U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Brachyramphus brevirostris*

COMMON NAME: Kittlitz's murrelet

LEAD REGION: 7

INFORMATION CURRENT AS OF: May 2010

STATUS/ACTION
__Initial 12-month Petition Finding:
___ not warranted
___ warranted
___ warranted but precluded (also complete (c) and (d) in section on petitioned candidate species- why action is precluded)
Species assessment - determined species did not meet the definition of endangered or threatened under the Act and, therefore, was not elevated to Candidate status
__New candidate
_X_Continuing candidate
___Non-petitioned
_X_ Petitioned - Date petition received: May 9, 2001
___90-day positive - FR date:
___12-month warranted but precluded - FR date:
_N__Is the petition requesting a reclassification of a listed species?
_N__Listing priority change
Former LP: 2
New LP:
Latest Date species became a Candidate: May 4, 2004
__Candidate removal: Former LP: ___
___A - Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
___U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.
___F - Range is no longer a U.S. territory.
___I - Insufficient information exists on biological vulnerability and threats to support listing.
___M -Taxon mistakenly included in past notice of review.
___N -Taxon may not meet the Act's definition of "species."
___X -Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Birds; Alcidae

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Alaska, Russian Far East

CURRENT STATES/ COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Alaska, Russian Far East

LAND OWNERSHIP: Offshore, Kittlitz's murrelets occur primarily in Alaska State waters (0-3 nautical miles (nm) from shore), and within the U.S. Exclusive Economic Zone (3-200 nm from shore). Onshore, this species is found on lands managed by the U.S. Forest Service, U.S. Fish and Wildlife Service (Service), National Park Service, the State of Alaska, Native lands, and Department of Defense lands. The proportion of the population nesting on each of these land ownerships is unknown.

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BIOLOGICAL INFORMATION

<u>Species Description</u>
Kittlitz's murrelet (*Brachyramphus brevirostris;* Vigors 1829) is a member of Alcidae or Auk family. *Brachyramphus* murrelets are unusual because unlike the rest of this diverse family of seabirds, they nest solitarily. There are three species within the *Brachyramphus* genus, including marbled murrelets (*B. marmoratus*) that are similar in appearance to Kittlitz's murrelets. Both species are known for their cryptic plumage, but differences between them are well documented (Day *et al*. 1999). Kittlitz's murrelets are heavier, and have larger heads, longer wings and tails, and smaller bills than marbled murrelets (Pitocchelli *et al*. 1995; M. Kissling, US Fish and Wildlife Service, Juneau, 2010, pers. comm.) and the vocalizations of the two species are dissimilar (Day *et al*. 1999). The Kittlitz's murrelet's call is "like that of a small chick and also a groaning aaahrr" (BirdLife International 2005), whereas marbled murrelets exchange a variety of *Keer* calls (Nelson 1997).

<u>Taxonomy</u>
Kittlitz's and marbled murrelets are genetically distinct taxa (Pitocchelli *et al*. 1995; Friesen *et al*. 1996). Mitochondrial DNA (mtDNA) sequences and restriction fragment analysis show significant differentiation between the two species (Pitocchelli *et al*. 1995). In addition, nucleotide sequencing of the mtDNA cytochrome *b* gene clearly distinguishes Kittlitz's murrelet genotypes from other murrelet genotypes (Friesen *et al*. 1996). Analysis of allozymes further strengthens the evidence that these two murrelets are separate species, with fixed differences observed at 4 of 8 loci (Friesen *et al*. 1996). Finally, Pacheco *et al*. (2002) used nuclear introns

and cytochrome *b* gene sequencing and found no evidence of hybridization between the two species.

Kittlitz's murrelets are currently considered a monotypic taxon (AOU 1957, 2005); however, new data suggest there may be significant differentiation among geographically separated populations (Birt *et al*. 2010). Intra-specific analyses of genetic data (allozymes, cytochrome *b* gene, and control region of mtDNA) suggest very low rates of immigration and emigration between Kittlitz's murrelets in the western Aleutian Islands and mainland birds from Kachemak Bay on the Kenai Peninsula (Friesen *et al*. 1996; MacKinnon 2005). A recent study incorporating a larger sample size than previous studies and employing analyses of both mtDNA and nuclear genes suggests intraspecific genetic variation may be at a level that justifies alternative taxonomic classification within this species (Birt *et al*. 2010). There have been no genetic analyses comparing Kittlitz's murrelets from Russia with those from North America. We know of no genetic analyses assessing Kittlitz's murrelets from Russia.

<u>Life History</u>

Reproduction

The breeding range of Kittlitz's murrelets is limited to Alaska and the Russian Far East (Figure 1; Piatt *et al*. 1994; Day *et al*. 1999; Artukhin 2010). Until the late 1990's, only about two dozen nest records existed (Day *et al*. 1983; Day 1995; Day *et al*. 1999). Cryptic plumage and secretive behavior make it difficult to locate Kittlitz's murrelet nests. Although demographic data are sparse, Kittlitz's murrelets, like other seabirds, are believed to exhibit the characteristics of a K-selected species (MacArthur and Wilson 1967; Beissinger 1995). Theoretically, K-selected species are long-lived, highly adapted to their environment, and have low rates of reproduction (Begon et al. 1996). This reproductive strategy depends on the survival of the few offspring and recruitment of those offspring into the adult population.

Unlike many other alcids, Kittlitz's murrelets are neither colonial nor semi-colonial nesters (Kaler *et al*. 2009). There is evidence that nests are reused (Naslund *et al*. 1994; Kaler *et al*. 2010), which demonstrates the possibility that Kittlitz's murrelets exhibit nest site fidelity (Piatt *et al*. 1994). Generally, Kittlitz's murrelets nests are widely dispersed in areas with sparse or no vegetation where they utilize their cryptic mottled plumage for camouflage (Kaler and Kenney 2008). They nest solitarily on the ground, in very remote areas (Day 1995; Day *et al*. 1999). Its single egg is colored pale-green, olive-green and blue-green with brown mottling, ranging from speckling to streaking (Day *et al*. 1983; Piatt *et al*. 1994; Kaler and Kenney 2008). The egg is typically laid on bare or nearly bare ground, at the base of a large rock (Day *et al*. 1983; Naslund *et al*. 1994; Piatt *et al*. 1994). The timing of egg-laying appears to be asynchronous among nesting Kittlitz's murrelets (Kaler *et al*. 2010; Kissling, Service, 2007, unpublished data) in some areas, but not in others (e.g., Kodiak Island as per Lowann 2009). Egg laying initiates approximately 18 May through 29 June (Agness 2006; Kissling et al. 2007; Kaler *et al*. 2009), and there is evidence that Kittlitz's murrelets attempt to renest (Kaler and Kenney 2008; M. Kissling, Service, 2010, pers. comm.). Duration of incubation is 30 days (Kaler *et al*. 2009; Kissling, Service, 2007-2009, unpublished data). Mean hatch date on Agattu Island appears to be variable, ranging from 5 July to 22 July (Kaler and Kenney 2008; Kaler *et al*. 2009; Kaler *et al*. 2010).

The chick is fed for 24 to 30 days post-hatch (Day *et al* 1999; Nalsund *et al* 1994;) at a rate of 1-10 times/day (Naslund *et al*. 1994; Kaler *et al*. 2009; Kissling, Service, 2007-2008, unpublished data; Kaler *et al*. 2010). Both adults feed the chick throughout the day (Naslund *et al*. 1994; Kissling, Service, 2007, unpublished data; Kaler *et al*. 2010). In Kachemak Bay, southcentral Alaska, and on Agattu Island in western Alaska, adults carried fish to the nest mostly between dusk and dawn (Naslund *et al*. 1994; Kaler *et al*. 2010), whereas in Icy Bay in southeast Alaska, deliveries were most often made in the middle of the day (Kissling, Service, 2007-2008, unpublished data). Chicks completely shed their down just prior to fledging (Naslund *et al*. 1994; Kissling, Service, 2007, unpublished data). When they fledge, chicks are 50-60% of adult body mass, but their wing length is nearly adult size (80%; Kaler *et al*. 2009; M. Kissling, Service, 2010, unpublished data).

Little is known about juvenile survival and recruitment. Identification of juvenile Kittlitz's murrelets at sea is difficult, as their plumage variations are not well documented. Distinguishing between juvenile and adult Kittlitz's murrelets is especially difficult at the end of August when adults appear to be molting (Kuletz *et al*. 2008). This complication could potentially influence our ability to estimate juvenile distribution and abundance at sea. Juvenile Kittlitz's murrelets have been observed around Kodiak and Afognak Islands and Kachemak Bay during the breeding season (Kuletz *et al*. 2008; Stenhouse *et al*. 2008), and they appear to migrate from their post-fledging concentration areas to another undocumented area. In Kachemak Bay, juveniles were observed in low numbers until mid-August, when numbers peaked, and then they apparently completely disappeared from the Bay (Kuletz *et al*. 2008). Four juvenile Kittltitz's murrelets (three newly-fledged and one roughly 2-3 weeks fledged) were radio-tagged in 2008-2009 in Icy Bay (M. Kissling, Service, 2010 unpublished data). The three newly-fledged birds immediately left Icy Bay and were only located 0-1 days after radio-marking; the older fledgling was located in Icy Bay until mid-August, but was not detected thereafter.

<u>Western Alaska</u> - Since 2005, more than 40 Kittlitz's murrelet nests have been found on the mountainous scree slopes of Agattu Island, which is a far western Aleutian Island (Kaler and Kenney 2008; Kaler *et al*. 2010). In 2009, overall nest success from incubation through fledging was low; two of 13 nests fledged (Kaler *et al*. 2010). One nests failed due to predation, but starvation and/or exposure to inclement weather were the primary causes of nest failure (Kaler *et al.* 2010). Egg survival during the incubation period was relatively high in 2009 (0.708 with a 95% CI of ± 0.126), but the probability of a chick surviving the 30 day brood-rearing period was low (0.119 with a 95% CI of ± 0.103; Kaler *et al*. 2010). It is unknown if the research affected nesting behavior (Lowann 2009; Kaler *et al*. 2010).

<u>Southcentral Alaska</u> - Since the first nest was found on Kodiak Island in southcentral Alaska in 2006 (Stenhouse *et al*. 2008), 18 additional nests have been found in an intensive nesting study (Burkett and Piatt 2008, Lowann 2009). Nest success has been poor on Kodiak Island, and predation has been implicated as a primary cause. In 2008, none of the nests studied made it to

the chick stage (N=5). Four of the five nests were presumed predated by one of several potential avian or terrestrial predators. In 2009, one of 13 nests successfully fledged a chick; failure was attributed to predation and nest abandonment (Lowann 2009). Reproductive success is reportedly low among Kittlitz's murrelets in Prince William Sound (PWS; Day and Nigro 2004), but this conclusion was based on at-sea observations of juveniles during breeding season.

Southeast Alaska -- At Icy Bay in southeast Alaska, fecundity of Kittlitz's murrelets is high (Kissling *et al.* 2007a); about 90% of female Kittlitz's murrelets captured in 2007-2008 had elevated triglyceride and/or vitellogenin levels (M. Kissling, Service, 2010, unpublished data). Elevated levels of triglycerides and vitellogenin are correlated with egg production and provide a measurement of fecundity. But that year, only about 10% of the adult birds that were captured nested (Kissling *et al.* 2007a). Since the first Kittlitz's murrelet nest was found in Icy Bay in 1996, eight additional nests have been located. Four were monitored using remote video cameras; two of these fledged successfully and two failed (Kissling *et al*. 2007a). While the sample size is small, nest monitoring in Icy Bay suggests a 50% nest success rate. In summary, Kittlitz's murrelets nesting around Icy Bay appear to have high reproductive potential, and although nesting attempts seem low, nest success rate is high compared to other areas.

Habitat

Nesting – Nesting habitat in Alaska and Russia is believed to be unvegetated scree-fields, coastal cliffs, barren ground, rock ledges, and talus above timberline in coastal mountains, generally in the vicinity of glaciers, cirques near glaciers, or recently glaciated areas (Day *et al*. 1983; Day 1995; Day *et al*. 1999; Piatt *et al*. 1999; Vyatkin 1999). In contrast, some nests in the Aleutian Island chain, where there are no extant glaciers, are characterized by extensive vegetative mats of lichens, mosses and ericaceous plants (those that thrive in acidic conditions) (Kaler *et al*. 2009). Local climate, geomorphology, unobstructed view of the ocean and elevation may be important parameters determining nest site suitability (Kaler 2006; M. Kissling, Service, 2010, pers. comm.). A clumped distribution of nests found in some locations suggests they may aggregate in certain nesting areas due to habitat limitations (Kaler *et al*. 2010).

At-sea - The marine habitats in which Kittlitz's murrelets are most often associated are characterized by close proximity to tidewater glaciers, and waters offshore of remnant high-elevation glaciers and deglaciated coastal mountains (Day and Nigro 1999; Day *et al*. 1999). Kittlitz's murrelets can be found along coasts where waters are influenced by glacial outwash, such as the Malaspina Forelands in southeast Alaska, where glacial runoff seeps across miles of exposed coast before entering the ocean (Kozie 1993). Within the range of tidewater glaciers, the species is associated with waters containing icebergs and brash ice (i.e., ice cover of 5 - 15%), but avoids areas that contain heavy ice cover (i.e., more than 50% ice cover; Day and Nigro 1999; Day *et al*. 1999; Day *et al*. 2000). They prefer shallow, turbid waters near stable or advancing tidewater glaciers (Day and Nigro 1999; Day *et al*. 1999; Day *et al*. 2003; Kuletz *et al*. 2003a; Kissling *et al*. 2007b, Kissling *et al*. 2007c). During a summer survey of PWS, 99% of Kittlitz's murrelets were observed in five glacial fjords (Kuletz *et al*. 2003a), where tidewater glaciers were considered to be stable or advancing in 1987 (Lethcoe 1987); and the others were spread among 12 sites with receding glaciers or no glaciers (Kuletz *et al*. 2003a).

Along the Aleutian Island chain, Kittlitz's murrelets are associated with larger islands containing deep bays and inlets. This distribution outside of current glacial influence may represent remnant populations of previously glaciated habitat (AKNHP 2004). Oceanic topography may be the most biologically meaningful parameter with regard to predicting Kittlitz's murrelet at-sea habitat (Kissling *et al*. 2005). This hypothesis is supported by data from Attu Island in the Aleutians, where the number of Kittlitz's murrelets observed during a summer survey were three-times more likely to be within the 1-5 km from shore strata (Piatt *et al.* 2005). Offshore bathymetry is not necessarily deep water, and it was noted that prominent shoals extend many kilometers from shore where high densities of Kittlitz's murrelets were observed around Attu Island (Piatt *et al.* 2005)

Foraging

During the breeding season, Kittlitz's murrelets feed on schooling fishes such as Pacific capelin, Pacific sand lance, Pacific herring (*Clupea pallasi*), and walleye pollock (Piatt *et al*. 1994; Day and Nigro 2000; Agness 2006; Kissling *et al*. 2007a). Although they are considered a piscivorous species, Kittlitz's murrelets also feed on invertebrates (Sanger 1987; Hobson *et al*. 1994). Because the availability of high-energy forage fishes is seasonally influenced (Montevecchi and Piatt 1987; Litzow *et al*. 2004), Kittlitz's murrelets may switch prey at various times of the year (Ostrand *et al*. 2004). In PWS and Glacier Bay, they tend to forage as single birds or in small groups (Day and Nigro 2000; Agness 2006), and rarely forage in mixed-species feeding flocks (Day and Nigro 2000). Feeding in isolation may be a method to avoid prey theft (Agness 2006). However in Icy Bay, Kittlitz's murrelets tend to feed in small groups and sometimes large groups and prey theft is rarely observed (M. Kissling, Service, pers. comm.).

When feeding off the face of a glacier, Kittlitz's murrelets pursue prey by diving and capturing them underwater (Day and Nigro 2000). Their preference for glacially fed marine waters may be related to higher primary productivity in these areas as compared to siltier, less saline fjords with receding glaciers (Hegseth *et al*. 1995; Weslawski *et al*. 1995). Silty glacial runoff limits light availability to chlorophyll near tidewater glaciers, but zooplankton abundance is enhanced in the surface waters, and varies along an increasing temperature gradient over the summer (Arimitsu 2009). The distribution of high energy forage fishes is dependent on physical parameters such as water depth, topography, salinity and temperature (Abookire and Piatt 2005; Arimitsu *et al*. 2007). For example, Pacific capelin (*Mallotus villosus*), Pacific sand lance (*Ammodytes hexapterus*), and walleye pollock (*Theragra chalcoramma*) are associated with shallow sills and strong currents (Arimitsu *et al*. 2007). Pacific capelin is more likely to occur near the face of tidewater glaciers than other areas of Glacier Bay (Arimitsu *et al*. 2008). The physical parameters that best explain this relationship between adult Pacific capelin and waters near tidewater glaciers include lower temperatures, higher turbidity, higher dissolved oxygen, and decreased chlorophyll a (Arimitsu *et al*. 2008). As with other seabird species, the availability of high energy forage fishes likely influences the marine distribution of Kittlitz's murrelets (Litzow *et al*. 2004), but Kittlitz's murrelets are more likely to occur in areas with higher biomass near glaciers compared to marbled murrelets (Arimitsu 2009).

Migration

Little information on their migratory behavior has been documented (Day *et al.* 1999), but recent radio and satellite telemetry data suggest significant diurnal movements as well as considerable seasonal movements (J. Piatt, USGS, 2009, unpublished data; M. Kissling, Service, 2010, pers. comm.; K. Kuletz, Service, 2010, pers. comm.). Numeric data from marine surveys (Kuletz *et al.* 2008) and dawn vocalization surveys (Burkett and Piatt 2008) in southcentral, Alaska, suggest Kittlitz's murrelets are most active and very concentrated in July, which corresponds well with the chick-rearing period when both members of a nesting pair are at sea. But, by late July-early August, the young have fledged and have presumably gone to sea. In 1969, about 150 Kittlitz's murrelets were observed up to 65 miles off-shore from Port Moller on the north side of the Alaska Peninsula during a survey in August (Bartonek and Gibson 1972), but it is unknown what proportion of those birds were juveniles.

<u>Distribution</u>

The Kittlitz's murrelet is known only to Beringia, a vast area between the Russian Far East and the Northwest Territories of Canada (Figure 1). It has been widely accepted that a large proportion of the world population of Kittlitz's murrelets breed, molt, and winter in Alaska (Day *et al*. 1999), but this elusive seabird may actually have a more expanded, but similarly clustered distribution than which was previously recognized.

Historically, Kittlitz's murrelets inhabited coastal waters discontinuously from Point Lay south to northern portions of Southeast Alaska. While it is believed that Kittlitz's murrelet summer distribution is associated with proximity to tidewater glaciers (Day and Nigro 1999; Day *et al*. 1999), both contemporary and historic observations indicate that they also occur in marine habitat where glaciers are extinct. Large numbers of Kittlitz's murrelets were observed along the Lisburne Peninsula during the early 1970's (Day *et al*. 1999; J. Piatt, USGS, pers. comm.), which suggests that notable numbers of birds occurred in the Chukchi Sea at that time. Kittlitz's murrelets are also found around Kodiak Island, the Aleutian Islands, Bristol Bay, Seward Peninsula, Cape Lisburne, and Chukotka and Kamchatka peninsulas in Russia; areas not currently influenced by glaciers.

During nesting season, the distribution of Kittlitz's murrelets is highly clumped within its geographic range (Isleib and Kessel 1973). Kittlitz's murrelets in Alaska primarily occur in four regions during breeding season (Table 1): 1) Southeast Alaska, 2) Southcentral Alaska, 3) the Aleutian Islands, and 4) the Alaska Peninsula. Northwestern Alaska is likely an additional breeding season concentration area (Day *et al*. 2010); however, we lack abundance data at this time. Information on Kittlitz's murrelets from the Russian Far East is sparse. Kittlitz's murrelets have been considered a breeding bird of Russia only since the 1970s (Vyatkin 1999), and it has been estimated that 10% of the world population of Kittlitz's murrelet breeds in the Russian Far East from the Okhotsk Sea to the Chukchi Sea (Day *et al*. 1999). Only four nests have been documented: one on the Chukotka Peninsula, one in northeastern Kamchatka, and two on the coast of the Sea of Okhotsk (Kondratyev *et al*. 2000). In the late 1990's large numbers of Kittlitz's murrelets were reported from the Kamchatka Peninsula (Vyatkin 1999). In the summer they range from the coastal waters of Wrangel Island in the East Siberian Sea, along the coast of

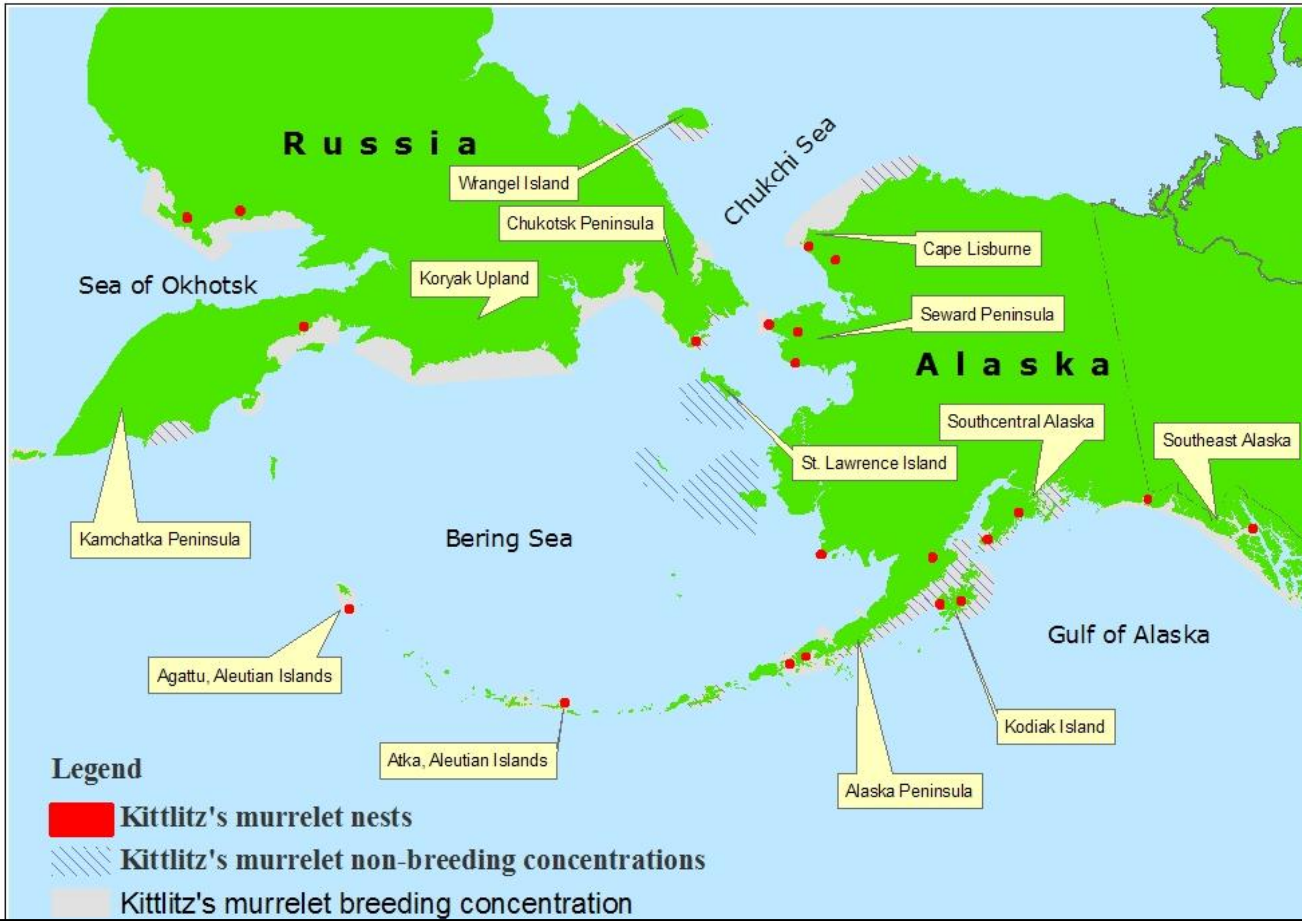

Figure.1. Known distribution of Kittlitz's murrelets at sea and approximate nest locations (Thayer 1914; Thompson *et al*. 1966; Bartonek and Gibson 1972; Day *et al*. 1983; Murphy *et al*. 1984; Piatt *et al*. 1994; Day 1995; Day and Stickney 1996; Kendall and Agler 1998; Day *et al*. 2000; Stephenson and Andres 2001; Kuletz *et al*. 2003; Mcnight *et al*. 2003; van Vliet 2003; Lindell 2005; Piatt *et al*. 2005; Romano and Piatt 2005; van Pelt and Piatt 2005; Kissling *et al*. 2007; Kirchoff 2008; Kuletz *et al*. 2008; Burkett and Piatt, 2008; Stehnhouse *et al*. 2008; Kaler *et al*. 2009; Piatt 2009, unpubl. data; Artukhin 2010, unpubl. data; Day *et al*. 2010; Kissling *et al*. 2010; Kuletz 2010).

Table 1. Abundance estimates for Kittlitz's murrelets. Grey-highlighted values were used to estimate current population abundance.

Region	Area	Year	Abundance (mean)	95% CI*	Reference
Southcentral Alaska	Kenai Fjords	2006	845	204-3,496	Romano *et al*. 2006
		2002	509	126-2,050	van Pelt and Piatt 2003
	Prince William Sound –All (PWS)	2009	2,080	1,409-2,990	A. Allyn, Univ. of Mass, 2010, unpublished data
		2007	2,346	514-4,178	McNight *et al*. 2008
		2001	1,969	911-3,027	Kuletz *et al*. 2003a
	PWS- Harriman Fjord	2003	639	0-1,278	McNight *et al*. 2003
		2001	873	491-1,255	Kuletz *et al*. 2003b
	PWS - College Fjord	2003	349	94-604	McNight *et al*. 2003
		2001	408	124-692	Kuletz *et al*. 2003b
	Lower Cook Inlet	1993	3,353	1,635-5,071	Kendall and Agler 1998
	Cook Inlet-Kachemak Bay	2007	993	0-2,633	Kuletz *et al*. 2008
		2006	3,108	123-6,420	
		2005	1,712	0-3,737	
Alaska Peninsula	Southern Alaska Peninsula	2003	2,265	1,165-4,405	van Pelt and Piatt 2005
Aleutian Islands	Unalaska	2005	1,594	1,015-2,501	Romano *et al*. 2005
	Atka	2004	749	352-1,593	Romano and Piatt 2005
	Attu	2003	279	103-756	Piatt *et al*. 2005
Southeast Alaska	Glacier Bay	2009	5,317	2,812 - 6,155	Kirchoff *et al*. 2010
		2007	4,299	2,092-8,943	Kirchoff 2008
		1993	1,800	256-3,344	Lindell 2005
	Icy Bay	2009	723	0-2,444	Kissling *et al*. 2010
		2008	1,907	0-4,684	
		2007	1,000	0-2,207	
		2005	1,317	0-3,693	
		2002	2,258	0-4,481	
	Malispina Forelands	2009	165	0-369	
		2008	39	0-82	
		2002	10	4-16	
		1992	641	615-666	
	Manby Point	2002	988	0-3,410	
	Mainland Fjords-Wilderness Bays	2002	555	0-2,697	
	Outer coast (OC) -Icy Point	2003	101	0-334	
	OC-Mouth of Lituya Bay	2004	129	0-500	
	OC-Lituya Bay	2003	31	0-145	
	OC-Cross Sound	2003	28	0-256	
	OC-Exposed North & South	2004	144	0-1,047	
	Yakutat Bay – All (YB)	2009	2,822	0-9,988	
		2000	966	0-2,830	
	YB-Disenchantment Bay	2000	927	0-2,636	Stephenson and Andres 2001
	YB-Russel & Nunatak Fjords	2000	55	0-568	

*when confidence intervals were not provided, they were calculated using a normal distribution the Chukotka Peninsula, to the southern tip of Kamchatka, and around to the Sea of Okhotsk (Kondratyev *et al*. 2000; Artukhin *et al*. 2010). During breeding season they are commonly found along a 3km-wide strip of coastal waters from the Chukotka to Kamchatka Peninsulas (Vyatkin 1999; Artukhin *et al*. 2010).

The winter range of the Kittlitz's murrelet is not well known, but is probably pelagic (open ocean) (Day *et al.* 1999). The shift between summer and winter distribution appears to be rapid and asynchronous (Day *et al*. 1999). But, surveys in the waters off Kodiak Island indicate that Kittlitz's murrelets are year-round residents there (Stenhouse *et al*. 2008). There are records of occasional winter sightings in southeast and western Alaska, and locally common sightings in a few locations in southcoastal Alaska (Kendall and Agler 1998; Day *et al.* 1999; Kissling *et al*. 2010). In winter, Kittlitz's murrelets have been observed in the protected waters of PWS, Kenai Fjords, Kachemak Bay, Kodiak Island, Yakutat Bay and Sitka Sound (Kendall and Agler 1998; Day *et al*. 1999; Stenhouse *et al*. 2008; Kissling *et al*. 2010). Kittlitz's murrelets are also reported during winter in the mid-shelf regions of the northern Gulf of Alaska (Day and Prichard 2001). New information indicates that the polynyas (an area of open water surrounded by sea ice) southwest of St. Lawrence Island, as well as east of the Pribilof Islands and southeast of St. Matthew Island may be important wintering areas (Kuletz 2010). Winter range of the species outside the Americas is largely unknown, but observations have been reported from the Kamchatka Peninsula and the Kuril Islands in the Russian Far East (Flint *et al*. 1984). A few birds have been observed during late winter in the Sireniki polynya of southern Chukotka in Russia (Konyukhov *et al.* 1998).

Status

Abundance

The International Union for Conservation of Nature and Natural Resources (IUCN) considers Kittlitz's murrelets critically endangered, a category shared only by one other bird species in Alaska, the Eskimo curlew (*Numenius borealis*), which is thought to be extinct (BirdLife International 2005). NatureServe categorizes Kittlitz's murrelets as Globally Imperiled (G2; NatureServe 2005).

Prior to the 1970's, Kittlitz's murrelets in the northern Gulf of Alaska were roughly estimated to number in the hundreds of thousands (Isleib and Kessel 1973). In several PWS fjords and waters near the Malaspina-Bering icefields, Kittlitz's murrelets were reported to "outnumber all other alcids in these waters," but except for Icy Bay, this no longer is the case (Isleib and Kessel 1973; Kissling *et al*. 2007c). During the 1990s, Kendal and Agler (1998) estimated the Alaska population at 12,130 birds (range = 3,818 – 20,448).

The Russian population estimate of Kittlitz's murrelet is based on few surveys. The abundance estimate is derived by doubling the number of birds estimated in the marine environment because they assume that each bird on the water represents one individual of a breeding pair. This estimate assumes 100% breeding propensity. Thus, the Russian population is estimated at about 11,100; there may be as many as 10,000 birds along the north-eastern coast of Kamchatka (Vyatkin 1999), 100 birds on the southeastern tip of the Chukotka Peninsula (Konyukhov *et al*.

1998), and 1,000 Kittlitz's murrelets in the Sea of Okhotsk (Artukhin *et al*. 2010). This is a rough estimate that is based on the assumption that every Kittliz's murrelet that was observed or estimated during marine surveys was a breeding bird with its mate on a nest (and therefore not observed). Given what we know about breeding propensity in Alaskan breeding Kittlitz's murrelets, we suspect this assumption is incorrect. But, until we are provided with a more accurate estimate (expected in 2010; Y. Artukhin, Kamchatka Branch of Pacific Institute of Geography, 2010, pers. comm.), we consider the point estimate of 11,110 breeding birds to be the best available biological information for Russian breeders.

Since the Kittitz's murrelet became a candidate species in 2004, we have compiled abundance data from various locations and from various years to estimate population size. Previously, we estimated total abundance of Kittlitz's murrelets by summing the most recently estimated mean abundance for each of the surveyed concentration areas, and assumed there were no birds outside the concentration areas. As such, in 2009 we estimated that the current population of Kittlitz's murrelets was approximately 24,678 birds (19,578 in Alaska and 5,100 in Russia). This year, we revised our approach to estimating the world population because previous estimates may have been biased low.

There are significant differences in opinion about how to survey for Kittlitz's murrelets and estimate their abundance. Various survey and analytical techniques tend to result in divergent abundance estimates. In the December, 2009 meeting of the Pacific Seabird Group, the Kittlitz's Murrelet Technical Committee held a special session to discuss differences of opinion regarding approaches used to estimate the abundance of these birds. The Technical Committee will continue to work toward standardizing the most valid estimation techniques and reconcile data gathered thus far. Until this important dispute is resolved, however, we have attempted to account for the possibility that previous estimates of Kittlitz's murrelet abundance were biased low. In our estimate of abundance for 2010, we refrain from providing a single discrete estimate of abundance. Instead, we provide a range of values. We summed the most recent estimates of the mean abundance of Kittlitz's murrelets from concentration areas (Table 1, highlighted in grey) and assumed that this value represents the low estimate because Kittlitz's murrelets may also occur outside of the surveyed areas. We also summed the upper 95% confidence interval for each abundance estimate (Table 1, highlighted in grey) to calculate the high approximation of the total population. We incorporated a refined point estimate for the Russian population, which is double the approximation used in 2009. The current estimate for the Russian population is 11,110 birds. Therefore, for 2010, we estimate the world-wide abundance of Kittlitz's murrelets to be between 30,900 and 56,800 individuals[1].

[1] Low estimate was derived by summing mean abundance highlighted in Table 1 (19,808) plus 11,100 birds from the Russian population. High estimate was derived by summing the high-confidence interval value for each area highlighted in Table 1 (45,719), plus 11,100 birds from the Russian population.

Trends

Population trends for Kittlitz's murrelets have been estimated with statistical rigor in a number of locations throughout its range (e.g., PWS and Kachemak Bay). In other locations, trend information is less supported by statistical rigor, primarily due to a lack of time series data, but is still informative. To our knowledge, there are no data available to assess trends within the Russian population. Due to the difficulties associated with estimating Kittlitz's murrelet abundance (Kissling *et al*. 2007c), there is disagreement among biologists relative to the magnitude of some trend estimates (J. Hodges, US Fish and Wildlife Service, Juneau, pers. comm). Regardless, until better information is available, we report population trend information primarily from southcentral Alaska where a longer time series of data have been collected.

Southcentral Alaska -- In Kachemak Bay, between the two decadal periods (1988-1999 and 2004-2007), Kittlitz's murrelet densities declined significantly in the inner bay ($P = 0.009$) and in the entire bay ($P = 0.01$); a 20% and 43% (respectively) decline in density was estimated between decadal periods (Kuletz et al. 2008). While there is some dispute over the magnitude of the decline for the entire bay and statistical significance of the decline in the inner bay (J. Hodges, Service, 2010, pers. comm), we believe this to be among the most robust trend estimates available.

In PWS, the Kittlitz's murrelet population was reportedly in steep decline and of significant conservation concern (Kuletz *et al*. 2005). Kittlitz's murrelets declined an estimated 18% from 1989 to 2000 ($r^2 = 0.61$; $P = 0.04$; Kuletz *et al*. 2003b). Between 1989 and 2007, Kittlitz's murrelets in PWS declined by 64% (K. Kuletz, Service, 2010, unpublished data). However, data suggest the population may have stabilized since 2004; while overall, the population trend is negative, numbers increased between 2004 and 2007 (K. Kuletz, Service, 2010, unpublished data). In a separate survey effort, the Kittlitz's murrelet population in PWS was compared from 2001 and 2009, indicating a non-significant increase in the Kittliz's murrelet population in PWS over the last decade (K. Kuletz, Service, 2010, pers. comm.). Data from the two studies in PWS support the perception that the Kittlitz's murrelet population may have stabilized in recent years, but more years of data will be necessary to make a strong statistical case for any such changes.

Within the glaciated fjords of Kenai Fjords National Park, Kittlitz's murrelets reportedly declined 83% across the 26 years between 1976 and 2002 (van Pelt and Piatt 2003). Between 1986 and 2002, from a subsample of nearshore survey units, van Pelt and Piatt (2003) estimated that Kittlitz's murrelets declined at about 8.7% per year; P = 0.037), although the interpretation of these data has been questioned (J. Hodges, Service, 2010 pers. comm.). A 2006 survey yielded a slightly higher population estimate for Kittlitz's murrelets in Kenai Fjords, although the trend is not significantly different (Romano et al. 2006).

Southeast Alaska -- In Icy Bay, Kittlitz's murrelet abundance (±SE) exhibited a general downward trend from 2002 (2223 ±384) to 2009 (723 ±213) with a notable increase in numbers in 2008 (1907 ±409; Kissling et al. 2010). In Yakutat Bay, comparison of estimates from two surveys reveal that abundance of Kittlitz's murrelets was higher in 2009 (2822 ±637) compared to 2000 (966 ±183; Kissling et al. 2010).

Surveys conducted in 1991 and then again in 1999 and 2000 in Glacier Bay, Southeast Alaska, indicate the species has undergone a statistically significant decline of about 80% over nine years (Robards *et al*. 2003; Drew and Piatt 2008). However, there are differences of opinion regarding the actual magnitude of this decline (J. Hodges, Service, 2010 pers. comm). Furthermore, a recent survey was conducted in Glacier Bay, and abundance estimates from 2009 were compared to estimates from 1993. Results of this analysis suggest that the Kittlitz's murrelet population in Glacier Bay has been stable over the 16-year period (Kirchoff *et al*. 2010). We will be coordinating with Kittlitz's murrelet experts to reconcile these discrepancies in interpretation in the near future.

Kittlitz's murrelets from the Malaspina Forelands have declined over a 17 year period (from 1992 to 2009) and even fewer Kittlitz's murrelets were recorded in 2008 and 2009 (Table 1; Kissling *et al*. 2010). Population estimates of Kittlitz's murrelets have varied considerably in Icy Bay from 2002 to 2009 (Table 1), but the general trajectory since 2002 was downward with one high year (2008) which cannot be accounted for through increase in productivity (Kissling *et al*. 2010). Interestingly, population estimates of marbled murrelets in Icy Bay and the Malaspina Forelands have remained stable across the same time periods (Kissling *et al*. 2010).

<u>Aleutian Islands</u> -- Data from two surveys (1995 and 2006) around Adak Island in the Aleutians suggest an annual decline of 7.4% for marbled and Kittlitz's murrelets combined (Piatt *et al*. 2007). While this estimate lacks statistical rigor (Piatt *et al*. 2007; J. Hodges, Service, 2010 pers. comm.), it provides a valuable index for the western Aleutian population.

Notwithstanding the difficulties associated with surveying this cryptic seabird with a clumped distribution, long-term survey efforts suggest that, in at least some areas, Kittlitz's murrelets have suffered significant declines over the past decades. It is possible that their population declines are beginning to subside in some areas. We will continue to work with species' experts to reduce uncertainty in abundance and trend estimates throughout the range.

THREATS:

A. <u>The present or threatened destruction, modification, or curtailment of its habitat or range</u>.

Glacial retreat—Loss of glacial volume is a phenomenon occurring on a global scale (Dyurgerov and Meier 2000; IPCC 2007). Glacial retreat has been occurring since the end of the Little Ice Age (around 1850), but during recent decades, glaciers are melting at rates that cannot be explained by historical trends (Brown *et al*. 1982; Dyurgerov and Meier 2000). It is highly likely that the increase in average yearly temperatures over the past 50 years is primarily due to the global rise in anthropogenic greenhouse gasses (Crowley 2000; IPCC 2001; Karl and Trenberth 2003; Stott 2003; IPCC 2007).

Glaciers respond to change in climate almost immediately (Dyurgerov and Meier 2000). Correlations between warm mean surface temperatures and concomitant glacial melting events (Dickey *et al*. 2002) suggest that glaciers, particularly the maritime glaciers of Alaska, are sensitive to warming trends (Calkin 1994). There is an association between glacial ice thickness and rate of retreat whereby retreat is accelerated when ice thickness decreases (van der Veen 1996). The retreat rate of tidewater glaciers is related to water depth, such that the deeper the water, the more rapidly the glaciers retreat (Adalgeirsdottir *et al*. 1998). The widespread decrease in glaciers and ice caps has contributed to sea level rise, creating a feedback mechanism, which increases the rate of retreat for tidewater glaciers in particular (IPCC 2007). There is high confidence that the rate of observed sea level rise increased from the 19th to the 20th century, and the rate of global average sea level rise has increased over the past decade (IPCC 2007). Projected climate change over the next century will further affect the rates at which glaciers melt. Best estimates for average surface air warming ranges from 1.1° C (the lowest estimate under the B1 or low emission scenario) to 6.4° C (the highest estimate under the A1F1 or highest emission scenario). Even with an average temperature rise of 1° C, glaciers will continue to retreat in the next century (Oerlemans *et al*. 1998).

The especially rapid retreat of Alaska's glaciers represents about half the loss in mass of glacial ice worldwide (Hassol 2004). Most glaciers in Alaska have been receding since the turn of the 20th century (Lethcoe 1987; Molnia 2001). The Harding Icefield, on the Kenai Peninsula, is the largest ice field in North America. Seven of its 38 glaciers are currently tidewater, and on average the icefield has undergone a total volume change of -34 km^3 over the past 43 years (Adalgeirsdottir *et al*. 1998). This volume change corresponds to an average elevation change of -21 m (±5 m). From 1961 to 2003, the thickness of "small" glaciers reportedly decreased approximately 8 meters (NSIDC 2006); however Adalgeirsdottir *et al*. (1998) found no significant correlation between volume loss and type or characteristics of glaciers. Bering Glacier has shrunk up to 7.4 miles in length during the past century (Barretta 1997; Wiles *et al*. 1999). The retreat of Muir Glacier in Glacier Bay has been documented since the turn of the 20^{th} century (Powell 1991), and is retreating at a rate of 3m/year (Hunter 1994). In PWS, there has been a near continuous ice retreat with minor advances since the Little Ice Age; one glacier reportedly has retreated 62 m/year for the past 75 years (Wiles *et al.* 1999).

Kittlitz's murrelets exhibit a strong association to glacially-influenced marine habitat in PWS, Kenai Fjords, Glacier Bay, Icy Bay, and the south side of the Alaska Peninsula (Kendall and Agler 1998; Kuletz *et al*. 2003a; Robards *et al*. 2003; van Pelt and Piatt 2003; van Pelt and Piatt 2005; Agness 2006). Their preference for areas near stable or advancing tidewater glaciers may be related to the diversity and abundance of energy-rich forage fishes such as Pacific capelin and Pacific sand lance (Piatt *et al*. 1994; Day and Nigro 2000; Agness 2006; Kissling *et al*. 2007a; Arimitsu 2009). The distribution and availability of these energy-rich forage fishes may change as glaciers recede, and the physical parameters of marine habitats are modified. Reduced diversity and abundance of energy-rich forage fishes may reduce the Kittlitz's murrelet's ability to provide sufficient nutrition to nestlings.

The accelerated melting and calving of tidewater glaciers is conducive to high rates of sedimentation (Koppes and Hallet 2002). Fjords are efficient traps for sediment produced by tidewater glaciers, leaving little opportunity for removal. Sedimentation can change the suitability of marine habitats for forage fish that Kittlitz's murrelets feed upon. In extreme cases, sedimentation, glacial retreat and glacial rebound may combine to transform marine feeding habitat into glacial rivers draining onshore cirque and valley glaciers (Plassen and Vorren 2003).

Climate warming may be causing glaciers to release increasingly contaminated melt water to receiving water bodies. A substantial percentage of current glacial melt originated from ice that was deposited in 1950 through 1970, when organochlorines were more concentrated in the atmosphere than they are now, or were before 1950 (Blais *et al*. 2001). In addition, organochlorines that were deposited during that time were deposited more heavily in colder locations, such as ice fields. Contaminants in the melt-water from glaciers may contribute high concentrations of pesticides for decades or centuries to come (Donald *et al*. 1999). Although there is currently no direct evidence to support this hypothesis, exposure to environmental contaminants in forage fish could increase mortality and decrease productivity in Kittlitz's murrelets that are associated with the receiving waters of the melting glaciers.

The interrelated effects of a rapidly warming climate on the glacially influenced marine environment may result in reduced availability of high quality food for Kittlitz's murrelet adults and young. If forage quality and quantity are reduced, productivity will be negatively affected and mortality of Kittlitz's murrelets will increase. Increased mortality of breeding adults generally has greater population level effects in long-lived species with delayed maturity and low rates of reproduction (i.e., K-selected species such as seabirds; MacArthur and Wilson 1967; Beissinger 1995).

Finally, primary succession following glacial recession may reduce nesting habitat for Kittlitz's murrelets (M. Kissling, Service, 2010, pers. comm.). Successional changes create new habitat for some species, and may provide connectivity between and among areas or habitats that may have been previously isolated (e.g., glacial nunataks [mountain top surrounded by glacial ice but not covered by ice]) where Kittlitz's murrelets are known to nest.

Hydrocarbon contamination -- Petroleum hydrocarbons in marine waters are considered among the most potentially harmful contaminants to organisms (Martin and Richardson 1991). Petroleum products released into the marine environment can remain for years (Hayes and Michel 1999), with documented adverse effects on marine birds (Custer *et al*. 2000; Esler *et al*. 2000; Trust *et al*. 2000; Yamato *et al*. 1996) and their prey (Glegg *et al*. 1999).

Based on the species' body size, diving behavior, tendency to cluster in nearshore waters, restricted distribution, and low productivity, the Kittlitz's murrelet is vulnerable to direct mortality from oil pollution (King and Sanger 1979). In 1989, the commercial oil tanker *Exxon Valdez* spilled nearly 11 million gallons of heavy Alaska crude oil into PWS, eventually contaminating approximately 30,000 km^2 of coastal and offshore waters that served as habitat for approximately one million marine birds (Piatt *et al*. 1990). Estimates of direct mortality of Kittlitz's murrelets from the spill range from approximately 500 (Kuletz 1996) to over 1,000 birds (van Vleit and McAllister 1994). In either case, a notable portion of the PWS population (perhaps 7-15%) was lost. The proportion of resident Kittlitz's murrelets lost in this oil spill exceeds that of all other species impacted by this spill.

In December 2004, the *Selandang Ayu* spilled approximately one-half million gallons of heavy bunker C and diesel fuel oils into the nearshore waters off Unalaska, Aleutian Islands, leaving approximately 35 km of shoreline oiled (Alaska Department of Environmental Conservation, Anchorage, Alaska, 2005, unpublished data; Unified Command 2005). Few *Brachyramphus* murrelet carcasses were recovered after this oil spill (Byrd and Daniel 2007). However, about one-third of all the Kittlitz's murrelet observations made around Unalaska were from Makushin Bay (Romano *et al*. 2005), an area heavily oiled from this spill, and murrelets were observed in oiled waters (Stehn, US Geological Survey, Anchorage, Alaska, 2005, unpublished data). Kittlitz's murrelet mortality that may occur from fuel spills and petroleum contamination may go largely unobserved in Alaska's vast and remote waters (Kuletz 2001). Consequently, lack of observed mortality from oil pollution does not confirm its absence.

Alaska Maritime National Wildlife Refuge manages much of the Aleutian Island's coastal habitat. Approximately 2,900 ships on US/Asia routes annually traverse a Great Circle Route that takes them in close proximity to these islands. Based on the certainty that oil spills will continue to occur in this region where high volumes of ships traverse dangerous waters, the Alaska Maritime National Wildlife Refuge is considered among the most vulnerable refuges in the country (NWRA 2005). Eighteen percent of Alaska's Kittlitz's murrelets cluster in this high risk region. Most of these individuals are clustered at just a few islands (e.g. Attu, Agattu, Adak, Atka, and Unalaska).

Petroleum hydrocarbons are frequently introduced into the marine environment within the range of Kittlitz's murrelets. Spills are expected to increase in frequency as vessel traffic increases. Therefore, the probability that Kittlitz's murrelets will be exposed to low levels of hydrocarbons (directly or through prey ingestion) will increase. This increased probability of exposure may result in reduced reproductive capacity and/or longevity. Chronic exposure to hydrocarbons is associated with risks of cancer, reproductive anomalies, and endocrine dysfunction (Irwin *et al*. 1997). The pathway to exposure is either direct or indirect via ingestion of contaminated prey.

From 1995 through August 2005, at least 1,923 small fuel spills from vessels resulted in the release of more than 271,700 gallons of petroleum hydrocarbons in Alaska waters (Alaska Department of Environmental Conservation, Anchorage, Alaska, 2005, unpublished data). Ninety percent of those spills occurred within the range of Kittlitz's murrelets. Additionally, cruise ships and recreational boating activity is increasing in glaciated fjords within Glacier Bay, Yakutat Bay and PWS, in the very habitats that are most important to Kittlitz's murrelets (Day *et al*. 1999; Murphy *et al*. 2004; Jansen *et al*. 2006). Road access has increased recreational boating opportunities in northern PWS; it was anticipated that new road access would increase recreation boating 45-fold (Murphy *et al*. 2004). As vessel traffic increases, so does the threat of petroleum contamination from both accidental spills and routine vessel operation.

B. <u>Overutilization for commercial, recreational, scientific, or educational purposes</u>.

The Kittlitz's murrelet does not appear to be at risk due to overutilization for scientific or educational purposes. It may be indirectly impacted by recreational and commercial operations.

Research – Lethal and non-lethal adverse effects are a possible result of capture and handling, attaching transmitters, and finding and revisiting nests. It is unknown if the capture, handling, or radio-marking of Kittlitz's murrelets influence reproduction or nesting behavior, but these methods are commonly used to study marbled murrelets in British Columbia (e.g., Lougheed *et al*. 2002), Washington (e.g., Bloxton and Raphael 2005), and California (e.g., Peery *et al*. 2006). The Kittlitz's Murrelet Technical Committee of the Pacific Seabird Group has formed a subgroup to evaluate potential adverse effects associated with the capture, handling and attachment of transmitters. Evaluations of potential adverse effects resulting from nesting studies are currently underway (Lowann 2009; Kaler *et al*. 2010).

Recreational Use -- This small, cryptic-colored seabird is rarely sought out by tour boat operators; however, the scenic tidewater glacier habitat with which it is associated (Day *et al*. 1999) is the ultimate destination for many recreational and commercial tour boats throughout the region (Murphy *et al*. 2004). Recreational and commercial tourism has increased substantially in many of its breeding areas, especially Glacier Bay, Yakutat Bay, PWS, Kenai Fjords, and lower Cook Inlet/Kachemak Bay (Glacier Bay National Park, Alaska, unpublished data; Murphy *et al*. 2004; Hoover-Miller *et al*. 2006; Jansen *et al*. 2006). The number of cruise ships allowed into Glacier Bay has increased 30% since 1985, while smaller charter boats and private boats have increased 8% and 15%, respectively. Mid-sized tour boat traffic has remained stable (Glacier Bay National Park, Alaska, unpublished data). Agness (2006) found that Kittlitz's murrelets were temporarily disturbed by vessel activity, near-shore, but concluded that vessel activity at currently observed levels does not constitute a loss of suitable habitat in Glacier Bay.

Excessive boat disturbance has been implicated in the decline of Kittlitz's murrelets in PWS (Day *et al*. 2003). Most human use in PWS is concentrated in the northwestern part of the Sound, and in central mainland fjords with tidewater glaciers, the same areas favored by murrelets (Murphy *et al*. 2004). In PWS and Kenai Fjords, peak vessel activity occurs in June and July (B. Conner, National Park Service, Seward, Alaska, pers. comm.; Murphy *et al*. 2004), a time when Kittlitz's murrelets face intense energetic requirements to complete chick-rearing, and when new fledglings first enter marine waters and must quickly learn to forage on their own. Disturbance can disrupt feeding birds and cause them to swallow fish meant for their nestling (Speckman *et al.* 2004), and persistent boat traffic may prevent murrelets from using high quality foraging areas (Piatt and Naslund 1995). Disturbance causing reduced access to high energy food and increased stress could negatively affect longevity and reproduction in Kittlitz's murrelets (Day *et al*. 2003); however, we lack data to confirm this.

Among all Kittlitz's murrelet population strongholds, Southeast Alaska's Icy Bay is the only fjord that remains relatively free of tourist traffic and commercial fishing (although the first cruise ship was observed in Icy Bay in July 2009). This is the only location where Kittlitz's murrelets still outnumber all other alcids. The importance of Icy Bay to the survival of the species may increase as anthropogenic disturbances increase throughout other portions of the species' range. Previously, it was believed that the logging operations near the entrance to Icy Bay did not overlap with Kittlitz's murrelet distribution in the Bay. However, telemetry data indicates that Kittlitz's murrelets utilize the entrance of the Bay as well as the upper portions (Kissling *et al*. 2007a). The logging camp closed in October 2008 and was replaced by a relatively large guided hunting outfit.

Commercial Fisheries--Commercial gillnet fisheries take an unknown number of Kittlitz's murrelets. In PWS, salmon gillnet fisheries occur each summer in or near Kittlitz's murrelets' habitat. Kittlitz's murrelets represented 5% and 30% of murrelet bycatch in gillnets during 1990 and 1991, respectively (Wynne *et al*. 1991, 1992). Impact from gillnet fisheries may be localized, possibly as a result of the patchy distribution of this species. In 1999 and 2000, a similar study by the National Marine Fisheries Service in lower Cook Inlet recorded no take of Kittlitz's murrelets, although marbled murrelets were taken (Manley *et al*. 2003). In July 2005, a juvenile Kittlitz's murrelet was killed in a gillnet fishery off Kodiak Island (Manly *et al.* 2007) and in July 2008, an adult Kittlitz's murrelet was killed in a gillnet in Yakutat Bay (Manly *et al*. 2009). Furthermore, there are anecdotal reports and opportunistic observations of both *Brachyramphus* species being taken in gillnet fisheries in other areas of Southcentral and Southeast Alaska (Manly 2007, 2009. Studies on the effects of gillnet fisheries on murrelet species (Carter *et al*. 1995) strongly suggest that gillnet fishery bycatch is a conservation concern for Kittlitz's murrelets. However, we have insufficient data to determine whether bycatch contributes substantially to the observed decline in Kittlitz's murrelets in recent years.

As we acquire new information about diurnal and seasonal migration patterns of Kittlitz's murrelets, we may discover overlap between their distribution and commercial fisheries. But until more is known about the night-time and winter distribution of Kittlitz's murrelets, significant mortality from commercial fisheries such as near-shore gillnetting and high-seas fisheries cannot be discounted. Such mortality events of alcids have been documented; a significant proportion of the entire population of Japanese murrelets (*Synthliboramphus wumizusume*) was reportedly killed in high-seas drift net fisheries in the North Pacific (Piatt and Gould 1994).

C. Disease or predation.

Disease--Except for one record of a tapeworm (*Alcataenia*) in a Kittlitz's murrelet from Kodiak Island (Hoberg 1984), there is no information available on disease or parasites in this species (Day *et al*. 1999).

Predation-- In the Gulf of Alaska and Aleutian Islands, bald eagles (*Haliaeetus leucocephalus*) and peregrine falcons (*Falco peregrinus*) commonly take marbled murrelets, which are similar in size and appearance to Kittlitz's murrelets (R. J. Ritchie, ABR Inc., Fairbanks, Alaska, pers. comm.; Hughes JH, in litt.; Schempf PF, in litt.; White CM, in litt. as cited in Day *et al*. 1999).

Predation is believed to be a significant factor affecting nesting success of marbled murrelets (McShane *et al*. 2004). Marbled murrelet eggs and chicks are depredated by corvids (Nelson 1997), raptors, and small mammals (McShane *et al*. 2004). This may also be the case with Kittlitz's murrelets (Day *et al*. 1999). Circumstantial evidence suggests that predation from corvids may be increasing with glacial retreat (M. Romano, US Geological Survey, Anchorage, Alaska, pers. comm.). However, Kittlitz's murrelet use of high-elevation nesting habitat may result in a lower rate of nest depredation compared to forest-nesting marbled murrelets (Day *et al*. 1999; Piatt *et al*. 1999). Fox predation is a suspected cause of nest failure on Kodiak Island (Burkett and Piatt 2008).

Peregrine falcons have been observed perching on vessel flagpoles and taking murrelets on the water (K. Kuletz, Service, pers. comm.). In Icy Bay, both peregrine falcons and bald eagles predated 28% and 13% (respectively) of the radio-tagged Kittlitz's murrelets (Kissling *et al*. 2007a). During summer of 2007, approximately 35 Kittlitz's murrelet remains were found in the territories (e.g., eyries and plucking posts) of 3 peregrine falcon pairs in Icy Bay (M. Kissling, Service, 2007, unpublished data). These data are preliminary; it is unknown at this time what proportion of the prey remains were adult Kittlitz's murrelets versus young of the year. Nesting peregrine falcons were not observed during a bird survey in 1993 (Kozie 1993). The current number of nesting peregrine falcons in Icy Bay may represent a recent increase in the peregrine falcon population (M. Kissling, Service, pers. comm.). This new information suggests that peregrine falcons and bald eagles may be important predators of Kittlitz's murrelets and are likely reducing adult survival.

Nest predation has been documented on Agattu Island in the Near Island group of the Aleutians. The rate of predation by glaucous-winged gulls on Kittlitz's murrelet eggs was high and accounted for the failure of 40% of nests observed (Kaler *et al*. 2009). Glaucous-winged gull abundance may be artificially inflated in the Aleutian Islands due to availability of seafood processing waste for food (Gibson and Byrd 2007).

D. The inadequacy of existing regulatory mechanisms.

The burning of fossil fuels has substantially increased the levels of carbon dioxide in the atmosphere. Carbon dioxide is a greenhouse gas that causes the earth's surface to warm. In order to prevent continued and accelerated climate warming, greenhouse gas emissions must be reduced (EPA 2010). Until recently, there have been no regulatory mechanisms to reduce greenhouse gas emissions. In 2010, the U.S. Department of Transportation (DOT) and the EPA established Federal rules that set national greenhouse gas emissions standards. The rules establish increasingly stringent fuel economy standards under DOT's National Highway Traffic Safety Administration's Corporate Average Fuel Economy program and greenhouse gas emission standards under the Clean Air Act for 2012 through 2016 model-year vehicles. In conjunction with the United States' new regulation, Canada issued its Light Duty Vehicle greenhouse gas emissions regulation. These are the first regulations intended to curb greenhouse gas emissions that cause global warming. There are no international regulations in place to limit greenhouse gas emissions from other countries.

Although the Migratory Bird Treaty Act (MBTA) has no provision to allow for incidental take of any migratory bird, (including Kittlitz's murrelets), such take does occur in commercial fisheries in Alaska (Stehn *et al*. 2001). Murrelets do not appear to be taken by longliners, trawlers, or within pot fisheries (Stehn *et al*. 2001). However, where studies have examined seabird bycatch in nearshore gillnet fisheries in the range of Kittlitz's murrelets, murrelets (marbled and Kittlitz's) comprise between 11% and 70% of seabird mortality from gillnets (Wynne *et al*. 1992; Carter *et al*. 1995; Manly *et al*. 2003, 2007). As noted above (see Factor B), we lack sufficient data to determine whether bycatch is occurring to such a degree that it contributes substantially to the observed decline in Kittlitz's murrelets. Gillnet fisheries in Alaska generally occur within State territorial waters, within the undisputed regulatory jurisdiction of the MBTA and fisheries managed by the State. Melvin *et al*. (1999) report on gear types and fishing methods that reduce such bycatch, but regulations requiring the use of bycatch reduction techniques are not in place.

The Kittlitz's murrelet receives no special protection by the State of Alaska. On March 5, 2009, The Center for Biological Diversity (CBD), a non-profit, public interest environmental organization, petitioned the State of Alaska to list the Kittlitz's murrelet as endangered under the Alaska Endangered Species Act (AS §§ 16.20.180 – 210). The petition specified that because of their small population size, precipitous population declines, and multiple, ongoing threats to its continued existence, the Kittlitz's murrelet should receive State-level regulatory protection. On April 9, 2009, the state rejected CBD's petition to list the Kittlitz's murrelet as endangered under the Alaska Endangered Species Act, claiming insufficient evidence indicating that their numbers have decreased to the extent to cause endangerment. Specifically, the petition was denied because range-wide trends are uncertain and survey data may be biased due to the cryptic plumage of the species.

E. <u>Other natural or manmade factors affecting its continued existence</u>.

Causal factors resulting in changes in forage availability may be difficult to differentiate. While a rapidly warming climate may lead to cascading events that ultimately reduce forage quality and availability, similar outcomes may result from ocean climate regime shifts.

Climate Regime shift—Long-term changes in food supply may be part of a natural ecosystem response to a change in the ocean's climate (Kitaysky *et al*. 2007). Climate changes in the marine environment play a significant role in the population regulation of phytoplankton, zooplankton, and fish, and can disturb the balance in predator-prey relationships (Hunt and Stabeno 2002). As ocean temperatures change, forage fish abundance changes (Hunt *et al*. 2002). The marine climate regime shift that occurred in 1976-1977 is hypothesized as being partially responsible for the decline in Kittlitz's murrelets (van Vleit 1993; Day *et al*. 1999). Other piscivorous marine bird species in the Gulf of Alaska have declined over the past few decades (Piatt and Anderson 1996; Agler *et al*. 1999), apparently influenced by wide-spread changes in ocean climate and forage fish abundance (Piatt and Anderson 1996; Anderson and Piatt 1999; Hare and Mantua 2000; Hollowed *et al*. 2001). Marbled murrelets, which may have a high degree of dietary overlap with Kittlitz's murrelets (Day *et al*. 2003), have also declined in some areas (Stephensen *et al*. 2001; Robards *et al*. 2003) lending support to the hypothesis that broader ecological changes have affected Kittlitz's murrelets. Ocean climate related declines in forage abundance and quality can cause food-related stress in sea birds, and those stressors may be further exacerbated by anthropogenically-caused mortalities such as pollution and commercial fishing (Piatt and Anderson 1996; Kitaysky *et al*. 2006).

Population ecology--Juvenile recruitment of Kittlitz's murrelets remains largely unobserved, despite intense survey effort (Day and Nigro 1999; Kuletz *et al*. 2008; M. Kissling, Service, 2010, pers. comm.). Poor recruitment may be a factor hindering the species' ability to survive and recover. If low recruitment is occurring and is persistent, a population decline is inevitable. The reasons for the perceived low recruitment rate in this species remain unknown. Lack of observed juvenile recruitment may be explained by the low density of birds, the synchronicity of their dispersal, their dispersal behavior, or because they are so difficult to identify (K. Kuletz, Service, pers. comm.).

Kittlitz's murrelet populations are currently small and disjunct. Genetic information suggests very low rates of immigration and emigration between the western Aleutian Islands and Kachemak Bay on the Kenai Peninsula (Friesen *et al*. 1996). Like most alcids, Kittlitz's murrelets probably habitually return to their natal sites. If so, this creates a situation in which small isolated populations may become extirpated and may not be replaced through immigration, especially if habitat quality in those locations is waning due to glacial recession. As the overall population becomes smaller, it will certainly become less resilient to stochastic events. Such events increase the likelihood that extinction will occur (Soulé 1986).

CONSERVATION MEASURES PLANNED OR IMPLEMENTED

No conservation agreements are known to exist. Because of previously limited knowledge of this species, no conservation measures have been implemented to date. However, research studies are ongoing or planned in several areas (including Prince William Sound and Icy Bay), and results may assist the development of future conservation measures. The Service recently completed the Spotlight Species Action Plan for this species, which identifies the actions we will pursue in cooperation with our partners over the next 5 years, to further its conservation. In addition, several meetings of seabird biologists have been conducted over the past year to discuss research needs for this species.

SUMMARY OF THREATS

At this time, the ultimate cause for the population decline of Kittlitz's murrelet is unknown. It appears the decline may be waning in some portions of its range in recent years. Major threats to Kittlitz's murrelets appear to be habitat based, caused by one or a combination of mechanisms including: change to forage fish quality and availability due to rapid atmospheric and/or decadal oceanic climate change, contamination of the marine environment, reduced nesting habitat due to primary succession following glacial recession, and reproductive failure as a result of weather, starvation and predation pressures. Additive to this underlying stress to the population may be adult mortality from incidental bycatch in commercial fisheries, disturbance by tour boats, and adult predation.

The present or threatened destruction, modification, or curtailment of its habitat or range: The cascading effects of rapid, global climate change may be a significant factor in the decline of Kittlitz's murrelets in Alaska. Glacial retreat caused by global climate change may influence the murrelet's survival and reproduction by reducing forage fish quality and availability. Kittlitz's murrelets are adapted to foraging in turbid, shallow waters that support abundant populations of high energy density fish (Day *et al*. 2003; Arimitsu *et al*. 2007; Arimitsu *et al*. 2008; Arimitsu 2009). In order to successfully reproduce, Kittlitz's murrelets rely on the availability of energy-rich food to provision their young. Changes in forage fish abundance, availability, and quality will negatively affect Kittlitz's murrelet reproduction. Poor recruitment may be a factor hindering the species' ability to survive and recover from other mechanisms that depress populations. If low recruitment is occurring and is persistent, a population decline is inevitable. However, the precise mechanisms that link climate warming to the decline in Kittlitz's murrelets have not yet been identified.

Additive destruction of Kittlitz's murrelet habitat, such as chronic oiling of the marine habitat, will increase the stress of reduced forage availability, quantity and quality. Oil spills in waters inhabited by Kittlitz's murrelets, especially during nesting season, are reasonably certain to occur. If historic petroleum hydrocarbon spills are considered constant over time, more than 27,000 gallons will be spilled annually in Alaskan waters (Alaska Department of Environmental Conservation, Anchorage, Alaska, 2005, unpublished data). Chronically introduced hydrocarbon petroleum in the marine environment can result in loss of forage fish quantity and quality.

Overutilization for commercial, recreational, scientific, or educational purposes: While overutilization does not appear to be a primary cause for the decline of Kittlitz's murrelets, it may be a mortality factor that causes further stress to this species. Two main pathways to harm have been identified: 1) bycatch in commercial fisheries, and 2) disturbance from recreational boating. Because Kittlitz's murrelets are caught in gill nets, and possibly other commercial fisheries (e.g., driftnet fishing operations), we believe commercial fishing could be a significant factor in their population decline and should be investigated further.

Tour boat visitation to glacial fjords is a growing industry, and this activity may increasingly disrupt Kittlitz's murrelet feeding behavior. Disturbance can disrupt feeding birds and persistent boat traffic may prevent murrelets from using high quality foraging areas (Piatt and Naslund 1995; Agness 2006). Among all Kittlitz's murrelet population strongholds, Southeast Alaska's Icy Bay is the only fjord that remains relatively free of tourist traffic and commercial fishing and this may be why this is the only location where Kittlitz's murrelets still outnumber all other alcids.

Disease or predation: Reduction in breeding habitat quality due to glacial recession may result in increased predation of breeding birds by corvids (M. Romano, USGS, pers. comm.). Predation is believed to be a significant factor affecting nest success of marbled murrelets (McShane *et a*l. 2004). Eggs and chicks are depredated by corvids (Nelson 1997) raptors, and small mammals (McShane *et al*. 2004). This may also be the case with Kittlitz's murrelets (Day *et al*. 1999), but to date nest predation on Kittlitz's murrelets has only been documented at Agattu Island where eggs were depredated by glaucous-winged gulls (Kaler *et al*. 2009). Further, predation of Kittlitz's murrelets by peregrine falcons may be significant, particularly if the murrelets taken are nesting adults. The population level impacts of predation on nestlings are considered less than the repercussions from loss of adult nesting birds. Kittlitz's murrelets are believed to exhibit a K-selected reproductive pattern; they are believed to be long-lived and slow reproducing birds, such that the effect of losing adult, breeding birds has more serious implications for the population than losing non-breeders (MacArthur and Wilson 1967)

The inadequacy of existing regulatory mechanisms: Because a population decline is occurring under existing regulatory mechanisms, we conclude that they are inadequate to protect Kittlitz's murrelets. There are neither protective mechanisms to reduce bycatch of Kittlitz's murrelets during commercial fishing operations, nor to prevent disturbance of birds by tourist and other vessels.

Other natural or manmade factors affecting its continued existence: Piscivorous marine bird species in the Gulf of Alaska have declined over the past few decades (Piatt and Anderson 1996; Agler *et al*. 1999), apparently influenced by wide-spread changes in ocean climate and forage fish abundance (Anderson and Piatt 1999; Hare and Mantua 2000; Hollowed *et al*. 2001; Piatt and Anderson 1996). The effects of decadal oscillations in marine climate may be further exacerbated by global climate change; temperature differentials during the interdecadal periods have been reduced over the past 40 years (i.e., cooling periods are warmer; Lau and Weng 1999). The ultimate results are expected to produce changes in forage fish availability, abundance and quality (Piatt and Anderson 1996; Lau and Weng 1999; Kitaysky *et al*. 2007). These changes may produce a challenging environment for Kittlitz's murrelets to survive and breed. As forage fish availability and quality decline, Kittlitz's murrelets will need to adapt their foraging strategy, switch prey, or perish. Yet changes to forage availability and quality alone may not be the only negative pressures on the population. Anthropogenic stressors such as disturbance and petroleum hydrocarbon contamination may tip the scales.

Chronic petroleum releases in the marine environment are relatively certain to occur at a rate of at least 27,000 gallons per year (Alaska Department of Environmental Conservation, Anchorage, Alaska, 2005, unpublished data), and may negatively affect forage quality and quantity. Large, catastrophic oils spills occur less frequently, but can be devastating to local populations of seabirds. In 1989, 11 million gallons of heavy Alaska crude oil was spilled in PWS, and in 2004 more than 500,000 gallons of heavy bunker C and diesel fuel oils spilled into the nearshore waters off Unalaska, Aleutian Islands. Direct evidence from the *Exxon-Valdez* oil spill in 1989 indicates that Kittlitz's murrelets are vulnerable to oil spills in the marine environment (King and Sanger 1979; J. Piatt, USGS, pers. comm.). Catastrophic events, such as oil spills, in any of the four marine regions, could have a significant negative effect on the population through direct loss of numerous individuals.

For species that are being removed from candidate status:
____Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions (PECE)?

RECOMMENDED CONSERVATION MEASURES:

1. Collaborate with Alaska Department of Fish and Game and fishers to test gillnet fishing gear or methods to reduce bycatch mortality. The Kittlitz's murrelet could benefit from cooperation between government agencies and fishermen, such as has occurred in the Alaska longline fishery. Seabird bycatch in the Alaska longline fishery has been drastically reduced due to: 1) the development and distribution of seabird deterrent devices; 2) outreach and education efforts explaining to fishermen how to catch fewer seabirds and why catching fewer seabirds is desirable; and 3) promulgation and enforcement of regulations requiring the use of seabird avoidance techniques and deterrent devices (G. Balogh, US Fish and Wildlife Service, Anchorage, Alaska, pers. comm.).

2. Work with/educate the tourist industry and recreational boaters on the need to minimize speed and reduce disturbance to Kittlitz's murrelets in upper fjords with tidewater glaciers.

3. Work with Alaska Department of Environmental Conservation and their project partners to initiate consideration of oil spill risk to Kittlitz's murrelets when developing new, and reviewing old Geographic Response Strategies.

4. Collaborate with universities, and State and Federal agencies to fill needed data gaps in Kittlitz's murrelet biology that include: demographics, diet, fledging dispersal, diurnal and seasonal migration, contaminant load in their environment, and distribution/abundance in areas not well surveyed.

5. Prepare and distribute Kittlitz's murrelet adult/juvenile identification training materials to at-sea observers so that more may be learned about juvenile dispersal.

6. Work with the International community (e.g., Russia and Japan) to assess the potential risk to Kittlitz's murrelets from at-sea drift net fisheries.

7. Work with Russian partners to collect genetic material from Russian-breeding and wintering Kittlitz's murrelets for analyses and comparison with North American specimens.

LISTING PRIORITY

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2*
		Subspecies/population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for Listing Priority Number

Magnitude-- The magnitude of threats to this species is high. Kittlitz's murrelets prefer habitat near tidewater glaciers or in turbid, glacial fed waters (Day *et al*. 1999; Day and Nigro 1999). These shallow, turbid waters are productive for energy-rich forage fishes preferred by Kittlitz's murrelets during nesting season (Day *et al*. 2003; Arimitsu *et al*. 2007; Arimitsu 2009). Availability of high energy foods in close proximity to the remote nests of Kittlitz's murrelets allow for provisioning rates that are conducive to fledging young. Due to a warming climate, many glaciers in Alaska have retreated to the degree that they are no longer tidewater glaciers or are in the process of rapid retreat (B. Molnia, US Geological Survey, Reston, Virginia, pers. comm.). Not all Kittlitz's murrelets share this affinity toward glacially influenced waters during the breeding season (Day *et al*. 1999; Vyatkin 1999), but approximately 60% of Kittlitz's murrelet sightings in Alaska occur in glacially influenced waters (Robards *et al*. 2003 ; Kuletz *et al*. 2003b; van Pelt and Piatt 2003; Kissling *et al*. 2005; Piatt *et al*. 2005; Speckman *et al*. 2005; van Pelt and Piatt 2005; Kissling, Service, 2006, unpublished data; Romano and Piatt 2005). We conclude that prime habitat for Kittlitz's murrelets is being depleted as glaciers retreat. Because of feedback mechanisms, even if greenhouse gas emissions were to stabilize immediately, temperature and sea level will continue to rise into the foreseeable future, resulting in further retreat of tidewater glaciers (IPCC 2007). Moreover, greenhouse gas-induced warming is continuous, and additive to the naturally cyclic ocean climate. Related declines in forage abundance and quality can cause food-related stress in sea birds (Piatt and Anderson 1996; Lau and Weng 1999; Kitaysky *et al*. 2007). These food-limited related stressors are further exacerbated by indirect and direct mortality from commercial fishing and pollutants in the marine environment. The food-related stressors, global climate change and decadal ocean climate shifts, are considered universal throughout the range of Kittlitz's murrelets. (Anderson and Piatt 1999; Hare and Mantua 2000)

Both chronic and acute oiling of the marine environment is certain to occur into the future. Each year, at least 27,000 gallons of petroleum hydrocarbons are spilled in marine habitats within the range of Kittlitz's murrelet (Alaska Department of Environmental Conservation, Anchorage, Alaska, 2005, unpublished data). Based on increasing vessel traffic in Alaskan waters, and assuming a constant probability of spill for each vessel, petroleum hydrocarbons entering the marine ecosystem will increase into the future. This chronic introduction of contaminants into the marine environment increases the concomitant risk that Kittlitz's murrelet prey will become contaminated. Large oil spills are also reasonably certain to occur, although difficult to predict. In 15 years, two large spills have occurred within the range of Kittlitz's murrelets: 1) *Exxon-Valdez*, spilling over 11 million gallons, and 2) Selendang Ayu, spilling over 500,000 gallons. Each spill resulted in the mortality of Kittlitz's murrelets (van Vleit and McAllister 1994; Kuletz 1996; Stehn, USGS, 2005, unpublished data). The *Exxon-Valdez* oil spill killed up to 15% of the Kittlitz's murrelets inhabiting PWS. Evidence supports the assumption that both chronic and acute oiling of the marine environment will have significant effects on Kittlitz's murrelets in some habitats in Alaska.

In PWS, salmon gillnet fisheries occur each summer in or near Kittlitz's murrelet habitat. Kittlitz's murrelets represented 5% and 30% of murrelet bycatch in gillnets during 1990 and 1991, respectively (Wynne *et al*. 1991, 1992). Kittlitz's murrelets are caught in gillnets and other murrelets are caught in the deep-sea driftnet fisheries. It is unknown if Kittlitz's murrelets are caught in drift nets during winter. Direct loss of individuals through being incidentally caught in fishing operations may be impacting the Kittlitz's murrelet population.

Most human use in PWS is concentrated in the northwestern part of the Sound, and in central mainland fjords with tidewater glaciers; these are the same areas favored by murrelets (Murphy *et al*. 2004). Disturbance can disrupt feeding birds and cause an increase in flight behavior (Agness 2006). Persistent boat traffic may prevent murrelets from using high quality foraging areas primarily within PWS and Glacier Bay (Piatt and Naslund 1995).

A large percentage (>60%) of Kittlitz's murrelet's range is restricted to Alaska, and available information indicates populations have declined (Kuletz *et al*. 2003b; van Pelt and Piatt 2003; Kuletz et al 2005; Kissling et al. 2007b; Piatt et al. 2007; Kuletz et al. 2008). The current population estimate for Alaskan birds is between 30,900 and 56,800 individuals.

Imminence--Threats to Kittlitz's murrelets are global, ongoing and increasing. Warming climates are accelerating glacial retreat, which may cause detrimental habitat changes for Kittlitz's murrelets. Population declines occurring in areas free of direct anthropogenic disturbance suggest these populations are being driven downward by oceanographic and climatological phenomena. Documented ongoing threats to Kittlitz's murrelets include oil spills and bycatch in commercial fisheries. Furthermore, tour boat traffic probably disturbs Kittlitz's murrelets while the birds forage during nesting season (Agness 2006). As a result, immediacy of threats is considered imminent.

yes Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Is Emergency Listing Warranted?
Emergency listing of Kittlitz's murrelet is not warranted at this time. Available trend data indicate that while population declines have been sharp, extirpation of a significant proportion of the population is not likely to occur before a routine listing process for this species could be completed.

DESCRIPTION OF MONITORING:
The Service, U.S. Geological Survey, U.S. Forest Service, and National Park Service have conducted population surveys in areas used by Kittlitz's murrelets including: 1) PWS in 2001, 2003, 2004, 2005, 2007 (Kuletz *et al*. 2003a,b; McNight *et al*. 2003; McNight *et al*. 2008; Stephensen 2009); 2) Southeast Alaska in 2002, 2003, 2004, 2005, 2007, 2008 and 2009 (Kissling *et al*. 2007; Kirchoff 2008; Kirchoff *et al*. 2010; Kissling *et al*. 2010); 3) Aleutian Islands in 2003, 2004, and 2005, 2006 (Romano and Piatt 2005; Piatt *et al*. 2005; Romano *et al*. 2005; Piatt *et al*. 2007); 4) Alaska Peninsula in 2003 (van Pelt and Piatt 2005); Kenai Fjords in 2002 and 2006 (Romano *et al*. 2006; van Pelt and Piatt 2003); 5) Lower Cook Inlet in 2004, 2005, 2006, and 2007 (Kuletz *et al*. 2005; Kuletz *et al*. 2008); and 6) Yakutat Bay in 2009 (Kissling *et al*. 2010).

A collaborative study with the University of Washington, US Geological Survey, and Alaska Department of Fish and Game was conducted to assess the effects of human disturbance on Kittlitz's murrelets in Glacier Bay (Agness 2006).

In 2006, the Service with the National Oceanic and Atmospheric Administration (NOAA) commenced a multi-year study to conduct at-sea pelagic bird surveys aboard a NOAA research vessels (Kuletz *et al*. 2010)

Beginning in 2006, the Service and a graduate student from the University of Massachusetts, embarked on a four year study of marine habitat use and foraging of seabirds, including Kittlitz's murrelets in five fjords within PWS.

In 2006, the Service and ABR, Inc. began a comparative study of plumage variations among museum specimens and live captured Kittlitz's murrelets.

In 2007, the Service and the National Park Service commenced a 5-year study to investigate population declines of Kittlitz's murrelets in Icy Bay, Wrangell-St. Elias National Park and Preserve. The ultimate goal of this work is to estimate population parameters necessary for demographic modeling. VHF radio-transmitters will be applied to ≤75 Kittlitz's murrelets and solar-powered satellite transmitters to ≤10 Kittlitz's murrelets for the purposes of estimating population growth rate by generating empirical estimates of adult survival, reproductive measures, and population abundance. This study received continued funding through 2011; final reports and publications are expected in 2012.

In 2007, the Service, National Park Service and others began evaluating Kittlitz's murrelets for Hg and other contaminants. Samples have been collected and submitted to the laboratory; results are pending.

In 2008, the Service, National Park Service, Dancing Star Foundation, and Wildlife Conservation Society collaborated with Oregon State University to support a graduate student to study trophic foraging ecology and reproductive energetics of Kittlitz's murrelets in Icy Bay, Alaska. This study is expected to be completed in December 2010.

In 2008, the US Geological Survey in partnership with the Service initiated a pilot study on nesting Kittlitz's murrelets on Kodiak Island. This survey followed a brief radar study that identified potential nesting habitat on the Island (Day and Barna 2007). The main goals of the study were to: 1) study the behavior of Kittlitz's murrelets during their early morning and late evening hour visits to the site (and quantify arrival-departure patterns, visual sightings, vocalizations, courtship displays, etc.); 2) search for and locate nest sites on the ground; and, 3) if successful in locating nests, characterize the nest site habitat, and monitor the development of eggs and chicks at the site (Burkett and Piatt 2008; Lowann 2009). This study has continued with modifications in 2009, and in 2010 research will be conducted by a graduate student from Oregon State University.

After great success finding nests in 2006, the Alaska Maritime National Wildlife Refuge and US Geological Survey initiated a study in 2008 to monitor Kittlitz's murrelet nests on Agattu Island in the Aleutian Islands (Kaler and Kenney 2008; Kaler *et al*. 2009; Kaler *et al*. 2010). This study will continue with the following long-term objectives: 1) describe habitat characteristics of nest sites; 2) quantify breeding chronology; 3) determine chick growth rates, nestling diet and adult nest attendance patterns; 4) measure nest survival rates and overall reproductive success; 5) collect genetic samples for comparative study of murrelet populations; and 6) measure research influenced nest success.

In 2010, the Service and ABR, Inc. began an effort to summarize available information on the distribution and at-sea abundance of Kittlitz's murrelets in northern Alaska.

In 2008, the US Geological Survey in partnership with the Service began a 5-year, comprehensive study to fill data gaps regarding phylogenetics, demography, nesting biology, distribution, status and trends of Kittlitz's murrelets in Alaska. The objectives of the study are to: 1) clarify the phylogeographic variation among of Kittlitz's murrelet populations and sub-populations; 2) measure components of demography such as reproductive success and study nesting biology (e.g., meal deliveries, diet composition, chick growth and survival); 3) determine seasonal patterns of Kittlitz's murrelet distribution and migratory movements; and 4) compile available information and fill gaps in our knowledge of population status and trends throughout the range of Kittlitz's murrelets.

In 2010, the Service with NOAA will commence a two-year at-sea pelagic survey to assess abundance and distribution of seabirds, including Kittlitz's murrelets in the Gulf of Alaska. In 2010, the Service will monitor Kittlitz's murrelet populations in PWS for the purposes of estimating abundance and comparing with previous estimates for a trend analysis.

In 2010, the Service and the National Park Service will initiate a study to determine the extent of raptor predation on Kittlitz's murrelets in Icy Bay, southeast Alaska. This study will utilize radio telemetry and stable isotope analysis along with classical techniques to evaluate predation rates.

COORDINATION WITH STATES:
Kittlitz's murrelet was selected as a featured species in Alaska's Comprehensive Wildlife Conservation Strategy (ADF&G 2006) based on: 1) its classification by NatureServe as imperiled; 2) the noticeable decline in abundance; 3) its rarity; 4) our identification of the species as a candidate for listing under the Endangered Species Act; 5) its endemism; 6) its seasonally restricted local range; 7) its sensitivity to environmental disturbance; and 8) its disjunctive distribution. The issues and concerns identified for Kittlitz's murrelets include habitat loss (i.e., receding glaciers), gillnet mortality, vessel disturbance, mining, climate change, and climate regime shifts. To date, two Kittlitz's murrelet studies have been funded through the State Wildlife Grant process.

We have collaborated with the Alaska Department of Fish and Game (ADF&G) on past research projects for Kittlitz's murrelet, and are continuing this coordination on current and future work.

In July 2004, the Service commenced a 3-year study of Kittlitz's murrelet annual and seasonal patterns of abundance within Kachemak Bay, funded in part through Alaska's State Wildlife Grant program (Kuletz *et al*. 2008).

In 2007, Alaska Department of Fish and Game gathered abundance data on Kittlitz's murrelets in Glacier Bay National Park in conjunction with a larger study of marbled murrelets. This study was funded through Alaska's State Wildlife Grant program.

In 2008, Alaska Department of Fish and Game initiated a study to assess by-catch of Kittlitz's murrelets in Alaskan gillnet fisheries. By examining the spatiotemporal overlap of Kittlitz's murrelets and gillnet fishing activities, ADF&G hopes to determine the potential risk that the gillnet fishery poses to Kittlitz's murrelets. In addition, in 2010, ADF&G will conduct simultaneous aerial surveys of gillnet distribution and boat-based surveys of Kittlitz's murrelet distribution in Yakutat Bay to examine their fine-scale overlap. This study is supported with section 6 funds, and is on-going.

In 2009, Alaska Department of Fish and Game in cooperation with Audubon Alaska conducted a survey of Kittlitz's and marbled murrelets in Glacier Bay (Kirchoff *et al*. 2010). This work will continue through 2010.

Alaska Department of Fish and Game has contracted Bob Day, ABR Inc., to conduct a review of past population estimates of Kittlitz's murrelets and identify potential biases in methodology, design and analyses. The purpose of this review is to provide a framework for consistency and standardization in future survey efforts. This work is to be completed in 2010.

LITERATURE CITED

Abookire AA, Piatt JF. 2005. Oceanographic conditions structure forage fishes into lipid-rich and lipid-poor communities in lower Cook Inlet, Alaska, USA. Marine ecology progress series, 287:229-240.

Adaldeirsdottir G, Echelmeyer KA, Harrison WD. 1998. Elevation and volume changes on the Harding Icefield, Alaska. Journal of Glaciology, 44:570-582.

[ADF&G] Alaska Department of Fish and Game. 2006. Our wealth maintained: A strategy for conserving Alaska's diverse wildlife and fish resources. Alaska Department of Fish and Game, Juneau, Alaska. xvii+824 p.

[AKNHP] Alaska Natural Heritage Program. 2004. Kittlitz's murrelet. http://aknhp.uaa.alaska.edu/zoology/pdfs/birds/Kittlitz's%20murrelet.pdf, accessed November 9, 2007

Agness AM. 2006. Effects and impacts of vessel activity on the Kittlitz's murrelet (*Brachyramphus brevirostris*) in Glacier Bay, Alaska. Master's thesis, University of Washington. P 51.

Anderson PJ, Piatt JF. 1999. Community reorganization in the Gulf of Alaska following ocean climate regime shift. Marine Ecology Progress Series 189:117-123.

[AOU] American Ornithologists' Union. 1957. Check-list of North American birds. 5th ed. American Ornithologists Union. Baltimore, MD.

[AOU] American Ornithologists' Union. 2005. Check-list of North American birds. 7th edition. August 19, 2005 <http://wwww.aou.org/checklist/index.php3>.

Arimitsu ML. 2009. Glacial features in Kittlitz's murrelet foraging habitat. Master's thesis, University of Alaska, Fairbanks. 69 p

Arimitsu ML, Piatt JF, Litzow MA, Abookire AA, Romano MD, Robards MD. 2008. Distribution and spawning dynamics of capelin (*Mallotus villosus*) in Glacier Bay, Alaska: a cold water refugium. Fisheries Oceanography 17:137-146.

Arimitsu ML, Piatt JF, Romano MD, Douglas DC. 2007. Distribution of forage fishes in relation to the oceanography of Glacier Bay National Park. *in* Piatt, J.F., and Gende, S.M., eds., Proceedings of the Fourth Glacier Bay Science Symposium, October 26–28, 2004: U.S. Geological Survey Scientific Investigations Report 2007-5047, p. 102-106

Artukhin YB, Vyatkin PS, Andreev AV, Konyukhov NB, van Pelt TI. 2010. Current and historical information on Kittlitz's murrelets in the Russian Far East. Source: http://www.pacificseabirdgroup.org/index.php?f=pubs&t=Publications&s=1, accessed 29 April 2010.

Barretta P. 1997. Glacial retreat. The Polar Times 2(10):17.

Bartonek JC, Gibson DD. 1972. Summer distribution of pelagic birds in Bristol Bay, Alaska. The Condor 74:416-422.

Begon M, Harper JL, Townsend CR. 1996. Ecology. Individuals, Populations, and Communities. Blackwell Scientific Publications, Inc. Cambridge, MA.

Beissinger SR. 1995. Population trends of the marbled murrelet projected from demographic analyses. In: Ralph CJ, Hunt GL Jr., Raphael MG, Piatt JF, editors. Ecology and conservation of the marbled murrelet. USDA For. Serv. Gen. Tech. Rep. PSW-GTR-152. p 385–394.

BirdLife International. 2005. Species factsheet: *Brachyramphus brevirostris*. August 19, 2005 <http://www.birdlife.org>.

Birt TP, MacKinnon D, Piatt JF, Friesen VL. 2010. Conservation genetics of Kittlitz's murrelet. http://www.pacificseabirdgroup.org/index.php?f=pubs&t=Publications&s=1, accessed 29 April 2010.

Blais JM, Schindler DW, Muir DCG, Sharp M, Donald D, Lafreniere M, Braekevelt E, Strachan WMG. 2001. Melting glaciers: a major source of persistent organochlorines to subalpine Bow Lake in Banff national Park, Canada. AMBIO 30(7):410-415.

Bloxton TD, Jr, Raphael MG. 2009. Breeding ecology of marbled murrelet in Washington State: five year project summary (2004-2008). Unpublished report. USDA Forest Service, Pacific Northwest Research Station, Olympia, Washington. 41 p.

Brown CS, Meier MF, Post A. 1982. Calving speed of Alaska tidewater glaciers, with application to Columbia Glacier. US Geological Survey Professional Paper 1258-C. 13p.

Burkett E, Piatt J. 2008. Kittlitz's murrelet research on Kodiak National Wildlife Refuge in 2008. Unpublished report. USGS, Alaska Science Center, Anchorage, Alaska.

Byrd GV, Daniel L. 2007. Bird species found oiled, December 2004 – January 2005, at Unalaska Island following the M/V Selendang Ayu oil spill. Unpublished draft report, US Fish and Wildlife Service, Alaska Maritime National Wildlife Refuge, Homer, Alaska.

Calkin PE. 1994. Initial comparison of glacial and tree-ring paleoclimate: northeastern Pacific. Geological Society of America, Abstracts with Programs 26(7):176.

Carter HR, McAllister MLC, Isleib MEP. 1995. Mortality of marbled murrelets in gill nets in North America. In: Ralph CJ, Hunt GL Jr., Raphael MG, Piatt JF, editors. Ecology and conservation of the marbled murrelet. USDA For. Serv. Gen. Tech. Rep. PSW-GTR-152. p 271-284.

Crowley TJ. 2000. Causes of climate change over the past 1,000 years. Science 289:270-277.

Custer TW, Custer CM, Hines RK, Sparks DW, Melancon MJ, Hoffman DJ, Bickham JW, Wickliffe JK. 2000. Mixed-function oxygenases, oxidative stress and chromosomal damage measured in lesser scaup wintering on the Indiana Harbor Canal. Archives of Environmental Contamination and Toxicology, 38(4): 522-529.

Day RH. 1995. New information on Kittlitz's murrelet nests. Condor 97:271-273.

Day RH, Barna JB. 2007. Movements and behavior of Kittlitz's murrelets on Kodiak Island, Alaska: a pilot study. Report prepared for US Fish and Wildlife Service, Kodiak National Wildlife Refuge. ABR, Inc., Fairbanks, Alaska.

Day RH, Nigro DA. 1999. Status and Ecology of Kittlitz's Murrelet in Prince William Sound, 1996-1998. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 98142). ABR, Inc., Fairbanks, Alaska.

Day RH, Nigro DA, Prichard AK. 2000. At-sea habitat use by the Kittlitz's murrelet *Brachyramphus brevirostris* in nearshore waters of Prince William Sound, Alaska. Marine Ornithology 28:105-114.

Day RH, Kuletz KJ, Nigro DA. 1999. Kittlitz's murrelet (*Brachyramphus brevirostris*). In: Poole A, Gill F, editors. The Birds of North America. Academy of Natural Sciences, Philadelphia, PA, and American Ornithologists' Union, Washington, DC.

Day RH, Nigro DA. 2000. Feeding ecology of Kittlitz's and marbled murrelets in Prince William Sound, Alaska. Waterbirds 23:1-4.

Day RH, Nigro DA. 2004. Is the Kittlitz's murrelet exhibiting reproductive problems in Prince William Sound, Alaska? Waterbirds 27:89-95.

Day RH, Oakley KL, Barnard DR. 1983. Nest sites and eggs of Kittlitz's and marbled murrelets. Condor 85(3):265-273.

Day RH, Prichard AK. 2001. Biology of wintering marine birds and mammals in the northern Gulf of Alaska. Exxon Valdez Oil Spill Restoration Project Final Report (Restoration Project 00287). U.S. Fish and Wildlife Service, Anchorage, Alaska.

Day RH, Prichard AK, Nigro DA. 2003. Ecological specialization and overlap of Brachyramphus murrelets in Prince William Sound, Alaska. Auk 120(3):680-699.

Day RH, Stickney AA. 1996. Kittlitz's murrelet surveys at remote air force sites in Alaska, 1995. Unpublished report prepared for the United States Air Force, Elmendorf AFB, Alaska.

Dickey JO, Marcus SL, Viron O, Fukumori I. 2002. Recent earth oblateness variations: unraveling climate and postglacial rebound effects. Science 298:1975-1977.

Donald DB, Syrgiannis J, Crosley RW, Hodsworth G, Muir DCG, Rosenberg B, Sole A, Schindler DW. 1999. Delayed deposition of organochlorine pesticides at a temperate glacier. Environ. Sci. Technol. 33:1794-1798.

Drew GS, Piatt JF. 2008. Using geographic information systems to compare non-uniform marine bird surveys: detecting the decline of Kittlitz's murrelet (*Brachyramphus brevirostris*) in Glacier Bay, Alaska. The Auk 125:178-182.

Dyurgerov MB, Meier MF. 2000. Twentieth century climate change: evidence from small glaciers. Proceedings of the National Academy of Sciences 97:1406-1411.

Esler D, Schmutz JA, Jarvis RL, Mulchay DM. 2000. Winter survival of adult female harlequin ducks in relation to history of contamination by the Exxon Valdez oil spill. J. Wildl. Manage. 64(3):839-847.

[EPA] Environmental Protection Agency. 2010. DOT, EPA Set Aggressive National Standards for Fuel Economy and First Ever Greenhouse Gas Emission Levels For Passenger Cars and Light Trucks. http://yosemite.epa.gov/opa/admpress.nsf/8b770facf5edf6f185257359003fb69e/562b44f2588b871a852576f800544e01!OpenDocument, accessed April 29, 2010.

Flint VE, Boehme RL, Kostin YV, Kuznetsov AA. 1984. A Field Guide to Birds of the USSR. Princeton University Press.

Friesen VL, Piatt JF, Baker AJ. 1996. Evidence from Cytochrome b sequences and allozymes for a "new" species of alcid: the Long-billed Murrelet (*Brachyramphus perdix).* Condor 98:681-690.

Gibson DD, Byrd GV. 2007. Birds of the Aleutian Islands, Alaska. Nuttall Ornithological Club and The American Ornithologists' Union, Washington, D.C.

Glegg GA, Hickman L, Rowland SJ. 1999. Contamination of limpets (*Patella vulgator*) following the Sea Empress oil spill. Marine Pollution Bulletin. Vol. 38. No.2:119-125.

Hare SR, Mantua SJ. 2000. Empirical evidence for North Pacific climatic regime shifts in 1977 and 1989. Progress in Oceanography 47:103-145.

Hassol SJ. 2004. Arctic climate impact assessment; impacts of a warming arctic. Cambridge University Press. Also available at http://www.acia.uaf.edu.

Hayes MO, Michel J. 1999. Factors determining the long-term persistence of Exxon Valdez oil in gravel beaches. Marine Pollution Bulletin, 38: 92-101.

Hegseth EN, Svendsen H, von Quillfeldt CH. 1995. Phytoplankton in fjords and coastal waters of northern Norway: environmental conditions and dynamics of the spring bloom. In: Skjoldal HR, Hopkins C, Erikstad KE, Leinaas HP, editors. Ecology of fjords and coastal waters. Elsevier, New York. p 45-72.

Hoberg EP. 1984. *Alcataenia campylacantha* (Krabbe, 1869) from Pigeon Guillemots, *Cepphus columba* Pallas, and Black Guillemots, *Cepphus grylle* (Linnaeus), and *Alcataenia* sp. indet. (Cestoda: Dilepididae) from Kittlitz's Murrelets, *Brachyramphus brevirostris* (Vigors) in Alaska. Can. J. Zool. 62: 2297–2301.

Hobson KA, Piatt JF, Pitocchelli J. 1994. Using stable isotopes to determine seabird trophic relationships. Journal of Animal Ecology, 63:786-798.

Hollowed AB, Hare SR, Wooster WS. 2001. Pacific Basin climate variability and patterns of Northeast Pacific marine fish production. Progress in Oceanography 49:257-282.

Hoover-Miller A, Jezierski C, Conlon S, Atkinson S. 2006. 2005 Harbor seal population dynamics and responses to visitors in Aialik Bay, Alaska. Report to the Ocean Alaska Science and Learning Center and the National Park Service. 44 pp.

Hunt GL. Stabeno PJ. 2002. Climate change and the control of energy flow in the southeastern Bering Sea. Progress in Oceanography 55:5-22

Hunt GL, Jr., Stabeno P, Walters G, Sinclair E, Brodeur RD, Napp JM, Bond NA. 2002. Climate Change and Control of the Southeastern Bering Sea Pelagic Ecosystem *Deep-Sea Research II*, version 26, http://www.pmel.noaa.gov/foci/sebscc/special_issue/manuscripts/hunt_eco_rev2.pdf, accessed November 19, 2007.

Hunter L. 1994. Grounding-line systems of modern temperate glaciers and their effects on glacier stability. Ph.D thesis, Northern Illinois University. 467 p.

[IPCC] Intergovernmental Panel on Climate Change. 2007. Climate Change 2007: The Physical Science Basis. Summary For Policymakers**.** Contribution of Working Group I to the Fourth

Assessment Report of the Intergovernmental Panel on Climate Change. Last revised February 5, 2007; Retrieved April 19, 2007]. http://www.ipcc.ch/SPM2feb07.pdf.

[IPCC] Intergovernmental Panel on Climate Change. 2001. Climate change 2001: the science of climate change, contribution of working group 1 to the Intergovernmental Panel on Climate Change third assessment report. J.T. Houghton, Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.). Cambridge University Press, Cambridge, UK.

Irwin RJ, VanMouwerik M, Stevens L, Seese MD, Basham W. 1997. Environmental Contaminants Encyclopedia. National Park Service, Water Resources Division, Fort Collins, Colorado. Distributed within the Federal Government as an Electronic Document (Projected public availability on the internet or NTIS: 1998).

Isleib ME, Kessel B. 1973. Birds of the North-Gulf Coast- Prince William Sound Region, Alaska. Biological Papers of the University of Alaska 14:1-149.

Jansen JK, Bengtson JL, Boveng PL, Dahle SP, Hoef JV. 2006. Disturbance of harbor seals by cruise ships in Disenchantment Bay, Alaska: an investigation at three spatial and temporal scales. National Marine Fisheries Service, Alaska Fisheries Science Ceter AFSC Processed Report 2006-02. 87 p.

Kaler RSA. 2006. Kittlitz’s Murrelet Nest From Agattu Island, Aleutians, Alaska. U.S. Fish and Wildl. Serv. Rep. AMNWR 06/02.

Kaler RSA. Kenney LA. 2008. Breeding biology of Kittlitz’s murrelets at Agattu Island, Alaska in 2008: progress report. U.S. Fish and Wildl. Serv. Rep. AMNWR 08/17.

Kaler RSA, Kenney LA, Piatt JF, Williams JC, Byrd GV. 2010. Breeding biology of Kittlitz’s murrelet at Agattu Island, Alaska, in 2009: progress report. U.S. Fish and Wildl. Serv. Rep. AMNWR 2010/01.

Kaler RSA, Kenney LA, Sandercock BK. 2009. Breeding ecology of Kittlitz’s murrelets at Agattu Island, Aleutian Archipelago, Alaska Waterbirds 32:363-479.

Karl, T.R., and K. Trenberth. 2003. Modern climate change. Science 302:1719-1723.

Kendall SJ, Agler BA. 1998. Distribution and abundance of Kittlitz’s murrelets in southcentral and southeastern Alaska. Colonial Waterbirds 21(1):53-60.

Kirchhoff M. 2008. Methodological Considerations for At-sea Monitoring of *Brachyramphus* Murrelets in Glacier Bay, Alaska. Unpublished report, Alaska Department of Fish and Game, Douglas, Alaska.

Kirchoff M, Smith M, Wright S. 2010. Abundance, population trend, and distribution of marbled murrelets and kittlitz's murrelts in Glacier Bay National Park. Final Report to the National Park Service and Alaska Department of Fish and Game, 34 pp.

Kissling M, Gende S, Reid M, Lewis SB, Lukacs P, Hatch N. 2007a. Identifying nesting and foraging habitat of Kittlitz's murrelets (Brachyramphus brevirostris) in Icy Bay, Alaska; 2007 annual summary. Unpublished report, US Fish and Wildlife Service, Juneau, Alaska.

Kissling M, Kuletz KJ, Brockmann S. 2005. Distribution and abundance of *Brachyramphus* murrelets from Icy Bay to Cross Sound and in selected mainland fjords of Southeast Alaska. Unpublished report, U.S. Fish and Wildlife Service, Juneau, AK.

Kissling ML, Kuletz KJ, Brockmann SP, Hatch NR. 2007b. Distribution and abundance of *Brachyramphus* murrelets and other marine species from Icy Bay to LeConte Bay, southeast Alaska, 2002-2004. U.S. Fish and Wildlife Service, Juneau Field Office, Alaska.

Kissling ML, Reid M, Lukacs PM, Gende SM, Lewis SB. 2007c. Understanding abundance patterns of a declining seabird: implications for monitoring. Ecological Applications 17: 2164-2174.

Kissling ML, Lukacs PM, Lewis SB, Gende SM, Kuletz KJ, Hatch NR, Schoen SK, Oehlers S. 2010. Distribution, abundance, and changes in populations of the Kittlitz's Murrelet in Southeast Alaska. *Marine Ornithology IN REVIEW*

King JG, Sanger GA. 1979. Oil vulnerability index for marine oriented birds. In: Bartonek, JC, Nettleship, DN, editors. Conservation of marine birds of northern North America. U.S. Fish and Wildlife Service, Wildl. Res. Rep. 11:1-319.

Kitaysky AS, Kitaiskaia EV, Piatt JF, Wingfield JC. 2006. A mechanistic link between chick diet and decline in seabirds? Proceedings of the Royal Society B, 273:445-450.

Kitaysky AS, Piatt JF, Wingfield JC. 2007. Stress hormones link food availability and population processes in seabirds. Marine Ecology Progress Series 352: 245–258.

Kondratyev AY, Litvinenko NM, Kaiser GW. 2000. Seabirds of the Russian Far East. Special Publication Canadian Wildlife Service, Minister of Public Works and Government Services, Canada. ISBN 0-662-28997-8.

Konyukhov NB, Bogoslovskaya S, Zvonov BM, van Pelt TI. 1998. Seabirds of the Chukotka Peninsula, Russia. Arctic 51(4):315-329.

Koppes MN, Hallet B. 2002. Influence of rapid glacial retreat on the rate of erosion by tidewater glaciers. Geology 30(1):47-50.

Kozie KD. 1993. Coastal Wildlife Survey- Seabirds and marine mammals along the Malaspina Forelands 1992. Wrangell-St. Elias National Park and Preserve (WRST) Research and Resource Management Report 92-07.

Kuletz KJ. 1996. Marbled murrelet abundance and breeding activity at Naked Island, Prince William Sound, and Kachemak Bay, Alaska, before and after the *Exxon Valdez* oil spill. In: Rice SD, Spies RB, Wolfe DA, Wright BA, editors. Proceedings of the *Exxon Valdez* oil spill symposium. American Fisheries Society Symposium 18. p 770-784.

Kuletz KJ. 2001. Marine bird and mammal surveys pre- and post-spill for areas affected by the *Windy Bay* Oil Spill in Prince William Sound, summer 2001. Unpublished Report. U.S. Fish and Wildlife Service, Anchorage, Alaska.

Kuletz KJ, Lang A. 2010. Seabird and Marine Mammal Observations on the Polar Sea BEST-early spring cruise *In* Cruise Report - USCGC Polar Sea: 7 March-7 April 2010 - Bering Sea, Cooper LW, editor. North Pacific Research Board and National Science Foundation. 49p.

Kuletz KJ, Manly B, Nations C, Irons D. 2005. Declines in Kittlitz's and marbled murrelets in Prince William Sound, Alaska: Dealing with uncertainty. In: Foraging Behavior and Productivity of a Non-Colonial Seabird, the Marbled Murrelet (*Brachyramphus marmoratus*), Relative to Prey and Habitat. K. Kuletz. Ph.D. Dissertation, University of Victoria, Victoria, British Columbia. p 173-195.

Kuletz KJ, Labunski EA, Brenneman KM. 2003b. Distribution and abundance of Kittlitz's Murrelets in Prince William Sound, Alaska, in summer 2001. Unpublished Report. U. S. Fish and Wildlife Service, Anchorage, Alaska.

Kuletz KJ, Labunski EA, Speckman SG. 2008. Abundance, distribution, and decadal trends of Kittlitz's and marbled murrelets and other marine species in Kachemak Bay, Alaska. Final Report (Project No. 14) by U.S. Fish and Wildlife Service for Alaska Department of Fish and Game, State Nongame Wildlife Grant, Anchorage, Alaska.

Kuletz KJ, Stephensen SW, Irons DB, Labunski EA, Brenneman KM. 2003a. Changes in distribution and abundance of Kittlitz's murrelets *Brachyramphus brevirostris* relative to glacial recession in Prince William Sound, Alaska. Marine Ornithology 31:133-140.

Lau KM, Weng H. 1999. Interannual, decadal–interdecadal, and global warming signals in sea surface temperature during 1955–97. Journal of Climate, 12:1257-1267.

Lawonn MJ. 2009. Ecology and behavior of Kittlitz's murrelet in Kodiak National Wildlife Refuge, Alaska: 2009 progress report. US Fish and Wildlife Service, Kodiak National Wildlife Refuge, Kodiak, Alaska.

Lethcoe NR. 1987. An observer's guide to the glaciers of Prince William Sound, Alaska. Prince William Sound Books, Valdez, AK.

Lindell J. 2005. Results of at-sea *Brachyramphus* murrelet surveys in Icy Strait and other selected areas of Southeast Alaska. Unpublished report, USFWS, Ecological Services, Juneau, AK.78pp.

Litzow MA, Piatt JF, Abookire AA, Robards MD. 2004. Energy density and variability in abundance of pigeon guillemot prey: support for the quality-variability trade-off hypothesis. Journal of Animal Ecology, 73:1149-1156.

Lougheed C, Lougheed LW, Cooke F, Boyd S. Local survival of adult and juvenile marbled murrelets and their importance for estimating reproductive success. The Condor 104:309-318.

MacArthur RH, Wilson EO. 1967. The theory of island biogeography. Princeton University Press, Princeton, New Jersey.

MacKinnon D. 2005. A study of population genetics on Kittlitz's murrelets (*Brachyramphus brevirostris*) using the mitochondrial control region. Undergraduate Honours Thesis, Queen's University, Kingston Ontario, Canada.

Manly BFJ. 2009. Incidental take and interactions of marine mammals and birds in the Yakutat salmon setnet fishery, 2007 and 2008. Unpublished report. Western EcoSystems Technology Inc, Cheyenne, Wyoming. 96p.

Manly BFJ, Van Atten AS, Kuletz KJ, Nations C. 2003. Incidental catch of marine mammals and birds in the Kodiak Island set gillnet fishery in 2002. Final report by Western EcoSystems Technology, Inc., Cheyenne, WY, for National Marine Fisheries Service, Juneau, Alaska.

Manly BFJ, Sternfeld M, Kuletz KJ. 2007. Incidental Take and Interactions of Marine Mammals and Birds in the Kodiak Island Salmon Set Gillnet Fishery, 2002 and 2005. Final report by Western EcoSystems Technology Inc., Cheyenne, Wyoming, for National Marine Fisheries Service, Juneau, Alaska. <http://www.fakr.noaa.gov/protectedresources/observers/bycatch/kodiakreport02_05.pdf>, accessed March 17, 2009.

Martin M, Richardson BJ. 1991. Long term contaminant biomonitoring: views from southern and northern hemisphere perspectives. Marine Pollution Bulletin 22:533-537.

McKnight AE, Sullivan KM, Stephensen SW, Irons DB, Kuletz KJ, Labunski EA. 2003. Distribution, abundance, and foraging behavior of Kittlitz's (*Brachyramphus brevirostris*) and marbled murrelets (*Brachyramphus marmoratus*) in College and Harriman fjords, Prince William Sound, Alaska, in summer 2003. Unpublished report. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska.

McKnight A, Sullivan KM, Irons DB, Stephensen SW, Howlin S. 2008. Prince William Sound marine bird surveys, synthesis and restoration. *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 080751), U. S. Fish and Wildlife Service, Anchorage, Alaska.

McShane C, Hamer T, Carter H, Swartzman G, Friesen V, Ainley D, Tressler R, Nelson K, Burger A, Spear L, Mohagen T, Martin R, Henkel L, Prindle K, Strong C, Keany J. 2004. Evaluation report for the 5-year status review of the marbled murrelet in Washington, Oregon, and California. Unpublished Report. EDAW, Inc. Seattle, Washington.

Melvin EF, Parrish JK, Conquest LL. 1999. Novel tools to reduce seabird bycatch in coastal gillnet fisheries. Conservation Biology 13(6):1386-1397.

Molnia B. 2001. Glaciers of Alaska. Alaska Geographic 28(2). Alaska Geographic Society, Anchorage, AK.

Montevecchi WA, Piatt JF. 1987. Dehydration of seabird prey during transport to the colony: effects on wet weight energy densities. Canadian Journal of Zoology 65:2822-2824.

Murphy KA, Suring LH, Iliff A. 2004. Western Prince William Sound human use and wildlife disturbance model, *Exxon Valdez* Oil Spill Restoration Project Final Report (Restoration Project 99339), USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

Naslund NL, Piatt JF, van Pelt T. 1994. Kittlitz's murrelet. Pg 46 *in* Pacific Seabirds; a publication of the Pacific Seabird Group, volume 21.

NatureServe. 2005. Kittlitz's murrelet. August 29, 2005 <http://www.natureserve.org>.

Nelson SK. 1997. Marbled Murrelet (*Brachyramphus marmoratus*). In: Poole A, Gill F, editors. The Birds of North America, No. 276. The Academy of Natural Sciences, Philadelphia, Pennsylvania.

[NSIDC] National Snow and Ice Data Center. 2006. Glaciers. University of Colorado Boulder April 27, 2006 <http://www-nsidc.colorado.edu/sotc/glacier_balance.html>.

[NWRA] National Wildlife Refuge Association. 2005. 2005 focus: beyond the boundaries. September 19, 2005<http://www.refugenet.org/new-pdf-files/BeyondtheBoundaries.pdf>.

Oerlemans J, Anderson B, Hubbard A, Huybrechts P, Johannesson T, Knap WH, Schmeits M, Stroeven AP, van de Wal RSW, Walling J, Zuo Z. 1998. Modelling the response of glaciers to climate warming. Climate Dynamics 14:267-274.

Ostrand WD, Howlin S. Gotthardt T. 2004. Fish school selection by marbled murrelets in Prince William Sound, Alaska: responses to changes in availability. Marine Ornithology, 32:69-76.

Pacheco NM, Congdon BC, Friesen, VL. 2002. The utility of nuclear introns for investigating hybridization and genetic introgression: a case study involving *Brachyramphus* murrelets. Conservation Genetics 3:175-182.

Peery MZ, Beissinger SR, Burkett E, Newman SH. 2006. Local survival of marbled murrelets in central California: roles of oceanographic processes, sex and radiotagging. Journal of Willdife Management 70:78-88.

Piatt JF, Anderson PJ. 1996. Response of common murres to the Exxon Valdez oil spill and long-term changes in the Gulf of Alaska marine ecosystem. American Fisheries Society Symposium 18:720-737.

Piatt JF, Gould PJ. 1994. Postbreeding dispersal and drift-net mortality of endangered Japanese murrelets. The Auk, 111:953-961.

Piatt JF, Lensink CJ, Butler W, Kendziorek M, Nysewander DR. 1990. Immediate impact of the *'Exxon Valdez*' Oil Spill on marine birds. Auk 107:387-397.

Piatt JF, Naslund NL. 1995. Abundance, distribution, and population status of Marbled Murrelets in Alaska. In: Ralph CJ, Hunt GL Jr, Raphael MC, Piatt FJ, editors. Ecology and conservation of the Marbled Murrelet. US For. Serv. Gen. Tech. Rep. PSW-GTR-152, Albany, CA. p. 285-294.

Piatt JF, Naslund NL, van Pelt TI. 1994. Nest-site selection and fidelity in Kittlitz's Murrelet. Beringian Seabird Bull. 2: 54–56.

Piatt JF, Naslund NL, van Pelt TI. 1999. Discovery of a new Kittlitz's Murrelet nest: clues to habitat selection and nest-site fidelity. Northwest Nat. 80: 8-13.

Piatt JF, Romano MD, Gill V, DeGange A. 2005. Density and abundance of Kittlitz's and marbled murrelets in the Near Islands, Aleutian Islands, Alaska, July 2003. USGS Science Support Program Final Report for the U.S.Fish and Wildlife Service, Alaska Science Center, Anchorage, Alaska, 24 pp.

Piatt J, Romano M, Bodkin J, Kuletz K, Williams J. 2007. Appendix K. Population Changes of Marbled Murrelet at Adak Island, Alaska *in* Piatt, J.F., Kuletz, K.J., Burger, A.E., Hatch, S.A., Friesen, V.L., Birt, T.P. , Arimitsu, M.L., Drew, G.S., Harding, A.M.A., and K.S. Bixler, 2007, Status review of the Marbled Murrelet (Brachyramphus marmoratus) in Alaska and British Columbia: U.S. Geological Survey Open-File Report 2006-1387, 258 p.

Pitocchelli J, Piatt JF, Cronin M. 1995. Morphological and genetic divergence among Alaskan populations of Brachyramphus murrelets. Wilson Bulletin 107: 235-250.

Plassen L, Vorren TO. 2003. Sedimentary processes and the environment during deglaciation of a fjord basin in Ullsfjorden, North Norway. Norwegian Journal of Geology 83(1):23-36.

Powell RD. 1991. Grounding-line systems as second-order controls on fluctuations of tidewater termini of temperate glaciers In: Anderson JB, Ashley GM editors. Glacial marine sedimentation; paleoclimate significance: Geological Society of America Special Paper 261. Pp 75-94.

Robards M, Drew G, Piatt J, Anson JM, Abookire A, Bodkin J, Hooge P, Speckman S. 2003. Ecology of selected marine communities in Glacier Bay: zooplankton, forage fish, seabirds and marine mammals. Final report to the National Park Service, USGS ASC, Anchorage, Alaska 156p.

Romano MD, Piatt JF. 2005. At-sea density and abundance of Kittlitz's Murrelets (*Brachyramphus brevirostris*) and Marbled Murrelets (*Brachyramphus marmoratus*) at Atka Island, Alaska, June 2004. Final Report for the U.S. Fish and Wildlife Service, USGS Alaska Science Center, Anchorage, Alaska, 13 pp.

Romano MD, Piatt JF, DeGange AR. 2005. At-sea density and abundance of Kittlitz's and Marbled Murrelets around Unalaska Island, Alaska, June 2005. Final Report for the U.S. Fish and Wildlife Service, USGS Alaska Science Center, Anchorage, Alaska, 31 pp.

Romano MD, Piatt JF, Dubuisson C. 2006. Kittlitz's and marbled murrelets in Kenai Fjords National Park, Alaska: at-sea distribution and abundance, and initial observations of radio-marked Kittliz's murrelets. Anchorage, USGS Alaska Sciene Center, 2006 Annual Report to Kenai Fjords National Park, 47 pp.

Sanger GA. 1987. Trophic levels and trophic relationships of seabirds in the Gulf of Alaska. Pp. 229-257 *in* Seabirds: feeding ecology and role in marine ecosystems (Croxall JP, ed.). Cambridge University Press, Cambridge, United Kingdom.

Soulé ME. 1986. Conservation biology: the science of scarcity and diversity. Sinauer Associates, Inc. Massachusetts. 584p.

Speckman SG, Piatt JF, Kuletz KJ. 2005. Population status and trends of *Brachyramphus* murrelets in lower Cook Inlet, Alaska. Science Support Program/ Species at Risk Annual Report for U.S. Fish and Wildlife Service, USGS Alaska Science Center, Anchorage.

Speckman SG, Piatt JF, Springer AM. 2004. Small boats disturb fish-holding marbled murrelets. Northwestern Naturalist 85:32-34.

Stehn RA, Rivera KS, Fitzgerald S, Wohl KD. 2001. Incidental catch of seabirds by longline fisheries in Alaska. In: Melvin EF, Parrish JK, editors. Seabird Bycatch: trends, roadblocks, and solutions. University of Alaska Sea Grant, AK-SG-01-01, Fairbanks. p 61-77.

Stenhouse IJ, Stedebaker S, Zwiefelhofer D. 2008. Kittlitz's murrelet *Brachyramphus brevirostris* in the Kodiak Archipelago, Alaska. *Marine Ornithology* 36: 59-66.

Stephensen SW. 2009. Habitat selection by Kittlitz's and marbled murrelets in Harriman Fjord, Prince William Sound, Alaska. Master's thesis, University of Alaska, Anchorage. 94p.

Stephensen SW, Andres BA. 2001. Marine bird and mammal survey of Yakutat Bay, Disenchantment Bay, Russell Fjord, and Nunatak Fjord, Alaska. Unpublished Report, U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Anchorage, Alaska.

Stephensen SW, Irons DB, Kendall SJ, Lance BK, McDonald LL. 2001. Marine bird and sea otter population abundance of Prince William Sound, Alaska: Trends following the *T/V Exxon Valdez* Oil Spill, 1989-2000. *Exxon Valdez* Oil Spill Restoration Project Annual Report (Restoration Project 00159), U.S. Fish and Wildlife Service, Anchorage, Alaska.

Stott, P.A. 2003. Attribution of regional-scale temperature changes to anthropogenic and natural causes. Geophysical Research Letters 30:10.10292003GLO17324.

Trust KA, Esler E, Woodin BR, Stegeman JJ. 2000. Cytochrome P450 1A induction in sea ducks inhabiting near shore areas of Prince William Sound, Alaska. Marine Pollution Bulletin 40:397-403.

Unified Command. 2005. M/V Selendang Ayu grounding. Accessed September 15, 2005 <http://www.dec.state.ak.us/spar/perp/response/sum_fy05/041207201/041207201_index.htm>.

van der Veen CJ. 1996. Tidewater calving. Journal of Glaciology 42(141):375-385.

van Pelt TI, Piatt JF. 2003. Population status of Kittlitz's and Marbled Murrelets and surveys for other marine bird and mammal species in the Kenai Fjords area, Alaska. Unpublished Report, Alaska Science Center, USGS, Anchorage, Alaska.

van Pelt TI, Piatt JF. 2005. Population status of Kittlitz's Murrelet along the southern coast of the Alaska Peninsula. USGS Science Support Program, Draft Report for U.S. Fish and Wildlife. Service, USGS Alaska Science Center, Anchorage, Alaska, 63p.

van Vleit GB. 1993. Status concerns for the 'global' population of Kittlitz's Murrelet: is the 'glacier murrelet' receding? Pacific Seabird Group Bull. 20: 15-16.

van Vleit GB, McAllister M. 1994. Kittlitz's Murrelet: the species most impacted by direct mortality from the *Exxon Valdez* oil spill? Pacific Seabirds 21:5-6.

Vigors NA. 1829. Sketches in ornithology, or, observations on the leading affinities of some of the more extensive groups of birds. The Zoological Journal 4:357.

Vyatkin PS. 1999. New data about the range and numbers of the Kittlitz murrelet (*Brachyramphus brevirostris*) over the Bering Sea western coasts. In: Konfratyev AY, Zelenskaya LA, editors. Beringian Seabird bulletin. Number 4. Magadan, Russia. p 29-31.

Yamato O, Goto I, Maede Y. 1996. Hemolytic anemia in wild seaducks caused by marine oil pollution. J. Wildl. Diseas. 32(2). Pp. 381-384.

Weslawski JM, Koszteyn J, Zajaczkowski M, Wiktor J, Kwasniewski S. 1995. Fresh water in Svalbard fjord ecosystems. In: Skjoldal HR, Hopkins C, Erikstad KE, Leinaas HP, editors. Ecology of fjords and coastal waters. Elsevier, New York. p 229-242.

Wiles GC, Barclay DJ, Calkin PE. 1999. Tree-ring-dated ‘Little Ice Age’ histories of maritime glaciers from western Prince William sound, Alaska. The Holocene 9(2):163-173.

Wynne K, Hicks D, Munro N. 1991. 1990 salmon gillnet fisheries observer programs in Prince William Sound and south Unimak Alaska. Report by Saltwater Inc., Anchorage, Alaska. Available from Nat. Mar. Fish. Serv., Juneau, Alaska.

Wynne K, Hicks D, Munro N. 1992. 1991 marine mammal observer program for the salmon driftnet fishery of Prince William Sound Alaska. Final report., Saltwater Inc., Anchorage, Alaska. Available from Nat. Mar. Fish. Serv., Juneau, Alaska.

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approved: Acting Regional Director, Fish and Wildlife Service 24 May 2010 Date

Concur: ACTING Director, Fish and Wildlife Service Date: October 22, 2010

Do not concur: ______________________________ __________
Director, Fish and Wildlife Service Date

Director's Remarks:

Date of annual review:
Conducted by: