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PROPOSAL SUMMARY PAGE

Project Title:	Pigeon Guillemot Restoration Research in Prince William Sound, Alaska, FY11 Amendment
Project Period:	February 15, 2011 to December 31, 2016
Proposer(s):	David B. Irons, U.S. Fish and Wildlife Service, and Daniel D. Roby, U.S. Geological Survey – Oregon Cooperative Fish and Wildlife Research Unit
Study Location:	Prince William Sound, Alaska

Abstract: This amendment to project 070853, Pigeon Guillemot Restoration Research in Prince William Sound, Alaska, provides an opportunity to restore the population of Pigeon Guillemots (*Cepphus columba*) in Prince William Sound, Alaska, which has declined by more than 90% at the Naked Island group since 1989. A restoration plan for Pigeon Guillemots in PWS was prepared to address the species' lack of population recovery following injury by the 1989 *Exxon Valdez* oil spill. Predation on nests and adults by mink is now the primary limiting factor for guillemot reproductive success and population recovery at the most important historical nesting site for guillemots in PWS (i.e., the Naked Island group). Mink on the Naked Island group are descended in part from fur farm stock and apparently were introduced to the island group during the 1980s. Eradication of mink at these islands was selected as the preferred restoration alternative because it is feasible and most likely to result in the recovery of guillemots in PWS. Other alternatives are either currently unavailable or unlikely to be effective. An eradication effort is likely to be successful due to both well-developed methods and the low likelihood of re-colonization. Potential negative effects of the preferred alternative are either negligible or largely avoidable. The guillemot population at the Naked Island group would likely double within the first 10 years following mink eradication, and the Sound-wide population of guillemots would likely increase within 15 years of mink eradication at the Naked Island group, once guillemots nesting at the Naked Island group had become a source population for other parts of PWS.

Phase I : Completion of the NEPA process for the proposed action
Phase II: Mink eradication and restoration monitoring (if warranted by NEPA analysis)

Funding:	**EVOS Funding Requested:** (must include 9%GA) FY 2011 – $218,000.00 FY 2012 -- $580,081.00 FY 2013 –$580,081.00 FY 2014 –$360,656.70 FY 2015 –$347,669.90 FY 2016 --$347,669.90 TOTAL EVOS funding: $2,434,218.40 or $1,321,109.20* *NOTE: David Irons and Dan Roby are submitting a proposal to the National Fish and Wildlife Foundation for 50% of the $2.22 million budget (half of the budget, excluding the cost of NEPA analysis). If we get this matching money we will reduce our request to the EVOS TC to $1.32 million. We will know before Phase II begins if we have that money. **Non-EVOS Funds to be Used:** FY 2011 – $10,000.00 FY 2012 -- $173,000.00 FY 2013 –$173,000.00 FY 2014 –$113,000.00 FY 2015 –$98,000.00 FY 2016 --$98,000.00 TOTAL non-EVOS funding: $665,000.00 **TOTAL, EVOS and non-EVOS funding: $3,099,218.40 K**
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EXECUTIVE SUMMARY

The Pigeon Guillemot (*Cepphus columba*) is now the only marine bird species in Prince William Sound (PWS), Alaska that is listed as "not recovering" on the Exxon Valdez Oil Spill Trustee Council's Injured Resources List. Since 1989, the population of Pigeon Guillemots in Prince William Sound (PWS) has undergone a continuous and marked decline, with no sign of stabilization. Given this alarming trend, restoration is warranted for the recovery of Pigeon Guillemots in PWS. The logical location to focus restoration effort for guillemots is the most important historical breeding location in the Sound, the Naked Island group in central PWS. These islands provide an opportunity for recovery of a significant proportion of the PWS guillemot population, although the Naked Island group constitutes only about 2% of the total shoreline in PWS. One fourth of all guillemots nesting in PWS in 1989 (just after the spill) were located at the Naked Island group. Restoration of guillemots at the Naked Island group to the number counted at that time would result in a substantial increase in the Sound-wide population. Most of the available information on the factors limiting the Pigeon Guillemot population in PWS originates from research on guillemot population size, nesting success, and diet conducted at the Naked Island group during 15 breeding seasons between 1978 and 2008. These data, placed in a historical and socioeconomic context, permit the development of a restoration plan designed to facilitate the population recovery of Pigeon Guillemots in PWS.

A few historical events have had a considerable impact on Pigeon Guillemots nesting at the Naked Island group in PWS. First, fox farming occurred at the Naked Island group for more than 50 years beginning in 1895. The foxes (*Alopex lagopus*) almost certainly caused severe declines in the populations of native fauna, including Pigeon Guillemots, as they did across many formerly fox-free islands in Alaska. Nearly a century later, the EVOS caused acute mortality from oiling estimated at between 500 and 1,500 Pigeon Guillemots in PWS in the immediate aftermath of the spill. There was evidence that guillemots were exposed to and negatively affected by residual oil for at least a decade after the spill. However, there was no longer an indication of guillemot exposure to residual oil from EVOS by 2004. Studies have demonstrated that EVOS and/or a climatic regime shift associated with the Pacific Decadal Oscillation affected guillemots in the Sound through reduced availability of preferred forage fish species. The prevalence of high-lipid schooling forage fish in the diet of guillemot chicks at the Naked Island group was significantly lower in the decade after EVOS, and this change was associated with lower nestling survival and growth rates, and lower overall nesting success. The level of predation on guillemot nests at the Naked Island group also increased significantly during the 1990s when compared to pre-spill, potentially limiting the recovery of Pigeon Guillemots at this location.

The primary limiting factor for guillemot reproductive success and population recovery at the Naked Island group is now predation of nests and adults by American mink (*Neovison vison*). Guillemot population trends at the Naked Island group compared to the rest of PWS are consistent with this conclusion. At sites outside of PWS, guillemot population declines and even local extirpation of breeding guillemots due to predation by mink have been successfully and rapidly reversed through mink eradication as a restoration action. Although a precise estimate of the guillemot population response to proposed mink eradication at the Naked Island group is not possible, all available evidence indicates that eliminating mink predation on guillemot nests and

adults would result in a dramatic increase in the breeding population and productivity of Pigeon Guillemots at the Naked Island group. Nest predation by mink may also have caused declines in populations of other seabirds nesting at the Naked Island group, including Arctic Terns (*Sterna paradisaea*), Parakeet Auklets (*Aethia psittacula*), Tufted Puffins (*Fratercula cirrhata*), and Horned Puffins (*Fratercula corniculata*). The presence of foraging marine mammals and large flocks of piscivorous birds provide supporting evidence that predation by mink and not limitations in food supply have caused the declines in seabirds breeding at the Naked Island group. The introduction or range expansion of mink in areas outside of PWS have caused rapid population declines in a wide variety of taxa, including several species of ground-nesting birds, small mammals, amphibians (Banks et al. 2008), and crustaceans.

Mink are native to the mainland and nearshore islands of PWS, but do not naturally occur on offshore islands. Observational data indicate that mink were absent on the Naked Island group until the 1980s. Data from both mtDNA sequencing and nuclear microsatellite genotyping indicate that the mink on the Naked Island group are descended in part from fur farm mink stock and were likely introduced to the Naked Island group by humans.

The Naked Island group is part of Chugach National Forest with the exception of one small privately-owned parcel on Peak Island. The islands are used periodically for camping, hiking, deer hunting, and fishing. Although frequently exploited for their fur in other parts of PWS, trapping of mink at the Naked Island group occurs rarely. Pigeon Guillemots contribute to the success of ecotourism in PWS through their conspicuous, vocal, and charismatic displays along the shoreline.

The restoration objective for Pigeon Guillemots in PWS is population recovery, which in this case is defined as a stable or increasing population. All reasonable potential restoration alternatives have been considered and assessed for their likelihood of facilitating guillemot population recovery. The preferred alternative (Alternative A) is the eradication of mink (i.e., the removal of all individuals of the species) at the Naked Island group. The suggested method is trapping with lethal body grip traps set along the coastline during fall, winter, and especially early spring (when snow cover is present and mink are largely restricted to the shoreline), supplemented with hunting using dogs, as necessary. Successful eradication will likely require multiple years of effort, likely 3-5 years. Long-term monitoring of the islands should be conducted periodically when mink are most easily detected (i.e., when snow cover is present) and any mink discovered should be immediately trapped and the carcass saved for genetics analysis. The culling of mink (Alternative B) would result in suppression of the mink population at the Naked Island group, rather than complete elimination. This alternative was rejected for four primary reasons: (1) the level of culling effort necessary to cause a significant reduction in predation rates on guillemots is unknown, (2) culling would have to occur on an annual basis to be effective, (3) the ultimate economic cost and the total number of animals killed under a culling program would far exceed that of eradication, and (4) because even a single mink can devastate a guillemot colony, culling is unlikely to effectively enhance the recovery of the Pigeon Guillemot population. Alternative C, enhancement of the guillemot food supply during the nesting season, included the release of high-lipid hatchery-reared juvenile fish (i.e., Pacific herring, *Clupea pallasi*, and/or Pacific sand lance, *Ammodytes hexapterus*) near foraging areas of Pigeon Guillemots at the Naked Island group. Although this alternative may be an effective

restoration technique for guillemots and other species in the future, it was eliminated because there is currently no stock enhancement program for herring or sand lance in PWS, plus it fails to address the primary cause of guillemot egg and chick mortality at the Naked Island group. The construction and installation of guillemot nest boxes (Alternative D) to enhance the availability of sites inaccessible to mink was considered and rejected as well. A few nest boxes were installed at the Naked Island group during the 1990s, but there was a low incidence of use by guillemots, most likely because there was an abundance of available, unoccupied natural cavities. The population of Pigeon Guillemots at the Naked Island group is now significantly lower than it was during the 1990s, and thus nest box installation would almost certainly be an ineffective restoration technique. Alternative E consists of the lethal control of avian predators of Pigeon Guillemots and their nests, including Common Ravens (*Corvus corax*), Northwestern Crows (*Corvus caurinus*), and Black-billed Magpies (*Pica pica*). This alternative would require a constant, persistent, and intensive effort to reduce populations of avian predators, and the resulting increase in survival of guillemot eggs and chicks is likely to be insignificant in comparison to the loss of eggs, chicks, and adults due to mink predation. Alternative F consisted of a combination of provisioning of nest boxes (Alternative D) and control of corvid (Alternative E) and mink (Alternative B) populations. This combination of alternatives is unlikely to be more effective than any of the alternatives implemented on its own. The current management strategy (Alternative G), involves no restoration action. Given the high predation pressure on guillemot nests at the Naked Island group, this alternative will almost certainly lead to a continued low (< 25 nesting pairs) breeding population or local extirpation of the guillemot breeding population at this site.

Eradication of mink was selected as the preferred alternative because it is most likely to facilitate the recovery of Pigeon Guillemots throughout PWS. This alternative is less expensive, both economically and in terms of the number of mink killed, compared to any effective, perennial culling effort. Other alternatives are either currently unavailable or unlikely to be effective. An effort to eradicate mink at the Naked Island group is likely to be successful in a relatively short period of time (3-5 years) due to both well-developed methods of eradication and the low likelihood of mink re-colonization. Although, the preferred alternative would be implemented to address the Pigeon Guillemot population decline in PWS, a suite of other seabird species, including Tufted Puffins, Horned Puffins, and Arctic Terns, with depressed breeding populations at the Naked Island group would also benefit. Mink eradication may also promote local increases in other populations of ground-nesting birds (e.g., shorebirds, waterfowl), small mammals, amphibians, and crustaceans.

Potential negative effects of the preferred alternative appear to be either negligible or largely avoidable. Proposed eradication methods include steps to minimize capture of non-target species (i.e., selection of trap type and use of artificial burrows in which to set traps). The restoration of guillemots at the Naked Island group will not have a significant negative impact on herring stocks because juvenile herring have never been an important part of the diet of guillemots nesting at this location. Eradication of mink at the Naked Island group would not adversely affect trappers in PWS because mink at the Naked Island group are rarely exploited for their fur and are remote to trappers in the region. Due to the fur farm ancestry of mink at the Naked Island group, this alternative would not injure the Sound-wide population of native mink. There is no concern over a potential detrimental population eruption by small introduced herbivores or omnivores,

such as rabbits or rats, following mink eradication because no such species occur at the Naked Island group.

The population response of guillemots to mink eradication at the Naked Island group is measurable through the comparison of historical and recent guillemot population surveys completed at the Naked Island group and the Smith Island group (mink-free islands) using a Before–After–Control–Impact design. Although a precise prediction of the guillemot population response to mink eradication is not possible, the time expected to population recovery can be estimated. If the expected increase in guillemot productivity following mink eradication is realized and model assumptions are correct, the guillemot population at the Naked Island group would double within 10 years of mink eradication and the Sound-wide population of Pigeon Guillemots would begin to increase 15 years after eradication of mink at the Naked Island group.

PROJECT PLAN

I. NEED FOR THE PROJECT

A. Statement of Problem

Introduction

The Pigeon Guillemot (*Cepphus columba*) is now the only marine bird species injured by the 1989 *Exxon Valdez* oil spill (EVOS) that is listed as "not recovering" on the Exxon Valdez Oil Spill Trustee Council's Injured Resources List (*Exxon Valdez* Oil Spill Trustee Council 2010). Since 1989, the population of Pigeon Guillemots in Prince William Sound (PWS) has declined by an alarming 47%, and there is no sign of population stabilization (McKnight et al. 2008). Given this steady, long-term, and drastic trend, restoration action is warranted and in all probability necessary for the recovery of the Pigeon Guillemot population in PWS.

The Naked Island group is a logical location to focus restoration efforts for guillemots in PWS (Figure 1). These islands provide a unique opportunity to facilitate the recovery of a disproportionately large number of guillemots through restoration along a small portion (~2%) of the total PWS shoreline. The Naked Island group was historically the most important breeding location for guillemots in the Sound (Sanger and Cody 1994). Approximately one quarter of the guillemot population in PWS nested at the Naked Island group in 1989 in the aftermath of the EVOS (U.S. Fish and Wildlife Service, unpubl. data). Recovery of Pigeon Guillemots at the Naked Island group to the number counted just after the spill (Oakley and Kuletz 1996) would increase the Sound-wide population by nearly 45% (McKnight et al. 2008).

The Naked Island group is also the site where we have the most thorough understanding of mechanisms regulating Pigeon Guillemot populations in PWS. Data on population size, nesting success, and diet of guillemots has been collected at the Naked Island group during 15 years between 1978 and 2008 (Bixler 2010). The historical, ecological, and socioeconomic contexts of Pigeon Guillemots at the Naked Island group are presented below. This information provides the foundation crucial for the development and assessment of feasible restoration alternatives designed to facilitate the population recovery of Pigeon Guillemots in PWS.

Historical Context

The Naked Island group was the site of arctic fox (*Alopex lagopus*) fur farms for more than 50 years beginning in 1895 (Bailey 1993, Lethcoe and Lethcoe 2001). The foxes roamed free on the islands (Evermann 1914) and, as in other locations, likely relied on native small mammals (i.e., voles, shrews, and mice) and seabirds as a food source (Heller 1910, Bailey 1993). The populations of native fauna, including Pigeon Guillemots, almost certainly plummeted following the introduction of foxes to the Naked Island group, as they did across many formerly fox-free islands in Alaska (Bailey 1993). In fact, there were apparently no rodents or shrews on Storey Island and no shrews on Naked Island by 1908, within 15 years of the commencement of fox farming (Heller 1910). A variety of native species including salmon, herring, harbor seals, and even whales were killed to provide supplemental food for foxes in the Sound (Bailey 1993, Lethcoe and Lethcoe 2001, Wooley 2002), thereby altering the entire ecosystem. The depression of the 1930's, the end of World War II, and changes in women's

fashions in Europe together caused fox farming to become unprofitable (Lethcoe and Lethcoe 2001). Upon closure of the fox farms, foxes in PWS either were removed by trapping or died of starvation; arctic foxes are no longer found in the PWS region (Bailey 1993).

Other historical developments in PWS that may have directly or indirectly impacted the nearshore habitat of the Naked Island group include mining, commercial fishing of salmon and herring, pink salmon hatcheries, marine mammal harvest, and logging (Lethcoe and Lethcoe 2001, Wooley 2002). The 1964 earthquake resulted in an uplift of about four feet at the Naked Island group and massively altered both the shoreline and shallow nearshore habitat (Hanna 1971) where guillemots nest and forage (Ewins 1993).

On 24 March 1989, the T/V *Exxon Valdez* ran aground at Bligh Reef in PWS resulting in the release of at least 44 million liters of Prudhoe Bay crude oil into PWS. The oil spread to the southwest through the Sound and into the northern Gulf of Alaska. An estimated 500 to 1,500 Pigeon Guillemots in PWS were immediately killed due to oil exposure (Piatt and Ford 1996). There was evidence that guillemots were exposed to residual oil for at least a decade after the spill (Golet et al. 2002). However, there was no longer indication of direct contact with oil in guillemots by 2004 (B. Ballachey, U.S. Geological Survey, pers. comm.).

Previous studies have demonstrated that EVOS and/or a climatic regime shift associated with the Pacific Decadal Oscillation may have indirectly affected Pigeon Guillemots in PWS (Agler et al. 1999, Golet et al. 2002). The decline in the number of guillemots in the Sound, which began prior to EVOS, has been associated with the 1976 shift in the Pacific Decadal Oscillation (Agler et al. 1999, Golet et al. 2002) that resulted in reduced abundance of schooling forage fish across the North Pacific Ocean (Anderson et al. 1997, Francis et al. 1998, Anderson and Piatt 1999). EVOS also apparently contributed to the decline in populations of schooling forage fish, specifically Pacific herring (*Clupea pallasi*) and Pacific sand lance (*Ammodytes hexapterus)* in Prince William Sound (Marty et al. 1999, Golet et al. 2002, Marty 2008). The prevalence of high-lipid schooling forage fish in the diet of guillemot chicks at the Naked Island group was significantly lower in the decade after EVOS than prior to EVOS (Oakley and Kuletz 1996, Golet et al. 2002). Low proportions of high-lipid schooling prey, particularly sand lance, in the diet of Pigeon Guillemot chicks have been associated with lower nestling survival, lower nestling growth rates, and lower overall nesting success (Golet et al. 2000, Litzow et al. 2002).

Top-down factors, such as predation, may also have limited the recovery of the Pigeon Guillemot population in PWS (Hayes 1995, Oakley and Kuletz 1996, Golet et al. 2002). Common potential predators of guillemot nests in PWS include Glaucous-winged Gulls (*Larus glaucescens*), Black-billed Magpies (*Pica hudsonia*), Northwestern Crows (*Corvus caurinus*), Common Ravens (*Corvus corax*), river otters (*Lontra canadensis*), and American mink (*Neovison vison*) (Oakley and Kuletz 1979, Ewins 1993, Hayes 1995, Oakley and Kuletz 1996). The level of predation on guillemot nests at the Naked Island group increased significantly during the late 1990s compared to earlier years (Golet et al. 2002).

Current Ecological Context

The Pigeon Guillemot is a pursuit-diving seabird that preys upon a variety of nearshore demersal fishes, schooling fishes, and, occasionally, crustaceans (Ewins 1993). Guillemots are semi-colonial members of the seabird family Alcidae that produce 1- or 2-egg clutches (Ewins 1993). Pigeon Guillemots usually nest in rock crevices or burrows along rocky shorelines but are also known to nest in crevices of anthropogenic structures such as piers, bridges, and wooden

nest boxes (Ewins 1993). Guillemots nest along the coastline of western North America from the Bering Strait to Santa Barbara, California, and as far south as the Kurile Islands in the Russian Far East. The current number of Pigeon Guillemots is considered stable and estimated to be about 470,000 individuals range-wide (BirdLife International 2009). The species is regarded as "of least conservation concern" (BirdLife International 2009). The Pigeon Guillemot is however, susceptible to long-term local declines in breeding populations (Ewins 1993).

The availability of schooling forage fish may continue to limit the rate and extent of Pigeon Guillemot population recovery, both at the Naked Island group and in the Sound as a whole (Bixler 2010). The prevalence of schooling forage fish in the diet of Pigeon Guillemots at the Naked Island group has not recovered to pre-EVOS levels. In addition, the average group size of Pigeon Guillemots detected in surveys declined near the Naked Island group, but also across a number of other important guillemot nesting areas in central and western PWS, a pattern consistent with a region-wide reduction in food availability.

However, the primary limiting factor for guillemot reproductive success and population recovery at the Naked Island group is now predation by a recent colonizer of the islands, the American mink (Bixler 2010). The overall abundance of schooling forage fish at the Naked Island group has increased since the 1990s, suggesting that forage fish populations are recovering from EVOS. Despite improving prey resources, the guillemot breeding population at the Naked Island group has declined by more than 90% during the last 15 years. Guillemots, like many other seabirds, produce few offspring and their populations are sensitive to even small decreases in adult survival. The rate of egg and chick predation increased during the 1990s and caused the majority of nest failures during this period. By 1998, at least 60% of monitored guillemot nests and 4.5% of breeding adults at those nests were killed by mink. In 2008, we determined that the rate of nest predation at the Naked Island group was similar to the late 1990s, and mink were still able to locate guillemot nests and kill guillemot nestlings, despite few remaining nests (only 17 active guillemot nests found). The prevalence of guillemot nest sites in crevices on cliffs increased at the Naked Island group, while the prevalence of nests in crevices or burrows near the ground, presumably more accessible to mink, decreased compared to pre-spill. The guillemot population trend at the Naked Island group compared to elsewhere in PWS is also consistent with the hypothesis that mink predation is the primary limiting factor. Guillemot numbers were stable between 1990 and 2008 at nearby mink-free islands (Smith Island group), and guillemot population declines at the Naked Island group since EVOS have been much more severe than across the rest of PWS. The number of guillemots at the Naked Island group comprised about 25% of the total population in PWS just after the spill in 1989. But in 2008, the number of guillemots at the Naked Island group comprised just 1% of the total Sound-wide population.

Prior to the invasion of mink during the 1980s, the Naked Island group had the largest nesting colony of Parakeet Auklets (*Aethia psittacula*) in PWS and high densities of Tufted Puffins (*Fratercula cirrhata*), Horned Puffins (*Fratercula corniculata*), and Arctic Terns (*Sterna paradisaea*), in addition to supporting the highest numbers of nesting Pigeon Guillemots (Oakley and Kuletz 1979). Nest predation by mink likely caused declines in these other seabirds nesting at the Naked Island group. Arctic Terns and Parakeet Auklets have been extirpated as breeding species at the Naked Island group. Other seabirds currently nest in greatly reduced numbers (i.e., Tufted Puffins and Horned Puffins; KSB, pers. obs). The few remaining pairs of puffins nesting on the Naked Island group are restricted to the highest available shoreline cliffs (80 - 100 m) on the archipelago. Foraging humpback whales (*Megaptera novaeangliae*), minke whales

(*Balaenoptera acutorostrata*), harbor seals (*Phoca vitulina*), and Steller sea lions (*Eumetopias jubatus*) along with large foraging flocks of piscivorous birds, including Marbled Murrelets (*Brachyramphus marmoratus*), Black-legged Kittiwakes (*Rissa tridactyla*), and Glaucous-winged Gulls (*Larus glaucescens*) still occurred in the nearshore waters of the Naked Island group in 2008 (KSB, pers. obs.). These aggregations of piscivorous marine birds and mammals near the Naked Island group provide supporting evidence that predation by mink, and not limited forage fish, have caused the decline in seabirds breeding at the site.

Mink are semi-aquatic, largely nocturnal, generalist carnivores that are native to the mainland and nearshore islands of PWS. The natural distribution of mink on the more isolated, offshore islands in PWS is less well known, however, due to two centuries of trapping of furbearers by non-Native Alaskans and 50 years of fur farms for foxes and mink (Lethcoe and Lethcoe 2001, Fleming and Cook 2010). Mink most likely arrived at the Naked Island group during the 1980s (U.S. Fish & Wildlife Service, unpubl. Data; Appendix B. Evidence from both mtDNA sequencing and nuclear microsatellite genotyping suggest that the mink on the Naked Island group are descended in part from fur farm mink (Fleming and Cook 2010). In addition, mink were almost certainly introduced to the Naked Island group by humans (Appendix B). There is no evidence of a gradual natural immigration of individuals and the founding population size was about 5 pairs, larger than expected from a natural colonization event. Mink from the Naked Island group are most closely related to those that occur on Knight Island, the nearest island to the Naked Island group (6 km away). This distance exceeds by 2 km the longest recorded natural dispersal distance over open water by mink. Mink were intentionally introduced by federal and state agencies to at least one remote island in PWS (i.e., Montague Island) in order to provide a harvestable population (Paul 2009). There is also suggestive evidence of introductions of mink to islands in PWS by fox farmers (Fleming and Cook 2010) and fur trappers (R. Ellis, USDA-Wildlife Services, pers. comm.) to establish new harvestable populations.

American mink have escaped from fur farms or from been intentionally introduced across much of Europe (Bonesi and Palazon 2007) where they have caused rapid population declines in a variety of ground-nesting birds (Ferreras and MacDonald 1999, Clode and MacDonald 2002, Nordström et al. 2002, Nordström et al. 2003, Banks et al. 2008), small mammals, amphibians (Banks et al. 2008), and crustaceans (Bonesi and Palazon 2007). These effects are especially apparent on islands (Banks et al. 2008). A long-term, large-scale American mink removal program on islands in the Baltic Sea demonstrated that 1) nearly all species of birds, mammals, and amphibians present on the islands were negatively affected by mink predation and 2) populations of most species increased following mink removal (Nordström et al. 2003, Banks et al. 2008). Mink eradication resulted in successful reversal of the population decline and local extirpation of Black Guillemots (*Cepphus grylle*), a close relative of Pigeon Guillemots, in this study (Nordström et al. 2003).

Although we are unaware of any examples of mink eradication programs within the breeding range of Pigeon Guillemots, introduced arctic foxes have been removed from multiple islands in the Alaska Maritime National Wildlife Refuge Complex (Byrd et al. 1997). At two of these islands, Simeonof and Chernabura islands in the Shumagin Islands, the population of Pigeon Guillemots increased by 275% and 150%, respectively, within just six years of fox removal (Byrd 2001).

Not all guillemot nesting failure on the Naked Island group is caused by mink predation and the diet of the few guillemots that continue to nest on the Naked Island group does not

include as high a proportion of schooling forage fishes as pre-EVOS (Bixler 2010). Consequently, a precise estimate of the guillemot population response should mink be eradicated at the Naked Island group is not possible. However, all available evidence indicates that eliminating mink predation on guillemot nests and adults would result in a measureable increase in the Pigeon Guillemot breeding population and its productivity at the Naked Island group, as well as increases in the breeding populations of other seabirds at the Naked Island group.

Socioeconomic Context

Outside of one privately owned parcel of land on Peak Island, the Naked Island group is part of the publically owned Chugach National Forest (Oakley and Kuletz 1979). The islands are used periodically for camping, hiking, deer hunting, and fishing (Oakley and Kuletz 1979). The protected bays on the west and north sides of Naked Island provide safe anchorages for sailboats, fishing boats, and an oil spill response barge. Although frequently exploited for their fur in other parts of PWS, trapping of mink at the Naked Island group rarely occurs due to the low price of furs and the time and expense involved in traveling to the islands (R. Ellis, U.S. Department of Agriculture – Wildlife Services, pers. comm.). Although Pigeon Guillemots have little subsistence value, they contribute to the success of ecotourism in PWS. Guillemots are conspicuous, vocal, and charismatic and thus play a role in the auditory and visual experience of all who frequent the shoreline of PWS.

B. Relevance to 1994 Restoration Plan Goals and Scientific Priorities

The proposed restoration would facilitate the recovery of a species injured by EVOS, the Pigeon Guillemot, through eradication of mink at the Naked Island group. Given the high level of guillemot egg and chick mortality at the Naked Island group, there is no evidence to suggest that the population could recover without restoration action. Because the Naked Island group is the most important historical nesting area for guillemots in PWS, this proposal provides an opportunity for recovery of a significant proportion of the PWS guillemot population.

The removal of all mink from the Naked Island group would promote naturally occurring productivity and diversity in Prince William Sound. This population of mink was almost certainly introduced to the Naked Island group. A suite of seabird species with depressed breeding populations at the Naked Island group (e.g., Arctic Terns, Parakeet Auklets, Tufted Puffins, and Horned Puffins) (KSB, pers. obs.; Oakley and Kuletz 1979) would benefit from this restoration action in addition to Pigeon Guillemots. Mink eradication may promote local increases in other populations of ground-nesting birds (Ferreras and MacDonald 1999, Clode and MacDonald 2002, Nordström et al. 2002, Nordström et al. 2003, Banks et al. 2008), small mammals, amphibians (Banks et al. 2008), and crustaceans (Bonesi and Palazon 2007).

II. PROJECT DESIGN

A. Alternatives

Introduction

The restoration objective for Pigeon Guillemots in PWS is population recovery, in this case defined as a stable or increasing population (*Exxon Valdez* Oil Spill Trustee Council 1994). All reasonable potential restoration alternatives have been considered. The ability of each alternative to meet the restoration objective was assessed and the most effective approach was selected as the preferred alternative. The compliance of the preferred alternative with the policies and standards of restoration of the *Exxon Valdez* Oil Spill Trustee Council (*Exxon Valdez* Oil Spill Trustee Council 1994) are addressed in more detail in Appendices A and B.

Detailed description of alternatives

Alternative A - Eradication of Mink – PREFERRED ALTERNATIVE

Actions under this alternative aim to eradicate mink at the Naked Island group. We consider eradication "the complete removal of all the individuals of the population, down to the last potentially reproducing individual" (Courchamp et al. 2003). The suggested method is lethal trapping with body grip traps along the coastline, supplemented with hunting using dogs as necessary.

Trapping is the most practical and effective method available to control mink (Boggess 1994, Macdonald and Harrington 2003, Moore et al. 2003). Although lethal trapping is more successful (Boggess 1994, Moore et al. 2003), live trapping followed by euthanasia with an air pistol or shotgun has been utilized in a few mink eradication projects due to concern for non-target captures and public acceptance (Moore et al. 2003). Other methods of euthanasia were considered but rejected. Although toxicants (e.g., sodium fluoroacetate - compound 1080 and sodium cyanide - M44) and fumigants (e.g. carbon monoxide) are in use in the United States for carnivore control, there are currently no chemical agents registered by the U.S. Environmental Protection Agency for the control of mink (Boggess 1994, National Wildlife Research Center 2008). Further, poisoning or secondary poisoning of non-target species (Courchamp et al. 2003, Moore et al. 2003) such as river otters (*Lontra canadensis*) and Bald Eagles (*Haliaeetus leucocephalus*) would likely be unacceptable. Shooting as a method of killing mink is considered inefficient (Boggess 1994, Courchamp et al. 2003). Although a potentially important management tool in European countries (Macdonald and Harrington 2003, Bonesi and Palazon 2007), control of mink through enhancement of possible competitors (i.e., river otters) seems unlikely to be effective in PWS given the lack of evidence for niche overlap (BenDavid et al. 1996). Other means of biological control, such as virus vectored immune-contraception, have yet to be fully developed (Courchamp and Cornell 2000, Macdonald and Harrington 2003) and might pose an irreversible danger to the viability of mink and other closely-related native furbearers (e.g., American marten) outside of the Naked Island group.

Trapping success would be maximized through continuous effort for at least three months of the year during the mating (January to March), juvenile dispersal (August to October), and/or winter (November to December) seasons (Bonesi et al. 2007). The precise timing of trapping will be determined using an adaptive management approach (see below). Traps would be set along the coastline of the islands (See Bixler et al. 2010 for details). Although mink on the Naked Island group may occur along a few inland streams and small lakes, there is evidence that mink re-locate to the coast as territories become available during the eradication program (Bodey et al.

2010). We suggest the use of experienced trappers (Macdonald and Harrington 2003) for the duration of the project and hunting dogs to locate the last few mink (Moore et al. 2003).

Although we do not know the total number of mink at the Naked Island group, there likely is between 70 and 200 mink in this population (Fleming and Cook 2010). We anticipate that successful eradication would likely require multiple years of effort (Macdonald and Harrington 2003), potentially up to five years. Carcasses would be donated to permanent archives in public museums to be made available to research organizations for further genetic study. Long-term monitoring of the islands would be conducted periodically when mink are most easily detected (i.e., during deep snow cover; Bonesi and Palazon 2007) and any mink discovered will immediately be trapped.

The geography of the Naked Island group improves the likelihood of successful mink eradication, should eradication be attempted. The islands are relatively small with gentle topography and access to safe anchorages (Courchamp et al. 2003, Bonesi and Palazon 2007). Because the Naked Island group is geographically isolated, it is unlikely to be re-colonized by mink (Nordström and Korpimäki 2004, Bonesi and Palazon 2007).

Mink eradication at the Naked Island group would likely be followed by a clear and dramatic increase in the guillemot breeding population, but the precise response of the guillemot population following mink eradication is unknown. Based on the best available information, however, we estimate that the productivity of guillemots at the Naked Island group will increase by 16% to 36%. If this change in productivity is realized and model assumptions are accurate, the Sound-wide population should begin to increase within 15 years following eradication (See Chapter 4).

Alternative B - Culling of Mink

Alternative B is similar to Alternative A, with the exception that in this alternative the aim of lethal trapping is the suppression of the mink population at the Naked Island group, rather than eradication. Methods used would be identical to Alternative A with two main differences; 1) hunting with dogs would not be necessary and, 2) lethal trapping would have to occur indefinitely and on an annual basis in order to maintain a low density of mink on the archipelago (Bonesi et al. 2007).

There are several drawbacks to this alternative. It is possible for the population of mink to remain stable even under a culling program, and the level of culling necessary to cause and sustain a reduction in population density is unknown (Bonesi and Palazon 2007). If the population of mink declines and is released from density-dependent limiting factors, the reproductive rate would likely increase, raising the trapping effort required to maintain a low density (Courchamp et al. 2003). In order to maintain a low density population of mink, culling must occur annually (Bonesi et al. 2007), thus the ultimate economic cost and the total number of animals killed under a culling program would far exceed that of eradication (Courchamp et al. 2003). And finally, because even a single mink can devastate a guillemot colony (U.S. Fish and Wildlife, unpubl. data), culling is unlikely to significantly reduce the level of guillemot nest predation or facilitate population recovery.

Alternative C – Enhance the Pigeon Guillemot Food Supply during the Nesting Season

Actions under Alternative C would include the release of hatchery-reared juvenile forage fish within PWS, preferably in close proximity to the foraging areas of Pigeon Guillemots nesting at the Naked Island group. Due to the importance of prey lipid content to the reproductive success of guillemots (Golet et al. 2000, Litzow et al. 2002), only high-lipid schooling forage fish would be released (i.e. herring and/or sand lance). An increase in the abundance of high-lipid prey might lead to increased productivity and survival in guillemots (Golet et al. 2000, Litzow et al. 2002). The enhancement of native stocks of forage fish in PWS might also have a positive impact on populations of a variety of other species of seabirds, fish, and mammals that prey upon them, including the ESA-listed humpback whale (*Megaptera novaeangliae*) and Steller sea lion (*Eumetopias jubatus*). There is currently no stock enhancement program for either herring or sand lance in PWS. The initiation of such a program requires further research in order to ensure no unexpected negative consequences to the ecosystem (*Exxon Valdez* Oil Spill Trustee Council 2009). Although this alternative might be an effective restoration technique in the future, it is not a viable solution to stem the current alarming population decline of guillemots. More importantly however, this alternative fails to address the primary cause of guillemot nesting failure at the Naked Island group, namely predation on eggs and chicks.

Other methods of supplementing the guillemot food supply have been considered and rejected. For instance, releases of dead herring or sand lance into waters adjacent to active nests are unlikely to be utilized by guillemots because there is no indication that this species currently exploits such potential food resources (i.e., offal discarded from fishing vessels; Ewins 1993). Supplementing the diet of chicks in the nest was rejected as well. Although studies suggest that the supplementation of prey to nests can significantly increase productivity of seabirds (Robb et al. 2008), Pigeon Guillemots are prone to nest abandonment when subjected to high rates of human disturbance at the nest (Ainley et al. 1990, Vermeer et al. 1993).

Alternative D - Provide Nest Boxes to Enhance Nest Site Availability

Under this alternative, nest boxes would be installed on cliff faces that appear to be inaccessible to mink. The boxes would be placed in the immediate vicinity of either current or historical nesting locations.

Other options to prevent mink from depredating guillemot adults, chicks, and eggs inside nests were considered but eliminated. For instance, fencing is highly unlikely to be effective at reducing predation of guillemot nests at the Naked Island group. The prevention of gaps larger than 1 inch (Boggess 1994) on talus slopes and cliffs is not feasible. There are no registered chemical repellents or known effective frightening devices to modify the behavior of mink near guillemot nests (Boggess 1994, National Wildlife Research Center 2008).

There is no evidence that Pigeon Guillemots at the Naked Island group are limited by the availability of nesting habitat (Bixler 2010). A few nest boxes were installed at the Naked Island group during the late 1990s, but there was low incidence of use (DBI; pers. obs), most likely because there was an abundance of natural cavities available. The population of Pigeon Guillemots at the Naked Island group is now significantly lower than it was during the late 1990s. Consequently, nest box installation would almost certainly be an ineffective restoration technique.

Alternative E - Control Avian Predators of Pigeon Guillemot Nests

Actions under Alternative E intend to prevent the predation of Pigeon Guillemot nests through reduction in population of native avian predators at the Naked Island group. Avian species targeted would include the Common Raven (*Corvus corax*), Northwestern Crow (*Corvus caurinus*), and Black-billed Magpie (*Pica pica*). Lethal population control would be attained by shooting avian nest predators throughout the guillemot nesting season, April through August.

There are no other feasible methods of lethal or non-lethal control available. Although there is a conditioned taste aversion chemical registered by the U.S. Environmental Protection Agency (methiocarb) for corvid control, it is limited in use for the protection of federally threatened or endangered species (National Wildlife Research Center 2008). Similarly, lethal control of corvids through a toxicant (i.e. DRC-1339 [3-chloro-4-methylbenzenamine HCL]) is not permitted for this application (National Wildlife Research Center 2008). Harassment techniques, such as auditory deterrents, were rejected because they would likely negatively affect guillemot nest attendance.

There are several flaws inherent to this alternative. Culling by shooting has a decreasing efficacy for corvid species through time (Liebezeit and George 2002) suggesting that each year of control would require more effort with less success. The program would need to be conducted annually and continue indefinitely due to the high dispersal capability of these species. Finally, because an increase in survival of chicks after culling avian predators is likely to be insignificant in comparison to the loss of eggs, chicks, and adults due to mink predation, it seems very unlikely that this alternative would change the current population trajectory of Pigeon Guillemots at the Naked Island group.

Alternative F - Combination of Nest Boxes and Control of Predator Populations

Under this alternative, nest predators of Pigeon Guillemots (i.e., mink, ravens, crows, and magpies) would be culled and nest boxes would be installed at the Naked Island group. Actions taken include all of those listed in Alternatives B, D, and E. Due to flaws in each action (see above) that will not be lessened by the combination of alternatives, the population trajectory of Pigeon Guillemots at the Naked Island group is unlikely to change significantly.

Alternative G - No Action – Current Management

No management action would be taken under this alternative. The current breeding population of Pigeon Guillemots at the Naked Island group is likely to remain either exceedingly low (< 25 nesting pairs) or decline to local extirpation in the absence of restoration action given the high rate of predation on guillemot nests and adults by mink.

Rationale for selection of eradication of mink on the Naked Island Group as the preferred alternative

Alternative A, eradication of mink, is the preferred alternative because it is the most effective method to elevate the productivity of Pigeon Guillemots at the Naked Island group and facilitate the recovery of the species in PWS. This alternative is less expensive, both financially and in number of mink killed, than any culling method (Courchamp et al. 2003). Other alternatives are either currently unavailable or unlikely to facilitate guillemot population

recovery. Given the high level of guillemot egg and chick mortality at the Naked Island group, there is no evidence to suggest that the population could recover without such restoration action. Mink eradication at the Naked Island group is likely to be successful due to both well developed methods of eradication (Bonesi and Palazon 2007) and geographic isolation of the islands (Nordström and Korpimäki 2004). The removal of all mink at the Naked Island group can be achieved within a relatively short period of time (3-5 years). Although the population response of guillemots is difficult to predict precisely, mink eradication would result in an increase in adult survival, reproductive success, and population size at the Naked Island group. A suite of seabird species with depressed breeding populations at the Naked Island group (e.g., Arctic Terns, Parakeet Auklets, Tufted Puffins, and Horned Puffins) (KSB, pers. obs.; Oakley and Kuletz 1979) would also benefit from this restoration action. Mink eradication may promote local increases in other populations of ground-nesting birds (Ferreras and MacDonald 1999, Clode and MacDonald 2002, Nordström et al. 2002, Nordström et al. 2003, Banks et al. 2008), small mammals, amphibians (Banks et al. 2008), and crustaceans (Bonesi and Palazon 2007).

Potential negative effects of the preferred alternative appear to be negligible or largely avoidable. The preferred alternative includes steps to minimize capture of non-target species (i.e., trap type and use of artificial burrows as trap sites; see Bixler et al. 2010). There is no evidence to suggest that restoration of guillemots at the Naked Island group would have a significant negative impact on herring because they have never been an important part of the diet of guillemots at this site (Golet et al. 2000). Mink at the Naked Island group are rarely exploited for their fur (R. Ellis, U.S. Department of Agriculture – Wildlife Services, pers. comm.), and thus the eradication of mink at these islands would not adversely affect trappers in PWS. Due to fur farm ancestry, the preferred alternative would not have a negative impact on the Sound-wide population of mink. There is no concern of sudden destructive eruptions of small exotic herbivore or omnivore (e.g. rabbits, rats) populations (Bergstrom et al. 2009) following mink eradication because no such introduced species occur at the Naked Island group.

B. Objectives

Phase I

Complete the NEPA analysis process to decide how to proceed.

Phase II, if warranted by the outcome of the NEPA analysis.

1. Remove all mink from the Naked Island group.
2. Monitor the guillemot population response to mink eradication at the Naked Island group.

C. Procedural and Scientific Methods

Experimental Design

1. Mink eradication at the Naked Island group would require up to five years to accomplish via lethal trapping (Bixler et al. 2010) and hunting with dogs.

2. A long-term monitoring program is integral to the success of this proposed restoration. The Naked Island group would be surveyed every year for mink sign (tracks, scat) in snow, when mink are most easily detected (Bonesi and Palazon 2007). The population of

guillemots would be censused at both the Naked Island group and the Smith Island group during late May/early June each year using the protocol described in Oakley and Kuletz (1996). This monitoring will be continued by USFWS after the current project is over.

3. The preferred alternative requires an adaptive management strategy. This technique requires that data collected during trapping (e.g., trapping success, sex of trapped animals) as well as Pigeon Guillemot censuses be reviewed regularly to assess the success of the actions and methods. If there is evidence that the specified objective is not being met, the restoration methods or actions should be altered.

Time Frame for Pigeon Guillemot Population Recovery

We estimated the response of Pigeon Guillemot populations using a Leslie population-projection matrix after Golet et al. (2002). The following equation was used to calculate the population multiplication rate (λ):

$$\lambda = ((P_F * F_X * P_A^2) + (N_X * P_A)) / N_X$$

We assumed that fledgling survival (P_F) is 0.75 and age-constant adult survival (P_A) is 0.9. The initial population size (N_X) is the current population at the Naked Island group, 101 individuals. The initial number of offspring produced (F_X) was calculated using the average clutch size at the Naked Island group (1.7 eggs), average productivity after EVOS (0.35 chicks fledged/egg laid) plus 16% to 36%, and an initial breeding population size of about 90 (~ 45 pairs). The estimated increase in productivity, 16% to 36%, following the removal of all mink at the Naked Island group was derived from 1) the 16% increase in mortality of all chicks and eggs from pre-EVOS to post-EVOS coinciding with the apparent arrival of mink and 2) the 36% increase in the rate of predation of guillemot eggs and chicks in the years after EVOS compared to prior years. If this change in productivity is realized and model assumptions are accurate, the guillemot population at the Naked Island group would double within 10 years following eradication (Figure 2). Assuming that the model assumptions are met, the Sound-wide population of Pigeon Guillemots will increase within 15 years after eradication of mink at the Naked Island group (Figure 3). This will occur despite inclusion in the model of a 1.2% per year guillemot population decline that was documented between 1989 and 2008 across the remainder of the Sound.

Constraints

A precise estimate of the guillemot population response to mink eradication at the Naked Island group is not possible because there is some uncertainty about the exact proportion of all nest predation events that are caused by mink (Bixler 2010). Also there is some evidence that availability of preferred forage fish may affect the rate of guillemot population recovery in some parts of PWS. Consequently, the expected time until guillemot population recovery is an estimate based upon the best available information.

C. Data Analysis and Statistical Methods

The Pigeon Guillemot population trajectory between 1989 and 2008 at the Naked Island group and at the nearby Smith Island group (mink-free islands) can be compared to population trends following eradication using a Before–After–Control–Impact design (Smith 2002).

D. Description of Study Area

Restoration would occur at the Naked Island group. The Pigeon Guillemot population at both the Naked Island group and the Smith Island group would be monitored.

E. Coordination and Collaboration with Other Efforts

Implementation of this plan would require coordination with agencies with authority and responsibility of the Naked Island group, American mink, and Pigeon Guillemots (see below). Monitoring of Pigeon Guillemots would be conducted by the U.S. Fish and Wildlife Service. Permits for eradication of mink at the Naked Island group would be obtained from both the Alaska Department of Fish and Game and the U.S. Department of Agriculture – Forest Service. Mink eradication would be conducted by the U.S. Department of Agriculture – Wildlife Services or other contractor.

Authority and Responsibility

U. S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service mission is "to work with others to conserve, protect and enhance fish, wildlife and plants and their habitats for the continuing benefit of the American people." Along with other Federal, State, Tribal, local, and private entities, the Service protects migratory birds, endangered species, certain fish species, and wildlife habitat. The Service is the primary agency responsible for the conservation of the Pigeon Guillemot and its habitat as authorized by the Migratory Bird Treaty Act.

Alaska Department of Fish and Game

The mission of the Alaska Department of Fish and Game is to "protect, maintain, and improve the fish, game, and aquatic plant resources of the state, and manage their use and development in the best interest of the economy and the well-being of the people of the state, consistent with the sustained yield principle." The Department is responsible for maintaining a harvestable surplus of fish and wildlife species, including furbearers and marine forage fish.

U.S. Department of Agriculture Forest Service

The mission of the Forest Service is "to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations." The Forest Service is responsible for the management of the 5.4 million acre Chugach National Forest that includes nearly all of the Naked Island group, along with most of the rest of the land area of Prince William Sound.

III. SCHEDULE

A. Project Milestones

- Eradication completed at Naked Island group
  To be met by March 31, 2016

- Revise final report for EVOS project 10070853 to include details of eradication efforts and Pigeon Guillemot population trends.
  To be met by Sept 30, 2016

B. Measurable Project Tasks

FY 11, 2nd quarter (January 1 – March 31)
Project funding approved by Trustee Council
Begin Phase I: NEPA process begins

FY 11, 3rd quarter (April 1 – June 30)
Continue NEPA process

FY 11, 4th quarter (July 1 – September 30)
Continue NEPA process

FY 12, 1st quarter (October 1 – December 31)
Complete Phase I: NEPA process
Begin Phase II: Mink eradication and restoration monitoring (if warranted by NEPA analysis)

FY 12, 2nd quarter (January 1 – March 31)
Trap mink at the Naked Island group

FY 12, 3rd quarter (April 1 – June 30)
Census breeding guillemots at Naked Island and nearby islands, 28-30 May

FY 12, 4th quarter (July 1 – September 30)
Submit annual report to Trustee Council

FY 13, 1st quarter (October 1 – December 31)

Trap mink at the Naked Island group

FY 13, 2nd quarter (January 1 – March 31)
Trap mink at the Naked Island group

FY 13, 3rd quarter (April 1 – June 30)
Census breeding guillemots at Naked Island and nearby islands, 28-30 May

FY 13, 4th quarter (July 1 – September 30)
Submit annual report to Trustee Council

FY 14, 1st quarter (October 1 – December 31)
Trap mink at the Naked Island group

FY 14, 2nd quarter (January 1 – March 31)
Complete mink trapping and use dogs to check for any remaining mink at the Naked Island group

FY 14, 3rd quarter (April 1 – June 30)
Census breeding guillemots at Naked Island and nearby islands, 28-30 May

FY 14, 4th quarter (July 1 – September 30)
Submit annual report to Trustee Council

FY 15, 1st quarter (October 1 – December 31)

FY 15, 2nd quarter (January 1 – March 31)
Check for any remaining mink using dogs at the Naked Island group

FY 15, 3rd quarter (April 1 – June 30)
Census breeding guillemots at Naked Island and nearby islands, 28-30 May

FY 15, 4th quarter (July 1 – September 30)
Submit annual report to Trustee Council

FY 16, 1st quarter (October 1 – December 31)
Monitor to confirm absence of mink at the Naked Island group

FY 16, 2nd quarter (January 1 – March 31)
Set up field camp on Naked Island (Cabin Bay)
Monitor to confirm absence of mink at the Naked Island group
Eradication complete
Remove field camp on Naked Island

FY 16, 3rd quarter (April 1 – June 30)
Census breeding guillemots at Naked Island and nearby islands, 28-30 May
Amend Final Report with information on eradication and guillemot population trends

FY 16, 4th quarter (July 1 – September 30)
Submit Final report to Trustee Council

IV. RESPONSIVENESS TO KEY TRUSTEE COUNCIL STRATEGIES

A. Community Involvement and Traditional Ecological Knowledge (TEK)

All community input is always welcome to our project; the proposal process is open and the PAG members and other members of local communities may comment on proposals. The findings of the study will be communicated to local communities through various means including the annual EVOS meeting, on the web, distribution of reports, and the reports will be available in local libraries.

B. Resource Management Applications

The restoration described in this proposal is the only option likely to be effective or currently available to "initiate, sustain, or accelerate recovery", a recovery objective for Pigeon Guillemots identified in the 1994 Restoration Plan. This amendment represents the culmination of several years of research previously supported by the EVOS Trustee Council that assessed factors limiting recovery of Pigeon Guillemot populations damaged by EVOS. It directly reflects the findings of research conducted under Project 070853 in 2007 and 2008 on current factors limiting recovery of Pigeon Guillemots at the Naked Island group.

V. PUBLICATIONS AND REPORTS

An annual report for each year of this project will be submitted by 15 April of the following year. The final report for this project will be submitted by 30 September 2016. One manuscript will be generated from this research and will be published in the peer-reviewed scientific literature.

Budget Justification

FY 2011 – $218,000.00 Phase I
FY 2012 -- $580,081.00 Phase II
FY 2013 –$580,081.00 Phase II
FY 2014 –$360,656.70 Phase II
FY 2015 –$347,699.90 Phase II
FY 2016 --$347,870.00 Phase II
TOTAL: $2,434,218.40 Phase II

NOTE: David Irons and Dan Roby are submitting a proposal to the National Fish and Wildlife Foundation for 50% of the proposed budget of $2.2 million (half of the budget, excluding the cost of NEPA analysis). We will know before Phase II begins if we have been awarded funding by the National Fish and Wildlife Foundation.

Project Title: Pigeon Guillemot Restoration Research in Prince William Sound, Alaska, FY11 Amendment

Personnel: A project leader (GS 11) is needed to assist the Principal Investigators and must possess supervisory skills to oversee the activities of 9 subordinate workers. For the recovery monitoring we will need two bio techs for one month the first two years and three bio techs for three months the last three years. We will need one bio tech for 12 months each year to take care of all field gear preparation/maintenance and survey logistics. The project leader will allocate 7 months to the project -- 4 months for field work in each year of the project to conduct QA/QC on the data, enter data into the North Pacific Pelagic Seabird Database, conduct the analysis, and write the report. The analysis and writing will occur in FY16, when the report is due.

Request: (FY 2011: $0.0K; FY 2012: $98.1K; FY2013: $98.1K; FY 2014: $124.5K; FY 2015: $124.5K; FY 2016: $124.5K; TOTAL: $569.7K)

Travel: Three people in Years 1 and 2, and four people in Years 3, 4, and 5. Personnel will be traveling throughout Prince William Sound and will need approximately 8 nights of lodging in towns around the Sound. Per diem rates will be given to each person during the survey. A tunnel fee is assessed to every vehicle traveling through the tunnel between Portage and Whittier, and the truck/boat will make 10 round trips during the survey.

Request: (FY 2011: $0.0K; FY 2012: $9.1K; FY2013: $9.1K; FY 2014: $11.8K; FY 2015: $11.8K; FY 2016: $11.8K; TOTAL: $53.6K)

Contractual: A contract will be let to complete the NEPA analysis process in Phase I in FY 2011.

APHIS Wildlife Services will be contracted to eradicate mink at the Naked Island group. A minimum of three persons per boat (3 boats) for a total of nine persons are needed to trap mink for the first two years and one boat the last three years. We will need nine trappers for three months –in winter the first two years, six trappers for one month in year 3, and three trappers for one month for years 4 and 5. The trappers will need 6 nights of lodging in Whittier. Per diem rates will be given to the trappers while traveling and camping.
Prince William Sound is large and requires extensive travel by boat. To make the survey cost effective, a support vessel will be contracted to provide lodging and food for the winter trapping period, which is three months the first two years and one month the last three years. The small boats used to put the trappers on shore and for restoration monitoring will operate for hundreds of hours and will need repairs and replacement parts. There are also fees associated with launching and parking the boat in the harbors. Fuel storage at Naked Island will require a barge for transportation.

Requested: (FY 2011: $200.0K; FY 2012: $335.2K; FY2013: $335.2K; FY 2014: $119.0K; FY 2015: $113.1; FY 2016: $113.1K; TOTAL: $1,215.7K)

Commodities: Includes gas and oil to support boat transport and operation during the trapping in the winter, which will include three boats for three months the first two years, two boats for one month in the third year, and one boat for one month in the last two years. Restoration monitoring will require one boat for one month in the summer the first two years. During the last

three years, monitoring will require two boats for one month and one boat for two months. This also includes food for 6 people while conducting the restoration monitoring in the summer, when there would be no support vessel; and personal safety devices.

Request: (FY 2011: $0.0K; FY 2012: $86.8K; FY2013: $86.8K; FY 2014: $72.6K; FY 2015: $66.6K; FY 2016: $66.6K; TOTAL: $379.3K)

Equipment: We are using USFWS equipment for this survey as an in-kind contribution, but the survey work takes a toll on boats; on average, each boat will run a total of 40 full days. As a result, we are including funds for emergency replacement of motor parts that fail during the survey, should the need arise.

Request: (FY 2011: $0.0K; FY 2012: $3.0K; FY2013: $3.0K; FY 2014: $3.0K; FY 2015: $3.0K; FY 2016: $3.0K; TOTAL: $15.0K)

Indirect: We are using the standard G&A rate of 9%.

Request: (FY 2011: $18.0K; FY 2012: $47.9K; FY2013: $47.9K; FY 2014: $29.8K; FY 2015: $28.7K; FY 2016: $28.7K; TOTAL: $201.0K)

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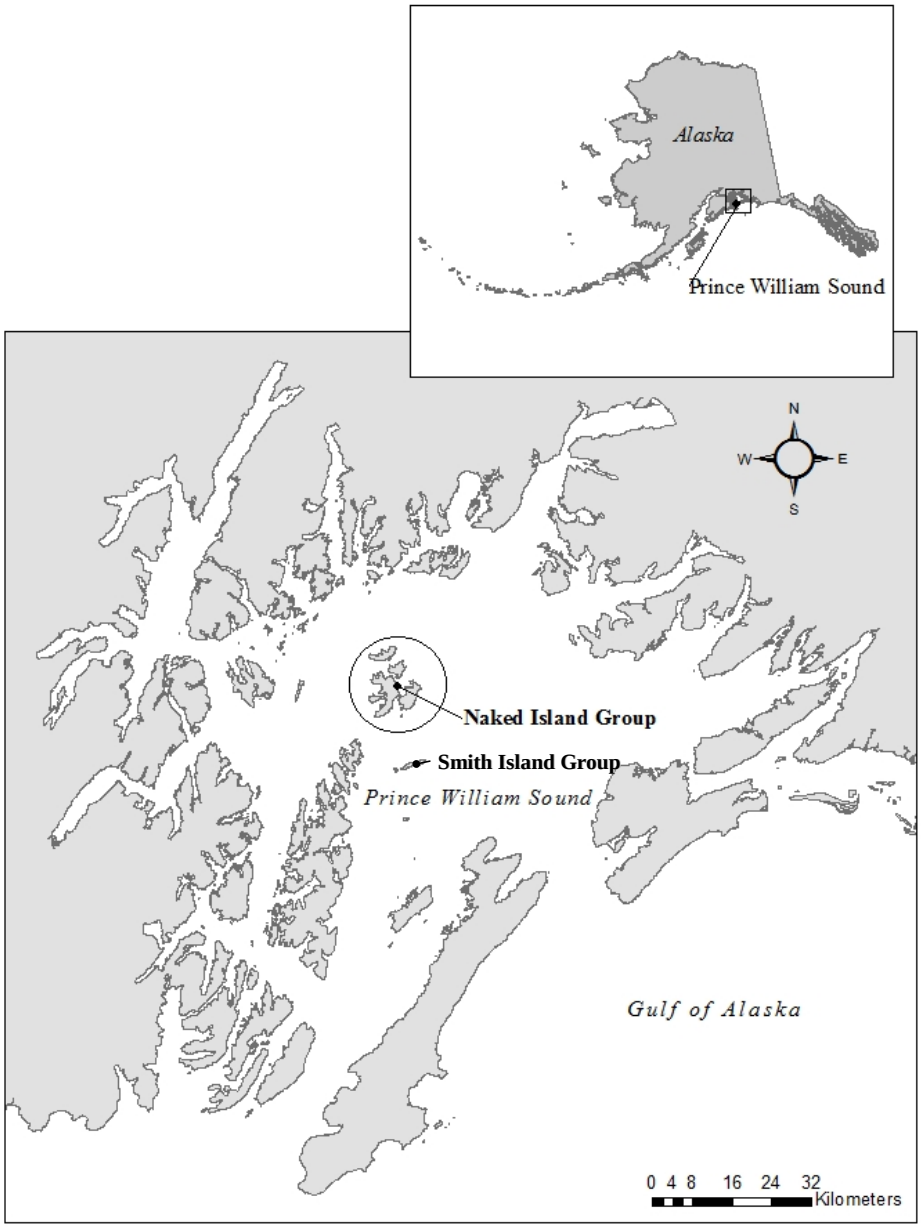

Figure 1. The location of Prince William Sound (inset map), the Naked Island group, and the nearby mink-free Smith Island group in Alaska.

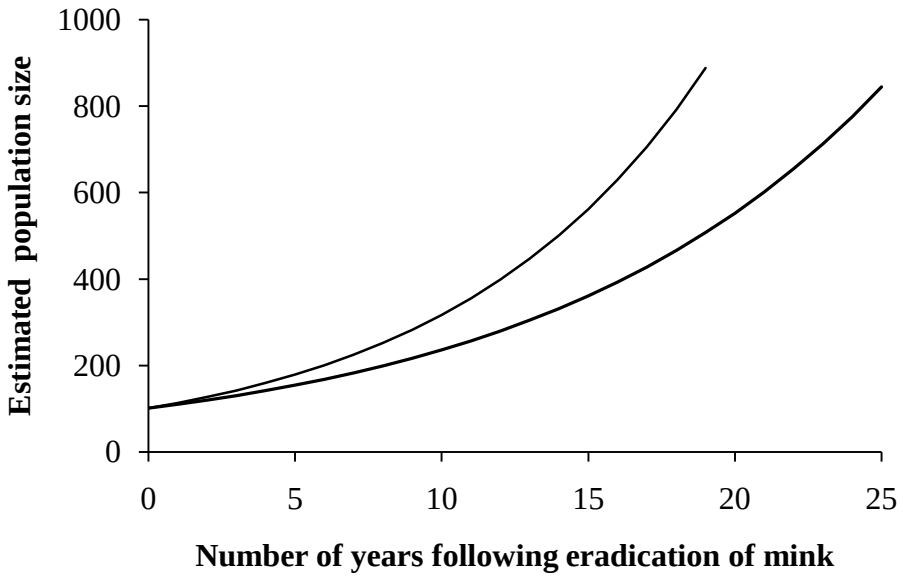

Figure 2. The maximum and minimum estimated Pigeon Guillemot population response at the Naked Island group in Prince William Sound, Alaska for 25 years after the eradication of American mink. The responses are calculated using a Leslie population-projection matrix after Golet et al. (2002). The two estimates are based upon an increase in productivity of 16% or 36% from the average productivity during the late 1990s, when the mink predation rate on guillemot nests was high at the Naked Island group.

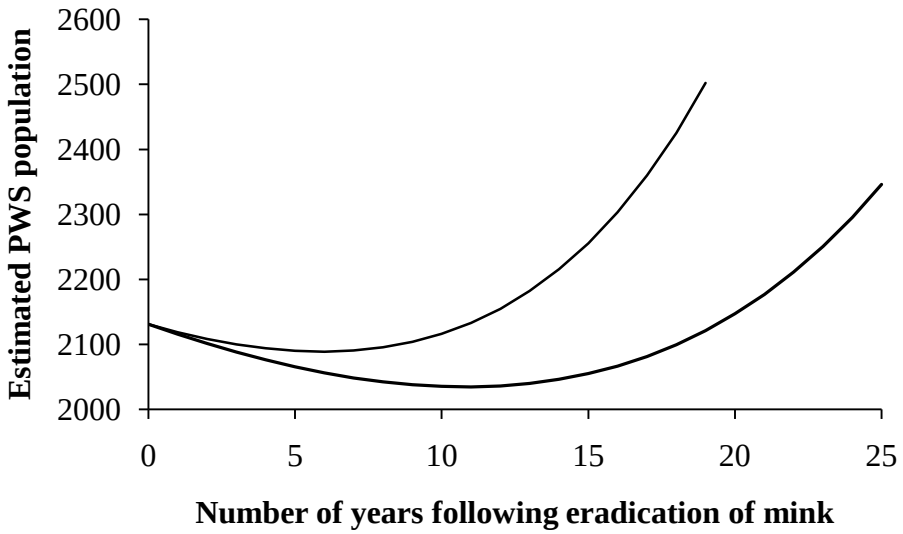

Figure 3. The maximum and minimum estimated Pigeon Guillemot population response in Prince William Sound, Alaska for 25 years after the eradication of American mink at the Naked Island group. The responses are calculated using a Leslie population-projection matrix after Golet et al. (2002). The two estimates are based upon a 16% or 36% increase from the average productivity at the Naked Island group during the late 1990s, when the mink predation rate on guillemot nests was high. Recovery of Pigeon Guillemots in Prince William Sound would occur despite the 1.2% mean decrease per annum in the population elsewhere in the Sound, as documented between 1989 and 2008.

Appendix A

American Mink Introduction to the Naked Island Group in Prince William Sound, Alaska: A Review of the Evidence

Kirsten S. Bixler, Dr. David B. Irons, and Dr. Daniel D. Roby

January 3, 2011

A recent drastic decline in numbers of Pigeon Guillemots (*Cepphus columba*) nesting at the Naked Island group in central Prince William Sound (PWS) is concurrent with the onset of sightings of American mink on the Naked Island group and frequent guillemot nest failures due to mink predation.

- Four islands in central PWS without mink had an average density of 49.4 Pigeon Guillemots/kilometer of shoreline. Four islands in central PWS with mink had an average density of 0.55 Pigeon Guillemots/kilometer of shoreline. Prior to the arrival of mink on the Naked Island group, the average density was 47.8 Pigeon Guillemots/kilometer of shoreline. After mink colonization, the Naked Island group had an average density of 0.96 Pigeon Guillemots/kilometer of shoreline.
- In 1978, no predation of guillemot nests was observed on the Naked Island group.
- By 1998, at least 60% of guillemot nests and 4.5% of breeding adult guillemots on the Naked Island group were depredated by mink.
- The Pigeon Guillemot breeding population at the Naked Island group has declined by more than 90% during the last 15 years, following the arrival of mink; in contrast, the guillemot population at nearby mink-free islands has been stable since 1990.
- Researchers have documented abundant food for guillemots (forage fish) near the Naked Island group.
- In addition to Pigeon Guillemots, several other seabird species show similar recent drastic declines in breeding populations on the Naked Island group. Tufted Puffins (*Fratercula cirrhata*) and Horned Puffins (*F. corniculata*) nest in greatly reduced numbers and are confined to the tallest cliffs. Parakeet Auklets (*Aethia psittacula*) and Arctic Terns (*Sterna paradisaea*) no longer nest at the Naked Island group.

Historical and current distribution of mink in Prince William Sound (PWS) demonstrate that mink are not native to the Naked Island group

- Mink do not naturally occur on isolated islands (> 5 km from the nearest mainland) in PWS (i.e., Montague, Green, Seal, Smith, and Little Smith islands).
- The Naked Island group is similarly isolated (6 km from the nearest island).
- The record for longest natural dispersal distance over open water by mink is 4 km.
- There were no mink found on the Naked Island group during a collecting expedition in 1908.

- No mink or evidence of mink were recorded on the Naked Island group between 1946 and the mid-1990's (see Ed Bilderback's Letter below) and mink were first documented on the Naked Island Group about 17 years ago.
- American mink have been intentionally introduced to isolated islands in PWS (i.e., Montague Island) and undocumented introductions of mink to other isolated islands have occurred in PWS.

Genetic study indicates mink at the Naked Island group were introduced

- Mink at the Naked Island group are descended in part from fur farm stock.
- Observed genetic diversity of mink at the Naked Island group is not consistent with natural colonization during infrequent dispersal events.
- The estimate of initial (founder) population size (about 5 pairs) is much larger than would be expected from a natural colonization event.

Published accounts of the effects of introduced American mink on their prey elsewhere document rapid and drastic declines in numbers of birds after mink introduction and large increases in bird populations following mink eradication

- On islands where mink were introduced, nearly all native species of birds, mammals, and amphibians present on the islands declined due to mink predation.
- Populations of most of these native species increased dramatically following mink removal.
- Eradication of introduced American mink on islands in the Baltic Sea resulted in a population increase of Black Guillemots (*Cepphus grylle*), a close relative of Pigeon Guillemots.

June 17, 2008

To Whom It May Concern:

I trapped mink, river otter, martin and wolverine throughout Prince William Sound from 1946 to 2002. I had a boat and traveled around trapping on the mainland and on most large islands. In the 1940's I noted that there were no mink on Montague, Green, Naked, Storey and Peak islands. There were river otter but no mink or martin. Mink occurred on the mainland and most large islands except for the ones mentioned above. Martin occurred on the mainland, but not on islands. In the 1950's the Alaska Department of Fish and Game introduced farmed mink on Montague Island, after that, I caught mink on Montague. I trapped the Sound every year and I never saw or caught a mink on the Naked Island group until the mid 1990's, when I saw a mink on Peak Island. It is my belief that mink did not naturally occur on Montague, Green, Naked, Storey, or Peak Islands.

Sincerely, Ed E. Bilderback

Ed Bilderback
P.O. Box 536
Cordova Alaska
99574

APPENDIX B

Compliance of Preferred Alternative with Standards Used to Judge Importance of Restoration Under the 1994 *Exxon Valdez* Oil Spill Restoration Plan

This document lists the seven standards used to assess the importance of restoration by the *Exxon Valdez* Oil Spill (EVOS) Trustee Council (*Exxon Valdez* Oil Spill Trustee Council 1994). Following each quoted policy, we provide details on compliance of the preferred alternative for restoration of Pigeon Guillemots (*Cepphus columba*) in Prince William Sound (i.e., eradication of mink at the Naked Island group; Restoration Project 10070853) with that standard.

1. "NATURAL RECOVERY"

There is no evidence that the population of Pigeon Guillemots in Prince William Sound (PWS) is recovering from the EVOS (McKnight et al. 2008, Appendix B). Given the persistent long-term population declines, even in the absence of exposure to residual oil (B. Ballachey, U.S. Geological Survey, pers. comm.), the population is unlikely to recover in the foreseeable future without restoration. Following action under the preferred alternative, we estimate that guillemot population at the Naked Island group would show significant signs of recovery within a decade and the Sound-wide guillemot population would show signs of increase within 15 years (Figure 3). This project provides a unique opportunity for recovery of an injured resource. There are no other restoration options currently available that are likely to be effective in addressing factors limiting recovery of the guillemot population in PWS.

2. "THE VALUE OF AN INJURED RESOURCE TO THE ECOSYSTEM AND TO THE PUBLIC"

The Pigeon Guillemot is neither federally endangered nor threatened, but it now the only marine bird species injured by EVOS that is listed as "not recovering" on the Exxon Valdez Oil Spill Trustee Council's Injured Resources List and has shown no sign of population recovery (*Exxon Valdez* Oil Spill Trustee Council 2009).

The Pigeon Guillemot is an apex predator in PWS, consuming a variety of nearshore demersal and schooling forage fishes. As such, the guillemot has been a sensitive indicator of both residual oil and changes in availability of marine forage fish in PWS (Golet et al. 2002). With its charisma and striking appearance the species contributes to the success of ecotourism, vital to the economy of the Sound.

3. "DURATION OF BENEFITS"

The benefits of the preferred alternative will be recognized indefinitely. The eradication of mink and subsequent monitoring will benefit the survival of both Pigeon Guillemot chicks and adults at the Naked Island group, increasing the viability of the species in the Sound in the face of large-scale environmental change.

4. "TECHNICAL FEASIBILITY"

Success in eradication of mink at the Naked Island group is expected. Due to geographic isolation, immigration by mink to the islands and natural recolonization is unlikely (Nordström and Korpimäki 2004). Methods of mink removal have been developed through several successful eradication campaigns in Europe, where feral American mink have had disastrous effects on native fauna (Bonesi and Palazon 2007). Methods for the lethal capture of mink have been successfully tested at the Naked Island group.

5. "LIKELIHOOD OF SUCCESS"

The best available science indicates that mink predation on guillemot nests and adults is the primary limiting factor for Pigeon Guillemots nesting at the Naked Island group (Appendix B). Further, there are striking declines in the guillemot population at the Naked Island group, where mink are present, and stable guillemot populations at nearby mink-free islands (Smith Island group). This suggests that mink eradication will result in a significant increase in guillemot adult survival, reproductive success, and population size. The effect of the proposed restoration action on the population size of guillemots at the Naked Island group would be readily measurable through periodic shoreline censuses using established protocols.

6. "HARMFUL SIDE EFFECTS"

The methods proposed in the preferred alternative include actions to minimize capture of non-target species. There is no evidence to suggest that restoration of guillemots at the Naked Island group would have a significant negative effect on herring (*Clupea pallasi*) because this fish has never been a large part of the diet of guillemots at this location (Golet et al. 2000). The unintended negative consequence of abrupt and destructive increases in the population of small exotic herbivores or omnivores following invasive carnivore removal (Bergstrom et al. 2009) is not a concern at the Naked Island group because no such exotic species (e.g., rabbits, rats) are present. Because mink at the Naked Island group are descendants in part from fur farm stock, their eradication would not have a negative impact on the Sound-wide population of native mink. Removal of mink from the Naked Island group would not pose a hardship to trappers in PWS because these islands are rarely used for mink harvest (R. Ellis, U. S. Department of Agriculture – Wildlife Services, pers. comm.).

7. "OPERATION AND MAINTENANCE SUPPORT REQUIRED"

Independent operational and maintenance funding will be identified during the competitive bid process.

8. "BENEFIT TO A SINGLE RESOURCE OR MULTIPLE RESOURCES"

The preferred alternative would be implemented specifically to address impacts on Pigeon Guillemots, but may also benefit a suite of seabird species whose breeding populations have declined or been locally extirpated at the Naked Island group including Arctic Terns (*Sterna paradisaea*), Parakeet Auklets (*Aethia psittacula*), Tufted Puffins (*Fratercula cirrhata*), and Horned Puffins (*Fratercula corniculata*) (Oakley and Kuletz 1979, KSB, pers. obs). Mink eradication may also benefit other populations of ground-nesting birds (Ferreras and MacDonald

1999, Clode and MacDonald 2002, Nordström et al. 2002, Nordström et al. 2003, Banks et al. 2008), small mammals, amphibians (Banks et al. 2008), and crustacea (Bonesi and Palazon 2007).

9. "EFFECTS ON HEALTH AND HUMAN SAFETY"

The lethal mink removal methods proposed as part of the preferred alternative are specific to mink and would pose no risk to human health and safety.

10. "CONSISTENCY WITH APPLICABLE LAWS AND POLICIES"

The preferred alternative complies with the mission and policies of the EVOS Restoration Plan as well as the state and federal agencies responsible for the involved resources. Prior to implementation, this plan requires permit approval from responsible agencies (U.S. Forest Service, Alaska Department of Fish and Game).

11. "DUPLICATION"

The proposed action is a unique opportunity for the restoration of Pigeon Guillemots in PWS and does not duplicate other projects.

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APPENDIX C

Compliance of Preferred Alternative with Policies of the 1994 *Exxon Valdez* Oil Spill Restoration Plan

This document lists all 21 restoration policies of the *Exxon Valdez* Oil Spill (EVOS) Trustee Council (*Exxon Valdez* Oil Spill Trustee Council 1994). Following each quoted policy, we provide details on compliance of the preferred alternative for restoration of Pigeon Guillemots (*Cepphus columba*) in Prince William Sound (i.e., eradication of mink at the Naked Island group; Restoration Project 10070853) with that policy.

1. "RESTORATION SHOULD CONTRIBUTE TO A HEALTHY, PRODUCTIVE, AND BIOLOGICALLY DIVERSE ECOSYSTEM WITHIN THE SPILL AREA THAT SUPPORTS THE SERVICES NECESSARY FOR THE PEOPLE WHO LIVE IN THE AREA"

The proposed restoration would occur within the EVOS area at the Naked Island group in PWS. This location is the most important historical breeding site for Pigeon Guillemots in Prince William Sound. Guillemots are a conspicuous and particularly stunning resident of nearshore waters, and thus contribute to ecotourism in Prince William Sound. Eradication of mink at this location is likely to benefit not just the population of Pigeon Guillemots but a variety of locally depressed breeding populations of seabirds including Arctic Terns (*Sterna paradisaea*), Parakeet Auklets (*Aethia psittacula*), Tufted Puffins (*Fratercula cirrhata*), and Horned Puffins (*Fratercula corniculata*) (Oakley and Kuletz 1979, KSB, pers. obs). Mink eradication at the Naked Island group may also benefit additional taxa for which population declines due to predation by invasive mink have been documented in other areas. These taxa include ground-nesting birds (e.g., waterfowl; Ferreras and MacDonald 1999, Clode and MacDonald 2002, Nordström et al. 2002, Nordström et al. 2003, e.g., waterfowl; Banks et al. 2008), small mammals, amphibians (Banks et al. 2008), and crustacea (Bonesi and Palazon 2007).

2. "RESTORATION WILL TAKE AN ECOSYSTEM APPROACH TO BETTER UNDERSTAND WHAT FACTORS CONTROL THE POPULATIONS OF INJURED RESOURCES"

There has been intensive research on the nesting ecology and mechanisms regulating the population of Pigeon Guillemots nesting at the Naked Island group during 15 breeding seasons in the last 30 years. This research has identified three main factors constraining guillemot population recovery following EVOS; 1) exposure to residual oil, 2) availability of preferred prey, and 3) nest predation. The most recent study of Pigeon Guillemot nesting ecology at the Naked Island group concluded that mink predation on guillemot nests and adults is now the primary factor limiting their recovery (Appendix B). A study of mink genetic structure at the Naked Island group and other locales in PWS determined that mink at the Naked Island group are in part descendants of fur farm stock and were most likely introduced to the Naked Island group by humans (Appendix C). The restoration alternatives evaluated as part of this plan were based upon the extensive research previously conducted on Pigeon Guillemots at the Naked

Island group and elsewhere in PWS, and the preferred alternative was selected because it most effectively addressed our understanding of the current primary factor limiting recovery of the Pigeon Guillemot population at the Naked Island group.

3. "RESTORATION ACTIVITIES MAY BE CONSIDERED FOR ANY INJURED RESOURCE OR SERVICE"

The Pigeon Guillemot is the only marine bird species known to have been injured by EVOS that is listed as "not recovering" on the Exxon Valdez Oil Spill Trustee Council's Injured Resources List and has shown no sign of population recovery (*Exxon Valdez* Oil Spill Trustee Council 2009).

4. "RESTORATION WILL FOCUS UPON INJURED RESOURCES AND SERVICES AND WILL EMPHASIZE RESOURCES AND SERVICES THAT HAVE NOT RECOVERED"

The population of Pigeon Guillemots in PWS was injured by EVOS and has declined by more than 90% on the Naked Island group since 1990. Although there is no longer evidence that residual oil from EVOS is having a direct negative effect on Pigeon Guillemots in the Sound (B. Ballachey, U.S. Geological Survey, pers. comm.), the population continues to decline.

5. "RESOURCES AND SERVICES NOT PREVIOUSLY IDENTIFIED AS INJURED MAY BE CONSIDERED FOR RESTORATION IF REASONABLE SCIENTIFIC OR LOCAL KNOWLEDGE OBTAINED SINCE THE SPILL INDICATES A SPILL-RELATED INJURY"

The Pigeon Guillemot in PWS is considered a resource injured by EVOS (*Exxon Valdez* Oil Spill Trustee Council 2009).

6. "PRIORITY WILL BE GIVEN TO RESTORING INJURED RESOURCES AND SERVICES WHICH HAVE ECONOMIC, CULTURAL AND SUBSISTENCE VALUE TO PEOPLE LIVING IN THE OIL SPILL AREA, AS LONG AS THIS IS CONSISTENT WITH OTHER POLICIES"

Although Pigeon Guillemots have little subsistence value, they contribute to the local culture as well as the success of ecotourism in PWS. Guillemots are conspicuous, vocal, and charismatic and thus play a role in the auditory and visual experience of all who frequent the shoreline of PWS.

7. "POSSIBLE NEGATIVE EFFECTS ON RESOURCES OR SERVICES MUST BE ASSESSED IN CONSIDERING RESTORATION PROJECTS"

The preferred alternative includes actions to minimize capture of non-target species (i.e., trap type and use of artificial burrows for trap deployment). There is no evidence to suggest that restoration of guillemots at the Naked Island group would have a significant negative effect on Pacific herring (*Clupea pallasi*). Herring have never been an important part of the diet of guillemots nesting at the Naked Island group (Golet et al. 2000). Mink at the Naked Island group are rarely exploited for their fur (R. Ellis, U.S. Department of Agriculture – Wildlife Services, pers. comm.), and thus a mink eradication project at this location would not pose a hardship to trappers in PWS. Due to fur farm ancestry, the eradication of mink at the Naked Island group would not have a negative impact on the Sound-wide population of native mink. Finally, because there are no small exotic herbivores or

omnivores (e.g., rabbits, rats) at the Naked Island group, there is no concern for abrupt and destructive increases in the population of exotic species following invasive carnivore removal (Bergstrom et al. 2009).

8. "RESTORATION ACTIVITIES WILL OCCUR PRIMARILY WITHIN THE SPILL AREA"

The preferred alternative consists of restoration actions at the Naked Island group located in the EVOS area. In fact, the first shoreline to be oiled following EVOS was the Naked Island group in the center of PWS (Oakley and Kuletz 1996).

9. "PROJECTS DESIGNED TO RESTORE OR ENHANCE AN INJURED SERVICE"

The preferred alternative is the most effective alternative available for increasing the reproductive success and population size of Pigeon Guillemots at the Naked Island group and would facilitate the recovery of this injured resource within PWS. However, the Pigeon Guillemot is not considered an injured service.

10. "COMPETITIVE PROPOSALS FOR RESTORATION PROJECTS WILL BE ENCOURAGED"

The restoration would be conducted by a team chosen through a competitive bid process.

11. "RESTORATION WILL TAKE ADVANTAGE OF COST SHARING OPPORTUNITIES WHERE EFFECTIVE"

Opportunities for cost sharing, especially with the U.S. Fish and Wildlife Service, will be identified during the competitive bid process.

12. "RESTORATION SHOULD BE GUIDED AND REEVALUATED AS INFORMATION IS OBTAINED FROM DAMAGE ASSESSMENT STUDIES AND RESTORATION ACTIONS"

The preferred alternative would use an adaptive management approach. Data collected through trapping (e.g., trapping success, sex of trapped animals), as well as shoreline censuses for Pigeon Guillemots would be reviewed regularly. If there is evidence that the project's objective is not being met, restoration project methods would be modified.

13. "PROPOSED RESTORATION STRATEGIES SHOULD STATE A CLEAR, MEASURABLE AND ACHIEVABLE ENDPOINT"

The restoration action includes eradication of mink at the Naked Island group, which should be achievable within 5 years or less. Continued monitoring, to document the response by the guillemot breeding population and verify the continued absence of mink at the Naked Island group, is recommended.

14. "RESTORATION MUST BE CONDUCTED AS EFFICIENTLY AS POSSIBLE, REFLECTING A REASONABLE BALANCE BETWEEN COSTS AND BENEFITS"

The preferred alternative is the most effective method to elevate the productivity and population size of Pigeon Guillemots nesting at the Naked Island group and facilitate the recovery of the species in PWS. This alternative is less expensive, both economically and in numbers of mink and other guillemot predators sacrificed, compared to culling methods (Courchamp et al. 2003). Other alternatives are either currently unavailable or unlikely to be effective in restoring Pigeon Guillemots.

15. "PRIORITY SHALL BE GIVEN TO STRATEGIES THAT INVOLVE MULTI-DISCIPLINARY, INTERAGENCY, OR COLLABORATIVE PARTNERSHIPS"

The Pigeon Guillemot restoration plan was developed by employees of the U.S. Fish and Wildlife Service, Oregon State University, and U.S. Geological Survey - Oregon Cooperative Fish & Wildlife Research Unit at Oregon State University. In addition, employees of the Museum of Southwestern Biology at the University of New Mexico contributed to the most current research used in the development of this restoration plan.

16. "RESTORATION PROJECTS WILL BE SUBJECT TO OPEN, INDEPENDENT SCIENTIFIC REVIEW BEFORE TRUSTEE COUNCIL APPROVAL"

In addition to the EVOS Trustee Council review, Appendix A, B, and C of this report have or will be subjected to the peer-review process required for M.Sc. thesis defense and/or publication in peer-reviewed scientific journal(s).

17. "PAST PERFORMANCE OF THE PROJECT TEAM SHOULD BE TAKEN INTO CONSIDERATION WHEN MAKING FUNDING DECISIONS ON FUTURE RESTORATION PROJECTS"

The past performance of potential project teams would be reviewed by the Council during the competitive bid process for restoration implementation.

18. "RESTORATION WILL INCLUDE A SYNTHESIS OF FINDINGS AND RESULTS, AND WILL ALSO PROVIDE AN INDICATION OF IMPORTANT REMAINING ISSUES OR GAPS IN KNOWLEDGE"

The preferred alternative would provide new quantitative information on the population response of Pigeon Guillemots within PWS to release from intense predation pressure by mink at the Naked Island group. These results would clarify the importance of predator management for seabirds in PWS and provide important information to seabird managers world-wide. The project team responsible for implementation of the restoration project would adhere to all EVOS Trustee Council reporting requirements.

19. RESTORATION MUST INCLUDE MEANINGFUL PUBLIC PARTICIPATION AT ALL LEVELS - PLANNING, PROJECT DESIGN, IMPLEMENTATION AND REVIEW"

Prior to implementation, the restoration plan would be subject to a public comment period.

20. "RESTORATION MUST REFLECT PUBLIC OWNERSHIP OF THE PROCESS BY TIMELY RELEASE AND REASONABLE ACCESS TO INFORMATION AND DATA"

The project team responsible for implementation would adhere to all EVOS Trustee Council reporting requirements.

21. "GOVERNMENT AGENCIES WILL BE FUNDED ONLY FOR RESTORATION PROJECTS THAT THEY WOULD NOT HAVE CONDUCTED HAD THE SPILL NOT OCCURRED"

There are currently no plans by government agencies to restore the breeding population of Pigeon Guillemots, either on the Naked Island group or within Prince William Sound.

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