

# YEAR-ROUND USE OF COASTAL LAKES BY MARBLED MURRELETS<sup>1</sup>

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**Abstract.** Sixty-seven records (from 1909 to 1984) of Marbled Murrelets (*Brachyramphus marmoratus*) using 33 freshwater lakes along the west coast of North America (78.6% in British Columbia, 12.1% in Alaska, 6.1% in Washington, and 3.0% in Oregon) were compiled and analyzed. The preponderance of records from southern British Columbia lakes possibly reflects the abundance of coastal lakes there that are accessible to high numbers of murrelets and observers. Fifty-three of the lake-use records were obtained during the species' breeding season (April through September); 13 were from the nonbreeding season (October to March). Most lakes used were within 20 km of the ocean, but a few murrelets were reported at lakes 50 to 75 km inland (Cultus, Harrison, and Swan Lakes, British Columbia). The multiple records of Marbled Murrelets using Cultus and Harrison Lakes suggest that these lakes are near nesting areas, and as such, are the farthest distances inland Marbled Murrelets can be expected to nest. Five or less individuals usually were reported in each record, although up to 46 were seen in summer on Nitinat Lake, Vancouver Island. Feeding occurred on some lakes in British Columbia, apparently mainly at night: the stomachs of four murrelets contained fingerling sockeye salmon (*Oncorhynchus nerka*), while another stomach contained the remains of salmon fry.

**Key words:** Marbled Murrelet; *Brachyramphus marmoratus*; alcid; inland; lake; feeding; nocturnal behavior; breeding; nonbreeding.

## INTRODUCTION

Marbled Murrelets (*Brachyramphus marmoratus*) nest solitarily along much of the coast of the north Pacific Ocean (Drent and Guiguet 1961, Sealy et al. 1982, Day et al. 1983, Sealy and Carter 1984). Although the nesting biology of the Marbled Murrelet is little known, the species is abundant and distributed widely usually within a few kilometers of shore (Sealy 1975, Sealy and Carter 1984). Twelve nests of this species have been found: on tree branches (Kuz yakin 1963, Binford et al. 1975), on open ground (Ornithological Society of Japan 1975, Simons 1980, Day et al. 1983), and in cavities (Johnston and Carter 1985). Murrelets have been presumed to fly directly to and from the ocean and their nests during the night (Simons 1980, Hirsch et al. 1981, Carter and Sealy 1983, Carter 1984). Notwithstanding this presumption, they have been observed using freshwater lakes during the breeding and nonbreeding seasons. To determine the nature of this use, we compiled records of Marbled Murrelets at lakes on the west coast of North America. These records reveal a more diverse use of inland habitats by Marbled Murrelets than has been recognized.

## METHODS

We compiled records of Marbled Murrelets at lakes throughout their range in North America (Alaska to California). We defined a lake record as one or more murrelets observed sitting

on the surface of a lake, flying over (or near) a lake, collected on a lake, or otherwise found "at lakes." Records were obtained from: literature; examination of specimens in most major museums in North America, and many smaller ones on the west coast; field notes, sight records, and nest records housed in the British Columbia Provincial Museum (Victoria); and through solicitation of workers who have studied seabirds along the west coast. We considered records between April and September and between October and March to be from the breeding and nonbreeding seasons, respectively (see Sealy 1974, Carter 1984, Carter and Sealy 1984). We measured the shortest distance between the shorelines of lakes and salt water, using topographic maps (1:250,000). Distances reported are minimal because murrelets were often recorded at the far reaches of lakes.

## RESULTS AND DISCUSSION

### RECORDS OF MARBLED MURRELETS AT LAKES

Sixty-seven records of Marbled Murrelets at 33 lakes have been reported on the west coast of North America from 1909 through 1984 (Table 1). Most of these lakes were in British Columbia (78.8%), while 12.1, 6.1, and 3.0% were in Alaska, Washington, and Oregon, respectively. Most lakes in British Columbia (88.5%) were on Vancouver Island and the adjacent mainland. Several factors apparently contribute to the preponderance of records from southern British Columbia: the abundance, distribution and access of lakes to murrelets and observers, observer effort, and the size of Marbled Murrelet populations. South of British Columbia to the southern limit of

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TABLE 1. Records of Marbled Murrelets at lakes along the west coast of North America ( $n = 67$  records at 33 lakes).

Record no.	Location	Date	No. birds <sup>1</sup>	Notes	Source(s) <sup>2</sup>
Alaska					
1	Harlequin Lake	25 Jun 1980	2	at lake	Patten (1982)
2	Iliama Lake	27 Jul 1940	some	on water	Gabrielson (1944), Gabrielson and Lincoln (1959) [USNM 589639]
3	Lake Aleknagik	14 Jun 1980	2	on water	Gibson (1980)
4	Little Kitoi Lake	12 Jun 1977	5-7	on water	D. J. Forsell ( <i>in litt.</i> )
5	Little Kitoi Lake	16 Jul 1977	15-20	flying	D. J. Forsell ( <i>in litt.</i> )
6	Little Kitoi Lake	17 Jul 1977	50+	flying	D. J. Forsell ( <i>in litt.</i> )
7	Little Kitoi Lake	2 Aug 1977	many	flying	D. J. Forsell ( <i>in litt.</i> )
British Columbia					
8	Alouette Lake	30 Nov 1981	1	at lake	R. W. Campbell ( <i>in litt.</i> )
9	Bobs Lake	24 Jun 1981	1	at lake	R. W. Campbell ( <i>in litt.</i> )
10	Cameron Lake	1 Oct 1981	1	at lake	R. W. Campbell ( <i>in litt.</i> )
11	Campbell Lake	1 Jul 1922		heard calling	T. Pearse (BCPM-FN)
12	Campbell Lake	9 May 1975	1	at lake	R. W. Campbell ( <i>in litt.</i> )
13	Campbell Lake	summer	some	heard calling	H. T. Laing ( <i>in litt.</i> )
14	Comox Lake	summer	some	heard calling	H. T. Laing ( <i>in litt.</i> )
15	Cowichan Lake	28 Nov 1923	many	on water	Munro (1924)
16	Cowichan Lake	7 Jan 1924	12	on water	Munro and Cowan (1947) [ROM 26, 2, 28, 1; ROM 82760]
17	Cowichan Lake	24 Dec 1924	8	at lake	Simpson (1925)
18	Cowichan Lake	27 Dec 1925	24	at lake	Simpson (1926)
19	Cowichan Lake	27 Dec 1926	30	at lake	Simpson (1927)
20	Cowichan Lake	May-Jun	some	flying	Munro (1924)
21	Cultus Lake	winter 1932-1933	many	on water	[ROM 34, 2, 27, 1 label]
22	Cultus Lake	4 May 1933	1	on water	[ROM 34, 2, 27, 1]
23	Cultus Lake	28 Dec 1936	6	at lake	Ricker (1937)
24	Cultus Lake	11 Apr 1959	6	at lake	R. W. Campbell ( <i>in litt.</i> )
25	Cultus Lake	13 Jun 1964	1	at lake	Boggs and Boggs (1964)
26	Drizzle Lake	Jul	2	on water	Reimchen and Douglas (1984)
27	Eden Lake	summer	some	on water	Guiguet (1956, <i>in litt.</i> )
28	Gray-Garrett Lakes	1 Aug 1975	8+	flying	H. A. Telosky (BCPM-SRF)
29	Great Central Lake	4 May 1941	3	on water	G. C. Carl (BCPM-FN) <sup>3</sup>
30	Great Central Lake	23 Sep 1970	5+	on water	W. E. Barraclough ( <i>in litt.</i> )
31	Great Central Lake	13 Jul 1971	1	flying	W. E. Barraclough ( <i>in litt.</i> )
32	Great Central Lake	1 Aug 1978	some	on water	W. E. Barraclough ( <i>in litt.</i> )
33	Great Central Lake	6 Jun 1984	9	on water	K. Vermeer ( <i>in litt.</i> )
34	Harrison Lake	3 Dec 1926	6	on water	Stewart (1927) [BCPM 6162]
35	Harrison Lake	28 Apr 1928	14-16	on water	Brooks (1928) [BCPM 6167] <sup>4</sup>
36	Harrison Lake	13 Dec 1980	1	at lake	R. W. Campbell ( <i>in litt.</i> )
37	Harrison Lake	3 Jan 1981	2	at lake	R. W. Campbell ( <i>in litt.</i> )
38	Henderson Lake	10 Nov 1922	many	on water	Munro (1923, 1924)
39	Henderson Lake	25 Jun 1982	2	on water	Sealy and Carter (1984)
40	Kantm Lake	16 Jun 1982	1	flying	Sealy and Carter (1984)
41	Kennedy Lake	28 Jun 1925	some	flying	Darcus (1927)
42	Kennedy Lake	29 Jun 1925	some	on water	Darcus (1927), Young (1927)
43	Kennedy Lake	19 Jun 1969	8	on water	Campbell (1970)
44	Kennedy Lake	2 Jun 1978	1	at lake	R. W. Campbell ( <i>in litt.</i> )
45	Kennedy Lake	7 Jun 1984	2	on water	K. Vermeer ( <i>in litt.</i> )
46	Kennedy Lake	19 Jun 1984	4	on water	K. Vermeer ( <i>in litt.</i> )
47	Kennedy Lake	20 Jun 1984	7	on water	K. Vermeer ( <i>in litt.</i> )
48	Kennedy Lake	26 Jun 1984	2	on water	K. Vermeer ( <i>in litt.</i> )
49	Kennedy Lake	3 Jul 1984	7	on water	K. Vermeer ( <i>in litt.</i> )
50	Kumara Lake	19 Aug 1974	some	at lake	R. A. Cannings (BCPM-SRF)
51	Nimpkish Lake	May 1975	2	at lake	R. W. Campbell ( <i>in litt.</i> )
52	Nimpkish Lake	14 Jun 1984	5	on water	K. Vermeer ( <i>in litt.</i> )
53	Nitinat Lake	21 Jun 1984	46	on water	K. Vermeer ( <i>in litt.</i> )
54	Pitt Lake	11 May 1963	2	on water	R. W. Campbell ( <i>in litt.</i> )
55	Pitt Lake	11 Jun 1973	2	on water	W. C. Weber (BCPM-SRF)
56	Pitt Lake	4 May 1975	1	at lake	R. W. Campbell ( <i>in litt.</i> )
57	Powell Lake	7 Aug 1979	1	on water	C. H. Burton (BCPM-BCNRS)
58	Powell Lake	13 Jun 1981	3	at lake	R. W. Campbell ( <i>in litt.</i> )
59	Ruby Lake	11 Jun 1981	1	at lake	R. W. Campbell ( <i>in litt.</i> )
60	Swan Lake	Jun 1979	1	at lake	R. W. Campbell ( <i>in litt.</i> )
61	Tsusiat Lake	14 Jun 1982	some	heard calling	T. A. Carson ( <i>in litt.</i> )
62	Vernon Lake	15 Jun 1984	5	on water	K. Vermeer ( <i>in litt.</i> )

TABLE 1. Continued.

Record no.	Location	Date	No. birds <sup>1</sup>	Notes	Source(s) <sup>2</sup>
63	Victoria Lake	15 Aug 1981	5	at lake	R. W. Campbell ( <i>in litt.</i> )
64	Woss Lake	15 Jun 1984	9	on water	K. Vermeer ( <i>in litt.</i> )
	Washington				
65	Lake Quinalt	18 Jul 1964	3	flying	Boggs and Boggs (1964)
66	Lake Washington	winter	some	on water	Dawson and Bowles (1909)
	Oregon				
67	Devil's Lake	4 Sep 1933	1	on ground	Jewett (1934), Gabrielson and Jewett (1940)

<sup>1</sup> All records are of after-hatching-year birds except for record nos. 43 (1 bird), 57 and 67 which were hatching-year birds.

<sup>2</sup> Sources in square brackets refer to specimens housed in the British Columbia Provincial Museum (BCPM), Royal Ontario Museum (ROM), and the U.S. National Museum (USNM). Other sources housed in the BCPM include field notes (FN), sight record files (SRF), and nest records scheme (BCNRS).

<sup>3</sup> Carl indicated that these birds were collected at "Camp 6" while he was en route to Stamp Falls. This location is presumed to be Great Central Lake through conversation with local people.

<sup>4</sup> This specimen bears the date 25 April 1925, the same locality and plumage as reported by Brooks (1928), but lacks a collector's name.

the Marbled Murrelet's range in California (Sealy et al. 1982), Marbled Murrelets and coastal lakes are less abundant. In Alaska, where Marbled Murrelets are most abundant, observer frequency is low. Nevertheless, records of Marbled Murrelets at lakes are widespread.

The behavior of murrelets at lakes is little known. At 20 lakes where it was known if birds were on the water or flying, 85.0% of lakes had been reported to have murrelets on the water. Only a few records were based on vocalizations heard at night (record nos. 11, 13, 14 and 61). Thus, most records presumably were obtained during daytime. Most records (46.3%) reported  $\leq 5$  murrelets at lakes. In most cases, however, we could not determine how much of the lake had been surveyed. Record nos. 41 to 49 were of birds observed in Clayoquot Arm of Kennedy Lake, the least accessible portion of the lake, and the farthest from roads. Here, single or groups of 2 murrelets were dispersed widely as noted at other lakes (Munro 1924; Brooks 1928; K. Vermeer, *in litt.*, 19 December 1984). Since most lakes were about 30 km long (range 2 to 130 km), it is likely that the actual numbers of murrelets using lakes are higher than reported. Four records reported between 20 and 50 murrelets (record nos. 6, 18, 19, and 53).

#### FEEDING IN LAKES

Collected Marbled Murrelets had been feeding in lakes. In record no. 29, G. C. Carl noted that the stomachs of 3 birds contained 1, 2, and 5 yearling Kokanee (*Oncorhynchus nerka kenerlyi*), respectively. In record no. 22, W. E. Ricker found that 1 stomach contained 2 fingerling sockeye (*O. nerka*). In record no. 35, R. M. Stewart noted that "the stomach was full of small fish which looked like salmon fry [*Oncorhynchus* or *Salmo* sp.]." Observational records suggest feeding, as well. W. E. Barraclough (*in litt.*, 31 March 1981) and T. Gjernes used a spotlight to observe murrelets diving

and "presumably feeding," among flocks of Mew Gulls (*Larus canus*) in the middle of a lake at night (record nos. 30 and 32, also see Guiguet 1971). J. A. Munro observed murrelets "diving and apparently feeding in deep water, some distance out from shore" (record no. 15).

Many of the lakes on which murrelets have been recorded are large nurseries for juvenile salmon (Foerster 1968, Robinson and Barraclough 1978). Juvenile salmon occur in the center of lakes at night (Pella 1964), where Barraclough observed murrelets. Barraclough (*in litt.*) further remarked that, in summer at Great Central Lake, juvenile sockeye migrate from depths of 45 to 90 m in the day to near the surface (0 to 30 m) after sunset until shortly before dawn. He recorded murrelets at 20:15, 00:30, and 23:00 hr (PDT) in record nos. 30 to 32, respectively. Murrelets may feed often at night when fish are available closer to the surface of lakes. Murrelets also feed at night on the ocean (Carter and Sealy 1984). Juvenile salmon occasionally undergo "dawn rises" (Robinson and Barraclough 1975), making them available near the surface in the first few hours of daylight. Observations of murrelets on lakes during the day may suggest that they are exploiting prolonged availability of prey. Guiguet (1956) reported murrelets taking off from Eden Lake at dawn, circling to heights, and flying towards the ocean. T. E. Reimchen (*in litt.*, 24 June 1981) recorded Marbled Murrelets once (record no. 26) despite hundreds of daylight hours at Drizzle Lake, yet he occasionally heard wingbeats presumably of this species landing on the lake at night and leaving before dawn.

#### REGULARITY OF USE OF LAKES

The anecdotal nature of observations of Marbled Murrelets at lakes and nocturnal use of lakes by murrelets make it difficult to determine the regularity of use of lakes. Only Kennedy and Little Kitoi lakes have more than

one record in the same summer (Table 1). Similarly, only Cowichan and Cultus lakes have more than one record in the same winter (Table 1). Six lakes (18.2%) have records of murrelets in different summers, three lakes (9.1%) have records in different winters, and four lakes (12.1%) have records in both summer and winter. Brooks (1928) and Munro (1924) further noted that murrelets occurred regularly during winter at Harrison and Cowichan lakes, respectively. Ricker (1934) must have observed murrelets regularly in winter at Cultus Lake because he figured a murrelet in basic plumage in a diagram that summarized predators of sockeye salmon at the lake. Some murrelets probably use lakes regularly during the breeding season. Use during the nonbreeding season is restricted to coastal lakes that regularly do not freeze over which occur from southern British Columbia south (Titus 1969, Allen 1977).

#### IMPORTANCE OF LAKE USE TO MARBLED MURRELETS

The 67 records above indicate that use of lakes is a widespread and regular behavior of at least some Marbled Murrelets on the west coast of North America. The Asiatic subspecies of the Marbled Murrelet (*B. m. perdix*) also uses lakes in summer along the coasts of Sakhalin and Kamchatka (Koslova 1957, Vyatkin 1981), but few details are available. Records of Asiatic Marbled Murrelets (Sealy et al. 1982) and other alcids at lakes in North America that are hundreds to thousands of kilometers from salt water, represent extralimital occurrences of disoriented individuals.

Most lakes used by Marbled Murrelets are within 20 km of the ocean. The few records of murrelets at lakes from 50 to 75 km inland (Cultus, Harrison, and Swan lakes) represent the farthest inland records known (Carter and Sealy 1983, unpubl.). The regular use of Cultus and Harrison lakes suggests that these lakes are near nesting areas and reveal the farthest distances inland Marbled Murrelets can be suspected to nest. Nesting has been confirmed up to 35 km inland (Carter and Sealy, unpubl.). All lakes used by Marbled Murrelets presumably occur within potential nesting habitats. This is supported by two records of hatching-year birds (record nos. 43, 56), one record of a downy chick (record no. 66), and one record of a female with a well-developed ovum (record no. 35) at lakes. During the breeding season, Marbled Murrelets may supplement their diets or obtain fish for their chicks from lakes, thus promoting nesting further inland. Use of Alouette and Pitt lakes (<20 km inland) could lead to use of Cultus and Harrison lakes farther inland (53 and 73 km inland, respectively). In

forested areas, lakes provide access to non-coastal tree-nesting habitat. Binford et al. (1975) speculated that Marbled Murrelets select old-growth coniferous trees with easy access to branches on which to nest. Thus, adult murrelets may stage and feed on lakes near their nests. Fledglings, on the other hand, may use lakes while en route to the ocean (Carter and Sealy, unpubl.).

Use of lakes by murrelets during the nonbreeding season probably occurs in conjunction with visits to nesting areas. Juvenile salmon are present in lakes during the winter but are deeper and less accessible than in summer (Robinson and Barraclough 1975). Nesting areas are visited in the nonbreeding season at night and at dawn in California where few or no lakes occur nearby (Chase and Paxton 1966, Singer and Verardo 1975, Winter and Laymon 1979, SOWLS et al. 1980, R. A. Erickson, pers. comm.). Cassin's Auklets (*Ptychoramphus aleuticus*) and Common Murres (*Uria aalge*) also visit nesting areas regularly during the nonbreeding season, primarily to defend nest sites in high-density nesting situations and to court (Manuwal 1974; Birkhead 1976; M. P. Harris, pers. comm.; Carter, pers. observ.). Since murrelets nest solitarily, we suspect that limited use of lakes in winter possibly is related to such activities as courtship, pairbond maintenance, and prospecting.

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