KITTLITZ'S MURRELET

TAXONOMY

Scientific name: *Brachyramphus brevirostris* (Vigors, 1829)
Common name: Kittlitz's Murrelet
Family: Alcidae
Taxonomic comments:
May be more closely related to the Marbled Murrelet *B. marmoratus* than to the Long-billed Murrelet *B. perdix* (AOU 1998).

DESCRIPTION

Basic description: A small seabird (murrelet)

General description:
A small alcid with a fairly large, squat head and small, short bill. Wings long, narrow and pointed. In flight, appears as small, rapidly flying bird with blurred wing-beats. Breeding and winter plumages are distinct. In breeding plumage, adult feathers of upperparts are predominantly dark gray with irregular edges of light buff or rufous gold on all except wings and tail. Underparts light buff or off-white, sparsely streaked on front and sides of head to upper chest with dark gray and thickly marked with dark gray or blackish, U-shaped feather edgings, or subterminal barring of feathers on remaining underparts creating barred effect. In winter plumage, upper parts and sides of upper breast slate gray, forming nearly complete dark-grey band across breast; gray on head lies above eye and forms narrow, dark gray crescent in front of eye; feathers of back and rump narrowly edged with white. Clean white on face, throat and remaining underparts. Wings dark grayish brown; upper wing-coverts dark grayish brown narrowly edged with white. The most definitive characteristic for distinguishing between *Brachyramphus marmoratus* and *B. brevirostris* is the presence of outer white tail feathers present in the latter. This feature is only conspicuous when the bird fans its tail feathers for take-off (Day et al. 1999).

Length (cm): 24
Weight (g): 224

Reproduction:
Limited information indicates single egg laid usually in June, with hatching in July and fledging mid- to late August; in areas of southcentral Alaska breeding chronology may be earlier by 1-2 weeks (Kuletz unpubl. data). Nesting dispersed, solitary (Johnsgard 1987). Presumably monogamous, like other members of the Alcid family, but the mating system has not been confirmed for this species (Day et al. 1999). May exhibit nest site fidelity (Piatt et al. 1999).

Ecology:
Found most often in association with marine tidewater glaciers and glacial-influenced waters; often in protected fjords or among islands. Nests remotely on steep unvegetated mountainsides and talus

slopes, above timberline, generally near glaciers and cirques. However, several northern and peripheral populations in North America (Bristol Bay, Seward Peninsula, Cape Thompson, and Cape Lisburne) and Russia are found in waters not influenced by glaciers; likely reflecting historical glacial distribution.

No detailed information on foraging home ranges, but thought to be on the order of a few square kilometers (Day et al. 1999).

Food:
Prey consists of fish (Pacific sand lance *Ammodytes hexapterus*, Pacific herring *Clupea pallasi*, capelin *Mallotus villosus*, Pacific sandfish *Trichodon trichodon*), euphasiids, amphipods and small crustacea (Sanger 1987, Vermeer et al. 1987, Day et al. 1999).

Prefers feeding in less clear, more turbid and colder water associated with glacial outflow than Marbled Murrelets (Day and Nigro 1999). Forages by pursuit diving and captures prey underwater, with a preference for shallow water (Day and Nigro 2000).

Migration:
Wintering areas largely unknown for most birds. Populations in the Bering and Chukchi Seas probably move south away from pack ice (Day et al. 1999). Other migration apparently limited; mainly an ecological shift at least in the south. Kittlitz's Murrelets breed in Prince William Sound (PWS); numbers peak in July but they begin to depart in August and by mid-August very few are left (Kuletz et al. 2003, Labunski et al. 2003).

Habitat:
Breeding: Nests on coastal cliffs, and barren ground, rock ledges, and talus above timberline in coastal mountains, generally near glaciers (AOU 1983), 0.25 to 75 kilometers inland (Piatt et al. 1999). Nests generally on ground on barren scree slopes, short distance below peak or ridge (Day et al. 1983, Day 1995, Piatt et al. 1999). Breeding generally occurs in high elevation alpine areas, with little or no vegetative cover. When present, vegetation is primarily comprised of lichens and mosses (Day et al. 1993). Some nest sites appear to be selected because they become snow-free earlier in the year than surrounding areas (Piatt et al. 1999). Though little data are available, nest sites appear to decrease in elevation in the northern portions of the range. Historically, it was believed that these birds preferred north facing slopes (Day et al. 1983). However, with additional nesting data the aspect of nests appears to correlate with elevation. For example, at high elevations a south-facing slope will become available earlier in the season than a north-facing slope (Day 1995). Breeding sites are usually chosen in the vicinity of glaciers and cirques (van Vliet 1993). During the breeding season, this species' distribution is highly clumped, with birds congregating near tidewater glaciers, and to a lesser extent, offshore of remnant high-elevation glaciers and deglaciated coastal mountains.

Non-breeding: Very poorly known. Probably mostly pelagic and along rocky seacoasts (AOU 1983); also in protected bays. Non-breeding or off-duty breeders spend summer in inshore areas, especially along glaciated coasts (Johnsgard 1987). Birds wintering in Prince William Sound occur in open waters, and limited data from southeastern and southcoastal Alaska suggest that many birds occur over open continental shelf and near submarine shoals (Day et al. 1999). Low numbers have

been recorded wintering at the edge of pack ice in the southeastern Bering Sea and near ice of the Sireniki Polynya of southern Chukotka (Day et al. 1999).

Foraging: Along shorelines, prefers shallow water when foraging, to depths of 41-60 m, areas 51-100 m from shore and <250 m from fresh water and icy substrates (Day and Nigro 2000, Day et al. 2002). Compared to its congener, the Marbled Murrelet, prefers water that is considerably icier, more turbid, and colder, likely reflecting foraging preferences (Day et al. 2002).

STATUS

Global rank: G2 (2005-01-14)
Global rank reasons:
The range is confined mainly to Alaska; populations are decreasing; potential threats from pollution and directly or indirectly from fishing are grounds for concern.

This species is known to have undergone population declines in three of its core population centers: Prince William Sound, Malaspina Forelands, and Glacier Bay. If current population trends continue, USFWS expects extirpation from Prince William Sound within 30 years and from Glacier Bay within 40 years. Data for Malaspina Forelands do not allow a reliable date of extirpation from that location, but the declines there are alarming (probably about a 75% decline in the past decade). Kenai Fjords, while not a population center, also appears to have a declining murrelet population. Anecdotal information suggests population declines are occurring in at least some other areas. If the projected extirpation from Glacier Bay and Prince William Sound occurs, and if the population decline in Malaspina Forelands continues, a significant reduction in the range of this species in the foreseeable future can be expected. Elsewhere, as populations become smaller, they will become increasingly vulnerable to stochastic events that may result in extirpation. [Source: USFWS 2002]

State rank: S2B, S2N (2004-07-20)
State rank reasons:
An estimated 90-95% of world population occurs in Alaska, although populations in Russia are not well censused. Populations have declined dramatically (70-80% over the past 10-20 years) in important population centers of Prince William Sound, Glacier Bay, southern Kenai Peninsula, and Malaspina Forelands. A potentially significant threat is the effect of climate change on tidewater glacial habitats. Species is highly susceptible to marine oil spills due to foraging behavior and limited and highly clumped distribution in coastal waters. Mortality associated with gill-net fisheries, disturbance due to commercial and recreational vessels, and status of prey species are of high concern.

DISTRIBUTION AND ABUNDANCE

Range:
Global range:
Kittlitz's Murrelet inhabits Alaskan coastal waters, discontinuously from Point Lay south to northern portions of Southeast Alaska; it is an uncommon and secretive breeder, with only about two dozen known nest records; all of the North American and most of the world population breed, molt, and winter in Alaska; a small proportion of the world population breeds in the Russian Far

East from the Okhotsk Sea to the Chukchi Sea (Day et al. 1999). The winter range is not well known, but the species is probably pelagic (Day et al. 1999). There are records of occasional winter sightings in southeast and western Alaska, and locally common sightings in a few locations in south-coastal Alaska (Kendall and Agler 1998, Day et al. 1999). Kittlitz's Murrelets also occur during winter in the mid-shelf regions of the northern Gulf of Alaska (Day and Prichard 2001). The winter range outside the Americas is largely unknown, but the species has been reported from the Kamchatka Peninsula and the Kuril Islands.

State range:
Breeding: Except for small populations in the Russian Far East, most Kittlitz's breed in Alaska (Piatt et al. 1999). Range is coastal and discontinuous between Point Lay in the north to Glacier Bay and nearby Southeast Alaska. Centers of abundance are outer coast of Wrangell-St. Elias National Park including Yakutat Bay and Icy Bay, Prince William Sound (PWS) and Glacier Bay. In general, distribution is highly clumped in mountainous areas with extensive ice sheets (Glacier Bay, outer coast of Wrangell-St. Elias National Park including Yakutat Bay, PWS, Kenai Fjords National Park, and Kachemak Bay), remnant high-elevation glaciers (Kodiak Island, Katmai National Park, Alaska Peninsula, a few Aleutian Islands), and recently deglaciated coastal mountains (Seward Peninsula, Cape Lisburne; Piatt et al. 1999).

Non-breeding: Winter range is poorly understood. Birds probably winter at sea and return to protected bays in spring (Day et al. 1999). Very few reports from Southeast Alaska, and none of these from Glacier Bay. Early spring reports from La Perouse Glacier, Lituya Bay, and Fairweather Grounds in early April suggest wintering nearby (Day et al. 1999). In Southcentral, common in only a few locations: outer coast of Kenai Peninsula off of Nuka, Northwest, and Aialik glaciers; in open waters of Prince William Sound; over open continental shelf in northern Gulf of Alaska; infrequently reported during Christmas Bird Counts in Cordova, Homer, and at sea between Seward and Kodiak; and in bays around Kodiak Island. Rare in southwest and west in winter; may occur in leads in pack ice (Day et al. 1999).

Abundance:
Global abundance:
Precise and accurate population estimates for this species do not exist in most areas of the range (USFWS 2002). Using existing information, USFWS (2002) concluded that the current Alaska Kittlitz's Murrelet population could be anywhere between about 9,000 and 25,000 birds, but they considered this crude population estimate to be somewhat speculative and dated, with the upper bound of the estimate almost certainly overestimating the current population. For the main population center (Cook Inlet to Southeast Alaska), USFWS (2002) noted that there is a statistically valid and relatively recent point estimate of about 14,000 Kittlitz's Murrelets, at least half of which are in Glacier Bay, Icy Bay, and Prince William Sound.

Ewins et al. (1993) suggested a global population of 25,000 to 100,000 Kittlitz's Murrelets, while during the same year, van Vliet (1993) suggested that there were fewer than 19,000 Kittlitz's Murrelets worldwide. USFWS (2002) noted that no data exists to support the upper range of the estimate put forth by Ewins et al. (1993) (Day et al. 1999). Taking into consideration all unsubstantiated and one-time estimates with estimates from surveys of key breeding areas prior to 1998, Day et al. (1999) concluded that the world population of Kittlitz's Murrelets during the late

90's was likely in the thousands or very low tens of thousands. A summation of all population estimates derived from systematic surveys fall in the lower end of this range.

State abundance:
Total Alaska population estimated at 9,505-26,767 birds in 2004 (USFWS 2004). Little breeding site information is known, making it difficult to estimate total population status (van Vliet 1993). Centers of greatest abundance in Alaska include: Glacier Bay National Park and Preserve (about 4,500 – 5,400 birds); Wrangell-St. Elias National Park, including Yakutat Bay (3,000 birds) and Icy Bay; northern and western Prince William Sound (280 - 3,370 birds); Katmai National Park, Alaska Peninsula to False Pass (2,265 birds); Kachemak Bay (1,500 birds); Aleutian Islands (Attu to Unimak Pass; 1,000 birds); and Kenai Fjords National Park, south Kenai Peninsula (500 birds) (van Vliet 1993, Kendall and Agler 1998, Day and Nigro 1999, Lance et al. 1999, Van Pelt and Piatt 2003, Kuletz et al. 2003, USFWS 2004).

Trends:
Global trend:
USFWS (2002) concluded that data for the Prince William Sound and Glacier Bay populations of Kittlitz's Murrelets indicate declining populations in both locations. The best available information also suggests declining populations in the Malaspina Forelands and the Kenai Fjords. Through modeling efforts, USFWS (2002) determined that in Prince William Sound, population estimates of identified Kittlitz's Murrelets show an annual decline of 18% between 1989 and 2000, with a predicted date of local extirpation around the year 2032. Models that incorporate unidentified murrelets indicate an annual decline of 31% and date of extirpation around the year 2012. Models incorporating data from Glacier Bay indicate that Kittlitz's Murrelet density in 2026 is predicted to be less than 1% the density in 2000, and less than 0.1% of the 2000 density by 2039. The 1992-2002 decline in Kittlitz's Murrelets along the Malaspina Forelands is at least 38%, and could be as high as 75% if we include in our analysis only those murrelets positively identified as Kittlitz's Murrelets. In Kenai Fjords, complete shoreline counts conducted between 1976 and 1990 indicate at least a 44% decline during those 14 years. A survey of randomly selected shoreline transects in the same region indicate a 70% decline in the past 16 years (1986-2002).

USFWS (2002) noted that there is a concern among some scientists that the observed decline in Kittlitz's Murrelets may be an artifact of differing abilities among observers to differentiate marbled from Kittlitz's Murrelets. If this is the case, then perhaps some of the Kittlitz's Murrelet decline could be attributed to Kittlitz's Murrelets being misidentified and recorded as Marbled Murrelets. However, USFWS did not believe that this can explain away the observed decline in Kittlitz's Murrelets in any of their population centers, and they believed that their modeling efforts have adequately allowed for such instances of misidentification. The model supports the observation of drastically declining Kittlitz's Murrelet populations, despite changes in the proportion of unidentified birds and uncertainty in the annual population estimates (large confidence limits). Most of the model runs using July data showed a decline in *both* marbled and Kittlitz's Murrelet populations.

USFWS (2002) concluded that there is little doubt that there used to be many more Kittlitz's Murrelets than there are now. In the portions of this species' range where trend data exist, it is in rapid decline.

State trend:
USFWS (2004) reports Kittlitz's Murrelet declines in four important population centers, Glacier Bay, Prince William Sound, the Kenai Peninsula, and Malaspina Forelands. Relatively complete data sets from Glacier Bay and Prince William Sound indicate population declines on the scale of 70-80% over the past 10-20 years (Lance et al. 1999, Robards et al. 2003, USFWS 2004). In Prince William Sound, the population declined by 84% between 1989 (6,436) birds and 2000 (1,033 birds). In Glacier Bay, density estimates for identified *Brachyramphus brevirostris* declined by 89.1% from 1991-2000. Recent surveys indicate Kittlitz's Murrelets have experienced a population decline of 83% since 1976 on the southern coast of the Kenai Peninsula, extending the geographic range of the known area of decline (Van Pelt and Piatt 2003). The rate of decline on the Kenai Peninsula appears to have been fairly steady over 26 years (Van Pelt and Piatt 2003). There is also evidence of a 38-75% decline in populations along Malaspina Forelands between 1992 and 2002 (USFWS 2004). There are no trend data from other parts of its range, but anecdotal information suggests population declines are occurring in at least some other areas as well (Van Pelt, pers. comm.).

EXISTING PROTECTION

Global protection:
Offshore, Kittlitz's Murrelets occur primarily in Alaska state waters (0-3 miles offshore); murrelets that occur in waters greater than 3 miles offshore are within the U.S. Exclusive Economic Zone. Onshore, this species is found on lands managed by the U.S. Forest Service, U.S. Fish and Wildlife Service, National Park Service, the State of Alaska, Native lands, and perhaps on some Department of Defense lands. It remains unknown what proportion of the population nests on each of these landholders' lands (USFWS 2002).

Perhaps 25% of breeding population is in Glacier Bay National Park (Kendall and Agler 1998).

State protection:
The U.S. Fish and Wildlife Service (USFWS) was petitioned to list the Kittlitz's Murrelet as threatened or endangered under the Endangered Species Act in May 2001 (Center for Biological Diversity 2001), and the murrelet became a candidate species for listing in May 2004 after assessment by the USFWS (Federal Register Vol. 69, No. 86, May 4, 2004; 50 CFR Part 17).

Around 20% of breeding population is in Glacier Bay National Park (NP) (Kendall and Agler 1998). Wrangell-St. Elias NP may encompass another 20%, and Kenai Fjords NP contains a small percentage of the population as well. Also, birds nesting along Alaska Peninsula, Aleutian Islands and other coastal or island areas may be afforded some protection under National Wildlife Refuge provisions. Waters within 20 nm of Stellar sea lion (*Eumatopius jubatus*) haulouts are protected from trawling; this may afford some protection in applicable nearshore waters of the Aleutians, Kodiak Island and Alaska Peninsula.

CHALLENGES

Global challenges:
Immediate and long-term threats exist which may affect the population. Present threats include 1) marine oil pollution. This species is considered to be extremely sensitive to this form of pollution by the U.S. Fish and Wildlife Service. 2) decreases in food stock. Changes in the forage-fish populations from the North Pacific food web have been linked to decreases in marine vertebrates. Murrelet numbers may also decline as a result of shifts in forage-fish distribution. 3) gill net fisheries. Mortality rates appear to be increasing due in part to gill-net by-catch. In a study in PWS in 1990 and 1991, a greater proportion of Kittlitz's Murrelets were taken in gill nets than Marbled Murrelets, compared to their populations. These rates are more significant in the Prince William Sound and off the Copper River Delta. The disappearance of coastal glaciers due to global warming may have a long term effect on the population. This species has a strong tie to these ecosystems and it is unclear how they will be influenced by the shrinking of these habitats (van Vliet 1993). In PWS, declines and distribution of Kittlitz's Murrelets were correlated with retreating glaciers, and fjords with more stable glaciers (mainly in northwest PWS) now support most of the populations in PWS (Kuletz et al. in press).

According to USFWS (2002), the causes for the declines remain speculative but may include: habitat loss or degradation (due to oceanic regime shifts and to glacial retreat), increased adult and juvenile mortality (due to take in fisheries and by petroleum contamination); and low recruitment (for reasons unknown). Glacial retreat and oceanic regime shifts have occurred throughout the species range (with perhaps the exception of the Lisburne Peninsula population). USFWS (2002) believed that glacial retreat and oceanic regime shifts are the factors that are most likely causing population-level declines in this species. Existing regulatory mechanisms appear inadequate to stop or reverse population declines or to reduce the threats to this species.

State challenges:
Climate change: This species' reliance on glacial-affected waters for foraging puts it at risk to changes in the environment brought about by global warming (van Vliet 1993), potentially resulting in reduction/loss of preferred foraging habitat (Day and Nigro 1997; Kendall and Agler 1998). Kittlitz's populations are declining in four areas with large ice fields (Prince William Sound, Glacier Bay, Malaspina Forelands, and the southern Kenai Peninsula). Van Pelt and Piatt (2003) hypothesized the observed declines in glacial areas are related to glacial thinning and retreat, and this was shown to be true in PWS (Kuletz et al. in press). Global warming is probably the single greatest threat to Kittlitz's Murrelets, and loss of glacial habitat could result in irreversible losses for the species.

Marine oil pollution: Ranked as one of the most vulnerable species to oil pollution (of 176 species using marine habitats in the North Pacific) by the U.S. Fish and Wildlife Service (King and Sanger 1979). Van Vliet and McAllister (1994) estimated as many as 1,000-2,000 Kittlitz's were killed as a direct result of the *Exxon Valdez* oil spill in Prince William Sound (PWS), 1989. If this number is correct, then this species suffered the largest proportionate loss to its estimated worldwide population (5-10%) of any species impacted by the spill. There is little evidence to suggest the PWS population is recovering (Lance et al. 2001).

Changes in prey availability: In addition to an observed warming trend, the Gulf of Alaska underwent a cyclical regime shift in the mid 1970's to late 1980's that resulted in changes in the composition, distribution and abundance of certain forage fish species (i.e. capelin, sand lance, and herring), which has been linked to declines in marine bird and mammal populations (Irons 1996, Piatt and Anderson 1996, Hayes and Kuletz 1997, Kuletz et al. 1997, Agler et al. 1999). The observed decline in the PWS Kittlitz's population may have been affected by changes in availability and quality of small forage fishes (Kuletz et al. 1997).

Loss to fishing bycatch: Qualitative observations suggest a high level of incidental bycatch occurs in selected gill net fisheries (Wynne et al. 1992, Carter et al. 1995, Day et al. 1999). The impact of this type of mortality is magnified due to the highly clumped distribution of the population. Degree of threat is unknown and deserves study.

Disturbance: Both Kittlitz's and cruise ships tend to concentrate in fjords and glacial areas. Recreational and commercial vessel traffic is highest in some areas with large populations (e.g. Glacier Bay and Prince William Sound), although other large populations exist in areas with less vessel traffic (e.g., Icy Bay, outer coast of Wrangell-St. Elias National Park). Vessels may disturb birds, causing them to abandon feeding areas, and/or interrupt reproductive behavior. Disturbance from underwater noise generated by large vessels may also be a potential threat, although the precise effect of underwater noise to this species is unknown (Center for Biological Diversity 2001).

RESEARCH AND INVENTORY NEEDS

Global research needs:
Future research and survey plans for Kittlitz's Murrelets for 2003-2005 include collaborative efforts on the part of the USFWS, USGS, and NPS. These efforts include: 1) a reanalysis of Lower Cook Inlet survey data; 2) continuation of Kittlitz's Murrelet population, ecology, and human disturbance studies in Glacier Bay; and 3) obtaining population estimates where current population data are weakest, specifically, Kenai Fjords, the Alaska Peninsula, the Malaspina Forelands, the Aleutian Islands, Icy Bay, Shelikof Strait, the Lisburne Peninsula, and from Yakutat south to Cape Spencer (USFWS 2002).

State research needs:
Research is needed to investigate the relationship between global warming, melting of glaciers and causative effects to Kittlitz's populations (Center for Biological Diversity 2001, Van Pelt and Piatt 2003). Studies on the impacts of disturbance by marine vessel traffic should be initiated (Van Pelt and Piatt 2003). Preliminary work found a negative (but not significant) relationship between Kittlitz's Murrelets and boat densities in PWS; individual-based observations indicated less foraging and greater flights leaving the area where boats arrive, but these were pilot studies and require further work before conclusions can be drawn (Kuletz et al. 2003). Estimates of numbers caught as by-catch in gill-net fisheries and an assessment of how many birds forage in areas with active gill-net fisheries are needed in order to better estimate the magnitude of this threat (Center for Biological Diversity 2001). Research is needed on the distribution, abundance, and availability of prey in various habitats (Day and Nigro 1999). Genetic analyses needed to decipher population and metapopulation structure (Van Pelt and Piatt 2003).

Global inventory needs:
See State inventory needs below.

State inventory needs:
In light of the recent petition to list the Kittlitz's Murrelet as an endangered species (Center for Biological Diversity 2001), accurate information on abundance and population trends is needed. Initiate or report on surveys in peripheral or low-density populations (e.g. eastern Gulf of Alaska outer coasts, the Aleutian Islands, and the Bering and Chukchi Seas) to establish status of global population and further investigate environmental correlates with population trends (Day and Nigro 1997, Van Pelt and Piatt 2003, Kuletz et al. in press). Continue to monitor known concentrations in Prince William Sound and Glacier Bay and extend monitoring programs in other areas with accessible concentrations (e.g. Kenai Fjords, Icy Bay, Kachemak Bay) (Van Pelt and Piatt 2003, USFWS 2004).

CONSERVATION AND MANAGEMENT NEEDS

Global conservation and management needs:
To better assess factors that pose risks to this species, USFWS hopes to conduct collaborative studies with the Alaska Department of Fish and Game, USGS, the National Park Service, and NMFS to address: 1) gillnet mortality rates throughout the species' range; 2) effects of large vessel traffic in fjords on murrelets; and 3) effects of large vessel traffic in fjords on murrelet habitat. The Alaska Department of Fish and Game stresses the importance of initiating, as soon as possible, studies that identify the distribution and abundance of the species throughout their range and throughout their life cycle, especially outside of Prince William Sound, Glacier Bay, and the Yakutat/Icy Bay area. In addition, they state that population trends and productivity should be monitored in these outlying areas. They suggest the implementation of studies to address threats to Kittlitz's Murrelet, and to address the effects of oceanic regime shifts on their foraging and prey availability. The State suggests that the impacts of gillnet fisheries on this species could be assessed by monitoring bycatch in coordination with existing marine mammal studies. Finally, the Alaska Department of Fish and Game suggests investigating the effects of tour boats (of all sizes) on Kittlitz's Murrelet behavior, their foraging efforts, productivity, and the effects of these vessels upon Kittlitz's Murrelet habitat and the distribution and behavior of their prey. [Source: USFWS 2002.]

State conservation and management needs:
1) Conservation of coastal glacier habitat: Kittlitz's preference for glacially-affected areas suggests these habitats are of greatest importance in conserving this species (Day et al. 2000). These areas should be protected from disturbance, especially during the summer (Day and Nigro 1999).

2) Protection from gill net fishery bycatch: Seasonal or temporal gill net fishery closures in high concentration zones would reduce murrelet bycatch (Carter et al. 1995), but other methods such as baited deterrents have been shown to eliminate bycatch in longline fisheries (Melvin et al. 2001), and may be a more acceptable solution.. Observer coverage should be increased in order to document the actual extent of bycatch (Center for Biological Diversity 2001).

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