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

SCIENTIFIC NAME: *Marmota caligata sheldoni*

COMMON NAME: Montague Island marmot

LEAD REGION: Region 7

DATE INFORMATION CURRENT AS OF: 08/20/2012

STATUS/ACTION

_X_ Species assessment - determined either we do not have sufficient information on threats or the information on the threats does not support a proposal to list the species and, therefore, it was not elevated to Candidate status

___ Listed species petitioned for uplisting for which we have made a warranted-but-precluded finding for uplisting (this is part of the annual resubmitted petition finding)

___ New candidate

___ Continuing candidate

___ Listing priority number change
Former LPN: ___
New LPN: ___

Petition Information:
_x_ Non-petitioned
___ Petitioned; Date petition received:
90-day substantial finding FR publication date:
12-month warranted but precluded finding FR publication date:

ANIMAL/PLANT GROUP AND FAMILY: Mammals; *Sciuridae*

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Montague Island, Prince William Sound, Alaska

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Unknown. Montague Island marmots were last observed in July 1908, at Hanning and Zaikoff Bays, Montague Island, Alaska, USA.

LAND OWNERSHIP: Montague Island is largely federally owned (92%); except for 63 square kilometers (km^2) (24 square miles, mi^2) of private lands around Patton Bay and Macleod Harbor that were conveyed to the Chugach Alaska Corporation, under the authority of the Alaska Native Claims Settlement Act of 1971. The State has selected uplands in Port Chalmers and owns the tidelands surrounding the islands. Public lands on Montague Island are managed by the U.S. Department of Agriculture, Chugach National Forest, Cordova Ranger District. Private lands are managed by the Chugach Alaska Corporation, Anchorage, Alaska.

LEAD REGION CONTACT: Sonja Jahrsdoerfer, 907/786-3323

LEAD FIELD OFFICE CONTACT: Ellen W. Lance, 907/271-1467

Edmund Heller holding a Montague Island marmot captured near Hanning Bay on August 2, 1908 (photograph courtesy of MVZ Archives, Berkeley, No 170).

BIOLOGICAL INFORMATION:

Species Description

The hoary marmot (*Marmota caligata*) is a large, ground-dwelling squirrel with a thick body, broad head, small neck, short, rounded ears, short, stocky, powerful limbs and a bushy tail about a quarter of the body length. The hoary marmot is the largest of the six distinct marmot species that occur in North America, weighing up to 14 kilograms (30 pounds; Banfield 1974, p. 112). The hoary marmot from Montague Island, south-central Alaska, was classified as a distinct subspecies (*M. c. sheldoni*) based on smaller size and skull characteristics relative to other island and mainland hoary marmot populations (Howell 1914, p. 18).

Taxonomy

Hoary marmots likely originated in North America (Kruckenhauser et al. 1999, p. 53; Steppan et al. 1999, p. 725), but are closely related to the Old World alpine marmots (*M.* marmot; Steppan et al.1999, p. 724). Nine subspecies of hoary marmots are recognized, with three occurring in Alaska (Cook 1998, p. 39; Howell 1915, p. 19). Two subspecies (Glacier Bay hoary marmot, *M. c. vigilis*, and Montague Island hoary marmot) are endemic to Alaska, with Montague Island marmots occurring only on Montague Island in Prince William Sound (PWS), Alaska (Howell 1915, pp. 61-62). The distribution of the mainland form (*M. caligata*) includes other PWS islands (Howell 1915, p. 59).

The sub-specific status of Montague Island marmots is based on their smaller size and differences in skull morphology, including narrower premaxillae (a pair of small cranial bones at the very tip of the upper jaw) and shorter nasals than those of mainland subspecies of hoary marmot (Howell 1914, p. 18). However, taxonomic clarification of the Montague Island marmot is needed as this sub-specific classification was based only on analysis of morphological characters in eight specimens collected in 1908 (Howell 1914, p. 18). The current hypothesis concludes that hoary marmots, isolated on Montague Island, experienced significant evolutionary change, similar to Vancouver Island marmots (*M. vancouverensis*; Cardini et al. 2007, pp. 1840-1843). The use of genetic tools could elucidate the taxonomic validity of the Montague Island marmot as being differentiated at the sub-specific level. Similar methods have been employed to investigate another rodent endemic to Montague Island, the Montague Island tundra vole (*Microtus oeconomus elymocetes*) that exhibited clear phylogeographic separation from other holarctic populations of tundra voles on PWS islands and the adjacent mainland (Lance and Cook 1998, p. 61; Galbreath and Cook 2004, p. 142).

Habitat/Life History

Little information exists regarding the life history or habitat use of the Montague Island marmot. The most appropriate analogs are likely to be other endemic, isolated, and/or island-dwelling marmots. Vancouver Island marmot, Olympic marmots (*M. olympus merriam*), and populations of hoary marmots on Hinchinbrook Island and the south-central Alaskan mainland are probably the most similar proxies for understanding Montague Island marmots.

Hoary marmots generally occur at high elevations, near timberline, on talus slopes and alpine meadows (Lee and Funderburg 1982, p. 195). Vancouver Island marmots are typically found above 1,000 meters (m) (3,281 feet (ft); Bryant and Janz 1996, p. 672). Marmots in the vicinity

of PWS, including those on Hinchinbrook Island and near Cordova, have been observed in the subalpine (approximately 305 m; 1,000 ft; Milo Burcham, U.S. Forest Service, personal communication, 2012), down to sea level (Heller 1910, p. 338; Holbrook 1999 in Lance 2002 p. 3; Lance 2010 pp. 6-8).

Vancouver Island marmots prefer subalpine meadows but also have been found occupying steep cliffs, talus, open meadows with southern exposure, and logging-slash areas (Heard 1977, pp. 22-24; Dearden 1986, p. 168; Bryant and Janz 1996, p. 672). Although hoary marmots most commonly dwell in alpine tundra, open-rolling meadows, rocky talus, and cliffs (Banfield 1974, p. 112), in south-central Alaska, hoary marmots may be found in a variety of habitats including flat meadows above tree line (Holmes 1984, p. 253), or as on Hinchinbrook Island, in natural rock cavities or relatively open, sand dune and tidal grass flat habitats near tide line (Howell 1915, p. 8; Lance 2010, pp. 6-8).

Marmots excavate burrows, often more than 1 m deep (3.3 ft; but hibernation burrows may be up to 7 m (23 ft) deep) in well-drained soil, and burrows usually have more than one entrance (Lee and Funderburg 1982, p. 197). Areas surrounding dens often are heavily grazed (Banfield 1974, p. 112). Marmots feed mainly on green vegetation, especially grasses and forbs. Eighty percent of hoary marmot diet from the Kenai Peninsula, Alaska, was composed of vetches (*Oxytropis*, *Astragalus*), sedges (*Carex*), fleabanes (*Erigeron*), and fescues (*Festuca*). Other common foods included lichens (*Cladonia*), moss species, dryas (*Dryas*) and willows (*Salix*) (Hansen 1975, p. 350). Studies of Vancouver Island marmots show a seasonal pattern of decreased grass consumption and increased forb consumption as summer progresses (Martell and Milko 1986, p. 242). As with many hibernators, marmots accumulate substantial fat reserves in summer, and weight loss during hibernation ranges from 46 to 53 percent of total body weight (Lee and Funderburg 1982, p. 192).

In south-central Alaska, hoary marmots are monogamous and breed every 2 to 3 years, within the first 2 weeks of emergence from hibernation (Holmes 1984, p. 254). Gestation generally lasts 25 to 30 days and litters of two to five young (Banfield 1974, p. 112; Holmes 1984, pp. 254-255) are born in burrows in late June to mid-July, though the timing of most stages of reproduction varies by latitude and altitude (Lee and Funderburg 1982, pp. 191-194). Colonies of hoary marmots in south-central Alaska are composed of a single adult male-female pair and their two to five young (Holmes 1984, p. 250) with young hoary marmots generally dispersing from their natal colony by their third year (Barash 1973, p. 261; Holmes 1984, p. 236). Dispersal distances up to 7.4 km (4.6 mi) have been reported for Vancouver Island marmots (Bryant 1996, p. 684). Intercolonial encounters may be aggressive (Holmes 1984, p. 260).

Historical Range/Distribution

Hoary marmots occur throughout much of Alaska, and southward along the coast through western Canada and into high elevations of the northwestern United States, including western Montana (Cook 1998, p. 39). Historic range and distribution of Montague Island marmot are unknown. The marmot was first reported in July of 1908 in alpine habitat, near timberline (approximately 300 m; 984 ft), at Hanning and Zaikoff Bays (Heller 1910, p. 338). Since those first records, the few anecdotal reports of Montague Island marmot observations have not been substantiated (Holbrook 1999 as cited in Lance 2002, p. 3; Bryant 2009, p. 4).

Figure 1. Rugged northeast coastline of Montague Island, Alaska.
Photo credit: Milo Burcham.

Current Range/Distribution

Current range and distribution of the Montague Island marmot are unknown. At 841 km^2 (325 mi^2) and 80 km (50 mi) long, Montague Island is the largest island in PWS, with elevations to 914 m (3,000 ft). Grass and alpine habitats are present over a 228 km^2 (88 mi^2) area (Kesti et al. 2005, p. 3). However, the island contains little suitable habitat for marmots, as avalanche bowls with good soil development (important for digging burrows) and grass-herb vegetation are particularly rare (Bryant 2009, p. 3; Figure 1).

Population Estimates/Status

Montague Island marmot population size and trends are unknown and their existence is uncertain. No marmots were detected during the course of extensive foot transects for Montague Island tundra voles, studied in 1991 and 1992, near Hanning Bay, Jeanie Cove, Patton Bay, and Port Chalmers (Ellen Lance, USFWS, personal observation, 2012). Additionally, no sign of marmot presence was found during alpine treks east of Zaikof Bay and between Zaikof Bay and Port Chalmers in 1998 (John Delapp, USFWS, personal communication, 2012). Opportunistic aerial surveys of suitable habitats at 180-305 m (590-1000 ft) elevation in May 2009 (Bryant 2009, p. 2) and May 2010 (Lance 2010, pp. 2-3) failed to detect marmots or definitive evidence (i.e., marmots, tracks, emergence tunnels) of their existence on the island. Subsequent foot reconnaissance in June 2010 of burrow-like holes in alpine habitat spotted from the air revealed no conclusive evidence of marmot presence (Lance 2010, pp. 3-5). Despite the lack of evidence of the existence of marmots on Montague Island, numerous presumptive marmot burrows were observed during overflights of "high probability marmot habitats" on the island on May 16 & 21, 2009 (Bryant 2009, p. 3). These observations suggest that marmots may be extant at low densities on the island (Bryant 2009, p. 5). Given the lack of any confirmed marmot sightings in the recent past, we cannot attribute these features to marmots with certainty, as plausible alternative explanations exist (e.g., excavations made by foraging bears).

THREATS

A. The present or threatened destruction, modification, or curtailment of its habitat or range.

Logging - Thousands of hectares of high-elevation, clear-cut logging has impacted Vancouver Island marmots by creating a demographic sink. The lifetime reproductive performance of females was lower in clear-cuts than female marmots occupying natural habitats, and colonies that became established in clear-cut forests could be maintained only through continued immigration (Bryant 1996, p. 686).

Between 1946 and 1998, approximately 2.5 percent of the Montague Island landscape was altered through low-elevation timber harvest (Kesti et al. 2005, p. 82). Timber harvest has occurred on National Forest and Chugach Alaska Corporation lands at MacLeod Harbor and

between Nellie Martin River and Beach River, and along the Montague straits coast and Zaikoff Bay. Harvested stands regenerated naturally and currently contain uniform stands of western hemlock (*Tsuga heterophylla*) and Sitka spruce (*Picea sitchensis*) that are densely vegetated by salmonberry (*Rubus spectabilis*).

Historic records suggest Montague Island marmots occupy alpine habitat during summer (Heller 1910, p. 338), but the absence of contemporary information impedes our assessment of the habitat usage of these marmots. Thus, a robust assessment of the potential effects of forestry practices is not possible. However, because the extent of land affected by timber harvest on Montague Island is relatively small and has occurred at mid- to- low elevation, we conclude that timber harvest is not a threat to Montague Island marmots.

Mineral Development - Although all public domain lands are open to mineral entry under the 1872 Mining Law unless specifically closed, no current mining claims exist in the area (USFS 1989, ch.3, p.4). Copper in the form of chalcopyrite has been found near Jeanie Cove (USFS 1989, ch. 3, p. 4), but overall potential for mineral development in this area is low (Kesti et al. 2005, pp. 119-120). Thus, we conclude mining development is not a threat to the Montague Island marmot.

Recreational Activities - A 0.8 km (0.5 mi) private road exists on the north side of MacLeod Harbor. A hunting and fishing lodge is located on Montague Island, but is quite small and used only seasonally (Kesti et al. 2005, p. 63). Forest Service public recreation cabins located on Montague Island at Port Chalmers, San Juan Bay, Log Jam Bay, Nellie Martin River, and Beach River are isolated and receive moderate seasonal use (Kesti et al. 2005, p. 71-72). Recreational pressures are thought to be a significant factor in the decline of the Vancouver Island marmot as a result of direct disturbance and habitat degradation such as vegetation trampling (Dearden and Hall 1983, p. 63).

Similar to Hinchinbrook Island marmots, Montague Island marmots may (at least) seasonally occupy beach habitat, where recreational activities are likely the most intense (Figure 3). Hoary marmot colonies persist on the beach at Boswell Bay on Hinchinbrook Island. Boswell Bay is relatively well-visited by humans and their dogs, but the marmot colonies persist there, perhaps having habituated to this regular disturbance (Ellen Lance, USFWS, personal observation, 2012).

Figure 2. Hoary marmot on the beach in south-central, Alaska. Photo credit: Milo Burcham.

An estimated one million people per year are expected to recreate in PWS (Kesti et al. 2005, p. 69). However, visitation to Montague Island is likely relatively low with the greatest pressure occurring during summer by outdoor enthusiasts, and during spring and fall by deer and bear hunters. We anticipate that recreational pressure will likely remain relatively low due to the island's remote location. Therefore, we conclude that recreational activities are not a threat to Montague Island marmots.

Oil Spills - Because hoary marmots on neighboring Hinchinbrook Island occupy beach habitat, at least during spring, summer, and fall, Montague Island marmots may also inhabit beach-fringe habitat during some or all of the year. Therefore, if an oil spill fouled a beach on Montague Island, marmots could be exposed to oil. However, there are no data or observations to support the supposition that marmots forage on intertidal vegetation; thus, exposure to oil spilled in the marine environment is expected to be of extremely low probability. While portions of Montague Island, mainly near Rocky Bay and Hanning Bay, were oiled as a result of the Exxon Valdez oil spill (March 24, 1989), there is no evidence that this affected Montague Island marmots. The risk of an oil spill impacting Montague Island marmots is unlikely.

In conclusion, because the Montague Island hoary marmot may be extirpated (or its population is very small) and only a small fraction of potential habitat has been disturbed by human activity, we conclude that habitat destruction, modification, or curtailment is not a threat to this species.

B. Overutilization for commercial, recreational, scientific, or educational purposes.
Hoary marmots are managed by the Alaska Department of Fish and Game as a furbearer. A trapping license is required to either trap or shoot them, but there is no closed season or bag limit (Alaska Board of Game 2011-12, p. 28). Hunting/trapping pressure on the hoary marmots of PWS is currently low, due in part, to the very low monetary value of a pelt (Dave Crowley, Alaska Department of Fish and Game, personal communication, 2012).

Hoary marmot fur and meat may have made it an important subsistence species in the past. Native Americans from the Pacific Northwest prized hoary marmot pelts for clothing (Drucker 1947, p. 246), and a measurement of wealth among the Tlingit tribe from Southeast Alaska (Armitage 2003, p. 203). Anthropological evidence suggests that marmots provided food for the indigenous people of PWS; bones from *M. c. caligota* were found in 2,000 year-old middens at an archaeological site on Hawkins Island in PWS (Yarborough 1999, as cited in Lance 2002, p. 3).

Sport shooting (plinking) is generally considered a threat to marmots (Yensen and Sherman 2003, pp. 2, 20; Kolesnikov et al. 2009, p. 371). Hunting, trapping, or sport shooting could contribute to the extirpation of a small endemic population (MacArthur and Wilson 1967, Groom 2006, p. 88; Reynold and Peres 2006, pp. 266-267). However, there is no evidence to conclude that intentional killing of Montague Island marmots occurred historically. It is unknown if the collection of eight specimens in 1908 for scientific purposes had a population level effect, and we are not aware of collection of Montague Island marmots for any other purpose. Thus, we conclude that mortality from overutilization is not a current threat.

C. Disease or predation.

Disease - There is no information regarding disease or parasitism in Montague Island marmots, but in other areas of Alaska, cestodes, fleas, mites, ticks, and nematodes are known to infest hoary marmots (Howell 1915, p. 15; Rausch and Rausch 1971, pp. 92-93), and marmots carrying spotted fever have been found (Howell 1915, p. 15). Squirrel ticks (*Ixodes angustus*) are common on voles and shrews on Montague Island (Ellen Lance, USFWS, personal observation, 2012), and serve as vectors of Lyme disease and babesiosis (Eadie 1954, p. 89). *Babesia* (a blood parasite) is prevalent in small mammals on Montague Island; over 50 percent of voles and shrews are infected (Goethert et al. 2006, p. 828), but the fitness consequences of this infection are unknown. Based on prevalence data from other rodents, it is likely that Montague Island marmots host ticks and other parasites that carry disease-causing agents such as *Babesia*, but it is unknown how babesiosis or other vector-borne diseases affect hoary marmots. In other species of marmots (*M. flaviventris*) reduction in fitness is associated with disease-carrying fleas (Armitage 2003, p. 200). While it likely that Montague Island marmots are infested with parasites and harbor vector-borne diseases, there is no indication that these result in fitness consequences; therefore, we cannot conclude that disease is a threat.

Predation - Marmots on Montague Island could be prey for raptors, such as bald eagles (*Haliaeetus leucocephalus*) and great horned owls (*Bubo virginianus*), and brown bears (*Ursus arctos*). Bald eagles are generally thought to be significant predators of hoary marmots, and brown bears are known to capture and feed on hoary marmots by excavating their dens (Howell 1915, p. 10; Banfield 1974, p. 112; Cook 1998, p. 40). Coastal Alaska brown bears are omnivorous and feed on sedges, roots, deer, anadromous salmon, skunk cabbage, intertidal invertebrates, and berries depending on the season and availability (Schoen et al. 1994, p. 328; Ben-David et al. 2003, p. 469). Inclusion of meat in the diet from salmon or terrestrial vertebrates is important to the fitness of individual bears and to the overall success of the population (Hilderbrand et al. 1999, p. 135; Mowat and Heard 2006, p. 473).

Between 1916 and 1923, a founding population of 24 Sitka black-tailed deer (*Odocoileus hemionus sitchensis*) was introduced to Hinchinbrook and Hawkins Islands of PWS in what is now considered the most successful big game transplant in Alaska (Paul 2009, p. 9). Although at the extreme northern limit of their range, the Sitka black-tailed deer thrived in the maritime climate of PWS, and spread throughout the area. Today, the larger islands, including Montague Island, support most of the deer population. It is not known with certainty how the brown bear population on Montague Island responded to the introduction of Sitka black-tailed deer, but considering the importance of meat in their diet at the population level (Hilderbrand et al. 1999, p. 135; Mowat and Heard 2006, p. 473) it is plausible that the influx of high quality prey resulted in an increased bear population.

Because brown bears are omnivorous and are known to eat rodents in general (Stelmock and Dean 1983, pp. 156, 161), and hoary marmots in particular (Cook 1998, p. 40), an increase in brown bear population could have led to increased predation pressure on the Montague Island marmot. Reduction in population size for an island endemic can lead to extirpation because there are fewer individuals available to survive random events (e.g., extreme weather events) and immigration of new individuals (colonizers) is not possible because none are available (MacArthur and Wilson 1967; Pimm et al. 2005, pp. 757, 769-771; Groom 2006, p. 88). Increased predation from any of the predators could lead to the same outcome.

We conclude that predation has likely always been source of mortality to Montague Island marmots and it may have played a role in their presumed extirpation. Because existence of the Montague Island marmot has not been confirmed since 1908, we are unable to conclude that predation is a threat at this time.

D. The inadequacy of existing regulatory mechanisms.
Hoary marmots are managed by the Alaska Department of Fish and Game as a furbearer. There is no closed season or bag limit (Alaska Board of Game 2011-2012 p. 28). No records are available for marmots taken from the Island (Dave Crowley, Alaska Department of Fish and Game, personal communication, 2012), but reporting marmots taken is not a requirement of the trapping regulations (Alaska Board of Game 2011-2012, p. 15). Therefore, it is not possible to assess the current extent of marmot harvest through trapping and hunting. Unlimited harvest of a geographically and demographically isolated population could pose a significant threat to its continued existence; however, the local game biologist for the State of Alaska does not believe that hoary marmots from PWS are killed by hunters or trappers due, in part, because there is no market for their pelts (Dave Crowley, Alaska Department of Fish and Game, personal communication, 2012). Based on this expert opinion, we believe that hunting and trapping is currently not a threat to Montague Island marmots.

E. Other natural or manmade factors affecting its continued existence.
Introduced Species - In 1951, 24 mink were released on Montague Island, resulting in a harvestable population (Paul 2009, p. 106). Mink likely pose little risk to marmots as they are highly adapted to forest habitat, which is unlikely to overlap with habitats used by marmots.

In 1993, a private citizen illegally released 35 rabbits on Montague Island (Paul 2009, p. 114). It is unknown if the rabbits posed a risk to marmots though competition or disease transmission;

however, there is no evidence that the rabbits survived (Dave Crowley, Alaska Department of Fish and Game, personal communication, 2008, as cited in Paul 2009, p 114).

Climate Change - Our analyses under the Endangered Species Act include consideration of ongoing and projected changes in climate. The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). "Climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

Rapidly warming temperatures are predicted to affect mountain-dwelling small mammals, including marmots, especially geographically isolated populations (McDonald and Brown 1992, pp. 409, 411; Beever et al. 2003, pp. 43, 45; Grayson 2005, pp. 2106-2107; Moritz et al. 2008, pp. 262-263). Specific threats to range-restricted populations (e.g., island endemics), include predator-prey-forage interactions that are disrupted by differential responses to a warming climate (Parmesan 2006, p. 637), loss of suitable habitat because of an upward shift in vegetative zones (McDonald and Brown 1992, p. 412; Haslett 1997, p. 4), or increased occurrence of unsuitable temperatures (Beever et al. 2003, p. 48; Beever et al. 2010, pp. 165, 174-175). Because upward migration is limited by the amount of mountain-top habitat available, range contractions will result (Krajick 2004, p. 1600).

A second type of response to climate change is variation in the timing of life-history events. For hibernating small mammals such as yellow-bellied marmots (*M. flaviventris*), behavior has apparently changed over the past several decades, with marmots emerging much earlier, cuing into warmer temperatures but not necessarily coincident with less snow (Inouye et al. 2000, pp. 1630, 1632). In fact, snowfall may increase with warming temperatures. The consequences of early emergence, weeks before vegetative green-up, are greater reliance on fat reserves, and a greater risk of starvation (Inouye et al. 2000, p. 1633). Conversely, marmots may benefit from warming temperatures by giving birth earlier in the season, which allows for a longer period of time for feeding before the start of hibernation leading to an increased body mass entering hibernation (Ozgul et al. 2010, p. 482). These patterns may ultimately lead to a phenotypic change (i.e., a body size alteration) in response to the environmental changes (Gunderson et al. 2009, p. 859). Phenotypic plasticity is the capacity of a taxon to respond to the selective forces of environmental variability with structural and functional modifications (Lincoln et al. 1982, p. 188); when food is scarce, body size is expected to decrease, and when food is plentiful, body size is expected to increase. Similar to other small mammals (Yom-tov and Yom-tov 2005, p. 803), body size in marmots may be plastic and respond positively to a warming climate and higher food availability in winter.

While it is possible that future climate change could affect Montague Island marmots (if they still exist) through increases in air temperature, it is also possible that they could respond, phenotypically, to environmental changes. For example, the smaller body size that was noted by Heller in 1908 may have been a phenotypic response to unique environmental factors on Montague Island at the time. Given the uncertainty regarding how climate change will affect the islands of PWS, the unknown responses of Montague Island marmots to climate change, and because we cannot study the effects of climate change on Montague Island marmots, we are unable to conclude that climate change is a threat to them at this time.

Endemism - Island endemics are isolated populations with small ranges and restricted habitat (Cody 1986, p. 185). It is well documented that insular endemics are at high risk of extinction because geographic isolation leads to a reduction in genetic variation, making these taxa particularly vulnerable to demographic and environmental stochasticity, disease, and anthropogenic disturbance (Brussard 1991, p. 8; Wilson 1992, p. 232; Cook and MacDonald 2001, p. 207). Due to the limited founding events that occur on isolated islands, small, isolated populations may go extinct as a result of genetic mutation, inbreeding depression, or by random chance alone (Wilson 1988, p. 184; Wilson 1992, p. 237). While rarity alone may not be a threat, genetic isolation combined with small population size (vulnerability to stochastic events) could be, and may have contributed to the extirpation of this species. Because this species has a very small population size (if it is extant), it will remain vulnerable to random events.

CONSERVATION MEASURES PLANNED OR IMPLEMENTED

Phylogenetic analysis of hoary marmots, including Montague Island marmot specimens collected in 1908, is currently underway. A complete, island-length foot transect of alpine habitat to search for Montague Island marmots was planned for summer 2012, but due to extensive snow cover and bad weather, the survey was aborted. Both projects are being undertaken by University of Alaska Fairbanks personnel (with financial support from the U.S. Fish and Wildlife Service, Wildlife and Sport Fish Restoration Program, State Wildlife Grant).

An effort to search for documented marmot observations that were recorded in recreational cabin notebooks at five cabins on Montague Island is currently underway. Cabin notebook records have been reviewed at three of the five cabins to date, and the remaining reviews are expected to be completed by September 31, 2012.

SUMMARY OF THREATS

Under Factor A, the present or threatened destruction, modification, or curtailment of its habitat or range, we concluded that logging activities, mineral development, disturbance from recreational activities, and exposure to oil spills are not currently a threat to the Montague Island marmot. Likewise, Under Factor B, we determined that overutilization for commercial, recreational, scientific, or educational purposes, is not a contemporary threat. Although the Montague Island marmot population could harbor parasites (Factor C) that carry disease-causing agents such as *Babesia*, it is unknown how babesiosis or other vector-borne diseases affect hoary marmots and we are not aware of fitness consequences associated with these infestations. Therefore we do not consider disease and parasites a threat to the population. The brown bear population on Montague Island may have increased in response to the introduction of Sitka

black-tailed deer. A larger brown bear population could have increased predation pressure on the marmots, contributing to their extirpation. However, we have no direct evidence that this occurred. While the existing regulatory mechanism, considered under Factor D, does not protect Montague Island marmots from hunting and trapping, marmots are not locally taken for pelts or meat; therefore, the regulatory mechanism is considered adequate. Under Factor E, other natural or manmade factors affecting its continued existence, we considered introductions and their indirect effects on ecological systems but concluded that the introduction of mink and rabbit is not a threat. Literature on the effects of climate change on other isolated small mammal populations indicates that there could be a loss of suitable alpine habitat or temperatures. However, because we do not have information on how climate change will affect Montague Island, the life history of the species and its ability to adapt is unknown, and the species appears unavailable to study, we are unable to conclude that climate change is a threat. Finally, while rarity alone is not a threat that justifies protection under the Endangered Species Act, it does contribute to the species vulnerability, if it still exists.

Given the paucity of marmot observations on Montague Island, especially in recent years, we are uncertain if the species is extant. Clearly this situation makes it difficult to determine what may be a threat, or what may have led to their extirpation. As opportunities arise, we recommend the search continue for this smaller than average marmot, because a relict population could persist within the wild remote landscape of Montague Island.

RECOMMENDED CONSERVATION MEASURES

The logical first step of any conservation effort involving the Montague Island marmot would be to determine if marmots are present on Montague Island. Numerous efforts have thus far failed to document a contemporary marmot population on Montague Island, but with the recognition that the landscape is vast and rugged, aerial and/or foot surveys should continue as opportunities arise. If marmots are documented on Montague Island, future conservation actions should include:

- population mapping,
- population estimation,
- genetic testing,
- coordination with Alaska Department of Fish and Game to review trapping regulations
- monitoring,
- development of conservation agreements with the U.S. Forest Service and Chugach Alaska Corporation.

COORDINATION WITH STATES

The Service has worked with Alaska Department of Fish and Game (Cordova) on the Montague Island marmot for several years. As noted, the Alaska Department of Fish and Game has provided financial support to the University of Alaska, Fairbanks, to conduct a foot survey for Montague Island marmots and to study their genetic relationship to other hoary marmots. The State of Alaska was asked for information June 25, 2012, leading to the preparation of this assessment, and on July 17, 2012, we received comments back from the Alaska Department of Fish and Game and their comments were incorporated as appropriate. In addition, we sent a

draft version of the Montague Island marmot species assessment to the Alaska Department of Fish and Game on August 31, 2012 for their review, and received comments on September 17, 2012. This final species assessment reflects revisions we made to address those comments.

Approve: _____ 9/20/12
Regional Director, Region 7 Date

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