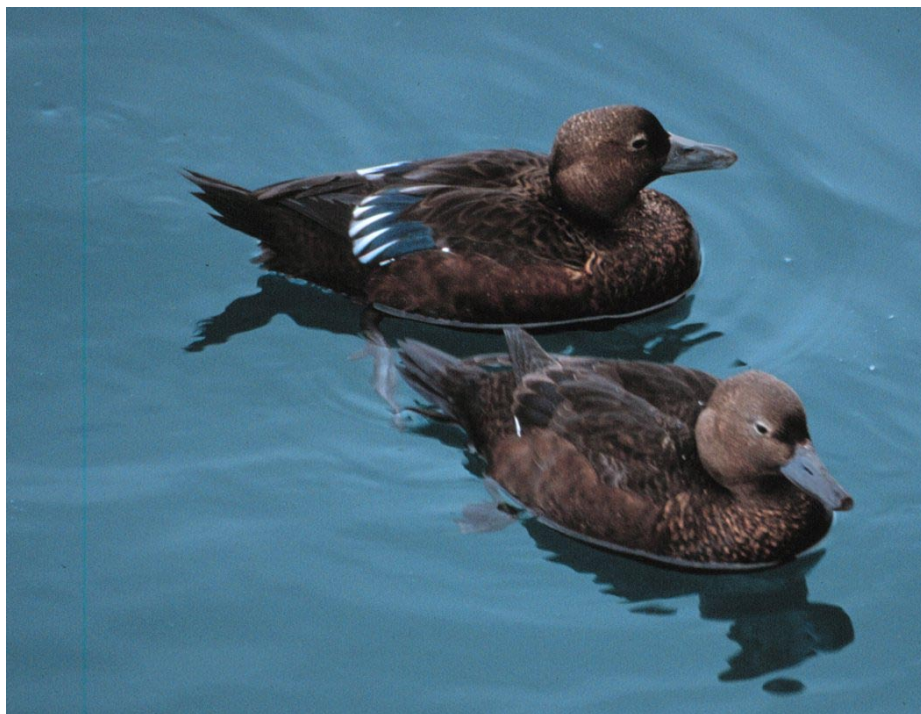


Steller's Eider Recovery Plan

Draft for Public Review



Cover photos of male and female Steller's Eiders by Ted Swem, U.S. Fish and Wildlife Service.

Introduction

The Alaska-breeding population of the Steller's Eider (*Polysticta stelleri*) was listed as threatened under the Endangered Species Act (Act) on June 11, 1997. The decision to list the Alaska-breeding population of Steller's Eiders as threatened was based on a substantial decrease in the species' nesting range in Alaska and the resulting increased vulnerability of the remaining breeding population to extirpation.

This Recovery Plan presents the tasks necessary to recover Alaska-breeding Steller's Eiders and explains the process used to implement these actions. Section I is a brief and general background on the species and its natural history. Section II presents and explains the criteria used in measuring recovery. Section III is an annotated list of recovery tasks that the Fish and Wildlife Service (Service) and the Steller's Eider Recovery Team (Recovery Team) have identified as necessary for recovery of the species. Section IV explains how the Service intends to implement and update this plan. Section V includes appendices that augment information provided in the first four sections.

I. Background

Description

The Steller's Eider is the smallest of four eider species, with both sexes averaging about 800 grams (1.8 pounds) in weight. From fall to mid-summer, adult males are in breeding plumage with a black back, white shoulders and sides, chestnut breast with a dark spot on the side, and a white head with black eye patches and a greenish tuft (Fig. 1). During late summer and fall, males assume a non-breeding plumage that is primarily dark brown

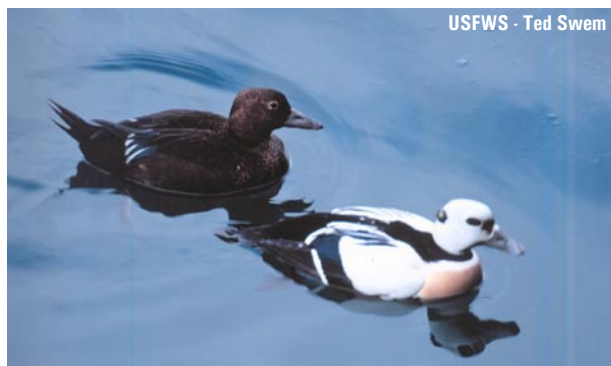


Figure 1. Male (right) and female Steller's Eiders.

except for a white-bordered bluish patch (speculum) on the wing; this plumage is replaced during autumn molt when males reacquire breeding plumage that lasts through the next summer. In contrast, females and juveniles are primarily mottled dark brown throughout the year, although many possess a blue or purplish speculum that frequently is bordered with white on the leading and trailing edges.

Range

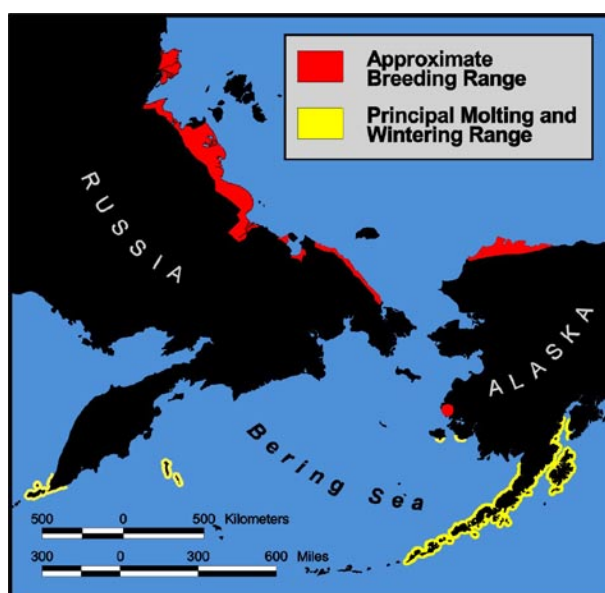


Figure 2. Distribution of the Pacific population of the Steller's Eider.

Three breeding populations of Steller's Eiders are recognized; two in Arctic Russia and one in Alaska (Fig. 2). The majority of Steller's Eiders breed in Russia and are separated into two breeding and wintering distributions (Nygard et al. 1995). The Russian Atlantic population nests west of the mouth of the Khatanga River and winters in the Barents and Baltic seas (not shown in Fig. 1). The Russian Pacific population nests east of the Khatanga River and winters in the southern Bering Sea and northern Pacific Ocean, where it mixes with the Alaska-breeding population. The Alaska-breeding population nests primarily on the North Slope, although a very small subpopulation remains on the Yukon-Kuskokwim Delta. Neither Russian population is listed as threatened or endangered. The Alaska-breeding population is the only population listed under the Endangered Species Act, and this recovery plan pertains exclusively to the

conservation of this population.

Steller's Eiders nest in the terrestrial environment, but they spend the majority of the year in shallow, near-shore marine waters. During autumn molt, winter, and spring migration, the Alaska-breeding population intermixes with the much more numerous Russian Pacific population in the marine waters of southwest Alaska. Because individuals from the two breeding populations are indistinguishable, knowledge of the distribution and ecology of Steller's Eiders in marine waters of southwest Alaska is based on observations of the species as a whole rather than information specific to the listed Alaska-breeding population. As a result, it is unknown whether the Alaska-breeding population concentrates in distinct areas or intermixes with the Russian Pacific population.

Biology



Figure 3. Steller's Eider ducklings, approximately one day old.

Steller's Eiders in Alaska nest on tundra adjacent to small ponds or within drained lake basins, generally near the coast but ranging at least as far as 90 km (56 miles) inland. They nest in a small depression in the vegetation that is lined with a thick bed of down, incubating 1-8 eggs for about 25 days (Quakenbush et al., in review). Young hatch in late June, although many nests are partially or completely depredated during incubation by foxes, ravens, jaegers, or other predators. Shortly after hatching, ducklings are led by females to nearby wetlands to feed on aquatic insects and plants until they are capable of flight at

about 40 days (Obritschkewitsch et al. 2001).

After breeding, Steller's Eiders move to marine waters where they undergo a complete molt, including simultaneous replacement of their flight feathers. Individuals remain flightless for about 3 weeks, but the overall period of flight feather molt for the species lasts from late July until late October, with subadults molting first, followed by adult males and then adult females (Petersen 1981). Steller's Eiders (presumably including members of both the Alaska-breeding and Russian Pacific populations) molt in a number of locations in southwest Alaska, but the largest numbers concentrate in four areas along the north side of the Alaska Peninsula: Izembek Lagoon, Nelson Lagoon, Port Heiden, and Seal Islands (Gill et al. 1981, Petersen 1981, Metzner 1993). Molting areas where large numbers concentrate tend to be characterized by extensive shallow areas with eelgrass (*Zostera marina*) beds and intertidal sand flats and mudflats where Steller's Eiders forage on marine invertebrates such as molluscs and crustaceans (Petersen 1980, 1981; Metzner 1993).

After molting, many Steller's Eiders disperse to the Aleutian Islands, the south side of the Alaska Peninsula, Kodiak Island, and as far east as Cook Inlet, although thousands may remain in the lagoons used for molting unless freezing conditions force them to move to warmer areas. Wintering Steller's Eiders usually occur in waters less than 10 m (30 feet) deep, so are usually found within 400 meters (m) (400 yards) of shore except where shallows extend further offshore in bays and lagoons or near reefs. Prior to spring migration, thousands to tens of thousands of Steller's Eiders stage in estuaries along the north side of the Alaska Peninsula, including several areas used during molt and winter, such as Izembek Lagoon, Nelson Lagoon, Port Heiden, and Seal Islands. From there, they cross Bristol Bay, and it is thought that virtually the entire Alaska-wintering adult population spends days or weeks feeding and resting in northern Kuskokwim Bay and in smaller bays along its perimeter before continuing northward to nesting areas.

Population Status and Distribution

The Alaska-breeding population of Steller's Eiders occurs in two subpopulations: the western Alaska subpopulation and the northern Alaska subpopulation. The status of both subpopulations is inadequately understood due to lack of precise population size estimates and limited historical information for comparison with current estimates.

In northern Alaska, anecdotal historical (pre-1970) records indicate that the species occurred from Wainwright east, nearly to the Alaska-Canada border (Anderson 1913). There are very few

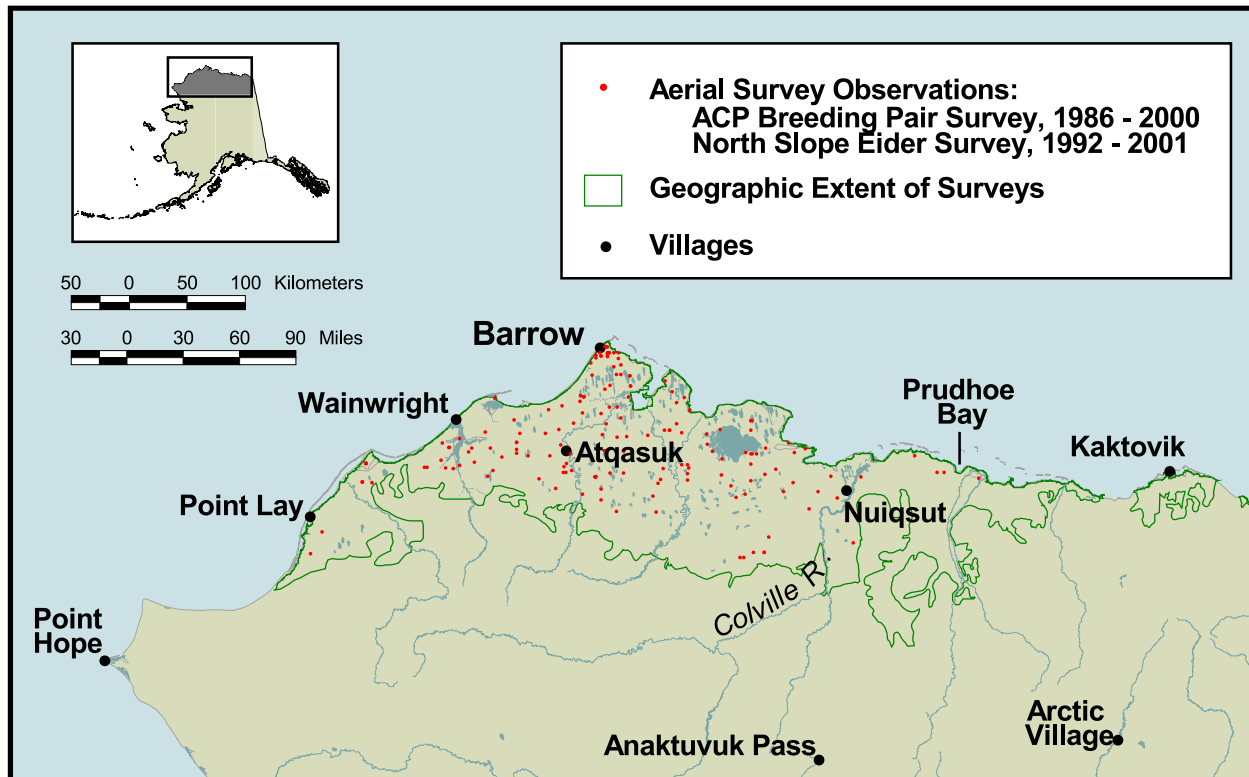


Figure 4. Distribution of Steller's Eider on the Arctic Coastal Plain, northern Alaska. Locations are derived from U.S. Fish and Wildlife Service aerial surveys, and include all "on-transect" observations.

records from the eastern North Slope, however, so it is unknown how abundant the species was or how frequently it occurred there. In recent years, Steller's Eiders have been seen mainly on the western Arctic Coastal Plain, in the northern half of the National Petroleum Reserve-Alaska (NPR-A), and on private land near Barrow. The majority of sightings in the last decade have occurred east of Point Lay, west of Nuiqsut on the Colville River, and within 90 km (56 miles) of the coast. The lack of recent observations on the eastern Arctic Coastal Plain suggests that the species' range may have contracted in northern Alaska in recent decades, but the few available historical observations form a poor basis for quantitative comparison.

Aerial surveys provide the only currently available means of objectively estimating Steller's Eider population size in northern Alaska. Population size point estimates based on annual waterfowl breeding pair surveys from 1989 to 2000 ranged from 281 to 2,543 (Mallek 2001). These surveys likely underestimate actual population size, however, because an unknown proportion of birds are missed when counting from aircraft, and no species-specific correction factor has been developed and applied. Nonetheless, these observations indicate that hundreds or low thousands of Steller's Eiders occur on the North Slope. These surveys do not demonstrate a significant population trend from 1989-2000, although only a dramatic trend would be

statistically significant given the imprecision of the estimates and short sampling interval.

These aerial survey data also provide the best information on distribution of Steller's Eiders in northern Alaska. The observations indicate that Steller's Eiders occur over a vast area, but that density is much greater near Barrow, the northernmost point in Alaska (Fig. 4). All other available information, including other aerial surveys and ground observations, supports the conclusion that the region surrounding Barrow is the core of the Steller's Eider's breeding distribution in northern Alaska, and that this area will be disproportionately important to the survival and recovery of the Alaska-breeding population.

In western Alaska, historical (pre-1970) data suggest that Steller's Eiders formerly nested on the Yukon-Kuskokwim Delta in several locations and at least occasionally at other western Alaska sites, including the Seward Peninsula, St. Lawrence Island, and possibly the eastern Aleutian Islands and Alaska Peninsula. Within the vegetated intertidal zone of the central Yukon-Kuskokwim Delta, the Steller's Eider was considered a "common" breeder in the 1920s (Murie 1924; Brandt 1943). However, the bird was recorded breeding in only a few locations, so it is unknown how widespread and abundant Steller's Eiders were on the Delta (Fig. 5). By the 1960s or 70s, the species had become extremely rare on the

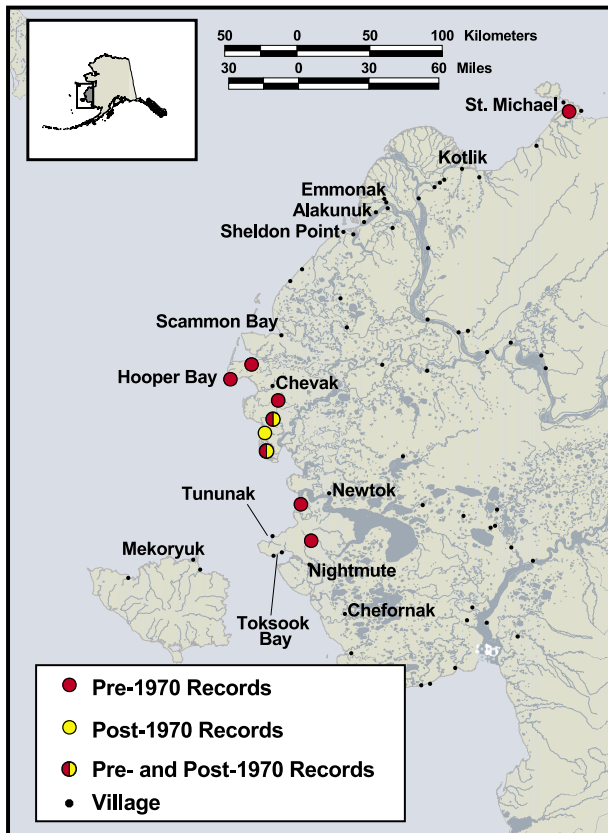


Figure 4. Historical and recent breeding locations for the Steller's Eider on the Yukon-Kuskokwim River Delta, western Alaska.

Delta, and no nests were found from 1975-1994. Six nests were found on the Delta from 1994 to 1998, suggesting that the species may continue to occur there regularly at low densities (Flint and Herzog 1999). No nests have been found elsewhere in western Alaska for several decades.

Threats

When the Alaska-breeding population of the Steller's Eider was listed as threatened, the factor or factors causing the decline was (were) unknown. Factors identified as potential causes of decline in the final rule listing the population as threatened (62 FR 31748) included predation, hunting, ingestion of spent lead shot in wetlands, and changes in the marine environment that could affect Steller's Eider food or other resources. Since listing, other potential threats, such as exposure to oil or other contaminants near fish processing facilities in southwest Alaska, have been identified, but the causes of decline and obstacles to recovery remain poorly understood. A significant number of early recovery tasks, therefore, will involve research to identify threats and evaluate their impacts.

II. Recovery Criteria

Section 4 of the Endangered Species Act provides guidance for evaluating the listing status of species and developing recovery plans. Section 4(a)(1) lists five factors to be considered when determining whether or not species warrant protection under the Act. Once species are listed, Section 4(f) requires that plans are developed to guide recovery, and that recovery plans provide objective, measurable criteria for determining when species have recovered to the point that protection under the Act is no longer needed. To the extent possible, therefore, recovery plans should contain quantitative criteria to evaluate a species' status in light of the five listing factors and other relevant factors such as distribution or abundance. The following discussion provides criteria and threshold levels for reclassifying (i.e., from threatened to endangered) and delisting Steller's Eiders in this context. In this discussion, only the status of the Alaska-breeding population will be considered. Unless otherwise indicated, the term "population" means Steller's Eiders that breed in Alaska, and the term "subpopulation" means a pool of Steller's Eiders that forms a geographic subunit of the Alaska-breeding population (i.e., northern Alaska and western Alaska subpopulations).

Listing Factors

Five listing factors (presented below) are to be considered when determining whether species warrant protection under the Act. When the Alaska breeding population of Steller's Eiders was listed as threatened in 1997, there was little information about these factors as they relate to this species. As discussed in "threats," above, little additional information regarding potential causes of decline and obstacles to recovery of this species has been acquired since the population was listed. At this time, therefore, there is insufficient information to develop objective, measurable criteria to guide evaluation of this species' status relative to the five listing factors. The tasks established in this recovery plan are intended to develop the information necessary to identify and address the issues encompassed by the five listing factors. Objective, measurable criteria to be used in evaluating each factor will be developed, if appropriate, when sufficient information is available. These five factors are discussed below.

(A) the present or threatened destruction, modification, or curtailment of its habitat or range: Destruction or modification of habitat does not appear to have played a major role in the decline of the Alaska-breeding population of the Steller's Eider. However, localized developments in habitats used by eiders may impede recovery. Tasks A, D, E, F, and H outline activities targeting acquisition of

information about habitat-related issues.

(B) overutilization for commercial, recreational, scientific, or educational purposes: There is no information suggesting that overutilization caused the decline of this species or presents an obstacle to recovery. Accordingly, recovery objectives for this factor do not appear to be needed at this time.

(C) disease or predation: Disease does not appear to be a factor affecting the population, but predation may be a significant factor in the decline of this species. Task B identifies several activities to reduce predation of nesting Steller's Eiders. Recovery objectives specific to this factor will be developed as more information becomes available.

(D) the inadequacy of existing regulator mechanisms: Although hunting Steller's Eiders is prohibited under the Migratory Bird Treaty Act, some intentional or unintentional shooting occurs. Task C identifies tasks to reduce hunting/shooting Steller's Eiders. Recovery objectives addressing this issue will be developed as appropriate as these tasks are implemented.

(E) other natural or manmade factors affecting its continued existence: There are likely other factors, in addition to those listed in factors (A)-(D), that

have contributed to the decline of Steller's Eiders in Alaska; however, evidence is lacking at this time. More information is needed to assess the natural or manmade factors that may be affecting this species, and many of the tasks outlined in the recovery plan encompass activities targeting acquisition of this information. Recovery objectives addressing this issue will be developed as appropriate.

Recovery Units

A primary consideration in listing the Alaska-breeding population as threatened was the species' near extirpation as a breeding species from the Yukon-Kuskokwim Delta in western Alaska. This subpopulation must survive or, if extirpated, must be re-established, for the Alaska-breeding population to be considered for delisting. Further, it is believed that the Alaska-breeding population's vulnerability to extirpation would be significantly reduced by the occurrence of viable subpopulations in both northern and western Alaska. However, the northern and western subpopulations occur in widely-separated locations subject to different environmental conditions and threats. As a result, the subpopulations likely will not recover at comparable rates or times, requiring different management prescriptions and possibly reclassification of subpopulations separately. Thus, the range of the



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Figure 6. Male Steller's Eider.

Alaska-breeding population is subdivided into two portions, designated the Northern and Western Recovery Units.

Reclassification Process and Population Model

A recovery plan must identify objective, measurable criteria for determining when delisting or reclassification (e.g., from threatened to endangered) is appropriate. Historical or pre-decline information on population size or other demographic parameters could provide an appropriate basis for these decision thresholds. In the case of the Steller's Eider, however, insufficient historical information is available, so other methods

of developing decision thresholds must be used. Population Viability Analysis (PVA) is a modeling tool that relates demographic parameters such as productivity, survival rates, and population size to the probability of extinction. By setting the probability of extinction and inputting available information on productivity and survival, the model can estimate the corresponding population size. Actual population size estimates, derived from aerial surveys or other means, can then determine when and if the population crosses these thresholds, which would then trigger delisting or reclassification decisions. The delisting and reclassification criteria in this recovery plan relate categories of protection to risk of extinction, with the levels of

Criteria for Reclassifying from Threatened to Endangered

Section 4(a)(1) of the Act lists five factors that must be considered when evaluating the listing status of species: (1) present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) the inadequacy of existing regulatory mechanisms; and (5) other natural or man-made factors affecting its continued existence. The Alaska-breeding population of Steller's Eiders will be considered for reclassification from Threatened to Endangered when these five factors for listing under the Act are under control or being positively managed, and when:

The population has $\geq 20\%$ probability of extinction in the next 100 years for 3 consecutive years;

OR

The population has $\geq 20\%$ probability of extinction in the next 100 years and is decreasing in abundance.

Criteria for Delisting from Threatened Status

The Alaska-breeding population of Steller's Eiders will be considered for delisting from threatened status when the five factors for listing are under control or being positively managed, and when:

The Alaska-breeding population has $\leq 1\%$ probability of extinction in the next 100 years;

AND

Subpopulations in each of the Northern and Western Recovery Units have $\leq 10\%$ probability of extinction in 100 years and are stable or increasing.

Criteria for Delisting Recovery Units Separately

A Recovery Unit (Northern or Western) can be delisted separately when the five factors for listing under the Act are under control or being positively managed, and when:

The recovery unit is stable or increasing and has $\leq 1\%$ probability of extinction in the next 100 years.

In the event that one recovery unit is delisted separately, the second recovery unit can be delisted when the five factors for listing under the Endangered Species Act are under control or being positively managed and when:

The recovery unit has $\leq 10\%$ probability of extinction in 100 years.

extinction risk and corresponding categories of protection determined by the recovery team. The PVA model will be refined as more demographic information becomes available through specific Recovery Plan research tasks. Because the model is integral to measuring the success of recovery efforts, this recovery plan, by necessity, includes specific recovery tasks aimed at acquiring current demographic information needed for accurate population modeling. It is important to note that the model and its output are expected to change as information on the species improves and modeling techniques advance.

Estimated Date for Completion of Recovery

The estimated date for recovery of the Alaska-breeding population of Steller's Eiders is indeterminable at this time for several reasons. First, the cause(s) of the decline are unknown. Second, the obstacles to recovery are unknown or poorly understood. Third, without greater understanding of the threats facing the species, it is impossible to predict how effectively the threats will be eliminated or ameliorated. Fourth, good estimates of population size and trends are lacking, hampering estimation of time for recovery. The recovery date will be estimated in subsequent revisions of this plan as more information becomes available.

III. Recovery Tasks

The ultimate objective of this Recovery Plan is to provide strategies to recover the Alaska-breeding population of Steller's Eiders to the point that protection under the Endangered Species Act is no longer required (i.e., "delisting" is appropriate). Interim objectives are: (1) to prevent further declines of the Alaska-breeding population (including both the northern and western Alaska subpopulations); (2) to protect Alaska-breeding Steller's Eiders and their habitats; (3) to identify and alleviate causes of decline and/or obstacles to recovery; and (4) to determine size, trends, and distribution of the northern and western Alaska-breeding subpopulations.

The recovery tasks described in this section have been identified by the Steller's Eider Recovery Team and/or Service as being high priority actions needed to achieve the ultimate and interim objectives listed above. The tasks are divided into the following 10 categories to facilitate presentation of background information and justification for the tasks:

- A. Reduce exposure to lead
- B. Reduce nest predation

- C. Reduce hunting and shooting mortality
- D. Elucidate distribution and abundance
- E. Acquire information on marine ecology
- F. Acquire information on breeding ecology
- G. Acquire demographic information needed for population modeling efforts
- H. Maintain or re-establish subpopulation on Yukon-Kuskokwim Delta
- I. Develop partnerships for recovery efforts

These categories are not mutually exclusive, and in some cases, tasks are placed into one of several categories that are equally as appropriate. Also note that the categories, and tasks within each category, are not listed in order of relative priority but are listed in the order that most easily facilitates presentation of the background material and justification for the tasks. Appendix A repeats the list of tasks, without the accompanying text, listed in order of their relative priority, as recommended by the Recovery Team in March, 2001. Thus, Appendix A allows the reader to see how tasks are currently prioritized within and among categories.

It is also important to note that many of the tasks focus on actions near the village of Barrow. Although Steller's Eiders occur over an extensive area on the Arctic Coastal Plain, the species occurs at much higher density near Barrow than elsewhere. The comparatively large number of Steller's Eiders nesting there, combined with the area's well-developed road system and research facilities, provide opportunities for study and adaptive management that are likely not possible elsewhere.

A. Reduce exposure to lead

Exposure of waterfowl to lead has been documented in the range of the Alaska-breeding population of Steller's Eiders. Elevated blood and tissue lead levels, morbidity, and mortality from lead poisoning were found in Spectacled and Common Eiders (*Somateria fischeri* and *S. mollissima*, respectively) on the Yukon-Kuskokwim Delta (Franson et al. 1995, Flint et al. 1997, Flint and Herzog 1999). On the breeding grounds near Barrow, one Steller's Eider found dead in June had liver and kidney lead concentrations suggestive of lead poisoning (Trust et al. 1997), although several other Steller's Eiders examined at the same time of year had lower lead tissue concentrations (U.S. Fish and Wildlife Service, unpubl. data). Blood samples from nesting hens trapped near Barrow in 1999 and 2000 showed that all (8 of 8) had concentrations exceeding the clinical threshold for lead exposure and nearly all (7 of 8) exceeded

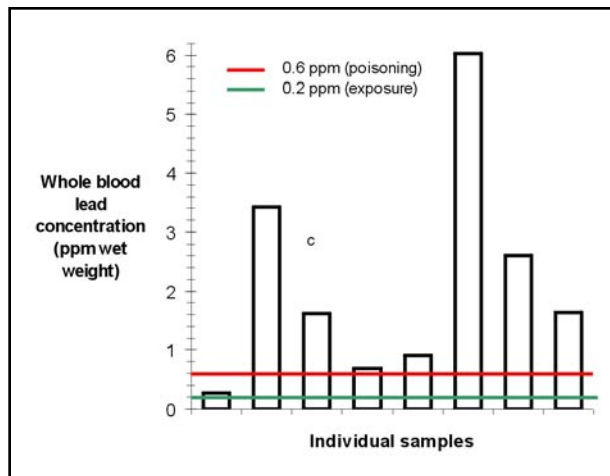


Figure 7. Whole blood lead concentration (ppm ww) in eight nestling female Steller's Eiders near Barrow, Alaska, 1999

the threshold for lead poisoning (Fig. 7). If the source of lead is on the breeding grounds, exposure to lead is expected to be greatest and to increase over the breeding season for nesting hens and young, which stay on the breeding grounds the longest (Flint et al. 1997). Because waterfowl are primarily exposed to lead by ingesting shot, and because lead shot has been widely used for decades by subsistence hunters on the Yukon-Kuskokwim Delta and near Barrow, ingestion of lead shot is the probable route of exposure for breeding Steller's Eiders.

Task A-1. Continue steel shot information and Education (I & E)

Lead shot is banned for waterfowl hunting in the U.S., but is legal for upland game birds. In other areas of the country, where wetland and upland habitats are distinct, this ban has resulted in reduced lead poisoning of waterfowl (Samuel and Bowers 2000). In Northern Alaska, however, wetlands and upland habitats are interspersed. Therefore, legal upland game bird hunting (e.g. for Ptarmigan, *Lagopus* spp.) can result in introduction of lead shot to wetlands. Further, the familiarity and relatively low cost of lead shot compared to non-toxic shot compel many shooters to continue to use lead, even illegally. Steel shot clinics began in 1998, and other proposed activities include exchanges of steel for lead shot shells, buy-backs of lead shot shells, and other I & E efforts to inform vendors and hunters of the risks of lead shot and benefits of non-toxic alternatives.

Task A-2: Screen the Alaska-breeding population for lead exposure, including temporal and spatial variation

Assessing the exposure and effects of lead on Steller's Eiders is necessary to understand

impacts on Steller's Eider populations. Exposure assessment includes evaluating the type and geographic distribution of lead and the propensity for Steller's Eiders to ingest available sources. Although ingestion of lead is thought to take place primarily on the breeding grounds, exposure in marine molting and wintering areas has not been definitively excluded. Many molting Steller's Eiders trapped on the Alaskan Peninsula had low blood lead concentrations, but a few samples approached clinical thresholds for exposure (USGS, unpubl. data). Preliminary data from nesting hens indicate that lead exposure may be a significant problem for Steller's Eiders breeding near Barrow, a large community with many hunters. The geographical extent of the problem is unknown, however. Further, exposure may be proportional to residence time on the breeding grounds, leading to differential effects on females and young. For example, lead poisoning accounted for 40-60% of mortality of female Spectacled Eiders during brood rearing on the Yukon-Kuskokwim Delta (Flint and Grand 1997). Lead screening throughout the breeding areas, and between breeding and molting areas (which are separate in time and space), may help identify sources of lead exposure by addressing geographical and temporal variation. On a longer time scale, continued sampling may document decreasing lead exposure from declining use of lead shot, as it has elsewhere in North America.

Task A-3: Assess effects of lead exposure on Steller's Eiders

Lead poisoning effects in wild birds may include mortality or sub-lethal effects such as reproductive impairment. Thresholds and physiological responses to lead poisoning have been established using laboratory and field data for some waterfowl species, although not for seabirds. Dose-response studies would enhance understanding of species-specific individual- and population-level impacts. To do so, however, would require sacrifice of captive Steller's Eiders, using wild-trapped or captive-reared birds. Because the techniques and facilities for maintaining captive Steller's Eiders have not been developed, dose-response studies will not be possible in the immediate future. As captive flocks are developed, research and management actions involving their use will need to be prioritized. It is premature at this point, therefore, to predict when these studies will be implemented.

Task A-4. Evaluate grit selection criteria of Steller's Eiders

The propensity of waterfowl to ingest shot is affected by feeding behavior and diet. Waterfowl

that normally feed on hard grains or seeds ingest grit as a digestion aid, and lead shot fragments may be selectively consumed as grit. Birds may also accidentally consume shot by mistaking it for food, or with ingestion of other food items in sediments (Locke and Thomas 1996). Breeding Steller's Eiders consume insect larvae found in freshwater tundra ponds, including midge (Chironomidae) and caddisfly (Trichoptera) larvae (Quakenbush et al. 1995). Plant matter is also eaten by juveniles and breeding adults. Although larvae may have a keratinaceous carapace or hard case, digestion of these may not require the grit that hard grains do. The high protein content in insect larvae and plant materials in breeding Steller's Eider diets may also provide relative protection. However, more information is needed on diet and the use of grit by breeding Steller's Eiders.

Task A-5. Assess management options regarding lead-contaminated habitats, such as habitat sampling or grit broadcast

Developing management options for reducing ingestion of lead shot first requires defining the extent of the problem. This can be accomplished by sampling birds (Tasks A-2 and A-3), or sampling sediments for lead shot, although research in western Alaska showed that detecting lead shot in sediments may be very ineffective (P. Flint, U.S.G.S., pers. comm). Grit broadcasts, which would ostensibly saturate feeding areas with alternate grit to reduce selection of lead shot, assumes that lead shot are ingested for use as grit; this has not yet been established for Steller's Eiders. Also, broadcasting grit could have unintended effects. For example, broadcast of oyster shell grit would introduce large amounts of calcium carbonate into tundra ponds, which are slightly acidic near Barrow (Kalf 1968), possibly disrupting normal nutrient dynamics. Gravel has also been used in grit broadcast efforts, but mallards with access to excess grit passed lead pellets faster; but with more erosion, than birds that did not have excess grit (Sanderson and Irwin 1976, cited in Sanderson and Bellrose 1995). Thus, developing a greater understanding of the management options for reducing lead shot ingestion and their potential efficacy is warranted.

B. Reduce predation of nesting Steller's Eiders

Numerous studies have shown that predation is an important cause of nest failure in waterfowl. In extreme cases, nest predation can seriously limit waterfowl production and even cause population declines. For example, on the Yukon-Kuskokwim Delta, nest predation was considered

a factor contributing to the decline of Brant populations (*Branta bernicla*; Raveling 1989). Kertell (1991) hypothesized that changes in predation pressure, possibly caused by population declines in alternate prey, may have contributed to the near-disappearance of Steller's Eiders from the Yukon-Kuskokwim Delta.

In recent years, concern has been raised that human actions may have disrupted normal predator-prey relationships in Alaska by providing nesting sites for Common Ravens (*Corvus corax*), which can allow them to breed in otherwise unsuitable areas, and by providing food sources for avian and mammalian predators, such as ravens, gulls, and foxes, which can affect their distribution and abundance by increasing fecundity and survival. The degree to which predator populations have been enhanced by anthropogenic factors is unquantified, but the fact that foxes, gulls, and ravens congregate at refuse dumps and storage facilities at villages and oil field facilities is well documented. Additionally, Common Ravens, which are effective predators at bird nests in some situations, have expanded their range northward to the arctic coast in recent decades, nesting on human structures where their natural nesting sites on cliffs are absent. In northern Alaska, ravens now nest on human-made structures at most or all coastal villages and remote military radar sites, and at many oil field facilities (Day 1998).

There is very little information on predation of Steller's Eider nests throughout most of the species' range in Alaska. Near Barrow, however, nest success in recent years has been very poor. Of 186 nests found from 1991-2000, only 15-18% survived until hatching, with predation thought to be the primary factor causing nest failures (Quakenbush et al. 1995, Obritschkewitsch et al. 2001). In addition to causing complete nest failures during incubation, predators at Barrow further reduced productivity through partial predation (where some but not all eggs in a nest were taken) and by killing ducklings that survived the incubation period (Quakenbush et al. in prep.). Available data are insufficient to identify which predator species are having the greatest impacts, but known or potential predators of Steller's Eiders and their nests in northern Alaska include Arctic Foxes (*Alopex lagopus*), Red Foxes (*Vulpes vulpes*), Pomarine Jaegers (*Stercorarius pomarinus*), Parasitic Jaegers (*S. parasiticus*), Snowy Owls (*Nyctea scandiaca*), Common Ravens, and Glaucous Gulls (*Larus hyperboreus*), as well as several other less-common species. In western Alaska, additional potential predators include Mew Gulls (*Larus canus*) and mink (*Mustela vison*).

Objectives in regard to reducing predation of nesting Steller's Eiders include: 1) field studies to quantify rates of predation and identify which predator species are having the greatest impacts on productivity; and 2) management actions to control predators, including efforts to eliminate sources of food and nesting sites of predators, and efforts to directly reduce predator numbers through hunting, trapping, and interfering with reproduction.

Task B-1. Determine which predators are responsible for nest predation at Barrow

Predation is thought to be the primary factor causing most Steller's Eider nest failures near Barrow (Quakenbush et al. 1995, Obritschkewitsch et al. 2001). Management actions to reduce predation may be required, but the cost and difficulty of implementing some options, combined with public sensitivity to predator control, requires an accurate assessment of which predator species are affecting nest success. Preliminary tests of remote video technology have been made, and further tests will determine if video observations, direct observations, or other methods at nest sites will provide the best tool to study nest predation.

Task B-2. Reduce the availability of artificial food sources to predators at Barrow

Predator control efforts can be expensive, ineffective, and controversial with some sectors of the public. Therefore, efforts to reduce predation should be preceded or accompanied by actions to eliminate artificial food sources which may create or exacerbate predation problems. Accordingly, reducing or eliminating access by Glaucous Gulls, Arctic Foxes, and possibly Common Ravens to artificial food sources such as the village landfill is an important recovery action. However, given the size of the landfill and the difficulty of preventing access to both avian and mammalian predators, the strategies necessary to implement this action will require extensive coordination with local officials and possibly experimentation.

Task B-3. Implement raven control at Barrow

The northern limit of the Common Raven's historical nesting distribution in northern Alaska was presumably determined by the availability of cliffs for nesting (Johnson and Herter 1989). At Barrow, where Common Ravens were historically considered "stragglers" (Pitelka 1974), a single pair became resident by 1986 (B. J. McCaffery, pers. comm.) and began breeding on human-built structures in 1991 (R. Suydam pers. comm.). Although predation at Steller's Eider nests

has rarely been witnessed, a raven was seen removing five eggs from two Steller's Eider nests in 1991. Because the occurrence of ravens at Barrow depends on the use of human-constructed structures for nesting, they are considered an "unnatural" predator and eliminating depredation of Steller's Eider eggs and nests by ravens is considered a high priority recovery action. This may be accomplished by destroying raven eggs, young, or adults.

Task B-4. Implement fox control at Barrow

Arctic Foxes are important predators of ground-nesting birds, particularly waterfowl, during the nesting season (see Day 1998). Impacts to productivity can be extreme in some cases; for example, Anthony et al. (1991) estimated that foxes depredated > 90% of brant eggs during incubation. The population-level effects of human activities on fox numbers have not been studied, but it is well-documented that foxes congregate near human population centers where food is available at dumps and other sources. In the past, the effects of anthropogenic food sources on fox distribution and abundance may have been ameliorated to some degree near villages by increases in trapping. In recent years, however, trapping by villagers has declined with falling fur prices, and this has correlated with an increase in fox numbers at Barrow, according to Native elders. Therefore, it is expected that Steller's Eider nest success will increase if Arctic Fox numbers are reduced at Barrow. Methods to reduce fox numbers have not been developed, but may include subsidized trapping by village residents.

C. Eliminate hunting and shooting mortality of Steller's Eiders

Prior to 1991, a few dozen Steller's Eiders were taken annually by collectors and sport waterfowl hunters on the Alaska Peninsula and Kodiak and Nunivak islands (Robin West, pers. comm., 1991; Metzner 1993). In response to concern for the status of Steller's Eiders, sport hunting for the species was closed in 1991 by Alaska State regulations and Service policy. A few may be still be shot accidentally or illegally by sport hunters, but the number taken, although unknown, is likely very small.

Subsistence hunting of waterfowl, like sport hunting, is regulated at the Federal level under the authority of the Migratory Bird Treaty Act (MBTA). Until recently, the MBTA prohibited the hunting of waterfowl from 10 March to 1 September. In Alaska, however, the Service recognized the importance of subsistence hunting

to Native people and cultures and implemented selective non-enforcement of closed-season hunting to accommodate traditional use of waterfowl by subsistence hunters. Starting in 1994, the Service included Steller's Eiders on the closed season species list, meaning that restrictions on taking Steller's Eiders during all seasons would be enforced as violations of the MBTA. Recent amendments to the MBTA will result in the development of regulations that govern waterfowl hunting during spring and summer by subsistence hunters in Alaska, but hunting of Steller's Eiders will continue to be prohibited under the new regulations. It should be noted that, under the Endangered Species Act, hunting endangered and threatened species for subsistence purposes by permanent residents of Alaska villages is permissible under certain circumstances (section 10(e)). All hunting of Steller's Eiders, however, remains prohibited under the MBTA.

Available information, which includes published reports from surveys of subsistence hunters and anecdotal observations of field biologists, indicates that hunters continue to shoot Steller's Eiders in northern and western Alaska. Meeting the first recovery objective for Steller's Eiders, which is to protect and maintain existing subpopulations, requires that mortality, particularly that of breeding adults, is reduced to the extent possible. Efforts to reduce mortality should first focus on sources that are human-caused, as these are likely to be more easily addressed. Recovery efforts will include gathering information on the extent and geographic variation of hunting/shooting mortality, outreach efforts to educate hunters about the illegality of hunting Steller's Eiders, and law enforcement.

Task C-1. Summarize available information on subsistence harvest on the North Slope and at Kotzebue

The number of Steller's Eiders currently harvested by subsistence hunters is poorly known. Based on surveys of hunters, an estimated 313 Steller's Eiders were taken by hunters annually in the early 1990s in northern and western Alaska, with about 47% harvested on the North Slope (Amy Paige, Alaska Dept. of Fish and Game, pers. comm.). Four Steller's Eiders were taken in 1994 or 1995 in the Bering Strait region, which includes coastal villages of Norton Sound, the Seward Peninsula, and St. Lawrence, Diomed and King islands (Paige et al. 1996). In the Northwest Arctic region, which includes the coastal regions of Kotzebue Sound, the Selawik, Noatak, and Kobuk river drainages, and the arctic coast north to Kivalina, 115 Steller's Eiders were reportedly taken in 1997, all by hunters

from Kotzebue (Georgette 2000). The accuracy of these estimates is questionable, however, due to possible confusion over species identification and the relative unimportance of the species as a subsistence resource, which means estimates are extrapolated from very few reports of Steller's Eider being taken (C. Wentworth, U.S. Fish and Wildlife Service, pers. comm.). Additionally, these estimates do not reflect possible reduction in harvest prompted by recent outreach efforts. Current information from northwest Alaska and North Slope villages is needed to best guide efforts to reduce subsistence harvest. Efforts will first focus on summarizing available published and unpublished survey results. If adequate survey data are unavailable, existing surveys should be modified or new surveys developed and conducted.

Task C-2. Eliminate hunting and shooting mortality

Surveys in the 1990s indicated that hundreds of Steller's Eiders were harvested annually by subsistence hunters in northern and western Alaska (Paige et al. 1996, Georgette 2000, Wentworth 2001). Additionally, for reasons that are not clear, Steller's Eiders are occasionally shot but not harvested at Barrow (7 incidents documented from 1991 to 2001). Since 1994, the Service has conducted outreach efforts to inform hunters in villages that Steller's Eiders are threatened and that hunting them is prohibited. However, these efforts have undoubtedly not reached all residents of even the most frequently visited villages. Therefore, continued efforts to educate hunters are needed. Outreach efforts will include visits by Service and local officials to villages to contact hunters, dissemination of printed materials on Steller's Eiders, involving local residents in contacting hunters, and law enforcement.

D. Distribution and Abundance

Current and accurate information on Steller's Eider's distribution and abundance in Alaska is needed to evaluate the species' status and population trends, prioritize recovery actions, and evaluate the success of recovery tasks. Potential recovery tasks include the continuation and/or modification of existing waterfowl or Eider surveys, evaluating the efficacy of existing surveys, and analyzing existing data.

Task D-1. Continue existing aerial Breeding Pair Survey on Arctic Coastal Plain

Aerial Breeding Pair Surveys for waterfowl have been conducted annually on the Arctic Coastal Plain since 1984. This survey, which

samples an area of about 63,000 km² (~24,600 miles²) encompassing all contiguous waterbird habitat on the Arctic Coastal Plain, provides the least biased means of estimating abundance and depicting distribution currently available. Because alternate methods which improve on the Breeding Pair survey have not been developed or funded, continuing this ongoing survey is important for monitoring population trends.

Task D-2. Evaluate efficacy of applying North Slope Eider Survey data to Steller's Eiders

The North Slope Eider Survey is designed to assess population trends and breeding distribution for the Spectacled and King Eider (*Somateria spectabilis*) on the Arctic Coastal Plain. The Eider Breeding Population Survey is about 2 weeks earlier than the Waterfowl Breeding Pair Survey (Eider Survey occurs ~10-20 June vs. Breeding Pair Survey which occurs ~29 June-6 July) and survey coverage is about twice as great (Eider Survey covers ~4% of the survey area each year vs. ~2% for Breeding Pair Survey). In most years, fewer Steller's Eiders are detected during the Eider Breeding Population Survey than the later Breeding Pair Survey, which is counterintuitive, given that the Eider Survey provides more intensive survey coverage and given that breeding phenology at Barrow suggests the Eider Survey is more appropriately timed to maximize sightings of paired Steller's Eiders. Therefore, the methodology and results of the North Slope Eider Survey must be evaluated for the purposes of addressing Steller's Eider distribution and abundance. This task, which consists primarily of data analysis and presentation, may result in recommendations for modification of the survey or development of a new survey(s) specific to Steller's Eiders.

Task D-3. Determine visibility correction factor

Aerial waterfowl surveys do not detect all waterfowl present in a sample area, and this compromises the accuracy of population size estimates based on aerial surveys. By measuring the proportion of Steller's Eiders in the sample area that are detected during aerial surveys, visibility correction factors can be developed and applied to population size estimates. Visibility correction factors are species- and habitat-specific, and are unknown for the Steller's Eider in northern or western Alaska. Determining a visibility correction factor, along with an associated variance, is needed if aerial surveys are to provide an accurate means of counting Steller's Eiders in Alaska.

Task D-4. Determine breeding status elsewhere than Barrow

Aerial waterfowl surveys indicate that Steller's Eiders occur over an extensive area on the Arctic Coastal Plain. In recent decades, however, there have been very few observations of Steller's Eider nests or young other than in the vicinity of Barrow. This has caused speculation that Steller's Eiders may nest primarily near Barrow and sightings elsewhere correspond mainly to non-breeders or birds that dispersed following failed nesting attempts near Barrow. Understanding the actual breeding distribution of the species is needed for estimating effective population size and focusing recovery tasks appropriately. Effective methodologies have not been developed and may require experimentation, but ground searches for nests at sites where Steller's Eiders are detected during aerial surveys will likely be required.

Task D-5. Determine feasibility of monitoring population size with migration counts along the Chukchi Sea coast

Aerial Breeding Pair Surveys currently provide the best method available for estimating Steller's Eider population size in northern Alaska. However, the low density of Steller's Eiders on the Arctic Coastal Plain and low survey coverage result in few Steller's Eider sightings and imprecise population size estimates. Further, it is unknown if annual variation in population size estimates (range 281-2,543 from 1989 to 2000) reflects actual variation in population size or sampling error. Therefore, an alternate method of estimating population size in northern Alaska that will improve or corroborate existing methods is needed. One method that warrants experimentation is shore-based counts of migrants passing along the Chukchi Sea coast. Methods and possible locations have not yet been identified.

Task D-6. Evaluate existing spring migration survey data

Banding and radio-telemetry data indicate that the Pacific-wintering population of Steller's Eiders includes members of the Russia-Pacific breeding population and Alaska-breeding population. Annual spring aerial surveys have been conducted in six years between 1992 and 2000 to assess the population status of Pacific-wintering Steller's Eiders as they migrate northward in southwest Alaska. Peak population estimates, which represent the highest count from up to 3 replicate surveys each year, ranged from 72,953 to 137,904 (uncorrected for visibility), and showed an average annual decline of 6.1% (Larned 2001). Although the majority of Steller's Eiders counted during this

survey are not from the listed Alaska-breeding population, trends in the Pacific-wintering population may portend trends in the Alaska-breeding population. Additionally, should trends in the Pacific-wintering and Alaska-breeding populations eventually prove to be different, this may help isolate and identify threats affecting the listed population. The indicated decline in this population further reinforces interest in continuing the spring migration survey. Thus, a thorough evaluation of existing survey data, the benefit of multiple replicates, and potential for using photographs of flocks to adjust for observer bias, need to be evaluated.

E. Marine Ecology

Steller's Eiders spend the majority of the year in the marine environment where they are exposed to a variety of natural and human-caused factors that may affect survival and fecundity. Current understanding of the marine ecology of Steller's Eiders is limited and this constrains identification of threats and development of actions to reduce threats. Further, during migration, molt, and winter, members of the listed Alaska-breeding population are indistinguishable from individuals from the more-abundant Russia-Pacific breeding population. Population-specific differences in distribution or ecology, which may be important in identifying or ameliorating threats, have not been identified. Potential recovery tasks in marine areas include filling information gaps on distribution and basic marine ecology, assessing potential threats, and reducing impacts of known threats.

Task E-1. Delineate the non-breeding distribution of the Alaska-breeding population

The distribution of the Alaska-breeding population of Steller's Eiders during the non-



Figure 8. Male Steller's Eider with a surgically-implanted satellite transmitter. The antenna is visible.

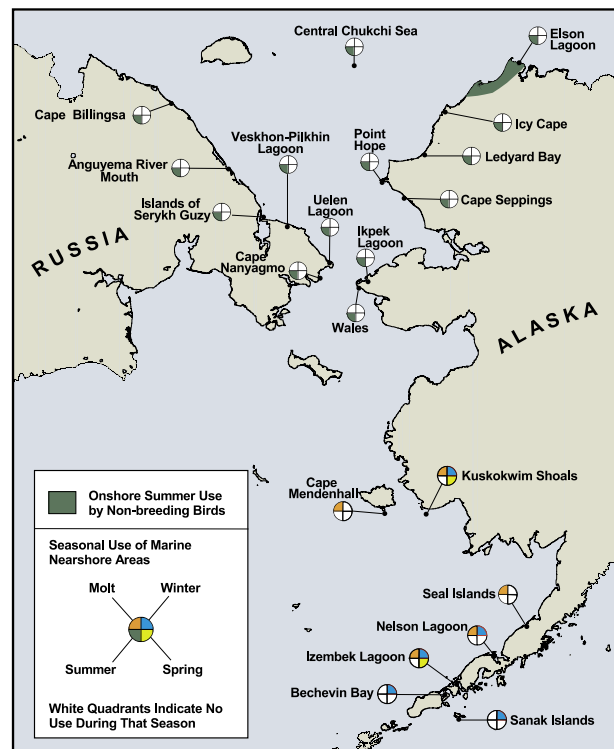


Figure 9. Distribution of Alaska-breeding Steller's eider during the non-breeding season, obtained from birds implanted with satellite telemetry devices at Barrow, Alaska, June 2000 and June 2001. Marked locations include all those at which a bird remained for at least three days. Three birds were instrumented in 2000, ten in 2001. Thus, winter and spring locations for the majority of birds were not yet available for this figure.

breeding season is poorly understood for two reasons. First, much of the marine distribution of the Steller's Eider in southwest Alaska has been inadequately surveyed. Repeated surveys have been conducted during molt and winter in notable concentration sites such as Izembek and Nelson lagoons, and to a lesser extent, in other nearby areas on the Alaska Peninsula. Most other marine areas used by Steller's Eiders have been surveyed a limited number of times, only during fall and spring, or have never been surveyed (such as large portions of the Kodiak Archipelago). Thus, our understanding of distribution and how it varies within and among years is poor for large portions of the species' non-breeding range. Second, it is currently unknown if the Alaska-breeding population concentrates in distinct areas in the non-breeding season or disperses throughout the species' broad marine range. Knowing where the listed population occurs in the marine environment will be valuable in identifying and addressing threats.

Until recently, recoveries of banded birds provided the only available information on movements of individual Steller's Eiders.

Steller's Eiders banded during molt at Izembek and Nelson Lagoons have been found during the breeding season near Barrow as well as in a number of locations in Russia (Jones 1965; Dau et al. 2000; Service, U.S. Geological Survey, and North Slope Borough, unpubl. data). Recent developments in satellite telemetry technology have allowed individual birds to be tracked continuously for months, providing data for approximately one year after capture. Adults implanted with transmitters at Barrow in 2000 and 2001 have provided information on migratory routes, staging areas, molting areas, and wintering areas of individual birds (Fig. 9). This study will continue if deemed appropriate by the Recovery Team, with desired sample size to be determined through periodic re-evaluation of results.

Task E-2. Conduct surveys from Nunivak Island to Bechevin Bay during molt to determine long-term changes in the distribution of molting Steller's Eiders

Most of the Pacific-wintering population of Steller's Eiders were found molting in a series of bays, lagoons, and protected waters in southwest Alaska from Nunivak Island to the western end of the Alaska Peninsula (Petersen 1981, Dau pers. comm.) during the 1970s. Because recent banding studies show that Steller's Eiders demonstrate high fidelity to molting areas (Flint et al. 2000), long-term shifts in molting distribution are unlikely to be a result of annual movements among molting areas. If shifts in molting distribution occur, therefore, they may indicate changes in habitat quality and suggest the need to manage these areas differently for birds during the molt. Extensive aerial surveys to census Steller's Eiders at molting concentration sites would help determine if long-term changes in molting distribution are occurring. Survey methodology will be developed as needed.

Task E-3. Assess exposure to and effects of contaminants in the marine environment

Understanding impacts of contaminants to Steller's eiders in the marine environment requires establishing plausible exposure pathways, evaluation of potential effects, documentation of exposure, and investigation of effects on individuals and populations.

A significant proportion of the world's population of Steller's eiders winter in shallow, near-shore waters from the eastern Aleutian Islands to southern Cook Inlet in Alaska, where they may be exposed to petroleum and other contaminants. Harbors and bays (eg. Akutan, Sand Point, Unalaska Bay, King Cove, and

Cold Bay), and areas with proposed harbors or harbor expansions, have substantial current or potential maritime traffic and large numbers of wintering Steller's eiders (Larned 2000). Steller's eiders have been observed roosting and feeding in near-shore waters near industrial activity and amid ship traffic at Dutch Harbor and Sand Point, Alaska by USFWS and USGS biologists. These observations are consistent with those of the selected habitat of wintering Steller's eiders in Europe (Fox and Mitchel 1997, Bustnes and Systad 2001, Systad and Bustnes 2001). Conservative estimates indicate that at least 18,000 gallons of petroleum products were spilled from activities associated with the commercial fishing/seafood processing industry from 1995 - 2000, and that at least 4,800 gallons of petroleum products will be spilled annually in harbors in southwest Alaska (Day and Pritchard 2000). Seventy-four percent (3,550 gallons) of the petroleum is expected to be spilled at Dutch Harbor, near where hundreds of Steller's eiders winter (Larned 2000). Other contaminants found in industrial marine wastes, such organochlorine pesticides and polychlorinated biphenyls (PCBs), may occur in or near Steller's eider wintering areas. Thus, it is plausible that Steller's eiders associated with near-shore waters influenced by industrial marine activity are being exposed to petroleum and other organic contaminants.

Linking exposure and effects is difficult in wild populations, but petroleum-based hydrocarbons from boating or fishing activities and accidental oil spills affected or killed Steller's eiders in Norwegian harbors (Fox et al. 1997).

Additionally, recent studies in sea ducks have documented links between petroleum exposure and chromosomal damage (Custer et al. 2000) and reduced productivity (Trust et al. 2000). The Service and USGS-BRD initiated a cooperative study on individual birds captured near industrial harbors in the Aleutians. The study measured exposure (contaminant concentrations in Steller's eiders and their prey) and specific physiological responses indicative of exposure and possible effects. Moreover, in the summer of 2002, the Service and the U.S. Army Corps of Engineers will conduct a pilot study using devices to measure organic contaminant concentrations in the waters near active harbors. Results from these projects will be used to focus future investigations on exposure pathways and contaminant effects.

Task E-4. Document the diet of Steller's Eiders in southwest Alaskan waters

Understanding the diet of Steller's Eiders in the marine waters of southwest Alaska is essential to identifying food-based threats. For

example, certain species of shellfish accumulate toxic components of petroleum, and their predators may be exposed to higher levels than suggested by routine environmental sampling of sediments or water. Preliminary data on diet are available from several studies in southwest Alaska (Petersen 1980, 1981; Troy and Johnson 1989; Metzner 1993), but the data are limited in geographic scope. Thus, site-specific knowledge of diet in areas of industrial development is needed to evaluate impacts of seafood processing effluent and petroleum contamination on the availability and quality of food.

Task E-5. Study foraging ecology in relation to fish processing facilities

The association between Steller's Eiders and harbors with seafood processing facilities suggests that Steller's Eiders may be drawn to these areas. If so, the likely attractant is the discharged seafood waste, which may be fed upon directly or which may increase invertebrate populations, which are then fed upon. Anthropogenic food sources might adversely affect Steller's Eiders if they are nutritionally poor or contain petroleum products, detergents, or other contaminants. Understanding how fish processing facilities affect eider diet is important in evaluating this risk. Study design will be developed to complement ongoing studies of contaminant exposure in marine areas (see above).

Task E-6. Develop a Habitat Conservation Plan for State-run fisheries in waters where Steller's Eiders molt or winter

Birds, including waterfowl, are occasionally killed by colliding with objects, particularly in inclement weather such as fog, rain, or snow (Schorger 1952, Still et al. 1994). Anecdotal reports indicate that Eiders, including Steller's Eiders, are vulnerable to striking lighted fishing vessels (U.S. Fish and Wildlife Service, unpubl. obs.). Although the magnitude of this threat is unknown, the potential for mortality from striking vessels in southwestern Alaskan waters is substantial, given the demonstrated vulnerability of Eiders and the large number of fishing vessels and preponderance of inclement weather in this region. Section 7 consultations, which are required for actions conducted, funded or permitted by the Federal government that may result in take of endangered or threatened species ("take" is defined under the Act to include harm, wound, or kill), may authorize take that is incidental to otherwise lawful activities (such as fishing). However, such consultations are not conducted for State-run fisheries where no Federal funding or permit is required. Thus, take

resulting from State-run fisheries in State waters is currently not authorized and is in violation of section 9 of the Act, which prohibits the taking of endangered and threatened species. Therefore, a Habitat Conservation Plan (HCP), developed under section 10 (a)(2)(A) of the Act, may be appropriate. An HCP for State-run fisheries would strive to reduce, quantify, and authorize take that is incidental to otherwise lawful activities associated with fishing in State waters. This HCP may be developed cooperatively with representatives from the fishing industry, State of Alaska, and local communities, as appropriate.

F. Breeding Ecology

Historical accounts of Steller's Eiders nesting in Alaska are largely anecdotal, and provide little detailed or quantitative information on breeding ecology. Since 1991, studies at Barrow have investigated basic breeding ecology, providing information on breeding propensity and productivity, factors affecting nest success, and associations with other species that breed in the vicinity. Nonetheless, knowledge of many aspects of breeding ecology remains rudimentary, dictating that continued research is needed as recovery strategies are developed.

Task F-1. Initiate comprehensive study of breeding ecology in relation to lemmings and their predators

From 1991-2001, Steller's Eiders nested near Barrow only intermittently, apparently breeding in only 5 of 10 years (Quakenbush and Suydam 1999; Obritschkewitsch et al. 2001, 2002; Quakenbush et al., in review). The cause for this "periodic non-breeding" remains unknown, but one hypothesis centers on the association between Steller's Eiders, Brown Lemmings (*Lemmus trimucronatus*), and their predators (see Quakenbush and Suydam 1999, Quakenbush et al., in prep). From 1992-2001, years in which Steller's Eiders nested near Barrow in significant numbers were characterized by abundant Brown Lemmings, which demonstrate tremendous annual variation in population size, and the presence of nesting Snowy Owls and Pomarine Jaegers, which normally nest near Barrow only when and where Brown Lemmings are abundant (Quakenbush et al., in prep.). One hypothesis is that predation of Steller's Eider nests by Arctic Foxes is reduced when Brown Lemmings are numerous because: 1) Brown Lemmings provide adequate food for foxes, reducing predation on alternate prey such as ground-nesting birds and their eggs; and/or 2) Steller's Eiders frequently nest near Snowy Owls and Pomarine Jaegers, which aggressively drive foxes from the vicinity of their nests, providing security for nearby nests

of other species. Understanding the relationships among Steller's Eiders, lemmings, and their predators will contribute to understanding habitat requirements and identifying potential causes of decline and obstacles to recovery.

Task F-2. Evaluate the effects of disturbance and extent of habitat loss at Barrow

The Barrow area is believed to be the core of the current breeding distribution of Steller's Eiders in Alaska. Barrow is also an important human population center, with the human population expanding from 951 in 1950 to 4,581 in 2000. As a result of the significant human presence and rapid growth, Steller's Eiders near Barrow are exposed to disturbance associated with human activity and loss or alteration of habitat resulting from development. Additionally, numerous research efforts, including those directed at Steller's Eiders as well as other topics, result in additional disturbance. Evaluating the response of Steller's Eiders to disturbance and habitat alteration is necessary to predict the effectiveness of conservation strategies for the species and its habitat near Barrow.

Task F-3. Determine the spring and summer diet of Steller's Eiders at Barrow

Basic understanding of Steller's Eider breeding ecology contributes to developing effective conservation measures, yet many aspects of the species' ecology remain poorly studied. Knowledge of breeding-season diet is important when evaluating habitat associations, contaminant (including lead shot) exposure risk, and how land management practices affect foraging ecology.

G. Demographic Information

Population models can contribute significantly to endangered species management by providing an objective means to estimate risk of extinction and by testing the sensitivity of population size to changes in demographic parameters. By identifying which demographic parameters have the greatest effect on population size, recovery efforts can be focused where the largest benefit can be derived. The value of a model and the reliability of its results, however, depends upon the accuracy of data used in the model. Demographic information on Steller's Eider must be improved in a number of areas to increase the reliability of modeling efforts. The following recovery tasks identify the specific aspects of survival or reproductive performance where information is lacking or needs to be improved.

Task G-1. Quantify annual survival rates at Izembek National Wildlife Refuge

Mark-recapture studies at molting areas on the Alaska Peninsula (Izembek National Wildlife Refuge and Nelson Lagoon) since 1975 have yielded significant information on Steller's Eider survival rates, although these data are not specific to the Alaska-breeding population. Results to date have shown that annual survival is lower in males than females, which is unusual in waterfowl, and may have long-term population implications if sex ratios in breeding populations become unbalanced (Flint et al. 2000). Additionally, annual survival may have declined during the duration of the study, suggesting that a decrease in adult survival may have contributed to population decline. Continuation of these studies at Izembek will monitor long-term changes in survival rates.

Task G-2. Quantify survival rate of juvenile Steller's Eiders on the North Slope from fledging to 1 year

Estimates of annual survival rates derived from mark-recapture studies along the Alaska Peninsula pertain exclusively to adults because birds are banded during molt, which does not take place until ducks are at least one-year old. Information on juvenile survival rates (fledging to 1 year), which is needed for population modeling, is entirely lacking.

Task G-3. Quantify survival rates of adult females nesting in northern Alaska

Estimates of adult female survival rates from mark-recapture studies along the Alaska Peninsula are based on all Steller's Eiders that molt in southwest Alaska, presumably representing the numerically dominant Russia-breeding population. Determining survival rates of the Alaska-breeding population will improve confidence in the model as a tool for recovery. Among-population differences might help reveal significant mortality factors and where and when they occur.

Task G-4. Determine the age at which Steller's Eiders first breed

The age at which Steller's Eiders first breed is currently unknown, but this information is needed for reliable population modeling. Trapping and banding female Steller's Eiders before they fledge and relocating them as breeding adults will be needed to acquire this information.

Task G-5. Determine breeding propensity on the North Slope

Studies at Barrow from 1991-2001 suggest that Steller's Eiders nested only intermittently, with little or no nesting in 5 of 10 years. This strategy, which has considerable population implications, is poorly understood. An accurate assessment of productivity, which is needed for population modeling, requires: 1) information on the frequency with which the population nests; and 2) what proportion of the population breeds in years when nesting takes place. Methods for acquiring this information have not yet been refined, although current studies at Barrow provide an estimate of part 1, and, with some assumptions, the Breeding Pair aerial survey may provide information on part 2.

Task G-6. Quantify productivity at Barrow

An estimate of productivity, which is typically expressed as the average number of young raised per female, is necessary for population modeling. At this time, estimating productivity of Steller's Eiders in northern Alaska is complicated by the difficulty of measuring duckling survival. Additionally, understanding factors that cause reproductive failure will assist in identifying and implementing recovery tasks. Quantifying breeding propensity (the proportion of females that breed), egg success (the proportion of eggs laid that survive to hatching), nest success (the proportion of nests in which at least one young hatches), and duckling survival (the proportion of hatched young that survive until capable of flight) will contribute to accurate estimates of productivity as well as contributing to identification of management efforts that will most effectively bolster reproductive performance. Ongoing efforts at Barrow are investigating aspects of reproductive performance, with refinements to annual study plans expected as appropriate.

H. Yukon-Kuskokwim Delta

The near-disappearance of Steller's Eiders from the Yukon-Kuskokwim Delta was one of the primary factors leading to the listing of the Alaska-breeding population as threatened under the Act. Consequently, re-establishment of the species to the delta is currently considered essential for recovery. Recovery tasks associated with this need pertain to investigating the genetic distinctiveness of Steller's Eiders from the Yukon-Kuskokwim Delta, evaluating current population size, and developing methods for translocating Steller's Eiders, should that be needed.

Task H-1. Assess intra-population variability among Steller's Eiders that currently nest in Russia and northern Alaska and eiders that historically nested in western Alaska

Task H-2. Assess temporal changes in phylogeographic relationships and population-genetics characteristics of breeding populations

Ensuring a viable subpopulation of Steller's Eiders in the Western Recovery Unit may require translocating Steller's Eiders to the Yukon-Kuskokwim Delta. Strategies to be used will vary depending on whether Steller's Eiders that nest in western Alaska are ecologically and genetically distinct from those that nest in northern Alaska and Russia. Thus, a DNA analysis of these populations is needed to assess genetic diversity among these breeding areas.

An assessment of genetic diversity at present population levels and estimated from samples from museum specimens collected in the same areas prior to population declines may allow detection of changes in genetic diversity and population-level gene frequencies. This information can be used to evaluate temporal changes in the effective size of the present breeding population and in the degree of isolation from other breeding populations. Initial work necessary to begin these analyses is ongoing.

Task H-3. Evaluate the use of ground plot surveys for estimating breeding population size on the Yukon-Kuskokwim Delta

Ground plot surveys are conducted annually for Spectacled Eiders on the Yukon-Kuskokwim Delta. These surveys, which consist of intensively searching 65-80 randomly selected 400 x 800 m plots within the core Spectacled Eider nesting area, provide valuable information on abundance, visibility correction factors, and nesting effort. Although Steller's Eiders have not been found during recent ground plot surveys, it is important to evaluate whether expanded or modified ground plot surveys can provide a means to evaluate Steller's Eider abundance on the delta. If this methodology is determined to be inadequate, development of new surveys should be explored.

Task H-4. Conduct experimental translocation to the Yukon-Kuskokwim Delta

Translocation of Steller's Eiders to the Yukon-Kuskokwim Delta may be needed in order to ensure viability of the western Alaska subpopulation. Although other waterfowl species have been effectively translocated, it is currently unknown whether translocation is feasible for Steller's Eiders. Experimental translocations are needed to evaluate the feasibility and



Figure 10. Male Steller's Eiders at Barrow, Alaska.

complications of this method of re-establishment. Translocations will not be conducted, however, until the genetic distinctiveness of Steller's Eiders from western Alaska is determined.

I. Develop Partnerships for Steller's Eider Recovery Efforts

Effective endangered species management requires partnerships between Federal, State, Native, local, and private entities. In some cases, this entails development of formalized agreements that commit agencies and organizations to allocating resources or other means of participation. In other cases, developing partnerships consists of informing local residents and private property owners of the presence and status of listed species, which can engender a sense of "ownership" and responsibility that results in conservation efforts. Where voluntary compliance with prohibitions against shooting Steller's Eiders and continued use of lead shot is not achieved, community support for law enforcement may be required.

Task I-1. Promote public awareness of Steller's Eiders in Barrow

The concentration of breeding Steller's Eiders near Barrow is vulnerable to both direct and indirect human influences. There is some intentional take and harassment by local hunters. Additionally, staging and nesting Eiders may be disturbed by people traveling across the tundra, individuals walking their dogs on the tundra, and by scientists conducting research. An increased effort to inform and educate the residents of Barrow and those who seasonally use Barrow will help reduce or eliminate some sources of mortality and disturbance and thus lead to increased survival of Eiders.

The indirect effects of human activity include habitat loss, exposure to contaminants (particularly lead shot in wetlands), and

increased concentration of predators, such as ravens, gulls, and Arctic Foxes, which are attracted to outdoor food storage sites. Reducing these impacts will likely require changes in land-use policy, waste disposal practices, and human behavior, with potential accompanying economic and social cost. The political viability of these strategies depends, in large part, on building local support through education. Current outreach activities include print and broadcast media contacts, brochures mailed to individual households, classroom visits, road signs, student field trips, and steel shot clinics. An increased level of effort in all of these arenas would be beneficial, as well as the expansion of public education activities. Additional activities should include regular informational presentations and additional displays focusing on specific management issues.

Task I-2. Develop information and education program for southwest Alaska

An information and education program is needed in southwest Alaska to engender support for Steller's Eider recovery efforts. Visits to communities and dissemination of printed materials are needed to inform residents of the threatened status of Steller's Eiders and the conservation efforts needed to recover the species.

Task I-3. Develop a Memorandum of Understanding for the Arctic Coastal Plain

The Arctic Coastal Plain is the primary area where members of the Alaska-breeding population of the Steller's Eider nest. Survival and recovery of the listed Alaska-breeding population, therefore, will unquestionably require the protection and expansion of this subpopulation. The necessary conservation efforts will require cooperative participation by a number of Federal, State, Native, Borough, and village government entities and private industries. This Memorandum of Agreement should establish the infrastructure for cooperative implementation of recovery tasks and address the means to eliminate threats, including hunting/shooting mortality, refuse management, predator control, and habitat loss and alteration.

IV. Implementation

Implementing this recovery plan includes: 1) identification, prioritization, and periodic re-evaluation of recovery tasks; and 2) completing recovery tasks.

The Steller's Eider Recovery Team was

established in 1997 to advise the Service on recovering the Alaska-breeding population of Steller's Eiders (the Spectacled Eider Recovery Team informally advised the Service on Steller's Eider conservation from 1993 - 1997). One of the primary responsibilities of the team is to meet regularly (usually annually) to review relevant information and prioritize recovery tasks to provide guidance for managers. Appendix A reiterates the tasks described in Section III, Recovery Tasks, above, but presents the tasks with the priority rankings recommended by the Recovery Team in April 2001. As this list is updated, the current version will be available by request from the Service and from the internet at the Fish and Wildlife Service, Alaska Region's website (<http://www.r7.fws.gov/es/te.html>). It is intended that this Recovery Plan will be revised periodically to reflect new information and the completion of recovery tasks; the current version of the plan will also be available at the internet address provided above. In the event that significant new strategies or directions in recovery are taken, public input and technical review will be sought.

Implementation of a number of recovery tasks has been initiated by the Service, U.S. Geological Survey, and North Slope Borough. Initiating and completing many of the tasks will require participation by a number of Federal and State agencies, borough and village governments, industry groups, and private organizations. Three efforts currently underway to establish the partnerships and infrastructure needed for cooperative recovery implementation are as follows:

Barrow Field Studies - The North Slope Borough and Service have been cooperatively conducting field studies on Steller's Eider breeding biology and distribution near Barrow since 1991. These field studies are made possible by the participation of the borough government, especially the Borough's Department of Wildlife Management, and the logistical capabilities and research facilities at Barrow. Current studies focus on monitoring local abundance and describing distribution, documenting breeding propensity and nest success, and investigating exposure to environmental contaminants, particularly lead. Investigators at Barrow have opportunistically provided samples for related research, including genetics, virology, and endocrine studies, as well as obtaining birds for satellite telemetry studies to elucidate movements during the non-breeding season. Research areas that will receive increasing attention include determining the causes of nest failure, analyzing habitat preference, estimating juvenile survival, and describing foraging

behavior. Barrow will also serve as a staging area for efforts to locate additional breeding areas on the North Slope.

Barrow Conservation Plan - The community of Barrow has undergone a sustained period of rapid growth since 1940. As the population grows and community infrastructure expands, there is increased potential for negative impacts to Steller's Eiders and their habitat. The U.S. Fish and Wildlife Service has authority to protect Steller's Eiders under the provisions of the Act and through its role in the regulation of wetland fill, under section 404 of the Federal Water Pollution Control Act amendments of 1972. The "404 program," authorizes the U.S. Army Corps of Engineers to issue permits for the discharge of fill into navigable waters, including wetlands. Nearly all of the Arctic Coastal Plain is comprised of wetlands, so there is a Federal role in virtually every proposed construction project. Consequently, most development projects require consultation under section 7 of the Act to evaluate the potential effect on threatened and endangered species. Such "project-by-project" review, however, is not the best way to serve the conservation needs of Steller's Eiders, because 1) significant habitat loss could be incurred in a piecemeal fashion, relatively unrestrained by the 404 process, 2) significant indirect effects such as increased human disturbance are difficult to manage in the context of the 404 process, and 3) cooperative conservation efforts are discouraged because of the essentially adversarial nature of the process.

As an alternative to project-by-project review, the Service and the North Slope Borough are formulating a comprehensive Steller's Eider Conservation Plan for the Barrow area. To be successful, the plan must provide a net conservation benefit to the listed species, and must allow for expansion of community infrastructure to meet social needs. The plan goals include:

1. Promote the recovery of the Steller's Eider by maintaining or increasing the number of breeding pairs in the Barrow area, and maintaining or increasing productivity.
2. Provide consistency and predictability for those aspects of federal permitting related to requirements of the Act, for development in the Barrow area.

Important conservation objectives of the plan are anticipated to include maintaining important nesting habitat in an undisturbed condition, eliminating intentional take and reducing

incidental take resulting from disturbance, reducing losses to predators, and promotion of monitoring and research. Important administrative objectives include outlining conservation measures that will be undertaken at a regional level that will lessen the burden to individual permit applicants, and identification of geographic areas of greater or lesser concern with regard to development proposals.

The Alaska SeaLife Center (ASLC), a marine science research facility in Seward, Alaska, received Congressional appropriations of \$600,000 in fiscal year (FY) 2001 and \$800,000 in FY 2002 for Spectacled and Steller's eider recovery research. ASLC has been working closely with the Service to develop a research plan that will utilize the considerable expertise and facilities available at the Center to provide valuable and integrative information regarding both species.

The research plan at ASLC encompasses a broad range of initiatives highly relevant to the recovery of Steller's and Spectacled Eiders. Project oversight will be provided by a marine ornithologist with extensive experience in seaduck natural history, biology, virology, and toxicology research. Primary goals of the research plan are to develop the infrastructure and husbandry techniques necessary to facilitate the maintenance of healthy captive populations of eiders for recovery research by a variety of scientists and resource managers, conduct research into the reproductive biology and the influence of contaminants upon reproduction, and initiate a web repository of eider research publications through ASLC. Future research plans will utilize the recovery plans for Steller's and Spectacled Eiders to guide and prioritize research.

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V. Appendices

Appendix A. Recovery Tasks, ranked by priority, as recommended in April, 2001 by the Steller's Eider Recovery Team.

Priority ^a	Task ID	Tasks	Status ^b	Estimated Duration (yrs) ^c	Estimated Cost (in thousand of dollars) ^c
1.22	A-2	Screen the Alaska-breeding population for lead exposure, including temporal and spatial variation	I	5	50
1.33	H-1	Assess intra-population variability among Steller's Eiders that currently nest in Russia and northern Alaska and eiders that historically nested in western Alaska	I	2	9
1.33	G-3	Quantify survival rates of adult females nesting in northern Alaska	F		
1.44	D-4	Determine breeding status elsewhere from Barrow	I	3	100
1.44	B-1	Determine which predators are responsible for nest predation at Barrow	I	5	40 + *
1.44	I-1	Promote public awareness of Steller's Eiders in Barrow	I	Annual	100
1.44	C-2	Eliminate hunting and shooting mortality	I	Annual	0
1.56	G-6	Quantify productivity at Barrow	I	Annual	200
1.56	E-1	Delineate the non-breeding distribution of the Alaska-breeding population	I	U	U
1.56	B-3	Implement raven control at Barrow	I	Annual	5
1.67	D-1	Continue existing aerial Breeding Pair Survey on Arctic Coastal Plain	I	Annual	Part of existing program
1.67	A-1	Continue steel shot I&E	I	3	50
1.78	A-3	Assess effects of lead exposure on Steller's Eiders	N	2	300
1.78	G-1	Quantify annual survival rates at Izembek National Wildlife Refuge	I	Annual	250
1.88	B-4	Implement fox control at Barrow	N	Annual	50
1.88	B-2	Reduce the availability of artificial food sources to predators at Barrow	N	Annual	U
1.89	G-2	Quantify survival rate of juvenile Steller's Eiders on the North Slope from fledging to 1 year	F		
1.89	G-5	Determine breeding propensity on the North Slope	N	5	150
1.89	D-6	Evaluate existing spring migration survey data	N	1	5
1.89	C-1	Summarize available information on subsistence harvest on the North Slope and at Kotzebue	N	1	5
1.89	E-3	Assess exposure to and effects of contaminants in the marine environment	I	5	250
2.00	D-5	Determine feasibility of monitoring population size with migration counts along the Chukchi Sea coast	N	1	25
2.00	G-4	Determine age at which Steller's Eiders first breed	N	U	U
2.22	H-3	Evaluate the use of ground plot surveys for estimating breeding population size on the Yukon-Kuskokwim Delta	N	1	0
2.22	H-4	Conduct experimental translocation to the Yukon-Kuskokwim Delta	N	1	25
2.22	F-1	Initiate comprehensive study of breeding ecology in relation to lemmings and their predators	N	5	250
2.22	H-2	Assess temporal changes in phylogenetic relationships and population-genetics characteristics of breeding populations	I	U	7
2.22	D-2	Evaluate efficacy of applying North Slope Eider Survey data to Steller's Eiders	F		
2.33	I-3	Develop a Memorandum of Understanding for the Arctic Coastal Plain	I	2	20
2.33	F-2	Evaluate the effects of disturbance and extent of habitat loss at Barrow	F		

2.33	E-2	Conduct surveys from Nunivak Island to Bechevin Bay during molt to determine long-term changes in the distribution of molting Steller's Eiders	N	Annual	40
2.33	E-5	Study foraging ecology in relation to fish processing facilities	I	3	250
2.44	D-3	Determine visibility correction factor	F		
2.44	I-2	Develop information and education program for southwest Alaska	N	Annual	50
2.44	A-5	Assess management options regarding lead-contaminated habitats, such as habitat sampling or grit broadcast	N	3	150
2.44	F-3	Determine spring and summer diet at Barrow	F		
2.56	E-4	Document the diet of Steller's Eiders in southwest Alaskan waters	I	3	80
2.88	A-4	Evaluate grit selection criteria of Steller's Eiders	N	1	100

^a lower numbers denote higher priority

^b I = initiated; N = not initiated; F = feasibility questionable; U = unknown

^c maximum of a 5-year planning horizon; U = unknown