Observations of Loons (*Gavia immer* and *G. stellata*) at a Bog Lake on the Queen Charlotte Islands

T. E. REIMCHEN and S. DOUGLAS

Department of Zoology, University of Alberta, Edmonton, Alberta T6G 2E9
Mailing address: Box 297, Port Clements, Queen Charlotte Islands, British Columbia V0T 1R0

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A small muskeg lake on the Queen Charlotte Islands was frequented in summer by up to 59 Common Loons (*Gavia immer*) and 19 Red-throated Loons (*G. stellata*), mostly non-breeding adults. The former occupied the deeper or central areas of the lake and were most abundant near mid-day, while the latter preferred the shallows and were present from early evening until dawn. Although interactions between the two species were rare, Common Loons were dominant to Red-throated Loons except when the latter were close to shore. During peak abundance, Common Loons congregated in large groups; Red-throated Loons usually occurred in pairs. Common Loons used the lake primarily for foraging, with peak activity in mid-morning and at dusk; the dominant fish species present was Threespine Stickleback (*Gasterosteus aculeatus*). Red-throated Loons obtained much of their food during daily visits to the ocean and foraged only intermittently on the lake. Dive durations in shallow water were approximately 30 s for both species and, in open water, 40 s for Common Loons.

Key Words: Common Loon, *Gavia immer*, Red-throated Loon, *Gavia stellata*, Queen Charlotte Islands, seasonal abundance, diurnal movement, foraging, Threespine Stickleback, *Gasterosteus aculeatus*.

The Queen Charlotte Islands are one of the few areas in western Canada where Common Loons (*Gavia immer*) and Red-throated Loons (*G. stellata*) overlap in their summer distribution. The Common Loon is at the western edge of a continuous range, extending across Canada south of the 60th parallel and north into the Yukon and Alaska. The Red-throated Loon on the islands occupies one of the few southerly breeding areas, their principal range being coastal regions from Alaska to Labrador (Godfrey 1966).

Reproductive biology of loons has received considerable attention (Munro 1945; Sjolander and Agren 1972; McIntyre 1975; Davis 1972; Bundy 1976), yet the activities of non-breeding adults on freshwater are not well known. At a bog lake on the Queen Charlotte Islands, we were able to observe both species and to detail some aspects of their life histories. This study documents seasonal and diurnal movements, habitat preferences, grouping patterns and foraging activity. Other aspects such as vocalizations, behavioral displays, and reactions to predators will be reported separately.

Study Area

Drizzle Lake (53°56'N, 132°05'W) (112 ha) is one of several small lakes in an expanse of muskeg and coniferous forest in the northeast corner of the Queen Charlotte Islands (Figure 1). A large marine inlet lies 2.5 km to the west and open ocean is about 15 km to the north and east. Although winter temperatures are moderated by proximity to the ocean, the lake occasionally has ice cover in December and January. The Drizzle Lake watershed was established as an ecological reserve in 1971, principally for its unusual population of stickleback (*Gasterosteus aculeatus*) (Moodie and Reimchen 1973) and as a representative muskeg area on the Queen Charlotte Islands (Krajina et al. 1978).

Surrounding vegetation includes stands of conifers including Western Red Cedar (*Thuja plicata*), Lodgepole Pine (*Pinus contorta*), and Western Hemlock (*Tsuga heterophylla*), a dense understory of salal (*Gaultheria shallon*), and open areas of *Sphagnum* muskeg. The lake is fed by a stream that drains the adjacent bogs; this results in a deep red staining to the lake, and a corresponding reduction in light penetration (maximum 2 m). Littoral vegetation is sparse and includes *Nuphar luteum*, *Juncus* spp., and *Lilaeopsis occidentalis*. Macro-invertebrates include trichopteran larvae and occasional odonate nymphs. Four species of fish are present, Threespine Stickleback, Cutthroat Trout (*Salmo clarki*), Dolly Varden (*Salvelinus malma*), and juvenile Coho Salmon (*Oncorhynchus kisutch*).

Methods

Records of bird activity were maintained from July to November 1977, and from January to November in 1978 and 1979. From May to August, observations were made on average 5 d per week, from dawn to 09:00, from 19:00 to dusk, and at irregular intervals throughout the rest of the day (weather permitting). In early spring and in fall, shorter day lengths restricted

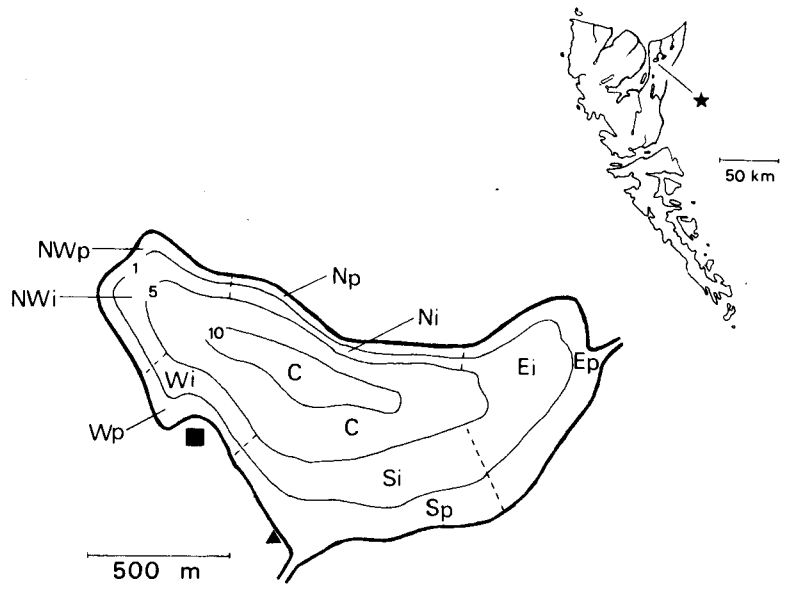


FIGURE 1. Study area. C = center, i = intermediate, p = peripheral. N, S, E, W, NW indicate compass directions. Inset —Queen Charlotte Islands. ■ = observation platform, ▲ = observation blind. Depth contours in metres.

evening observations. Loon activity, including numbers, positions, movement and diving, was recorded on standardized data cards. For recording positions of loons, the lake was visually divided into 11 areas, according to depth (assessed by lake transects) and compass direction (Figure 1). Four small floats were anchored in the southeast and northeast areas of the lake to mark the 1-m and 5-m depth contours. The majority of observations were made with a 20- to 45-power spotting scope from an elevated 4-m platform, allowing visual coverage of 97% of the lake surface. In July and August 1979, observations were made from a blind in the southern corner of the lake, adjacent to a nesting pair of Red-throated Loons. To determine age classes of loons, we observed plumage patterns and bill color at close range with the spotting scope and compared these with descriptions by Palmer (1962). Diving durations were timed to the nearest second.

Distributions of fish were assessed by standard mesh minnow traps, seine, and gillnets (mesh size 13, 25, and 89 mm) at monthly intervals from April to November. Species and length of captured fish were recorded before they were released.

Results

Abundance and Description

Both loons occurred on the lake from April through August, with similar patterns of abundance during the 3 yr of observation (Figure 2). Red-throated Loons (RT) arrived first (29 March 1978, 27 March 1979), their numbers increasing throughout April, and thereafter remaining similar (maximum 19) until the middle of August. Individual Common Loons (CO) occurred irregularly throughout April and May. In June, numbers increased sharply, reaching a maximum (59) in late July, and declined rapidly in August, with occasional birds until November. Peak numbers occurred between 18 July and 25 July in all 3 yr, and in each year this concentration of individuals remained for only 2 d.

All RT, except for a single chick raised on the lake in 1979, were in definitive alternate plumage (at least 2 yr old). As well, CO in spring and summer had reached full adult plumage (at least 3 yr old), although about 10% had a slight mottling of the lores and a reduced expression of the frontal neck band, presumably indicating an incomplete pre-nuptial molt. Both species were in breeding plumage, but only RT nested, one pair in 1977 and 1979, and none in 1978.

RT and CO differed in diurnal patterns of movement (Figure 3). Throughout spring and summer, the majority of RT left the lake from 1 to 3 h after dawn and flew west to the marine inlet. This destination was confirmed by intermittent observations mid-way between the lake and the ocean; they called continuously in flight and could be heard from at least 1 km away. They returned to the lake along similar flight paths,

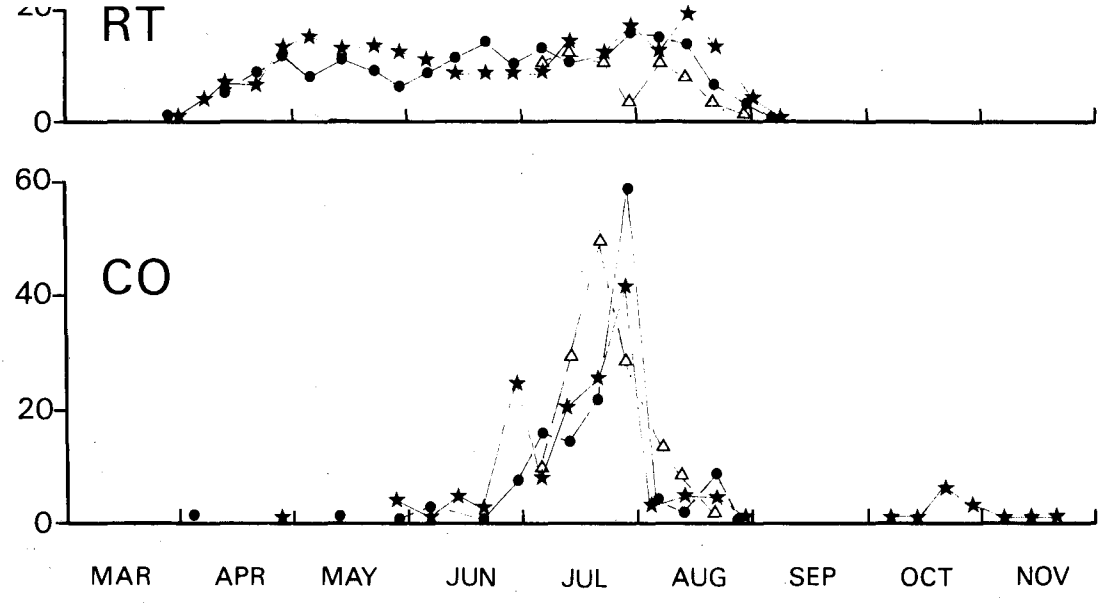


FIGURE 2. Maximum daily numbers of Red-throated Loons and Common Loons on the lake at weekly intervals. △ = 1977, ● = 1978, ★ = 1979.

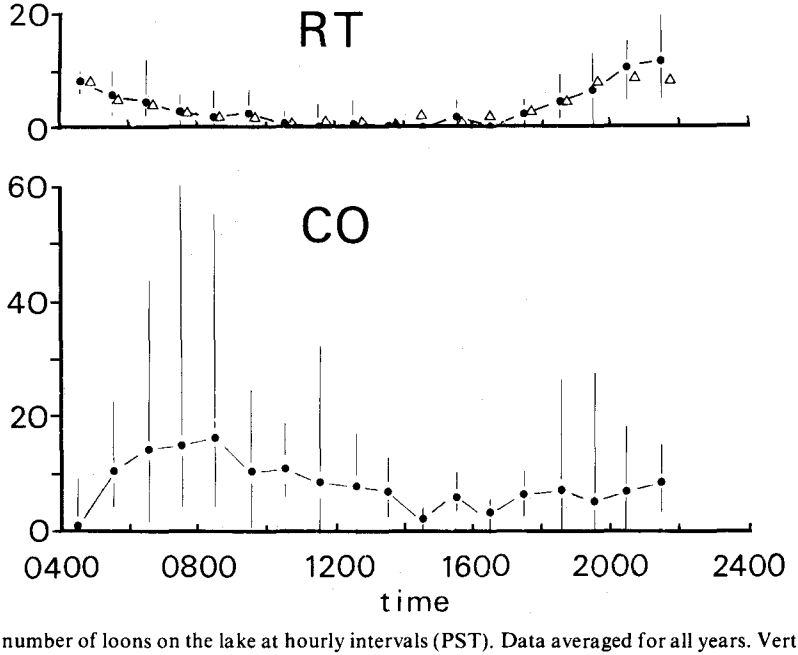
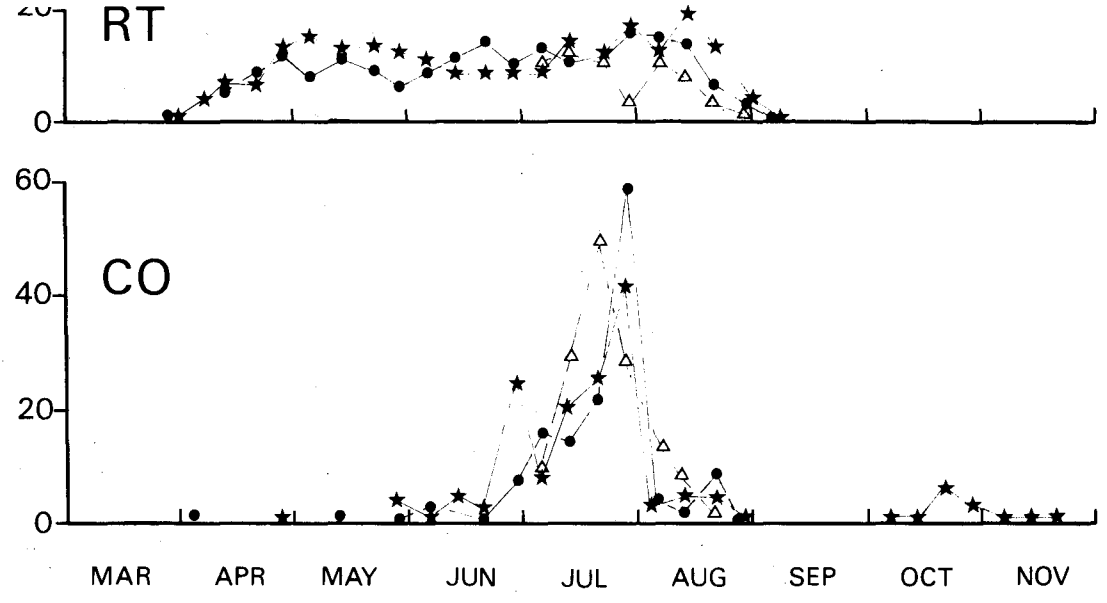


FIGURE 3. Mean number of loons on the lake at hourly intervals (PST). Data averaged for all years. Vertical line indicates 1 SD. △ = Red-throated Loons in April and May; ● = Red-throated Loons in June, July, and August; ● = Common Loons in July.



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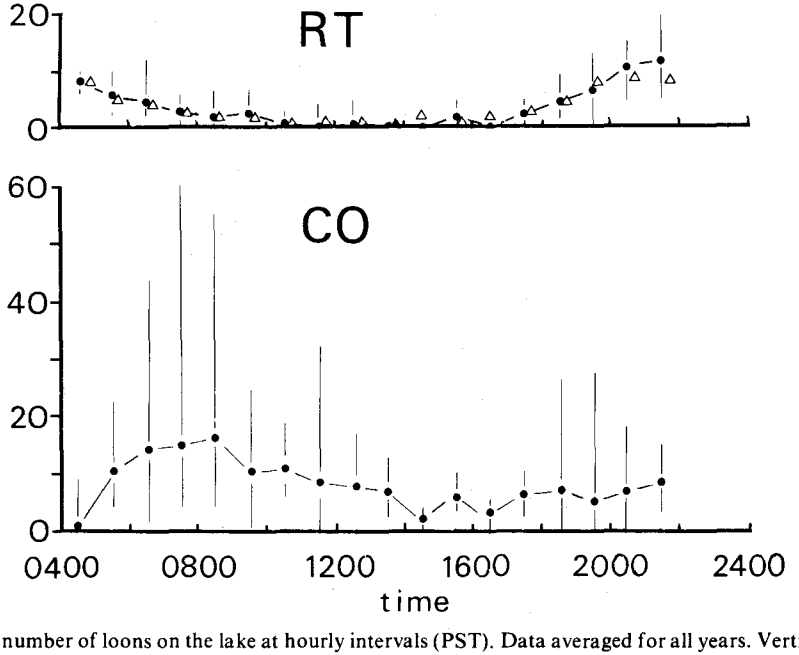

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forming near sunset, and dispersing before dusk. Display, vocalization, and brief flight activity were prevalent within these groups.

CO were more gregarious than RT, with pair associations uncommon. Of 216 CO arriving or departing (1979), 40% were individuals, 16% in pairs, and 44% in groups of three or more (maximum 16). Generally, about half of the CO on the lake occurred in a single group, with the remainder scattered in smaller groups or as individuals (Table 2). During peak numbers in July, aggregations of up to 44 birds were recorded. These large groups were primarily engaged in foraging, and aggressive interactions were rare.

Diving Activity and Prey Capture

Both species foraged in the lake throughout the season, CO more extensively than RT. For all individuals recorded in 1977 and 1978 (RT = 823, CO = 830), 15.2% of RT and 48.1% of CO were diving (chi-square test, $P < 0.001$). RT activity was greatest from 07:00 to 11:00, just prior to their departure from the lake, and again intermittently near sunset. Among CO, it was most extensive from 07:00 to 11:00, least common between 15:00 and 18:00, and increased again towards dusk, often continuing until darkness terminated observations. Spatial distribution of foraging in each species was similar to the general distribution (cf., Table 1). In RT, 70% of all diving was in water less than 1 m deep, while only 15% of CO dove in this region.

In July, when CO were abundant, we observed synchronous diving near shore (10–100 m). For example, a group of 34 birds dove within 10 s of each other and surfaced 20 to 40 s later over a wider area. While some of these individuals dispersed and continued with solitary diving, the remainder merged and dove again synchronously, this pattern continuing for several hours. We observed this type of diving only near shore; in the center of the lake, birds foraged individually or in loose aggregations. We did not see group diving in RT, even when pairs flocked together in June and July.

Mean duration of dives in shallow water was similar in both species: RT, 28.6 s (maximum 43.0, SD = 9.1, N = 36); CO, 30.4 s (maximum 48, SD = 11.9, N = 85). Open-water dives by CO in summer were longer: 41.1 s (maximum 72, SD = 6.2, N = 24).

Prey species in the lake differed in abundance and distribution. Stickleback (10–100 mm) was the only species common throughout the lake, occurring individually or in large schools. The remaining fish species were uncommon, with occasional Cutthroat Trout (200–4000 mm) in surface waters and Dolly Varden (40–100 mm) and juvenile Coho (30–120 mm) in the benthic regions during the day and inshore at dusk. Macro-invertebrates were also uncommon and were restricted to shallow water.

In spring and summer loons swallowed their prey beneath the surface and hence no data on food habits were obtained. In October, however, two CO brought their prey to the surface where it was possible to obtain minimal estimates of capture success and to identify species. Over a 2-wk period, we recorded 187 dives (15–61 per day), the majority of which took place in open water (Wi and C). In total, the loons surfaced with fish in 50.8% of these dives (range 46.1% to 70.4% on different days), and where the fish could be identified (N = 84) the prey was always stickleback (approximate length 50–70 mm). Dive duration averaged 40.6 (maximum 65, SD = 8.4, N = 85) when the loon surfaced without prey and 20.6 s (maximum 38, SD = 5.4, N = 44) when fish were brought to the surface. Manipulation time averaged 18.5 s (SD = 10.0); large dorsal and pelvic spines on these fish must be broken or depressed before they are swallowed.

Interactions

RT and CO were seldom observed within 100 m of each other in open water, the distance being usually maintained by RT slowly swimming away from approaching CO. Occasionally, confrontations occurred when CO encountered RT nearer to shore or in the southern area of the lake. The RT response was usually to fly to another area: this was prefaced by extensive bill-dipping, stretching, or "swim-flying" (McIntyre 1975) directly at the intruding CO. Infrequently, a pair of RT responded with the "plesiosaur race" (Huxley 1923) and associated vocalizations; in such cases, the CO retreated. Aggressive interactions were frequent in the vicinity of the single RT nest. When CO approached within 50 m, the RT, whether on the nest or floating nearby with a chick, dove and attacked the swimming CO from beneath the surface; the CO immediately swim-flew to another part of the lake.

Discussion

There has been a consistent temporal and numerical regularity in RT and CO on Drizzle Lake. RT arrivals in late March and April coincide with occupation of lakes at similar latitudes across their breeding range and are up to 2 mo earlier than at more northerly lakes (Palmer 1962; Dement'ev and Gladkov 1969; Bundy 1976). Presumably the disappearance of ice cover by February allows such early occupation of breeding areas. It is possible that these RT overwinter in British Columbia waters, since those wintering off the western United States begin migrating in April and do not reach Alaskan waters until mid-May (Palmer 1962).

Similarity in numbers from May to August, regularity of evening arrival times and flight paths, and consistency in surface distribution suggest that many

of the same individual RT frequented the lake daily throughout the season. Regular use of lakes by non-breeding adults (possibly 2-yr-old prebreeders) has not, to our knowledge, been documented previously for the species. Bundy (1976), however, refers to congregations of adult RT in spring on the Shetland Islands, where "long inactive periods are spent on larger 'communal' lochs."

Despite the abundance of small fish, RT did not forage extensively on the lake, and presumably did much of their feeding on the ocean, where they regularly spent the day. Movement to the ocean is common for RT that nest on ponds without suitable prey (Bent 1919; Dement'ev and Gladkov 1969; Davis 1972). A RT chick raised on the lake in 1979 was fed only marine fish (Osmeridae and Ammodytidae) in 6 wk of parental feeding (Reimchen and Douglas, unpublished data).

A striking characteristic of CO is the yearly peak abundance for a 2-d period near 20 July. Social flocking in this species within the breeding range has been reported for many areas (Palmer 1962). In southern Ontario, unmated birds and unsuccessful nesters congregated on lakes from mid-May through August (Rummel and Goetzinger 1978), and in Manitoba, groups of 60 to 100 loons foraged on large lakes in June and July (Rand 1948). Flocking has also been observed on lakes in southern British Columbia in May (Munro 1945) and on marine waters in June (Hatler et al. 1978).

In other geographical areas, RT nest on shallow or stained lakes while CO prefer larger and deeper lakes (Cramp and Simmons 1977). The surface distribution on Drizzle Lake, with RT in the shallows of the southeast and CO in the deeper central and northwest areas, corresponds to these generalized habitat preferences. The distribution of RT was generally independent of that of CO, as they occupied the same positions and showed the same daily movements to the ocean throughout the season, including March and April before CO had arrived on the lake. Direct interactions between the two species were limited by this spatial and temporal separation.

Diving durations for CO have been reported in a number of studies and include means of 34 s (Robinson 1923), 39.5 s (McIntyre 1978), 52.1 s (Stewart 1967), 64.4 s (Hatler et al. 1978) and at Drizzle Lake, 30.4 s for inshore dives and 41.1 s for open water. The duration of a dive will reflect the time spent in searching for, pursuing, and manipulating prey (Krebs 1978). Shorter diving times in the littoral regions at Drizzle Lake could result from a high prey density (shorter search time), shallower water (shorter search and pursuit), smaller prey (less manipulation), or a combination of these factors.

The patterns of loon abundance found in this study apply to other lakes on the Queen Charlotte Islands. We have visited about 50 lakes and ponds in this area, and on many of them have seen a similar diurnal movement to the ocean by RT. In three of the largest lakes, there were aggregations of foraging CO in July, and small numbers of non-breeding pairs of RT. Such regular use of lakes by foraging CO may contribute to the morphological divergence of stickleback in this area (Moodie and Reimchen 1976). The reasons for nightly habitation of freshwater by RT and for flocking of CO in the third week of July require further investigation.

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Literature Cited

Bent, A. C. 1919. Life histories of North American diving birds. United States National Museum Bulletin 107. 239 pp.

Bundy, G. 1976. Breeding biology of the Red-throated Diver. Bird Study 23: 249–256.

Cramp, S. and **K. E. L. Simmons.** 1977. Handbook of the birds of Europe, the Middle East and North Africa. Volume 1. Oxford University Press. 722 pp.

Davis, R. A. 1972. A comparative study of the use of habitat by Arctic Loons and Red-throated Loons. Ph.D. thesis, University of Western Ontario, London.

Dement'ev, G. P. and **N. A. Gladkov** (*Editors*). 1969. Birds of the Soviet Union. Volume II. Israel Program for Scientific Translations, Jerusalem. pp. 282–291.

Godfrey, W. E. 1966. The birds of Canada. National Museum of Canada Bulletin 203. 428 pp.

Hatler, D. F., R. W. Campbell, and **A. Dorst.** 1978. Birds of Pacific Rim National Park. British Columbia Provincial Museum Occasional Paper 20. 195 pp.

Huxley, J. S. 1923. Courtship activities in the Red-throated Diver, together with a discussion of the evolution of courtship in birds. Journal of the Linnaean Zoological Society 35: 253–292.

Krajina, V. J., J. B. Foster, J. Pojar, and **T. Carson.** 1978. Ecological Reserves in British Columbia. Ecological Reserves Unit, Ministry of the Environment, Victoria. 269 pp.

Krebs, J. R. 1978. Optimal foraging: decision rules for predators. *In* Behavioral ecology, an evolutionary approach.

Edited by J. R. Krebs and N. B. Davies. Sinauer Associates, Massachusetts. pp. 23–63.

McIntyre, J. W. 1975. Biology and behavior of the Common Loon (*Gavia immer*) with reference to its adaptability in a man-altered environment. Ph.D. thesis, University of Minnesota, Minneapolis.

McIntyre, J. W. 1978. Wintering behavior of Common Loons. Auk 95: 396–403.

Moodie, G. E. E. and **T. E. Reimchen.** 1973. Endemism and conservation of sticklebacks in the Queen Charlotte Islands. Canadian Field-Naturalist 87: 173–175.

Moodie, G. E. E. and **T. E. Reimchen.** 1976. Phenetic variation and habitat differences in *Gasterosteus* populations of the Queen Charlotte Islands. Systematic Zoology 25: 49–61.

Munro, J. A. 1945. Observations of the loon in the Cariboo parklands, British Columbia. Auk 62: 38–49.

Palmer, R. S. 1962. Handbook of North American birds. Volume 1. Yale University Press, New Haven. pp. 20–61.

Rand, A. L. 1948. Summer flocking of the loon, *Gavia immer* (Brun.). Canadian Field-Naturalist 62: 42–43.

Robinson, H. W. 1923. Dive of the Great Northern Diver. British Birds 17: 64.

Rummel, L. and **C. Goetzinger.** 1978. Aggressive display in the Common Loon. Auk 95: 183–186.

Sjolander, S. and **G. Agren.** 1972. Reproductive behavior of the Common Loon. Wilson Bulletin 84: 296–308.

Stewart, P. A. 1967. Diving schedules of a Common Loon and a group of Oldsquaws. Auk 84: 122–123.

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