1972) noted that because the eggs hatched a day apart, the oldest chick had an advantage over the other chick in competing for fish brought to them. He found that the youngest chick generally did not get fed until the oldest was satiated; hence it usually starved to death.

Nest Site Fidelity

Gomersall (1986) recorded a 65% reoccupancy of known breeding lochs (n = 157) in three consecutive years on the Shetland Islands. At Toker Point only 42% of the active ponds had nests in all of the first three years of the study (n = 62). The data for Shetland Islands compares more closely to the 53% reoccupancy by nesting pairs of active territories at Toker Point (n = 51). At McConnell River on the Hudson Bay coast, Davis (1972) reported a slightly higher rate of reoccupancy: 59% of the nesting territories (n = 39) were used three years in a row.

Gomersall (1986) and Davis (1972) also investigated the effect of breeding success on reuse of the same pond the following year. Similar to what we found at Toker Point, Davis (1972) noted a trend towards greater reuse of a pond following a successful year, but the difference was not statistically significant. However, on the Shetland Islands the effect of hatching success on reoccupancy of the lochs the following year was significant (Gomersall, 1986).

The degree of reoccupancy of the same nesting ponds by red-throated loons each year may be an indication of the amount of additional nesting habitat available to the loons. The reoccupancy rate would likely be highest in an area nearly full to capacity. If so, then Toker Point, which had the highest frequency of reoccupancy of ponds, had the least amount of additional suitable nesting habitat. Conversely, Nuvorak Point, which had the lowest rate of occupancy of ponds, had the greatest surplus of habitat. Should development occur along the coast of the Beaufort Sea, the impact on loons would likely be less severe if it was located in an area where nesting habitat was not full to capacity.

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