

DISTRIBUTION, BREEDING RECORDS, AND CONSERVATION PROBLEMS OF THE MARBLED MURRELET IN ALASKA

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Abstract. The current range of the Marbled Murrelet (*Brachyramphus marmoratus*) in Alaska extends from the southeastern border to the western Aleutians, based on distribution at sea. Breeding may occur throughout this range, based on nest records, collection of adults in breeding condition, and inland records of chicks and fledglings. Populations may have been higher in the Aleutian Islands before foxes were introduced there. Qualitative published reports and recent partial surveys of nearshore waters have suggested a population of approximately 250,000. The greatest numbers are in southeastern Alaska and the next largest numbers in Prince William Sound. The population is smaller but occurs continuously west to the Kodiak; south and west of there the species becomes sparse and localized. Highest numbers of Marbled Murrelets in Alaskan waters coincide in general with large areas of coastal old-growth forest. Problems that may affect Marbled Murrelet populations in Alaska include mortality from oil pollution and in fishing nets. Logging of old-growth forests is probably the greatest threat; logging could reduce Alaskan populations of Marbled Murrelets substantially, since most of the state's population is in areas where logging is expanding. The Alaskan population is the largest in North America, and major declines in this state would therefore be of continental significance.

Key words: Alaska; *Brachyramphus marmoratus*; distribution; inland sightings; Marbled Murrelet; nest records; population size.

INTRODUCTION

The state of Alaska is probably the population center of the Marbled Murrelet (*Brachyramphus marmoratus*) in North America at present. The species is found regularly from the western Aleutian Islands to southeastern Alaska and, in some cases, is the most abundant seabird. The general distribution of the species is well known, but numbers have not been surveyed quantitatively and at present the population can only be estimated from partial surveys. In Alaska the species is known to nest both on the ground (Day et al. 1983) and in trees (Quinlan and Hughes 1990). However, the relative distribution and importance of the two types of nesting habitat remain uncertain. Breeding has been confirmed from southeastern Alaska to Kodiak; breeding is suspected farther west, but no nests have yet been found there. The Kittlitz's Murrelet (*B. brevirostris*), which nests exclusively on the ground (Day et al. 1983), is sympatric over most of the Marbled Murrelet's range in Alaska, being absent only in part of the southeastern panhandle. Similarities between ground nests and eggs of the two species make the specific identification of the infrequently-found nests difficult.

In this paper I first review distribution at sea

and estimates of population size of the Marbled Murrelet in Alaska through the end of 1989. Records of nests, birds at freshwater lakes, and young birds at inland sites were reviewed recently by Day et al. (1983) and Carter and Sealy (1986, 1987), respectively. Since these accounts were published, one confirmed tree nest and several other indications of breeding have been discovered and are presented here. Finally, I summarize potential threats to Marbled Murrelet populations in Alaska.

DISTRIBUTION AND NUMBERS AT SEA

Data on the distribution and numbers of Marbled Murrelets in Alaska are scanty. The relative distribution of the species has been well known for some time and is documented in the literature. Numbers have not been surveyed systematically in most areas, however, owing to the length and remoteness of the Alaskan coast; the shoreline of Prince William Sound is approximately 5,000 km (unpubl. data, U.S. Fish and Wildlife Service), and length of the coast of Alaska has been estimated at 50,000 to 80,000 km.

Marbled Murrelets are found along the coast from southeastern Alaska to the western Aleutian Islands (Kessel and Gibson 1978). Areas of

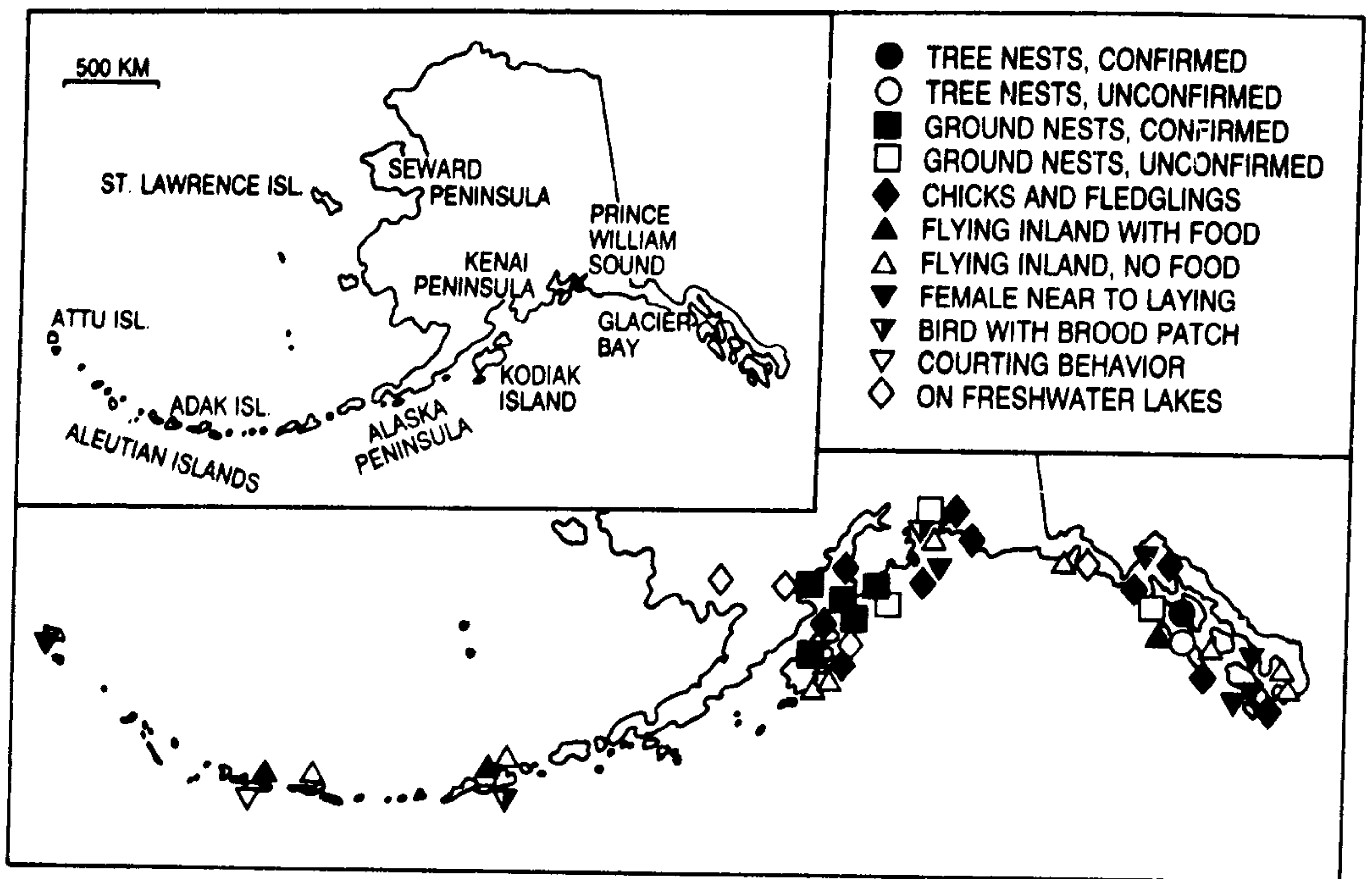


FIG. 1. Evidence of Marbled Murrelet breeding status in Alaska through 1989. One additional record, an unconfirmed ground nest, has been reported from the Seward Peninsula. Major place names are shown in the insert.

greatest abundance are southeastern Alaska, especially in Glacier Bay and LeConte Bay, and Prince William Sound (locations of major place names are given in Fig. 1). In these areas, observers have referred to the Marbled Murrelet as the most common of all seabirds (Grinnell 1910, Willett 1915, Bailey 1927, Jewett 1942, Gabrielson 1944, Gabrielson and Lincoln 1959, Isleib and Kessel 1973, Oakley and Kuletz 1979). The species is encountered regularly at lower densities, with some local concentrations, on the Gulf of Alaska coast near Yakutat (Shortt 1939, Gabrielson and Lincoln 1959) and from the Kenai Peninsula westward along the entire length of the Alaska Peninsula (Chapman 1902; Osgood 1904; Giannini 1917; Calahane 1944, 1959; Gabrielson and Lincoln 1959; Bailey 1977; Kessel and Gibson 1978; Bailey and Faust 1980, 1981, 1984). The species is also seen regularly in waters off Kodiak and adjacent large islands (Friedmann 1935, Cahalane 1943, Forsell and Gould 1981), but smaller barren islands in the western Gulf of Alaska have sparse (Bailey 1976, Bailey and Faust 1984) or no (Bailey 1978; Bailey and Faust 1980, 1981) populations.

In the Aleutians, small numbers of Marbled Murrelets are found at a few widely separated large islands with protected bays, from Unalaska Island in the east to Attu Island in the extreme west (Nelson 1887, Clark 1910, Bailey 1925, Murie 1959, Byrd et al. 1974, Kessel and Gibson 1978, U.S. Fish and Wildlife Service 1980, Nysewander et al. 1982, Bailey and Trapp 1986). Marbled Murrelets, like many seabirds, may have been more numerous in the Aleutian Islands before foxes were introduced there (Murie 1959, Jones and Byrd 1979). The northwestern limit of distribution appears to be Bristol Bay, where there have been a few sightings (Nelson 1883, Gabrielson and Lincoln 1959, Bartonek and Gibson 1972, Gould et al. 1982). Only isolated records exist beyond that point, including one from the Pribilof Islands (Hanna 1920), two at St. Lawrence Island on one occasion and three on another (Bedard 1966, Kessel 1989), and one at Little Diomed Island (Kozlova 1957).

Marbled Murrelets are most common in protected bays (Bailey 1977, Bailey and Faust 1981, Gould et al. 1982), but also occur in open waters of sheltered areas such as Prince William Sound

(Nysewander and Knudtson 1977, Irons et al. 1985). Small numbers are seen at sea over the continental shelf in all months except December through February (Gould et al. 1982). Flocks of Marbled Murrelets were observed offshore in July to August 1969 in Bristol Bay (Bartonek and Gibson 1972), and in April 1987 and 1988 approximately 60 km offshore in the northeastern Gulf of Alaska, over the Fairweather Grounds and south of Prince William Sound (M. McAllister, pers. comm.).

The Marbled Murrelet probably is resident year-round throughout the south coast of Alaska and the Aleutians (Kessel and Gibson 1978). However, there are local seasonal movements, indicated by lower numbers in Prince William Sound during the nonbreeding season (approximately September to mid-April; Isleib and Kessel 1973, Dwyer et al. 1976, Irons et al. 1985). The species remains in the Kodiak archipelago during winter, according to surveys conducted in November and February (Forsell and Gould 1981). Birds are common to abundant in southeastern Alaska in winter (Cantwell 1898, Gabrielson and Lincoln 1959, Trapp 1982), although numbers in Glacier Bay are lower in the nonbreeding season than in summer (G. Vequist, pers. comm.). Isleib and Eberhardt (1975) suggested that some Marbled Murrelets of the northern Gulf of Alaska may overwinter in bays of southeastern Alaska and British Columbia.

The sizes of Marbled Murrelet populations in Alaska are poorly known. Local numbers have been estimated in two areas, and one estimate has been made of the statewide population. A survey by boat of Prince William Sound in 1972-73, including both nearshore and open waters, resulted in estimates of approximately 104,000 birds in early August and 22,000 birds in March (Dwyer et al. 1976). Isleib and Kessel (1973) reported an estimate of 250,000 birds for Prince William Sound, based on a survey in July 1972. Isleib and Kessel (1973) suggested that the population of Prince William Sound together with the nearby coast of the Gulf of Alaska might be "several 100,000's, probably 1,000,000's." Winter populations of *Brachyramphus* murrelets, mostly Marbled, near Kodiak Island were estimated at 13,000 birds (Forsell and Gould 1981). Other surveys have given numbers of Marbled Murrelets sighted in shoreline transects without attempting to estimate total numbers in the area. Relative densities in the northern Gulf of Alaska have ranged from 0.1 to 14.9 birds per km of

shoreline (Bailey 1977, Baird 1980, Irons et al. 1985, Nishimoto and Rice 1987, Hogan and Irons 1988). Surveys of Marbled Murrelets from southeastern Alaska to the tip of the Alaska Peninsula have been conducted by M. McAllister (pers. comm.) during 6 years of commercial fishing between 1981 and 1988. Southeastern Alaska was surveyed in January and from June through September, other areas in April and May. Birds were counted from a herring vessel during most daylight periods that the boat was under way between seining locations. The observer stood approximately 6 feet above the water. Transect widths varied with viewing conditions but ranged up to 0.4 km (M. McAllister, pers. comm.). Based on his records of surveys, McAllister (pers. comm.) estimates that the total Alaskan population may be 250,000 birds. Estimates of major concentrations include 75,000 to 150,000 birds in southeastern Alaska during summer (June to mid-September), 20,000 to 40,000 birds in Prince William Sound in April, and an even distribution along the northern and western Gulf of Alaska coast in April and May, except for approximately 4,000 birds near western Kodiak Island and 2,000 birds at Chignik Bay on the Alaska Peninsula (M. McAllister, pers. comm.).

Published and unpublished observations on Marbled Murrelet numbers and distribution agree that the highest numbers in the state are concentrated in southeastern Alaska (from Glacier Bay to the international border) with a secondary concentration in Prince William Sound and much smaller numbers west of there. We have only one statewide estimate, 250,000 birds (M. McAllister, pers. comm.). McAllister's estimate needs to be corroborated by statistically-designed surveys; however, his results agree reasonably well with other estimates for Prince William Sound in winter (Dwyer et al. 1976) and for Kodiak (Forsell and Gould 1981), which suggests that McAllister's estimate of the statewide population is useful as a general indication of its size. The estimate of several million Marbled Murrelets for the northern Gulf of Alaska by Isleib and Kessel (1973) was a "long-shot guesstimate" based on extensive field experience but not surveys (Isleib and Kessel 1973:38). Discrepancies between population estimates can only be resolved in the future by systematic surveys.

TREE NESTS

Only one tree nest has been located in Alaska and confirmed by observation of an adult on the

nest, and one additional tree nest is suggested by anecdotal evidence.

Confirmed

Baranof Island, near Kelp Bay, southeastern Alaska (approximately 57°15'N, 135°00'W); 4 June 1984. Quinlan and Hughes (1990) used telemetry to locate a bird incubating on a moss-covered branch in an old-growth mountain hemlock (*Tsuga mertensiana*). The tree was in an open stand on a steep slope near timberline at 348 m elevation and about 1.2 km from salt water. Nest records and other evidence of breeding are shown in Fig. 1.

Unconfirmed

There is one casual report from Kuiu Island (56°35'N, 134°0'W) in southeastern Alaska. On an unknown date in the mid 1970's, a logger reported that "a little brown helldiver" with "a pale green egg" dropped from a tree as he felled it (R. Swanson, via J. H. Hughes, pers. comm.).

GROUND NESTS

Alaska is the only state where Marbled Murrelets are known to nest on the ground in treeless areas. Five ground nests of Marbled Murrelets in Alaska have been identified with certainty, based on sighting of the incubating bird. For four additional ground nests, we lack observations of the adult bird. Since nests of the Kittlitz's Murrelet resemble ground nests of the Marbled Murrelet and eggs of the two species are similar, we cannot be certain of the species to which these nests belong (Day et al. 1983).

Confirmed

Augustine Island, Cook Inlet, southcentral Alaska (59°24'N, 153°24'W); 27 June 1959. The adult bird was observed. The egg rested on bare lava rock (Day et al. 1983). The egg is in the United States Museum of Natural History (#41778).

Kodiak Island, on Pyramid Peak (or Pyramid Mountain; Orth 1967), southcentral Alaska (57°48'N, 152°34'W); 3 June 1962. In a shallow niche at 690 m elevation, 6.2 km from the coast. The bird and egg were seen, and the egg was collected (Hoeman 1965), but the location of the egg is unknown (Day et al. 1983).

East Amatuli Island, Barren Islands, southcentral Alaska (58°55'N, 151°59'W); 8 July 1978. The nest was in a shallow depression on partially-vegetated soil surrounded by tundra, 68 m above

the sea and 75 m from the shore. The adult, egg, and chick were observed (Simons 1980).

East Amatuli Island; 6 July 1979. Under a 1.5 m high rock ledge on a slope covered with grass and heath, 75 m from the foregoing nest. The adult, egg, and chick were observed (Hirsch et al. 1981).

Port Chatham, Kenai Peninsula, southcentral Alaska (approximately 59°15'N, 151°45'W); 2 July 1981. In a cavity under a rock ledge at 710 m elevation, 1–2 km from salt water. The ground nearby was covered with moss, but the egg rested on bare rock. The immediate area was sparsely vegetated, but lower slopes were heavily forested with spruce (*Picea sitchensis*). A bird was photographed on the nest (Johnston and Carter 1985).

Unconfirmed

Pye Islands, near Kenai Peninsula, southcentral Alaska (59°21'N, 150°25'W); 6 July 1976. The nest was on Outer Island in heavy grass at 150 m elevation. This nest was first published as Kittlitz's Murrelet nest by Bailey (1977), but was later considered to be a Marbled Murrelet nest by Day et al. (1983) on the basis of the surrounding vegetation, egg color, and species of adults seen near the island. No adults were identified on the nest itself.

Barry Arm, Prince William Sound (approximately 61°07'N, 148°07'W); 4 July 1987. David Ward and David Douglas (U.S. Fish and Wildlife Service, Anchorage, Alaska) flushed an unidentified murrelet from a sparsely vegetated talus slope above the lower Coxe Glacier. They found a nest in the shelter of a large boulder; the egg lay in a slight depression on bare ground, with moss and a few twigs nearby. It was at approximately 150 m elevation and 0.5 km from salt water, and was 30 m above a stream that ran parallel to the glacier. Ward and Douglas photographed the nest but the adult was not observed again (D. Ward, pers. comm.). According to L. Kiff (pers. comm.), a photograph suggests the color of a Marbled rather than a Kittlitz's Murrelet egg, but he added that conclusive identification for these species should rest on other evidence as well. Kittlitz's Murrelets have been reported to favor inlets where glaciers reach the sea (Gabrielson and Lincoln 1959), which would include Barry Arm, although Marbled Murrelets have also been noted in these habitats (e.g., Shortt 1939). In Prince William Sound, Kittlitz's Murrelets are found near the heads of such inlets, whereas Marbled Murrelets frequent waters clos-

er to forested shores (Isleib and Kessel 1973; M. E. Isleib, pers. comm.). However, information on marine or inland habitat selection is not adequate for nest identification.

Mt. Doolth, Chichagof Island, southeastern Alaska (57°40'N, 136°06'W; 13 June 1931). S. Warburton Jr. discovered a nest at 579 m after conducting a specific search on a slope below which murrelets had been observed flying at dusk. The egg was located "on a mossy setting within a cavity of rocks." Gabrielson and Lincoln (1959) reported the nest to be that of a Marbled Murrelet, but Drent and Guiguet (1961:85) were "inclined to believe that Kittlitz's Murrelet is involved" before identification of the egg had been attempted. Fragments of the egg were deposited in the Puget Sound Natural History Museum in Tacoma, Washington (Drent and Guiguet 1961), but no one has examined them critically. The egg's color suggested Kittlitz's rather than Marbled Murrelet based on examination of a photograph (Kiff 1981), but quality of the photograph was poor (L. Kiff, pers. comm.), so species identification remains uncertain.

Seward Peninsula, near Nome, western Alaska on an Iron River, possibly at 66°00'N, 163°10'W (Day et al. 1983) or at 65°33'N, 165°17'W (Kessel 1989); 10 June 1904. The nest was found by A. H. Durham and was reported originally as that of a Marbled Murrelet (Bent 1919). Its identification is still being debated. Gabrielson and Lincoln (1959) doubted that the nest belonged to a Marbled Murrelet because it was far outside the normal summer range of the species. Day et al. (1983) concurred and believed it probably was a Kittlitz' Murrelet nest, since the Seward Peninsula is well within the range of confirmed nesting by that species (Ford 1936, Bailey 1948, Gabrielson and Lincoln 1959, Thompson et al. 1966, Day et al. 1983, Murphy et al. 1984). However, it is now known that the egg is located in the Florida State Museum, and a color-calibrated photograph of it shows ground color typical of a Marbled Murrelet egg (Kessel 1989; Kiff, pers. comm.). The discrepancy between evidence from known breeding range and that from egg characteristics of Marbled Murrelets probably cannot be resolved for this nest.

OTHER EVIDENCE OF BREEDING

Although nests provide proof of breeding in a specific area and habitat, evidence of breeding in a general area is provided by collection of birds in breeding condition, finding of juveniles, and

observation of behavior that may be directed towards a mate or nest site. These types of observations have been recorded on many parts of the Alaskan coast where nesting has not been documented.

Courtship

Byrd et al. (1974) observed what he considered to be courtship behavior in 16 pairs of Marbled Murrelets in Clam Lagoon, Adak Island, in the central Aleutians (51°56'N, 176°34'W) on 29 May 1970. Pairs were described as extending the bill upward during the courtship display, calling shrilly, paddling rapidly in unison for several minutes, and then diving repeatedly (Byrd et al. 1974). A male with enlarged testes (10 × 5 mm) was collected nearby on 9 June 1970.

Females collected in breeding condition

Several females in breeding condition have been collected in Alaska. Females with shelled eggs in their oviducts have been taken in southeastern Alaska at Prince of Wales Island (approximately 57°28'N, 135°16'W; Cantwell 1898, Gabrielson and Lincoln 1959, Kiff 1981), near Wrangell (56°28'N, 132°22'W; Bailey 1927, Gabrielson and Lincoln 1959); and near Glacier Bay (58°22'N, 136°00'W; Jewett 1942, Gabrielson and Lincoln 1959, Kiff 1981). Dates of the collections ranged from 23 April to 13 July. The latest date is of interest because it suggests that some murrelets may not fledge young until mid-September, based on a 30-day incubation and a 28-day rearing period (Sealy 1974, Simons 1980, Hirsch et al. 1981). An adult carrying fish, presumably for a nestling, was observed in Kachemak Bay, southcentral Alaska (59°35'N, 151°52'W) on 16 September 1989 (K. J. Kuletz, pers. comm.). In Prince William Sound, a bird with a shelled egg in her oviduct was taken at Montague Island (approximately 60°10'N, 147°15'W) on 12 June 1977 by W. A. Lehnhausen and S. E. Quinlan, and a female with a brood patch was collected at Naked Island (60°40'N, 147°25'W) on 2 June 1978 by K. L. Oakley. Both skins are in the University of Alaska Museum (UAM 3623 and UAM 3698; D. D. Gibson, pers. comm.). The egg of the first bird is in the National Museum (L. Kiff, pers. comm.).

Three birds apparently in breeding condition have been collected in the Aleutians Islands. A female with a bare brood patch was taken at Unalaska Island in the eastern Aleutians (53°35'N, 166°50'W) on 8 August 1924 (Laing

1925), and a pair in breeding condition were collected by M. E. Isleib at Massacre Bay, Attu Island (52°50'N, 173°14'E) on 1 June 1986. The latter specimens are now in the University of Alaska Museum (UAM 5355 and UAM 5356); the female's ovary was enlarged (diameter of the largest ovum 9.5 mm), as were the male's testes (12 × 7 mm and 10 × 4.5 mm). The pair belonged to the North American subspecies, *B. m. marmoratus* (D. D. Gibson, pers. comm.). This race previously has been suspected of breeding in the Aleutians, although the Asiatic subspecies *B. m. perdix* may breed at the Commander Islands only 500 km west of Attu (Taczanowski 1893 in Kuzyakin 1963) and has been reported as an accidental from several locations in North America (Sealy et al. 1982). Only six Marbled Murrelets were observed at Attu Island in a flock of approximately 200 Kittlitz's Murrelets (M. E. Isleib, pers. comm.).

Downy young and fledglings

Carter and Sealy (1987) reviewed discoveries of young Marbled Murrelets away from salt water. *Brachyramphus* murrelets fledge in juvenal plumage (Simons 1980, Day et al. 1983), so small downy young are presumed to have fallen accidentally from a nest in the vicinity (Carter and Sealy 1987). Marbled Murrelet fledglings probably fly to salt water when they leave the nest (Binford et al. 1975, Sealy 1975, Simons 1980); fledglings found on the ground or fresh water generally are thought to have become stranded en route to the sea and have also been considered evidence of nearby nesting (Carter and Sealy 1987).

Five Marbled Murrelet chicks have been found on the northern Gulf of Alaska coast. A fledgling was found on the ground and photographed on Afognak Island to the north of Kodiak Island by R. King and identified by E. P. Bailey on 18 August 1976 (Carter and Sealy 1987). A second downy Marbled Murrelet chick was found on the ground on Kodiak Island in the northeast suburbs of the city of Kodiak (57°47'N, 152°24'W) on 12 August 1986 by K. Knight. The chick was below a large Sitka spruce (*Picea sitchensis*) in a partly-cleared grove. It was cared for at Kodiak National Wildlife Refuge, but died after a few days and was deposited at the University of Alaska in Museum in Fairbanks (UAM 5359; D. Nysewander, and D. D. Gibson, pers. comm.). This chick provides the first evidence of tree nesting on Kodiak Island. In June of 1987 activity and calling by adults were observed in the same grove

by M. McAllister (D. Nysewander, pers. comm.). Three Marbled Murrelet fledglings have been reported in the Prince William Sound area; two of the chicks are in the University of Alaska Museum. One fledgling (UAM 3103) was collected in Valdez Narrows in northeastern Prince William Sound (61°03'N, 146°40'W) on 11 August 1969. A second (UAM 4128) was found dead near the Cordova Airport (60°33'N, 145°45'W) on 20 August 1978 (Carter and Sealy 1987). A suspected Marbled Murrelet fledgling was found dead on 6 August 1987 on Montague Island (59°56'N, 147°25'W) at about 70 m elevation in mature Sitka spruce-western hemlock (*Tsuga heterophylla*) forest and 100 m from the Patton River. The specimen was not collected (G. Bucaria, pers. comm.).

Three fledglings have been observed inland in southeastern Alaska. One was seen at Little Port Walter on Baranof Island (56°23'N, 134°38'W) on 13 August 1940 (Gabrielson 1944) and a second at Boussole Lake in the Glacier Bay area (approximately 58°23'N, 136°55'W) on 23 July 1974 (Patten 1975). A fully-feathered but flightless chick was discovered on 18 July 1987 on a road near Dyea Flats in the vicinity of Skagway (approximately 59°30'N, 135°22'W; S. Home, unpubl. memo 25 April 1989; Klondike Gold Rush National Historic Park).

Flying inland with fish

Observations of Marbled Murrelets carrying food inland from the sea provide strong circumstantial evidence of nesting. Sites where birds have been seen carrying fish inland at dusk include Baranof Island, southeastern Alaska, between 19 and 25 July (Gabrielson and Lincoln 1959), Unalaska Island in the eastern Aleutians in July 1969 (Kessel and Gibson 1978), Adak Island in the central Aleutians on 21 August 1985 (D. D. Gibson, pers. comm.), and Kachemak Bay, southcentral Alaska on 9 and 10 July 1988 (Kuletz 1989) and 16 September 1989 (K. J. Kuletz, pers. comm.).

Observations of murrelets at freshwater lakes

Although Marbled Murrelets generally have been considered to use marine habitats except when at the nest site, there are a number of observations of the species on freshwater lakes (Carter and Sealy 1986), which provide some indication that birds may breed in the vicinity. The only evidence that Marbled Murrelets may breed in the Bristol Bay area comes from sight-

ings on lakes. Several marbled murrelets were seen on Lake Iliamna (59°30'N, 155°00'W), near the base of the Alaska Peninsula, 27 July 1940 (Gabrielson 1944, Gabrielson and Lincoln 1959), one of which was collected placed in the U.S. National Museum (USNM 589639, Carter and Sealy 1986), and a pair was observed on Lake Aleknagik (59°17'N, 158°37'W), approximately 150 km west of Lake Iliamna, on 25 June 1980 by M. E. Isleib (Gibson 1980). Habitat in the vicinity of both lakes includes open spruce forest and lowland and alpine tundra. Additional inland sightings have come from areas with various indications of breeding (reviewed above). There were four sightings of Marbled Murrelets on Little Kitoi Lake, Afognak Island (58°12'N, 152°22'W) between 12 June and 2 August 1977 (Carter and Sealy 1986). Two murrelets were seen on Harlequin Lake in southeastern Alaska (59°26'N, 138°56'W) on 25 June 1980, in the vicinity of tundra and old-growth forest (Patten 1982).

Other observations of murrelets at inland locations

Marbled Murrelets have been observed flying between land and sea during the breeding season in various areas. Records of birds flying inland with food have been reviewed above. Other inland sightings, like those on inland lakes, may suggest breeding in the vicinity, and observations have been made in areas where other evidence of breeding is still scanty. In the eastern Aleutian Islands, three birds were seen flying inland on Atka Island by R. H. Day (in litt.) on 16 July 1980, and at Beaver Inlet. On Unalaska Island, D. Forsell heard 40 to 50 birds flying inland at dusk on 17 and 18 July 1981 (Nysewander et al. 1982). Inland flights have been observed in many areas with other evidence of breeding. D. Forsell (in litt.) reported them in Shearwater Bay on Kodiak Island on 7 July 1977. In Prince William Sound, birds appeared to be flying inland to forests on Naked Island (Oakley and Kuletz 1979, K. J. Kuletz, pers. comm.) and to scree slopes on other islands (Isleib and Kessel 1973). Some birds were reported flying inland at Yakutat Bay southeast of Prince William Sound (Shortt 1939). In southeastern Alaska birds were reported flying inland in late May and June at Dall Island by Willett (1915), and an adult bird was found dead near Ketchikan on 3 June 1940 by Gabrielson (1944) and placed in the United States National Museum (USNM 589636).

Birds have also been reported flying inland in

winter. The relevance of this behavior to use of breeding habitats is unclear, but birds appear to visit nesting areas in winter in other places (Carter and Sealy 1986). Murrelets have been reported flying inland in winter near Ketchikan by Willett (1926) and in Chiniak Bay, Kodiak Island, by Dick (1979).

Repeated flights and vocalizations by Marbled Murrelets at specific locations have been recorded in other regions (British Columbia, Washington, Oregon, California) and considered as evidence of possible nesting areas (see other papers in this volume). Localized flights and vocalizations were heard and observed from a boat on 19 July 1987 in the Bay of Pillars, Kuiu Island, southeastern Alaska by Sharpe et al. (1988). Up to eight birds per site called repeatedly during predawn hours from the canopy of mature western hemlocks on steep north-facing slopes (Sharpe et al. 1988; F. A. Sharpe, pers. comm.). Predawn observations at four apparently similar sites in southeastern Alaska revealed no Marbled Murrelet activity (F. A. Sharpe, pers. comm.).

Marbled Murrelets breed in southeastern Alaska and from the Kenai Peninsula to Kodiak, as confirmed by discovery of nests. Other evidence of breeding is most abundant in these regions and in Prince William Sound, but scattered evidence extends throughout the species' normal range in Alaska. No intensive surveys for Marbled Murrelet activity and nesting trees had been carried out in Alaska through 1989, as they have in other states and British Columbia (Paton et al. 1988, this volume). One study area was surveyed intensively in 1990 and 1991, but results are not yet available (K. J. Kuletz, pers. comm.). An expanded search for nests would permit characterization of Marbled Murrelet nesting habitats in Alaska, which is important because logging of Alaskan old-growth forests is increasing.

POTENTIAL THREATS TO MARBLED MURRELETS IN ALASKA

Commercial development of natural resources in Alaska threatens the nesting habitat of Marbled Murrelets and causes mortality at sea. The principal threats come from logging, commercial fishing, and oil pollution.

Logging of old-growth forests

Logging of old-growth and mature coastal forests is a potential threat to the Marbled Murrelet in Alaska. The only confirmed nest from Alaska east of the Kenai Peninsula was in an old-growth tree (Quinlan and Hughes 1990). Both confirmed

tree nests and records of young birds found inland (reviewed above) suggest dependence of the species on old-growth and mature coastal forests where suitable ground-nesting habitat is unavailable and also possibly in some areas of Alaska where ground-nesting has been confirmed.

Coastal forests stretch from the southeastern tip of Alaska to the base of the Alaska Peninsula and northern Kodiak Island (Viereck and Little 1972). Quantitative descriptions of Alaskan coastal forests are in preparation by agencies and private landowners but are largely unpublished. The largest areas of forest are found on protected islands of the southeastern panhandle and Prince William Sound. On the mainland, high mountains often confine the forest to a narrow coastal strip except where it extends into large bays and river valleys. Most natural coastal forest in Alaska is old-growth coniferous forest, except for small deciduous riparian zones, mixed alpine timberline stands, and successional forest created by wind-throw, or in areas where glaciers have retreated recently such as Glacier Bay, Prince William Sound, and the Kenai Peninsula (G. Griffith, B. Rice, B. Connery, and G. Vequist, pers. comm.).

A major portion of Alaskan forest land is managed by the Federal government. The largest forested region in the state is in southeastern Alaska; 3.8 million ha of this forest are in the Tongass National Forest. Protection as wilderness or national monument is given to 890,000 ha of Tongass National Forest, including all types of old growth. Of the remainder, 1.4 million ha are considered commercial forest land by the Forest Service (capable of growing more than 0.6 m³ of timber per year), and 708,000 ha are actually scheduled for sale to loggers (compared with 157,000 ha that have been logged since commercial operations began in 1905) (U.S. Forest Service 1987; G. Griffith, pers. comm.). The dense lowland forest that has the highest commercial value, with a timber volume of over 290 m³ per ha (50,000 board-feet per acre) comprises 36,000 ha (Laycock 1987). Legislation passed by Congress in 1990 may modify logging plans in the Tongass National Forest. The second-largest block of forested coastal land in Alaska is in Prince William Sound, of which 486,000 ha is in Chugach National Forest. Approximately 400 ha of prime old-growth timber in two areas on Montague Island and near Port Gravina are scheduled for logging (K. Rice, pers. comm.). About 14,000 ha of forest in the western part of

the Sound has been recommended for wilderness designation (K. Rice, pers. comm.). Narrow strips of coastal old-growth forest are protected in national and state parks, including approximately 40,000 ha of forest in Glacier Bay National Park, 24,000 ha in Kenai Fjords National Park, 20,000 ha in Wrangell-St. Elias National Park and Preserve, and 40,000 ha in Kachemak Bay State Park (G. Vequist, B. Rice, B. Connery, and J. Johnson, pers. comm.).

Privately-owned forest land occurs in several coastal areas, and clearcutting is planned or underway in all privately-held forest. Timber sales in southeastern Alaska are primarily on and near Prince of Wales Island, where the Sealaska Corporation plans to cut 12,000 to 16,000 ha, in addition to 8,000 ha which have been logged up to now. Other private corporations may cut up to 8,000 ha in southeastern Alaska (J. Cody and J. McAllister, pers. comm.). Private logging of approximately 2,200 ha of forest is expected in Prince William Sound (K. Rice, pers. comm.) and 8,000 ha in Kachemak Bay (J. Johnson, pers. comm.). At the southwestern limit of commercial forest in Alaska, private logging is underway on the majority of Afognak Island; 48,000 m³ per year will be cut from stands averaging 120 m³ per acre for at least 25 years (Allan Fautsch, pers. comm.). Total forest areas are not available for private lands.

We do not know what portion of the Marbled Murrelet population in Alaska nests in old-growth forests or on the ground, nor which of the various old-growth associations (Harris and Farr 1974) are suitable habitat for nesting. Therefore, it is difficult for us to estimate impacts of logging on populations. The heaviest commercial pressure has been for logging of dense lowland old-growth, where there is some circumstantial evidence that Marbled Murrelets nest (see above); however, the only nest tree identified in Alaska as of 1989 was in a high-altitude open stand (Quinlan and Hughes 1990; J. H. Hughes, pers. comm.). It is not known whether birds that nest in trees are capable of nesting on the ground if old-growth forest is logged (Quinlan and Hughes 1990). Only tree nesting is known to occur in southeastern Alaska. Marbled Murrelets are able to fly over forests to nest on high ground on the Kenai Peninsula and Kodiak Island (Day et al. 1983, Johnston and Carter 1985), but individual birds may nest in only one type of habitat.

Logging may result in loss of a substantial portion of Marbled Murrelet nesting habitat in Alas-

ka if birds depend on old-growth forest in part of the state. Approximately 1 million ha of Alaskan old-growth forest is protected in conservation units such as national parks and wilderness areas, but a similar area on public and private lands combined is scheduled for logging or already has been logged. Major concentrations of Marbled Murrelets (reviewed above) coincide with the largest areas of old-growth forest, particularly in Prince William Sound and southeastern Alaska. Current guidelines in logging plans of the Tongass National Forest for conservation of wildlife habitat do not include specific consideration of the Marbled Murrelet (Sidle and Suring 1986). Although more data are needed before the effects of logging on Marbled Murrelets can be predicted in detail, all available evidence from Alaska and other areas (reviewed in this volume) indicates that logging of old-growth forests has led to declines in Marbled Murrelet populations and would do so here.

Mortality in fishing nets

Commercial fishing causes local mortality to Marbled Murrelets in Alaska. Drift gill-nets set for salmon within 10 km of the coast take murrelets incidentally in parts of Prince William Sound, offshore of the Copper River Delta, and in parts of southeastern Alaska; several hundred may be killed annually in each area (Carter and Sealy 1984; Sealy and Carter 1984; M. E. Isleib, pers. comm.). Two birds killed in gill nets in 1969 near Cordova were prepared as specimens and are now in the Western Foundation of Vertebrate Zoology (WVZ 22760 and 22761; H. R. Carter, pers. comm.). Bottom-set nets, such as those that have killed Common Murres (*Uria aalge*) and Marbled Murrelets in California (Carter and Erickson 1988, Takekawa et al. 1990), are uncommon here (R. Steiner, pers. comm.). It is not known whether fishing nets are affecting Alaska's murrelet populations adversely, as is suspected in British Columbia, where a significant proportion of one population is killed each year (Carter and Sealy 1984). Investigation of gill net mortality in some inshore fisheries may become feasible in the near future. Official observers were placed on drift-net vessels in Prince William Sound and near the Copper River Delta by the National Marine Fisheries Service for the first time in 1990, and records on seabird mortality will be made available to the U.S. Fish and Wildlife Service. The high-seas driftnet fishery for squid is not a threat to Marbled Murrelets, ap-

parently because it operates farther offshore than the normal range of the species. Only one bird was reported killed in the high-seas salmon fishery that operated near the western Aleutians until 1988 (DeGange et al. 1985; DeGange et al., in press).

Depletion of prey stocks on which seabirds depend is a potential threat from commercial fisheries. This problem is not known to have threatened marbled Murrelets in Alaska, since the principal fish in their diets are capelin (*Mallotus villosus*) and Pacific sand lance (*Ammodytes hexapterus*; Sanger 1986, 1987), for which there is no commercial fishery in Alaska. If commercial exploration of these species developed in the future, increased pressure on prey populations could be associated with substantial declines in populations of Alaskan seabirds, as has happened elsewhere (Lid 1981, Brown and Nettleship 1984, Nettleship and Birkhead 1985, Harris and Wanless 1990).

Oil pollution

Oil pollution is a potential local threat to Marbled Murrelets in Alaska, but there is little documentation in the state. Large numbers of Marbled Murrelets were found dead after the *Exxon Valdez* oil spill in March 1989. Of birds collected that had died of oil contamination in Prince William Sound, 334 (11.6 percent) were *Brachyramphus* murrelets; the true mortality, counting birds that were not recovered, may have been 3 to 10 times as high (Piatt et al. 1990). A higher proportion of Marbled Murrelets was killed than would be expected from their proportion in the marine bird population of the Sound (Piatt et al. 1990). Ongoing population monitoring by the U.S. Fish and Wildlife Service will allow evaluation of possible long-term impacts on the population. Murrelets are among the seabirds whose behavior on the water puts them at high risk of oiling (King and Sanger 1979). Tanker routes in Prince William Sound, Cook Inlet, and offshore of southeastern Alaska, and offshore oil developments in Cook Inlet and the Gulf of Alaska create the greatest risk of oil spills.

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