

BIOLOGICAL OPINION
on the Effects of Constructing a New Public Dock Complex for the City of Chignik, Alaska,
on the Threatened Steller's Eider (*Polysticta stelleri*)
Consultation #2002-0083

DESCRIPTION OF PROPOSED ACTION

Chignik is located on a year-round ice-free port with two privately owned deep-water docks capable of receiving ocean-going barges. Development in Chignik includes two sea food-processing plants, a school and store, homes, a road and an airport. The proposed public dock facility would be located southwest of the Chignik Pride dock and the new AIDEA tank farm (Fig. 1). The purpose of the proposed public dock facility iuys to help meet the current and forecasted needs associated with the fishing industry, ferry, and freighter service, and to provide landing, loading, unloading, fueling, and servicing area for the local fishing fleet and transient vessels.

The proposed dock construction would consist of placing approximately 15,000 cubic yards of armor and filler rock along the dock perimeter and backfilling with approximately 125,000 cubic yards of gravel and sand fill within 7.7 acres of intertidal and sub tidal tidelands below the high tide line, including 4.5 acres below mean low-low water. A 360 ft steel sheet pile dock face with a chain curtain facing, and a boat take-out facility consisting of 10-pipe pile will be constructed. New fill/distribution piping and marine fuel dispensers may be installed to service the fishing fleet.

STATUS OF THE SPECIES

Species Description

The Steller's eider was listed as a threatened species on June 11, 1997 (62 FR 31748). Critical habitat was designated for the Steller's eider on February 6, 2001 (65 FR 13262). The Steller's eider is the smallest of the eiders. The average weight of adult male and female Steller's eiders is 1.94 pounds (Bellrose 1980). Adult male Steller's eiders in breeding plumage have a black back, white shoulders, and a chestnut brown breast and belly. The males have a white head with black eye patches; they also have a black chin patch and a small greenish patch on the back of the head. Females and juveniles are mottled dark brown.

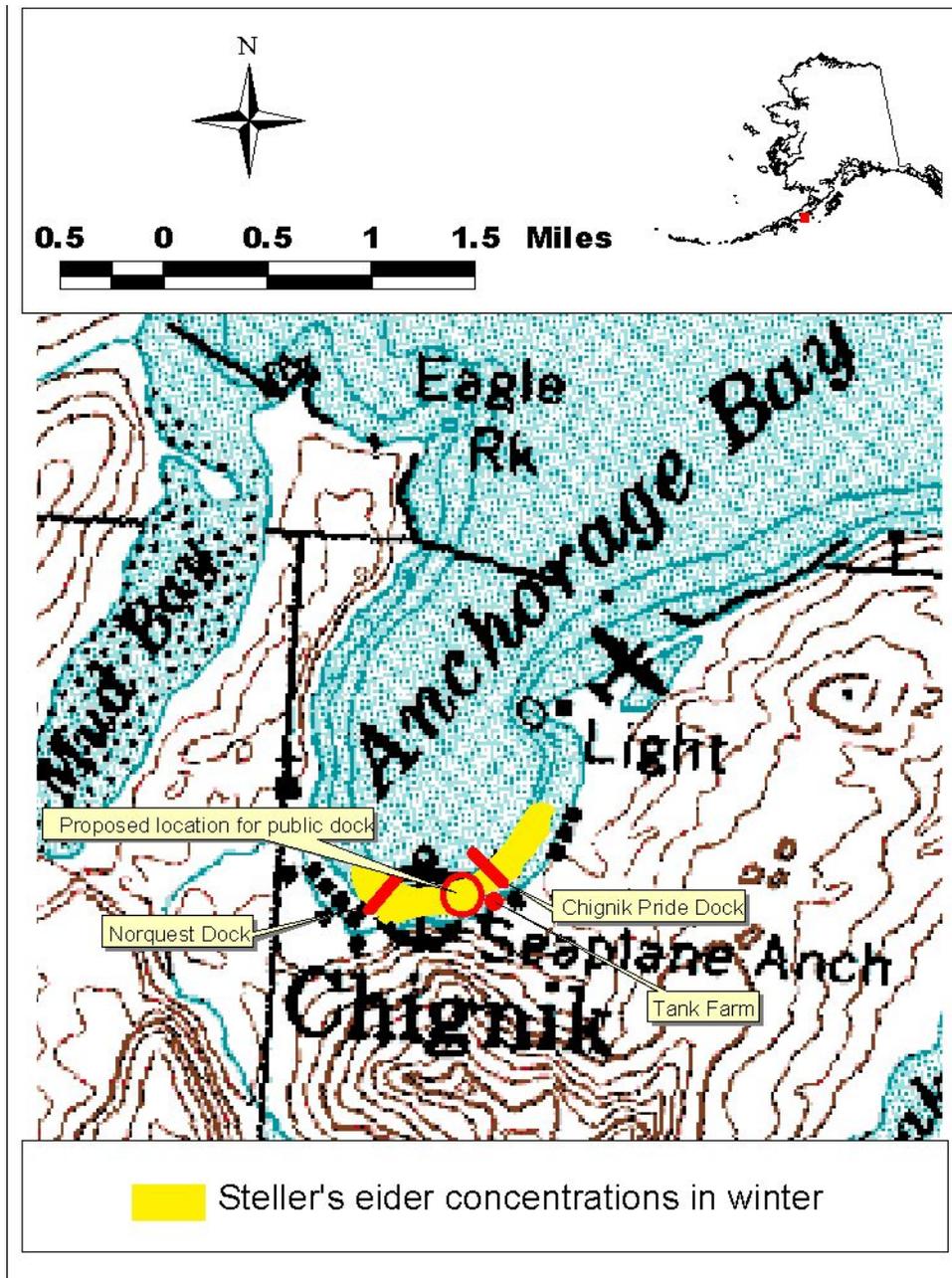


Figure 1. Locations of current and planned of development and winter concentrations of Steller's eiders, City of Chignik, Anchorage Bay, Alaska.

Life History

Longevity

Steller's eiders are long lived, with individuals known to have lived at least as long as 21 years and 4 months in the wild (band number 647-66747). Other ages recorded for this species in the wild are 20 years, 4 months (band numbers 647-66757 and 1077-13265), 19 years, 3 months (band number 647-64547), and 16 years (band numbers 1157-01787 and 1157-01876)(Chris Dau, pers. comm. 2000).

Energetics

Goudie and Ankney (1986) suggest that small-bodied sea ducks such as harlequin (*Histrionicus histrionicus*) and long-tailed ducks (*Clangula hyemalis*) that winter at northern latitudes do so near the limits of their energetic threshold. These species have little flexibility in regards to caloric consumption or on reliance of caloric reserves. Under this life history strategy, the species are vulnerable to perturbations within their winter habitat. Because the Steller's eider is relatively small-bodied, being intermediate in size to the harlequin and long-tailed ducks (Bellrose 1980), and because it overlaps with harlequins and long-tailed ducks in its choice of foraging areas and prey items, the species may, like the harlequin and long-tailed ducks, exist near its energetic limits. Unlike other larger eiders, Steller's eiders must continue to feed upon reaching their nesting areas, to build up enough energy reserves to breed (D. Solovieva, pers. comm. 2000). In addition, female Steller's eiders must continue to feed during incubation. Spectacled eiders, a larger bodied sea duck apparently do not exist so close to their energetic threshold; they arrive on the nesting grounds fit enough to fast through egg laying and incubation.

Age to Maturity

Sexual maturity is believed to be deferred to the second year (Bellrose 1980).

Reproductive Strategy

Johnsgard (1994) indicated that pair formation for most sea ducks occurs in fall and spring. Metzner (1993) hypothesized that Steller's eiders at Izembek Lagoon and Cold Bay paired in the spring because they were apparently too preoccupied with feeding during the fall and winter to form pair bonds. The length of time that Steller's eiders remain paired is unknown. However, long-term pair bonds have been documented in other ducks (Bengtson 1972, Savard 1985, as in Cooke et al. 2000).

Pairs of Steller's eiders arrive at Point Barrow as early as June 5 (Bent 1987). While nesting, Steller's eiders often occupy shallow coastal wetlands in association with tundra (Bent 1987, Quakenbush et al. 1995, Solovieva 1997), although we have records of aerial observations of Steller's eider pairs well inland on the Arctic Coastal Plain. This species establishes nests near shallow ponds or lakes, usually close to water.

Clutch size has been reported to range from 2 to 10 eggs (Bent 1987, Bellrose 1980, Quakenbush et al. 1995). The average clutch size of successful nests near Barrow is reported as 4.6 (n = 8). Solovieva (1997) found that clutch size for Steller's eiders on the Lena Delta varied between five and eight eggs with an average of 6.1 (n = 32). Nesting success near Barrow (percent of nests where eggs hatch) is variable (Quakenbush et al., 1995). In 1991, five of six nests hatched while in 1993, only four of 20 nests hatched. During some years, the species apparently does not even attempt to nest near Barrow (Quakenbush et al., 1995).

Recruitment

Steller's eider recruitment rate (the percentage of fledged birds that reach sexual maturity) is unknown. However, there is limited information regarding Steller's eider fledging rate. Near Barrow, 83.3 percent (five of six) of Steller's eiders nests with eggs hatched in 1991, 20.0 percent (four of 20) hatched in 1993 (Quakenbush et al. 1995), and 15 percent (three of 20) hatched in 2000 (Philip Martin, Service, pers. comm., 2000). In other years, Steller's eiders did not even attempt to breed near Barrow (Quakenbush et al. 1995). We conclude that the annual recruitment rate for this species is likely variable.

Seasonal Distribution Patterns

Banded and Satellite-Tagged Alaskan Breeding Birds: Little is known of the distribution of Alaska breeding Steller's eiders outside of the breeding season. A few band recoveries indicate that birds that breed near Barrow undergo molt in Izembek lagoon. A satellite telemetry study was initiated in 2000 to investigate the molting and wintering locations of the Alaskan population of Steller's eiders. Satellite transmitters were placed on four Steller's eiders captured in Barrow. Two Steller's eiders (one male and one female) spent the molting season on the Kuskokwim shoals, while a third (a male) molted near the Seal Islands (Philip Martin, Service, pers. comm., 2000). Both birds that molted at Kuskokwim Shoals moved on to the Hook Bay portion of Bechevin Bay in November. The male remained in Hook Bay at least until late December when his transmitter stopped working. The female remained at Hook Bay until early February, at which time she returned to Izembek Lagoon and remained there as of 5 March 2001. The bird that molted near the Seal Islands moved west to Nelson Lagoon after 9 October 2000. After spending approximately three weeks at Nelson Lagoon, this bird moved west to Sanak Island at the end of November. The bird remained at Sanak Island for three months. During this time his use area was small, only a few square kilometers. By March 4, he had

moved back Izembek Lagoon in the vicinity of his November locations (Philip Martin, Service, pers. comm., 2001).

Breeding Distribution: The exact historical breeding range of the Alaska-breeding population of Steller's eiders is not clear. The historical breeding range may have extended discontinuously from the eastern Aleutian Islands to the western and northern Alaska coasts, possibly as far east as the Canadian border. In more recent times, breeding occurred in two general areas, the Arctic Coastal Plain, and western Alaska, primarily on the Y-K Delta. Currently, Steller's eiders breed on the western Arctic Coastal Plain in northern Alaska, from approximately Point Lay east to Prudhoe Bay, and in extremely low numbers on the Y-K Delta.

On the Arctic Coastal Plain, anecdotal historical records indicate that the species occurred from Wainwright east, nearly to the Alaska-Canada border (Anderson 1913; Brooks 1915). There are very few nesting records from the eastern Arctic Coastal Plain, however, so it is unknown if the species commonly nested there or not. Currently, the species predominantly breeds on the western Arctic Coastal Plain, in the northern half of the National Petroleum Reserve - Alaska (NPR-A). The majority of sightings in the last decade have occurred east of the mouth of the Utukok River, west of the Colville River, and within 90 km (56 mi) of the coast. Within this extensive area, Steller's eiders generally breed at very low densities.

The Steller's eider was considered a locally "common" breeder in the intertidal, central Y-K Delta by naturalists early in the 1900s (Murie 1924; Conover 1926; Gillham 1941; Brandt 1943), but the bird was reported to breed in only a few locations. By the 1960s or 70s, the species had become extremely rare on the Y-K Delta, and only six nests have been found in the 1990s (Flint and Herzog 1999). One to two nests continue to be found each year during the course of extensive ground-based waterfowl research and surveys. Given the paucity of early-recorded observations, only subjective estimates can be made of the Steller's eider's historical abundance or distribution on the Y-K Delta.

A few Steller's eiders were reportedly found nesting in other locations in western Alaska, including the Aleutian Islands in the 1870s and 80s (Gabrielson and Lincoln 1959), Alaska Peninsula in the 1880s or 90s (Murie and Scheffer 1959), Seward Peninsula in the 1870s (Portenko 1989), and on Saint Lawrence Island as recently as the 1950s (Fay and Cade 1959). It is unknown how regularly these areas were used or whether the species ever nested in intervening areas.

Post-Breeding Distribution and Fall Migration: Following breeding, males and some females with failed nests depart their Russian nesting area and return to marine waters (Solovieva 1997). We know little of Steller's eiders use of marine waters adjacent to Alaska's Arctic Coastal Plain and along the west and southwest coast of Alaska during late summer and fall migration. Historical observations made by Murdoch (1885 as in Bent 1987) indicate that birds that have

bred near Point Barrow begin to return to the coast from the first to the middle of July. In addition, he indicated that they disappear from the Barrow area from the first to the middle of August. Steller's eiders arrived at St. Michael around 21 September (Bent 1987). Late date of departure was as follows: Point Barrow, September 17; St. Michael, October 5; and Ugashik, November 28 (Bent 1987).

Over 15,000 Steller's eiders were observed on September 27, 1996, in Kuskokwim Bay (Larned and Tiplady 1996). Most (nearly 14,000) were located along the mainland side of barrier islands while about 1,100 were detected further offshore. Despite this species' apparent preference for near shore habitats, several groups were detected over 10 kilometers (km) from shore and two groups were over 30 km from shore.

In late summer and fall, large numbers of Steller's eiders molt in a few lagoons located on the north side of the Alaska Peninsula (i.e., Izembek and Nelson Lagoon/Port Moller Complex, Seal Islands) (Petersen 1980 & 1981). Recent observations of over 15,000 Steller's eiders in Kuskokwim Bay, and the observation of two out of three satellite-tagged birds from Barrow molting there suggests that Kuskokwim Bay may also be a notable molting area for this species and for the listed entity (Larned and Tiplady 1996; Philip Martin, Service, pers. comm. 2000). Following the molt, large numbers of Steller's eiders are known to over winter in near shore marine waters of the Alaska Peninsula, Aleutian Islands, Kodiak Archipelago, and the Kenai Peninsula (e.g., within Kachemak Bay).

Molt Distribution: After breeding, Steller's eiders move to marine waters where they undergo a flightless molt for about three weeks. The majority is thought to molt in four areas along the Alaska Peninsula: Izembek Lagoon (Metzner 1993; Dau 1991; Laubhan and Metzner 1999), Nelson Lagoon, Herendeen Bay, and Port Moller (Gill et al. 1981; Petersen 1981). Additionally, smaller numbers are known or thought to molt in a number of other locations along the western Alaska coast, around islands in the Bering Sea, along the coast of Bristol Bay, and in smaller lagoons along the Alaska Peninsula (Swarth 1934; Dick and Dick 1971; Petersen and Sigman 1977; Wilk et al. 1986; Dau 1987; Petersen et al. 1991).

Winter Distribution: Following the molt many, but not all, Steller's eiders disperse from major molting areas to other portions of the Alaska Peninsula and Aleutian Islands. Winter ice formation often temporarily forces birds out of shallow protected areas such as Izembek and Nelson Lagoons. During the winter, this species congregates in select near shore waters throughout the Alaska Peninsula and the Aleutian Islands, around Nunivak Island, the Pribilof Islands, the Kodiak Archipelago, and in Kachemak Bay (Larned 2000a, Bent 1987, Agler et al. 1994, Larned and Zwiefelhofer 1995).

Larned (2000b) did not see Steller's eiders along most of the surveyed Alaska Peninsula coastline during winter. Most of the birds were concentrated within relatively small portions of

the coastal waters. Much of the population, detected during spring migration, was not detected on this winter survey. We believe this was because many Steller's eiders winter further west in the Aleutian Islands and/or along the south side of the Alaska Peninsula.

Spring Migration: In the spring, Steller's eiders form large flocks along the north side of the Alaska Peninsula and move east and north (Larned et al. 1993, Larned 1998, Larned 2000b). Spring migration usually includes movement along the coast, although birds may take shortcuts across water bodies such as Bristol Bay (William Larned, Service, pers. com. 2000). Interestingly, despite many daytime aerial surveys, Steller's eiders have never been observed during migratory flights (William Larned, Service, pers. com. 2000). Larned (1998) concluded that Steller's eiders show strong site fidelity to "favored" habitats during migration, where they congregate in large numbers to feed before continuing their northward migration.

The number of Steller's eiders observed in each site during migration surveys should be considered a minimum estimate of the number of eiders that actually use these sites during migration. These data represent eider use during a snapshot in time, when in reality, a stream of eiders likely flows into and out of these sites throughout the migration season. The spring migration survey was not intended to document the intensity of use of any particular site by Steller's eiders, but was designed to monitor the entire population of Steller's eiders and other sea ducks during the spring migration.

Because the spring Steller's eider aerial survey was not intended to quantify use of any particular area by Steller's eiders during spring migration, care must be taken in interpreting the results with this purpose in mind. For example, Steller's eider use of habitat near Ugashik and Egegik Bays was documented in 1992, 1993, 1997, and 1998 (Larned et al. 1993, Larned 1998). However, in 2000, no Steller's eiders were observed there (Larned 2000b). In fact, no Steller's eiders were observed from the Cinder River Sanctuary to Cape Constantine; an expanse of approximately 110 miles of coastline which encompasses these bays and which has had several thousand Steller's eiders documented in previous years (Larned et al. 1993, Larned 1998). However, 15,000 Steller's eiders were observed south of this area and were distributed between Port Heiden and Port Moller (Larned 2000b). Three days later, about 43,000 Steller's eiders were observed south of Port Moller (Larned 2000b). The birds were, in essence, stacking up behind Port Moller, or were otherwise phenologically late in their migration relative to the previous few years. Regardless, survey results from that year suggested low use of habitats north of Port Moller, even though the birds that were counted south of Port Moller presumably used those more northerly habitats following the conclusion of the spring aerial survey.

Several areas receive consistent use by Steller's eiders during spring migration, including Bechevin Bay, Morzhovoi Bay, Izembek Lagoon, Nelson Lagoon/Port Moller Complex, Cape Seniavin, Seal Islands, Port Heiden, Cinder River State Critical Habitat Area, Ugashik Bay, Egegik Bay, Kulukak Bay, Togiak Bay, Nanwak Bay, Kuskokwim Bay, Goodnews Bay, and the

south side of Nunivak Island (Larned et al. 1993, Larned 1998, and Larned 2000b).

Summer Distribution in Southern Alaska: A small number of Steller's eiders are known to remain along the Alaska Peninsula and Kachemak Bay during the summer; approximately 100 have been observed in Kachemak Bay, while a few may spend the summer at Izembek Lagoon (Chris Dau, Service, pers. comm. 2000).

Site Fidelity

Steller's eiders appear to show site fidelity at different spatial scales during different times of the year. There is good evidence of fidelity to molting sites in this species. About 95 percent of recaptured molting Steller's eiders are recaptured at the same site at which they were banded (Flint et al. 2000). Flocks of Steller's eiders make repeated use of certain areas between years (Larned 1998), although it is unknown to what extent individuals display repeated use of these areas.

Female philopatry to breeding grounds in waterfowl species is high. Female waterfowl tend to return to the area where they hatched for their first nesting effort, and subsequently tend to return to the same area to breed in the following years (Anderson et al. 1992). Despite having had only a few opportunities to observe Steller's eiders breeding on the Y-K Delta, we have observed philopatry displayed by a female Steller's eider there; one individual chose nest sites in two consecutive years that were about 124 m apart (Paul Flint, U. S. Geological Service, Biological Resource Division, pers. comm. 1999). Banding data from the Barrow area suggests some level of site fidelity for Steller's eiders breeding there as well (Quakenbush et al. 1995; Martin, Service, pers. comm. 2000). Interestingly, natal philopatry has not been observed in Steller's eiders nesting in Russia (D. Solovieva, Zoological Institute, Russian Academy of Science, pers. comm. 2000).

Further evidence of breeding site fidelity is found in other sea ducks. Female spectacled eiders did not move between general nesting areas (coastal versus interior) between years (Scribner et al. 2000). In addition, mitochondrial DNA analysis indicates that female spectacled eiders tend to return to their natal breeding area once they are recruited to the breeding population (Scribner et al. 2000). Natal, breeding, and winter philopatry in other sea ducks has also been documented (Dow and Fredga 1983, Savard and Eadie 1989, Robertsen 1997, Robertson et al. 1999).

Preliminary data from radio transmitters placed on 23 Steller's eiders captured in Captain's Bay and around Amaknak Island (near Dutch Harbor) in spring 2001 also reveal that eiders show site fidelity to general wintering areas (USGS April 2001 trip report). Steller's eiders remained in the general vicinity from which they were initially captured from mid-February to mid-March 2001 when the radio transmitters stopped working (Paul Flint, USGS, pers. comm., 2001). The birds marked in Captains Bay were never detected outside of the area that the flock was observed

using. Birds marked around Amaknak Island remained in the general area, but appeared to use a larger home range. Satellite telemetry data indicated that two tagged Steller's eiders used an area of only a few square kilometers from November through February (Philip Martin, Service, pers.comm., 2001). Although further investigation is needed, preliminary studies suggest that Steller's eiders show high site fidelity at over wintering sites, at least within one winter season. Whether Steller's eiders show fidelity to over wintering sites between years remains unknown.

We note that site fidelity has been observed in wintering harlequin ducks; they showed strong site fidelity for short stretches (5 km) of coastline (Cooke et al. 2000). Robertson et al. (1999) concluded that strong site tenacity suggests that local knowledge of an area is valuable and may help ensure high survival of individuals remaining in a familiar site. They suggest that site fidelity would be expected of long-lived species that are sensitive to adult mortality and depend, at least in part, upon habitat stability for survival.

Population Structure

Genetic analysis of vertebrate populations suggests that there are often genetic gradients or differences that correspond to the geographic distribution of the species (Lande and Barrowclough 1987). The Alaska breeding population of Steller's eiders may contain unique geographic sub-populations because of: (1) the distance between breeding populations on the Yukon-Kuskokwim (Y-K) Delta and the Arctic Coastal Plain [about 804 meters (500 miles)], and (2) the anticipated site fidelity of nesting adult females (Anderson et al. 1992). The similarly distributed North Slope and Y-K Delta populations of spectacled eiders possess distinct mitochondrial DNA markers, implying limited maternal gene flow between these two areas for that species (Scribner et al. 2000).

Food Habits

Steller's eiders employ a variety of foraging strategies that include diving to a maximum depth of at least 9 meters (30 feet), bill dipping, body tipping, and gleaning from the surface of water, plants, and mud. During the fall and winter, Steller's eiders forage on a variety of invertebrates that are found in near-shore marine waters (Metzner 1993, Petersen 1981, Bustnes et al. 2000). Esophageal contents from 152 Steller's eiders collected at Izembek Lagoon, Kinzarof Lagoon, and Cold Bay, Alaska, indicate Steller's eiders forage on a wide variety of invertebrates (Metzner 1993). According to Metzner (1993), marine invertebrates accounted for the majority of the Steller's eider diet (92%, aggregate dry weight). In addition, occurrence of shell-free prey (e.g., Crustacea, Polychaeta) predominated, compared to that of food items with shells (Metzner 1993). Metzner (1993) concluded that Steller's eiders were opportunistic generalists, foraging primarily on fauna associated with eelgrass beds in Izembek Lagoon and Kinzarof Lagoon, and infauna, epibenthos, and highly mobile fauna. During molt, Steller's eiders were found to have consumed blue mussel (*Mytilus edulis*), other bivalves (e.g. *Macoma balthica*), and amphipods (a

small crustacean). They were also found to have consumed more blue mussels while growing wing-feathers (Petersen 1981).

In northern Norway, 31 species were identified as Steller's eider winter food items; 13 species of gastropods (68.4% of total number of items), four species of bivalves (18.5%); 12 species of crustaceans (13%); and two species of echinoderms (0.1%) (Bustnes et al. 2000). Juveniles sampled in this study fed more on crustaceans ($x = 61\%$ aggregate wet weight) than did adults ($x = 26\%$ aggregate wet weight). Examination of female Steller's eiders found dead near Barrow had consumed mostly Chironomid larvae, which are the predominant macrobenthic invertebrate in arctic tundra ponds (Quakenbush et al. 1995).

Predators

Predators of Steller's eiders include snowy owls (*Nyctea scandiaca*), short-eared owls (*Asio flammeus*), peregrine falcons (*Falco peregrinus*), gyrfalcon (*Falco rusticolus*), pomarine jaegers (*Stercorarius pomarinus*), rough-legged hawks (*Buteo lagopus*), common raven (*Corvus corax*), glaucous gulls (*Larus hyperboreus*), arctic fox (*Alopex lagopus*), and red fox (*Vulpes vulpes*). Quackenbush et al. (1995) reported five adult male and three adult female Steller's eiders taken by avian predators in four years near Barrow. Predators included peregrine falcons, gyrfalcons, and snowy owls. In addition, pomarine jaegers preyed on Steller's eider eggs. On the Y-K Delta, Steller's eider nests have been destroyed by gulls (Paul Flint, USGS, pers. comm., 1999).

Population Dynamics

Population Size

Yukon-Kuskokwim Delta: Estimating the size of the Steller's eider breeding population in Alaska has proved difficult. The large sampling errors associated with the systematic aerial surveys preclude generation of an accurate/precise statistical estimate is unavailable. Aerial surveys that included the Y-K Delta but did not include the Arctic Coastal Plain indicate that the population sizes of eiders (*Polysticta stelleri* and *Somateria* spp.) had declined by 90% since 1957 (Hodges et al. 1996). For the 1950s and early 1960s, the upper limit of the population, excluding the North Slope, had been estimated to be approximately 3,500 pairs (Kertell 1991). Kertell noted, however, that the population might have been smaller due to the potential restriction of nesting Steller's eiders to specific habitats. Kertell (1991) concluded that the Steller's eider had been extirpated from the Y-K Delta prior to 1990.

Since publication of Kertell (1991), a few pairs of Steller's eiders have nested on the Y-K Delta (Table 1) (Paul Flint, USGS, pers. comm. 1999). In no single year have biologists found more than three nests there, despite extensive ground-based nest search efforts in good spectacled eider

breeding habitat.

Table 1. Recent sightings of Steller’s eiders on the Y-K Delta (Paul Flint pers. comm. 1999)

Year	General Location	Number of Pair	Nest Detected	Number of Eggs	Fate of Nest
1994	Kashunuk River near Hock Slough	1	1	7	Destroyed by Gulls
1996	Tutakoke River	1	1	6	Unknown
1997	Tutakoke River	2	0	NA	NA
1997	Kashunuk River	1	1	6	Hatched
1998	Tutakoke River; Kashunuk River	2;1	2; 1	Unk.; 7	Destroyed; Hatched

NA-Not Applicable

Unk.-Unknown

Arctic Coastal Plain: Aerial breeding pair surveys have been conducted on the Arctic Coastal Plain of Alaska for a number of years at two different times during the Steller’s eider nesting process. Mallek and King (1999) and Brackney and King (1995) (Table 2) report on surveys that are designed for optimal population estimates for the greatest number of breeding waterfowl species on the Arctic coastal Plain. Larned and Balogh (1996) (Table 3) report on annual aerial surveys conducted since 1992 that are designed to provide optimal population estimates for spectacled eiders. Quakenbush et al. (1995) report on ground surveys conducted specifically for Steller’s eiders around Barrow from 1991-1994. Laing 1995 has conducted helicopter based brood surveys around Barrow and south of Barrow. ABR (1999) conducted intensive aerial surveys within the “Barrow Triangle” area; surveys that, when compared to concurrent ground surveys, may be used to help derive an aerial survey visibility correction factor. Martin and Obritschkewitsch (Service, unpub. info.) conducted such concurrent ground surveys during two different years and derived two quite different visibility correction factors. Despite attacking the problem of Steller’s eider population estimation from many different angles, our collective efforts have shed little light on which method results in the best estimate and what the best

population point estimate actually is. The problem of population estimation lies largely with the fact that the species is spread across a huge landscape at very low densities. In addition, we acknowledge that the number of Steller's eiders present on the Arctic Coastal Plain may fluctuate dramatically from year to year for reasons that are unclear to us. However, it is the opinion of the biologists most familiar with the species on its Arctic Coastal Plain nesting grounds that the breeding population there is best described as numbering in the hundreds, or perhaps in the very low thousands.

Table 2. Aerial population estimates from aerial breeding pair surveys on the Arctic Coastal Plain (Mallek and King 1999).

Year	Population Estimate
1989	2,002
1990	534
1991	1,118
1992	954
1993	1,313
1994	2,524
1995	931
1996	2,543
1997	1,295
1998	281
1999	1,250

Table 3. Aerial population estimates for Arctic Coastal Plain (1992-2000).

Year	Number Seen	Population Estimate	95% Confidence Interval	Researcher(s)
1992	0	0	NA	Larned and Balogh (1996)
1993	11	263	11-713	Larned and Balogh (1996)
1994	4	91	4-215	Larned and Balogh (1996)
1995	14	322	14-725	Larned and Balogh (1996)
1996	0	0	NA	Larned and Balogh (1996)
1997	8	189	8-432	Larned et al. (1999)
1998	0	NA	NA	Larned et al. (1999)
1999	31	NI	NI	Larned pers. comm. 2000
2000	0	NA	NA	Larned pers. comm. 2000

ACP-Arctic coastal plain

NA-Not Applicable

NI-Not Indicated

Population Variability

Variability in the abundance of the Alaska breeding population of Steller's eiders is not well understood. The sampling errors around our population estimates are large enough to obscure large annual population fluctuations. However, ground-based efforts in the Barrow area suggest that the local breeding populations there fluctuate dramatically (Quakenbush et al. 1995). Indeed, during some years, Steller's eiders completely forego nesting in this area.

Population Stability

The Steller's eider is a relatively long-lived species. Such species do not typically display highly variable populations. That Steller's eiders completely forego nesting in some years near Barrow is consistent with the reproductive strategy for a long-lived species (Begon and Mortimer 1986). However, mortality factors may be undermining this species' ability to maintain a stable population. The population of Steller's eiders molting and wintering along the Alaska Peninsula appears to be declining (Flint et al. 2000, Larned 2000b). In addition, comparison of banding data from 1975 -1981 to 1991-1997 indicates a reduction in Steller's eider survival over time (Flint et al, 2000). Population models for other waterfowl applied to this species indicate that the observed reduction in annual survival over time would have a substantial negative effect on populations (Schmutz et al. 1997, Flint et al. 2000). If this decline is caused by something in the marine environment, it is reasonable to conclude that the Alaska breeding population and Asia breeding population are being affected similarly.

Status and Distribution

Reasons for Listing

The Alaska breeding population of Steller's eiders was listed as a threatened species on June 11, 1997 (Service 1997). It was listed due to (1) its recognition as a distinct vertebrate population segment, (2) a substantial decrease in the species' nesting range in Alaska, (3) a reduction in the number of Steller's eiders nesting in Alaska, and (4) the vulnerability of the remaining breeding population to extirpation (Service 1997).

Habitat Loss: The direct and indirect effects of future gas/oil development within the National Petroleum Reserve-Alaska, and future village expansion (e.g., at Barrow), were cited as potential threats to the Steller's eider (Service 1997). Within the marine distribution of Steller's eiders, perceived threats include marine transport, commercial fishing, and environmental pollutants (Service 1997).

Hunting: Although not cited as a cause in the decline of Steller's eiders, the take of this species by subsistence hunters was cited as a threat to the population of Steller's eiders near Barrow in the final rule (Service 1997). However, the gathering of subsistence harvest information similar to that collected from Native residents of the Y-K Delta has met with resistance from Native organizations on the Arctic Coastal Plain.

Predation: Increased predation by arctic foxes (*Alopex lagopus*) resulting from the concurrent crash of goose populations is cited as a possible contributing factor to the decline of the Steller's

eider on the Y-K Delta (Service 1997). The potential for increased predation near villages resulting from the villages' associated gull and raven populations was also cited as a potential threat to this species (Service 1997).

Lead Poisoning: The presence of lead shot in the nesting environment on the Y-K Delta was cited as a continuing potential threat to the Steller's eider. The Service is progressing in its efforts to enforce a nationwide ban on lead shot on the Arctic Coastal Plain (Service 1997).

Ecosystem Change: Direct and indirect changes in the marine ecosystem caused by increasing populations of Pacific walrus (*Odobenus rosmarus*), gray whale (*Eschrichtius robustus*), and sea otter (*Enhydra lutris*), were cited as potential causes of the decline of Steller's eiders. Subsequent declines in sea otter populations (65 FR 67343) and continuing declines in Steller's eider populations suggest that otters were not responsible for a decline in eider numbers. In addition, changes in the commercial fishing industry were also cited as perhaps causing a change in the marine ecosystem with possible effects upon eiders (Service 1997). However, we are unaware of any link between changes in the marine environment and contraction of the eider's breeding range in Alaska (Service 1997).

Range-wide Trend

Populations of Steller's eiders molting and wintering along the Alaska Peninsula have declined since the 1960s (Kertell 1991), and appear to be in continued decline (Flint et al. 2000, Larned 2000b). The imprecision of our breeding ground estimates precludes us from detecting any but the most obvious population trends. However, if a marine-based threat is causing a decline in the world population of Steller's eiders, then it seems reasonable to conclude that the Alaska breeding population may also be affected by such a threat.

New Threats

Chronic Petroleum Spills: The chronic release of petroleum products near large concentrations of Steller's eiders is not a new threat as much as it is a newly realized threat. The gregarious behavior of Steller's eiders during a spill event may result in acute and/or chronic toxicity in large numbers of birds. Indeed, Larned (2000b), expressed concern for the survival and reproductive success of the large number of Steller's eiders observed in harbors.

A life-history strategy of long life and low annual reproductive effort would be expected to evolve under conditions of predictable and stable non-breeding environments (Sterns 1992). The life history strategy of the Steller's eider seems to fit this model. That is, the Steller's eider is long-lived, has low annual recruitment, and winters in apparently productive and reasonably stable near-shore marine environments. Because the Steller's eider is relatively small bodied and winters at northern latitudes, it may do so near the limits of its energetic threshold. Harlequin

ducks and long-tailed ducks exist near their energetic limit in such climates (Goudie and Ankney 1986), and the Steller's eider is intermediate in size to these two species. Therefore, environmental perturbations that reduce prey availability or increase the species energetic needs may result in harm. Fuels and oils are toxic to Steller's eiders' prey (e.g., amphipods and snails) (Newey and Seed 1995 as in Glegg et al. 1999, Finley et al. 1999), and to the species itself (Holmes et al. 1978, Holmes et al. 1979, McEwan and Whitehead 1980, Leighton et al. 1983, Holmes 1984, Leighton 1993, Rocke et al. 1984, Yamato et al. 1996, Glegg et al. 1999, Trust et al. 2000, Esler et al. 2000). Therefore, we believe that spilled petroleum is likely to adversely affect Steller's eiders.

Increased Risk of Lead Poisoning: Because this species continues feeding near the nesting site before and during incubation (D. Solovieva, pers. comm. 2000), it may be subjected to an increased risk of exposure to lead shot over other waterfowl species that largely forego feeding at this time. Spectacled eiders do not seem to engage in feeding activities as much as Steller's eiders once breeding has commenced, however, spectacled eiders have been observed to have higher rates of exposure to lead than any species sampled on the Y-K Delta (Flint et al. 1997). The proportion of spectacled eiders on the Y-K Delta's lower Kashunuk River drainage that contained lead shot in their gizzards was high (11.6%, N = 112) compared to other waterfowl in the lower 48 states from 1938-1954 (8.7%, N = 5,088) and from 1977-1979 (8.0%, N = 12,880). Blood analyses of spectacled eiders indicated elevated levels of lead in 13% of pre-nesting females, 25.3% of females during hatch, and 35.8% of females during brood rearing. Nine of 43 spectacled eider broods (20.9%) contained one or more ducklings exposed to lead by 30 days after hatch (Flint et al. 1997). Thus, if spectacled eiders have experienced population level effects on the Y-K Delta due to lead poisoning, then Steller's eiders may have experienced similar, or even greater lead-induced effects.

Collisions with Manmade Structures: Steller's eiders have been documented to collide with wires, communication towers, boats, and other structures. During a 4-year period near Barrow, one adult Steller's eider female died from striking a wire and another adult Steller's eider was suspected to have died from striking a radio tower (Quakenbush et al., 1995). In addition, large numbers of Steller's eiders are known to have collided with communication towers in the wintering area along the Alaska Peninsula. "Bird storms" are a well-documented occurrence within the commercial crab fishery fleet, a result of their use of bright lights during inclement nighttime weather. In December 1980 or 1981, "at least 150" dead eiders (species unknown) were reported to be on the deck of the M/V *Northern Endeavor* the morning after the vessel, with crab lights illuminated, anchored on the Bering Sea side of False Pass (Day 2001). Based on the time of year and location, we assume these to be Steller's eiders. Two Steller's eiders died after striking the crab lights of the P/V *Wolstad* on February 15, 1994; no additional information was provided with this report. One male Steller's eider landed on the deck of the *Elizabeth F* on February 14, 1997 at 11:36pm; another male Steller's eider struck the vessel and died the following day at 5:00pm. Three spectacled eiders died after striking a Coast Guard cutter

conducting sampling in the Bering Sea in March 2001. Between September 26, 2001 and October 29, 2001, the Northstar facility on the North Slope of Alaska experienced 18 sea duck mortalities and one sea duck injury due to collisions with facility infrastructure. Sixteen dead eiders of unknown species were found on October 28, 2001 on the Endicott spur drilling island. A complete search of fishery observer logbooks for additional data has not yet been completed. The actual number of birds injured and killed through collisions with manmade structures is likely higher; many injured and killed birds are believed to go undetected, unreported, or become scavenged before humans detect them.

Stochastic Events: The small population size of the Steller's eiders on the Y-K Delta and the Arctic Coastal Plain may put them at risk of the deleterious effects of demographic and environmental stochasticity. Demographic stochasticity refers to random events that effect the survival and reproduction of individuals (Goodman 1987) (e.g., shifts in sex ratios, striking wires, being shot, oil/fuel spills). Environmental stochasticity is due to random, or at least unpredictable, changes in factors such as weather, food supply, and populations of predators (Shaffer 1987). As discussed by Gilpen (1987), small populations will have difficulty surviving the combined effects of demographic and environmental stochasticity. The risk of local extirpation is probably highest for Steller's eiders nesting on the Y-K Delta due to the low number of birds that breed there.

The world population of Steller's eiders is probably not at high risk of extinction due to environmental stochasticity alone, but local groups of wintering birds may be vulnerable to starvation due to stochastic events (e.g. unusually heavy ice cover in their feeding habitats).

Allee Effect: "Allee effect" refers to the destabilizing tendency associated with inverse density-dependence as it relates to population size and birth rate. One form of this occurs when the ability to find a mate is diminished (Begon and Mortimer 1986). For example, if the sex ratio of a population significantly shifts from a normal condition for a species, the ability of adults to produce young may diminish. For the Steller's eider, the higher mortality rate of males (Flint et al. 2000) may result in a lower number of pairs returning to nest (i.e., adult females unable to find a mate are effectively removed from the breeding population).

The annual survival rate for Steller's eiders molting and wintering in Alaska is estimated to be 0.899% 0.032 (\pm SE) for females and 0.765% 0.044 (\pm SE) for males (Flint et al, 2000). At this estimated annual survival rate, about 39 percent of the females of a cohort will reach 10 years of age, while only about 7 % of the males will survive for 10 years.

The observed difference in annual survival between sexes may be manifesting itself in the skewed sex ratio of Steller's eiders observed during the winter of 1999/2000. Female Steller's eiders notably out-numbered male eiders on winter surveys of three areas during January, February, and March (LGL 2000a, LGL 2000b). In waters off Unalaska and False Pass, female

Steller's eiders comprised 63 and 69 percent, respectively, of Steller's eiders observed (N = 2,053 and 114 respectively) (John Burns, pers. comm. 2000, LGL 2000b). At Akutan Harbor, the combined female to male sex ratio for all surveys was approximately 3 to 1 (n = 590) (LGL 2000b). Furthermore, band recoveries reported by Dau et al. (2000) also suggest a shift in Steller's eider sex ratios through time (Table 4). This observation is in stark contrast to that which is typical for many other Anatinae, where an excess of males is the norm (Johnsgard 1994). If this excess of females exists throughout the species range (as opposed to just at the three locations for which we have data) then the biased sex ratio may have implications regarding reproductive potential. Although our limited observations and Dau et al's (2000) banding data suggest that a biased sex ratio exists for this species, our information comes from only a few locations within the species wintering range. We do not know if this biased sex ratio exists range wide, or what may be causing it.

Table 4. Shifting sex ratio of Steller's eiders at sample area No. 1 in Izembek Lagoon. Data used are from Dau et al. (2000).

Years	Female	Male	Sample Size	Percent Male
1961-1966	271	566	837	68%
1968	60	85	145	59%
1974-1981	3576	2197	5773	38%
1991-1997	5971	708	6679	11%

Analysis of the Species Likely to be Affected

In summary, decreasing numbers range wide, highly variable reproductive success, winter distribution patterns, suggested fidelity for wintering habitats, and toxic effects of exposure in waterfowl to petroleum compounds all combine to make the Steller's eider vulnerable to the effects of the proposed construction and operation of a public dock and associated fueling facilities.

ENVIRONMENTAL BASELINE

The "environmental baseline" section summarizes the effects of past and present human and natural phenomena on the current status of threatened and endangered species and their habitat in the action area. The information presented here establishes the baseline condition for natural resources, human usage, and species usage in the action area that will be used as a point of comparison for evaluating the effects of the proposed action.

Defining the action area of the proposed action is integral to analyzing the effects of past, present, and future actions as well as the proposed action. The action area should be determined based on consideration of all direct and indirect effects of the proposed action, and other activities that are interrelated or interdependent with that action, on the species and/or its critical habitat. Indirect effects are those that are caused by the proposed action and are later in time, but are reasonably certain to occur. The action area includes all areas that may be affected directly or indirectly by the activities associated with construction of the proposed public dock.

Assumptions Used in Analysis of Past, Present and Future Effects

Patterns of Petroleum Releases

Patterns and conclusions suggested by Day's and Pritchard's (2000) summary of existing information on fuel spills in or near 10 harbors between January 1990 and November 1999 provide basis for the following assumptions regarding future patterns of petroleum releases within the action area.

Spill reporting during the 1990s revealed that the number of reported spills varied dramatically among locations. Spills were most often reported at larger harbors such as Akutan Harbor, Dutch Harbor/Unalaska, and St. Paul Island. In contrast, spills were rarely reported at locations such as Chignik Bay and Perryville; however, when they occurred they were substantial in size. Considering that an estimated 65% of petroleum released into marine waters is due to chronic discharges, and the remaining 35% to massive spills (Maccarone and Brzorad 1994), we assume that some underreporting occurs at all locations, and that petroleum releases are reasonably certain to occur.

Data indicated that 97% of all reported spills affected water, leading to our assumption that when material is spilled into the environment, marine waters will be most affected.

Both the highest number of spills and the greatest amount of material spilled resulted first from operator error (49% of all spills with known cause) and second from equipment failure (34%). Additionally, most releases appeared to occur during refueling operations. These facts led to the following three assumptions: first, that fueling stations represent a significant source of chronic petroleum contamination; second, that improved fueling standards and institution of best management practices may decrease rates of product loss; and third, that equipment failure and operator error will cause product losses from fueling infrastructure located outside secondary containment.

At only 2% of all measured material spilled, bilge and waste oil was only a minor component of

reported spills. However, it represented 6% of all spills of known type. As a result, we assume that contaminated bilge water discharge represents a potential source of chronic exposure to petroleum compounds.

Diesel fuel accounted for 89% of all measured material spilled and 68% of all spills of known type; thus, we assume that diesel fuel will constitute the majority of material likely to be spilled at docking facilities.

The frequency of spills according to spill-size category, in descending order, was 1.1 to 15 gallons (42% of all spills), 15.1 – 499 gallons (30% of all spills), trace to one gallon (25% of all spills), and spills in excess of 499 gallons (1% of all spills). Therefore, we assume that large spills are rare and sporadic, and that most discharges will be less than 499 gallons.

Proportion of Wintering Birds from Listed Population

We are assuming that 3.0 percent of all Steller's eiders observed on the wintering grounds in Alaska are from the listed Alaska breeding population. This estimate derives from our three most recent spring migration surveys for our total population estimate (82,560 birds) (Larned 2000b), and the highest point estimate of nesting Alaskan birds (2,524 birds) (Table 2). Both are conservative estimates and, thus, are negatively biased to an unknown degree.

Boundaries of Action Area

In a 15-knot wind and water temperatures of 40 degrees Fahrenheit, only 35% of spilled fuel will evaporate in four hours, the duration of tidal movement between high and low tide. Sixty-five percent of the spilled fuel will remain through the entire cycle. Therefore, we assume that maximum potential drift of oil during one tidal cycle from contamination source defines the action area.

Determination of Action Area

Currents and prevailing winds must both be considered when determining the area at risk due to petroleum spills. Specific information on climatic and marine conditions in Anchorage Bay is lacking. Along the southern side of the Alaska Peninsula, prevailing ocean currents flow westward; however, tidal velocities, eddy effects, and wind speed and direction may affect local conditions. Wind direction in Anchorage Bay is most likely controlled by topography, depending on weather systems dominating the region. During the winter, when eiders are present in the area, wind flows from the north towards the Alaska Peninsula, and then most likely follows the topographical features around Black Lake, Chignik Lake, and Chignik Mountain to enter Anchorage Bay from a southwesterly direction. The average speed of surface winds in

Kodiak and Sand Point, where we have site-specific climate data, are 9.2 knots and 12.0 knots, respectively (Brower et al. 1988). We averaged wind velocities at these two sites to arrive at an annual average wind speed of 10.6 knots for Chignik Bay. We assume that wind is the primary force generating surface currents and dictating oil movement on the water. Currents generated at the water surface from wind are approximately 3% of the wind speed (U.S. Fish and Wildlife Service, unpub. info.). Based on a 10.6-knot wind, the maximum potential drift of oil due to wind-generated currents alone during one tidal cycle in Chignik Bay would be 1.3 nm $[(4h)(10.6\text{nm}/h*0.03)]$. Therefore, the action area is comprised of the proposed public dock facility and all marine waters within a 1.3 nm radius of the dock site.

Status of the Species Within the Action Area

Steller's eider surveys by land and air were conducted in December 1999 and January 2000 (USACOE 2000) and February and March 2000 (Larned 2000).

A high count of 104 Steller's eiders were observed on December 16, 1999, during land-based surveys conducted by the U.S. Army Corps of Engineers (COE) between December 13 and 17, 1999 (USACOE 2000). Similar surveys conducted January 10 through 16, 2000, resulted in a high count of 171 on January 14, 2000. On both occasions, the majority of eiders were observed in the area between the Norquest and Chignik Pride docks (46% of all eiders observed on Dec 13, 1999 and 88% on January 10, 2000).

The Service conducted aerial shoreline surveys of areas in the vicinity of six proposed harbor projects in southwest Alaska. Anchorage Bay was surveyed February 14 and March 11, 2000. The total estimates for all project survey areas were 6,988 and 2,749 in February and March, respectively. A total of 50 Steller's eiders were observed in the action area of the proposed project during each of the Anchorage Bay surveys.

Based on the high estimate of 171 Steller's eiders in Anchorage Bay (USACOE 2000), we estimate that at least five birds of the listed population may be present in the action area of the proposed project.

Wintering Steller's eiders occupy shallow, near-shore marine waters, usually within 400 m of shore and in water less than 10 m (30 ft) deep, where they feed on the associated invertebrate fauna and underlying benthic organisms. Review of aerial photographs reveals that Steller's eider winter habitat appears to be limited in Anchorage Bay, primarily restricted to the several small deltas in the area. This underscores the relative importance of each intertidal area.

Factors Affecting Species' Environment Within the Action Area

Petroleum Spills: Between 1990 and 1999, five spills were reported in Chignik Bay including a single release of 500 gallons in 1998 due to operator error (Day and Pritchard 2000). A total of 620 gallons were reported spilled for the 10-year period of review. The average spill size in Chignik Bay was 145 gallons, and 1% of all spills occurred there. Future releases were estimated to be approximately 49.5 gallons annually.

EFFECTS OF THE ACTION

“Effects of the action” refers to the direct and indirect effects of the action on the species or its critical habitat. The effects of the action will be evaluated together with the effects of other activities that are interrelated or interdependent with the action. These effects will then be added to the environmental baseline in determining the proposed action’s effects to the species or its critical habitat (50 CFR Part 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

Factors to be Considered

Proximity of the Action

At least 171 Steller’s eiders have been observed within the action area of the proposed project (USACOE 2000). Although the action area contains eider foraging and resting habitat, this habitat has not been designated as Critical Habitat.

Distribution

Direct effects of dock construction will be limited to the 4.5-acre footprint. Indirect effects could occur in marine waters within 1.3 nm.

Timing

Although Steller’s eiders are not present in the action area during the summer when construction of the proposed dock is anticipated to occur, they are present in Anchorage Bay between November and March, when construction activity within the dock infrastructure may be occurring.

Nature of the Effect

Direct effects are anticipated due to construction of the public dock include the loss and degradation of Steller's eider foraging areas. Construction of the dock will result in the direct loss of habitat where Steller's eiders were observed foraging during the winter of 1999/2000. Indirect effects are anticipated as a result of the accidental release of petroleum products from vessels associated with the dock and proposed fueling facilities. As previously discussed, accidental petroleum releases can adversely effect the Steller's eider through either contamination of feathers, direct consumption of petroleum (e.g., during preening), contamination of food resources, or reduction in prey availability. Oiling of birds may result in sickness or death, or impaired physiological function.

Duration

The loss of foraging habitat due to construction of the harbor is anticipated to be permanent. The potential for accidental releases of petroleum to adversely affect Steller's eiders is anticipated to exist for as long as the public dock is operational.

The potential for petroleum to adversely affect Steller's eiders represents a chronic event that is anticipated to exist for as long as vessels use the dock facility and fueling stations are in operation. Petroleum products released into the marine environment may have both acute and chronic adverse effects. Anticipated adverse effects range from changes in prey abundance, distribution, and diversity, to the ingestion of acutely and chronically toxic levels of petroleum.

Disturbance Frequency

Construction of the dock represents a one-time disturbance event. However, according to Day and Pritchard (2000), an average of 0.9 petroleum spills (average size 145 gallons) per year were reported for Chignik Bay in the 1990s.

Disturbance Intensity

The intensity of the disturbance is a function of the species' status both before and after the disturbance. We know foraging habitat will be destroyed through construction of the dock. Currently, limited information makes the effects resulting from habitat degradation or physiological effects of chronic exposure to oil difficult to quantify and predict. Acute effects resulting from direct external contact with oil can be more easily estimated by the application of spill trajectory analysis and known eider distribution; predictions of these events may be based on historical data. The gregarious behavior of Steller's eiders may result in large numbers of birds being affected by relatively small spills.

Disturbance Severity

The severity of the disturbance is a function of the species' recovery rate. Any disturbance event that affects the species' ability to recover through decreased reproductive potential would be considered severe. Not only do Steller's eiders show high fidelity for specific molting sites within lagoons (Flint et al. 2000), but preliminary evidence also suggests that Steller's eiders show high within-season wintering site fidelity (Philip Martin, Service, pers. comm., Paul Flint, USGS, pers. comm.). Suitable wintering habitat may be limited for Steller's eiders. In fact, over-winter starvation resulting from displacement from feeding areas is thought to be a contributing factor to mass mortality of common eiders in the Wadden Sea (Camphuysen 2000). This suggests that, in some cases, alternative foraging areas of sufficient quality may not be available for wintering eiders. In short, eiders displaced by habitat destruction resulting from dock construction may not be able to simply relocate without being harmed.

High site fidelity also places Steller's eiders at increased risk of chronic and acute exposure to petroleum compounds where their wintering habitat and industrial developments overlap. Once oiled, feathers lose their water repellency, reducing the ability of eiders to maintain body heat. Immune defenses, survival and almost all aspects of reproduction may be affected by the ingestion of petroleum, either while preening or through consumption of contaminated food resources. Moreover, the availability of prey may be reduced by the introduction of petroleum products into the marine environment.

Analyses for Effects of the Action

This section analyzes the direct and indirect effects of the proposed and all interrelated and interdependent actions identified in the Environmental Baseline section. This includes a discussion of any beneficial effects anticipated to occur as a result of the proposed action.

Interrelated and Interdependent Actions

Actions that are interrelated or interdependent with the proposed construction of a public dock in Chignik include vessel use of the dock and operation of a new fueling station. Potential adverse effects resulting from dispensing of fuel at the fueling stations and releases from facility infrastructure without secondary containment must be included in our analysis of the effects of the proposed action.

Beneficial Effects

Beneficial effects are those effects of an action that are wholly positive, without any adverse effects, on a listed species or designated critical habitat. Although the construction and operation

of the public dock will have no wholly beneficial effect on the Steller's eider, measures included with the project description will likely minimize its affect on this threatened species. There are no known wholly beneficial effects of this project with regard to Steller's eiders.

Direct Effects

The construction of the public dock facility will result in a permanent loss of 4.5 acres of near-shore habitat that is known to be used by wintering Steller's eiders, and which may also be used by transient and migrating Steller's eiders. Construction activities are scheduled to occur during summer when eiders are not present; therefore, no take is anticipated to occur due to displacement of birds from foraging habitat during construction activities.

Indirect Effects

Acute and Chronic Exposure to Petroleum Compounds: An increase in the risk of both acute and chronic exposure to petroleum compounds is anticipated to result from releases of petroleum compounds during fueling operations and from vessel activity associated with the dock facility. Acute exposure due to direct contact with surface oil may result in sickness, death, or impaired physiological function. Chronic exposure to petroleum compounds through contaminated food sources may have sub-lethal effects on reproductive success, immune system function, and overall condition.

Results of spill trajectory modeling in Anchorage Bay indicated that in a 20-knot wind, discharged oil would travel a minimum of 1.3 nm by wind alone before its trajectory was disrupted by land, regardless of volume spilled. The sheen dimensions of an average size spill (145 gallons) in Chignik Bay would be approximately 100 m by 10 m (John Whitney, NOAA, personal communication, 2001). The point of entry for spilled fuel is the proposed dock facility. Since the majority of Steller's eiders were observed within approximately 150 m of shore during the December and January 2000 surveys (USACOE 2000), we anticipate that birds observed within closest proximity to this point of entry are at most risk of acute or chronic exposure to petroleum compounds. Our understanding of Steller's eider distribution in Anchorage Bay is cursory, and available information lacks details including flock size and specific locations. However, data do suggest that eiders in Anchorage Bay are strongly associated with available delta habitats located at the head of the bay. On January 14, 2000, the COE observed 150 Steller's eiders between the Chignik Pride dock and Norquest dock, in the vicinity of location for the proposed dock facility (Fig. 1). Because it is assumed that one of 34 Steller's eiders, that winter in Alaska (the listed entity), also breed in Alaska, total take anticipated to occur due to acute and chronic exposure to petroleum compounds over the life of the project (30 to 50 years) as a result of the proposed action is four Steller's eiders belonging to the listed Alaska breeding population.

Species' Response to Proposed Action

Numbers of Individuals in the Action Area Affected

Limited surveys indicated that at least 171 Steller's eiders use waters within the action area that is likely to be affected by the proposed project. Current winter population estimates of Steller's eiders using these waters do not include birds those that occur here during spring and fall migration. Thus, it is unlikely that our limited observations represent the maximum number of eiders that use Anchorage Bay.

Sensitivity to Change

Steller's eiders' behavior changes with changing environmental conditions. They have been observed foraging in close proximity to human structures, including docks, and homes. However, it has also been reported that they usually maintain a distance of at least 100 meters from humans themselves. We do not anticipate total abandonment of areas due to the physical presence of structures associated with the proposed project, but anticipate some level of disturbance due to the human activity associated with the proposed project.

Resilience

Little information exists regarding the resilience of this species to perturbations. The world population has declined by 80% from 1,000,000 in the 1940's, (Tugarinov 1941 as in Solovieva 1997) to 200,000 in 1994 (Solovieva 1997). Extensive banding efforts and aerial survey efforts over the past decade indicate that the trend for the world population continues to decline (Flint et al. 2000, Larned 2000b). Lack of resilience due to low fecundity, low recruitment, excessive adult mortality, and other unknown causes may be contributing to their continued decline.

Recovery Rate

The natural recovery rate of Steller's eiders is not known. Long-lived species with low annual fecundity have a relatively slow recovery rate compared to short-lived species with high annual fecundity. Given the Steller's eider's observed low fecundity (i.e., small clutch sizes, high variability in nesting attempts, and generally low nest success) (Quakenbush et al. 1995, D. Solovieva, pers. com. 2000), the recovery rate for this species is believed to be quite slow.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

According to the concept design report for the new Chignik tank farm facility (AEE 2001), planned near-term infrastructure improvement projects include, school additions, village utility upgrades, and new homes. Some developments may affect Steller's eiders, such as the expansion of community infrastructure, and any non-Federal activities directly impacting intertidal habitats. Effects to eiders of these projects may include direct habitat loss, increased risk of acute and chronic exposure to environmental contaminants, increased risk of bird strikes, and habitat degradation.

CONCLUSION

Steller's eiders at Chignik Bay represent 0.2% of the listed Alaska population. This value was derived by dividing the maximum number of birds seen, within the action area, that are believed to be from the Alaska population ($171 \times 0.03 = 5$) by the most current population estimate for the Alaskan population of this species (2,524). Based on this information in conjunction with the current status of the Alaskan breeding population of Steller's eiders, the environmental baseline for the action area, the cumulative effects, and the effects of the proposed action, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the species.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as

part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be required of the project participant so that they become binding conditions of any grant or permit issued, as appropriate, for the exemption in section 7(o)(2) to apply. As the originating grantor for this public dock facility, the COE has a continuing duty to regulate the activity covered by this incidental take statement. If the COE (1) fails to assume and implement the terms and conditions or (2) fails to require any applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the COE or any applicant must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR 402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE

We anticipate that incidental take of Steller's eiders will be difficult to document because: 1) Steller's eiders exposed to petroleum levels that are not immediately lethal may not die near the location of contact; 2) Steller's eiders exposed to sub-lethal levels of petroleum will not exhibit readily apparent signs of toxicity; 3) impacts to prey abundance and distribution from released petroleum products will not be readily apparent; 4) the extent to which petroleum contamination can be attributed to the proposed action will be difficult or impossible to determine, and 5) the actual number of Steller's eiders belonging to the Alaska breeding population at this site is uncertain.

The Service will not refer the incidental take of any migratory bird or bald eagle for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. §§ 703-712), or the Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. §§ 668-668d), if such take is in compliance with the terms and conditions (including amount and/or number) specified herein.

Take Related to Acute and Chronic Exposure to Petroleum Compounds: The Service anticipates that petroleum releases will occur in association with vessel operation associated with the public dock facility and the legal operation of the fueling stations due to operator error and equipment failure. This recognition by the Service is not intended to legitimize the otherwise illegal act of releasing petroleum into the environment. We estimate that no more than four Steller's eiders of the listed Alaska breeding population will be taken as a result of petroleum releases originating at the fueling facilities associated with the public dock over the 30-35 year life of the project. This take is expected to be in the form of harm or direct lethal take.

We are currently unable to distinguish between North American breeding Steller's eiders and Steller's eiders that breed elsewhere when the birds are present on their molting or wintering areas. Future research may enable us to distinguish between listed and non-listed populations. Absent such capabilities, we will consider the expected take levels associated with this Incidental Take Statement to have been exceeded if any of the following occur:

1. Greater than four Steller's eiders belonging to the listed Alaska breeding population are harmed or killed within the 30-50 year life of the public dock facility as a result of petroleum releases that can reasonably be attributed to the public dock infrastructure; or,
2. Greater than 150 Steller's eiders are harmed or killed within the 30-50 year life of the public dock facilities as a result of petroleum releases that can reasonably be attributed to the public dock infrastructure.

Effect of the Take

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the Steller's eider.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of Steller's eider:

1. The COE shall ensure that impacts to Steller's eiders are minimized during construction of the public dock facilities.
2. The COE shall ensure that impacts to Steller's eiders are minimized during operation of the public dock facilities.
3. The COE shall ensure that impacts to Steller's eiders are minimized during operation of the fueling stations associated with the public dock infrastructure.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of Section 9 of the ESA, the COE must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline reporting and monitoring requirements. These terms and conditions are non-discretionary.

1. The following Terms and Conditions implement Reasonable and Prudent Measure No. 1: "The COE shall ensure that impacts to Steller's eiders are minimized during construction of the public dock facilities."

- 1.1. Project participants shall ensure that all construction activities that may harm or harass Steller's eiders shall occur prior to the birds' arrival in the fall or after their departure in the spring. We estimate the arrival date to be November 15, but construction activities that may harass Steller's eiders shall cease as soon as eiders are observed in Anchorage Bay. We estimate the date of departure from the area to be March 30. However, upon concurrence of the Ecological Services Anchorage Field Office, construction activities may commence anytime after February 28th, provided that no Steller's eiders have been observed, by a trained observer, within 200 meters of the construction site for seven days prior to the commencement of construction. Project participants shall immediately notify the Field Office of the presence of any Steller's eider that is observed from the project area during construction.
2. The following terms and conditions implement Reasonable and Prudent Measure No. 2:
"The COE shall ensure that impacts to Steller's eiders are minimized during operation of the public dock facilities."
 - 2.1. Project participants shall design, produce, and install information signs for the purpose of minimizing potential impacts of development on Steller's eiders. One sign must address the effects of oil on the marine environment, ways that the public can prevent and reduce fuel spills, and that discharging oil is illegal. The other sign will give background information on Steller's eiders and their use of the surrounding area. Design, content, text, number, and placement of the signs will be developed in cooperation with the U.S. Fish and Wildlife Service. Signs shall be completed and installed by September 1 of the year the construction of the public dock is completed.
 - 2.2. Project participants shall include in the Facility Response Plan a discussion of the specific primary, secondary and tertiary response measures to be used to minimize effects to Steller's eiders and eider habitat in the event of a fuel spill. Contact the Ecological Services Anchorage Field Office (271-1467) for accepted protocols. The Facility Response Plan should also identify any contractor to be bonded for wildlife rehabilitation if required by regulations. The selected contractor should have, at a minimum, a Federal Permit for Migratory Bird Rehabilitation and appropriate training. A copy of the plan must be submitted to the Service for our records prior to the initiation of dock construction.
 - 2.3. The COE shall install waste oil, oiled rag, and oil filter receptacles near the on-shore entrance to the dock and shall include as a permit condition that the project participants shall maintain these waste oil receptacles, properly disposing of its contents, for the life of the project.
3. The following terms and conditions implement Reasonable and Prudent Measure No. 3:
"The COE shall ensure that impacts to Steller's eiders are minimized during operation of fueling stations associated with the public dock infrastructure."
 - 3.1. The COE shall require the local project sponsor to obtain two cases of fuel collars (100 collars/case) and to provide them to be used on fuel nozzles at fueling facilities associated with the public dock. The fuel collars shall be available for use no later than

September 1 of the year construction of the fueling facility is completed.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities whose purpose is to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. The COE will join with the Service, the Denali Commission (as per Conservation Recommendations specified in Chignik bulk fuel facility upgrade Biological Opinion) and their project participants to implement boat or aerial surveys to precisely delineate Steller's eider distribution in the action area, thereby allowing for improved oil spill response planning. Weather permitting, a qualified individual would conduct the surveys between November 15 and March 31 according to accepted Service protocol. The area to be surveyed (the action area) would be that area potentially impacted by an oil discharge in one tidal cycle based on average wind speed and direction and average current speed and direction for both ebb and flood tides. Within 30 days of survey completion, the information from individual surveys shall be provided to the Service.

REINITIATION NOTICE

This concludes formal consultation on the proposed action. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this biological opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this biological opinion; or (4) a new species not covered by this opinion is listed or critical habitat designated that may be affected by this action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take should cease pending reinitiation.

LITERATURE CITED

ABR, Inc. 1999. Results of Steller's eider surveys near Barrow, Alaska. Prepared for U.S. Fish and Wildlife Service, Fairbanks, Alaska.

Agler, B. A., S. J. Kendall, P. E. Seiser, and D. B. Irons. 1994. Monitoring seabird populations in areas of oil and gas development on the Alaskan Continental Shelf: Estimates of marine bird and sea otter abundance in lower Cook inlet, Alaska, during summer 1993 and winter 1994.

Alaska Energy and Engineering, Inc. 2001. Concept design report and construction cost estimate for consolidation and renovation of fuel storage and handling facilities in the community of Chignik Bay. Unpublished report prepared for State of Alaska, Alaska Energy Authority/Rural Energy Group. P.O. Box 111405, Anchorage, Alaska 99511.

Andersen, R. M. 1913. Arctic game notes. Distribution of large game animals in the far North: extinction of the musk ox; the chances for survival of moose and caribou; mountain sheep, polar bear and grizzly. *Natural History* vol 13. p. 5-21.

Anderson et al. 1992. Philopatry, dispersal and the genetic structure of waterfowl populations. Pages 365-395 in B. D. J. Batt, A. D. Afton, M. G. Anderson, C. D. Ankney, D. H. Johnson, J. A. Kadlec, and G. L. Krapu (eds.), *Ecology and management of breeding waterfowl*. University of Minnesota Press, Minneapolis.

Begon, M. and M. Mortimer. 1986. *Population ecology: a unified study of animals and plants*. 2nd ed. Blackwell Scientific Publications. Cambridge, MA.

Bellrose, F. C. 1980. *Ducks, geese and swans of North America*. A wildlife management institute book sponsored jointly with the Illinois Natural History Survey. Stackpole Books, PA.

Bengtson, S. A. 1972. Breeding ecology of the harlequin duck (*Histrionicus histrionicus*) in Iceland. *Ornis Scand.* 3:1-19.

Bent, A. C. 1987. *Life Histories of North American waterfowl*. Two parts bound as one. Dover Publications, Inc., New York.

Brackney, A. W. and R. J. King. 1996. Aerial breeding pair surveys of the arctic coastal plain of Alaska: Distribution and abundance 1995. U. S. Fish and Wildlife Service, Migratory Bird Management.

Brandt, H. 1943. *Alaska bird trails*. Cleveland: Bird Research Foundation. 464 p.

- Brooks, W. S. 1915. Notes on birds from east Siberia and arctic Alaska. *Bulletin of the Museum of Comparative Zoology*. Harvard University. v. 59, no. 5, p. 361-413.
- Brower, W.A., R.G. Baldwin, Jr., C.N. Williams, Jr. 1988. Climatic atlas of the outer continental shelf waters and coastal regions of Alaska / NCDC. AEIDC, James L. Wise, Lynn D. Leslie. Anchorage : AEIDC, University of Alaska.
- Bustnes, J. O., M. Asheim, T. H. Bjorn, H. Gabrielsen, and G. H. Systad. 2000. The diet of Steller's eiders wintering in Varangerfjord, Northern Norway. *Wilson Bull.*, 112(1):8-13.
- Camphuysen, K. 2000. Mass mortality of Common Eiders in the Wadden Sea, winter 1999/2000: food related parasite outbreak? *Atlantic Seabirds* 2:47-48.
- Cooke, F., G. J. Robertson, C. M. Smith, R. I. Goudie, and W. S. Boyd. 2000. Survival, emigration and winter population structure of harlequin ducks. *Condor* 102:137-144.
- COE. 2000. Sand Point Trip Report, Steller's Eider Surveys Nos. 1 and 2. Unpublished memorandum for record. CEPOA-EN-CW-ER (1105-2-10b). U.S. Army Corps of Engineers, Alaska District, Anchorage.
- COE. 2002. Biological Assessment of Steller's Eider (*Polysticta stelleri*) for 2-2000-0641, Chignik Bay 5. Unpublished Report. U.S. Army Corps of Engineers, Anchorage, AK 99503.
- Conover, H.B. 1926. Game birds of the Hooper Bay region, Alaska. *Auk* 43: 162-180.
- Dau, C. P. 1987. Birds in nearshore waters of the Yukon-Kuskokwim Delta, Alaska. *Murrelet*, vol. 68, no. 1, p. 12.
- Dau, C.P. 1991. Population size and migratory phenology of Soviet breeding Steller's eiders at the Izembek National Wildlife Refuge, (Abstract), Alaska Bird Conference and Workshop, 19-22 November 1991. Anchorage AK.
- Dau, C. P., P. L. Flint, and M. R. Petersen. 2000. Distribution of recoveries of Steller's eiders banded on the lower Alaska Peninsula, Alaska. *In Press*. *J. Field Ornithology*.
- Day, R. H. and A. K. Pritchard. 2000. Task 2C. Estimated future spills. Prepared for the U.S. Army Engineer District, Alaska. ABR, Inc., Fairbanks, Alaska.
- Dick, M.H. and L.S. Dick. 1971. The natural history of Cape Pierce and Nanvak Bay, Cape Newenham National Wildlife Refuge, Alaska. USFWS Unpublished Report., Bethel, Alaska. 77pp.

- Dow, H., and S. Fredga. 1983. Breeding and natal dispersal of the goldeneye (*Bucephala clangula*). *J. Anim. Ecol.* 53:679-692.
- Esler, Daniel, J. A. Schmutz, R. L. Jarvis, and D. M. Mulchay. 2000. Winter survival of adult female harlequin ducks in relation to history of contamination by the Exxon Valdez oil spill. *J. Wildl. Manage.* 64(3):839-847.
- Fay, F.H., and T.J. Cade. 1959. An ecological analysis of the avifauna of St. Lawrence Island Alaska. *Univ. Calif. Public. In Zool.* 63(2):73-150. Berkeley, CA.
- Finley, D. B., G. I. Scott, J. W. Daugomah, S. L. Layman, L. Reed, M. Sanders, S. K. Sivertsen, E. D. Strozier. 1999. Case study: Ecotoxicological assessment of urban and agricultural nonpoint source runoff effects on the grass shrimp, *Palaemonetes pugio*, p. 243-273. In M. A. Lewis, F. L. Mayer, R. L. Powell, M. K. Nelson, S. J. Klaine, M. G. Henry, and G. W. Dickson [eds], *Ecotoxicology and Risk Assessment for Wetlands*. A special publication of SETAC
- Flint, P.L. and Herzog, M P. 1999. Breeding of Steller's Eiders, *Polysticta stelleri*, on the Yukon-Kuskokwim Delta, Alaska. *Canadian Field-Naturalist.* 113(2):306-308.
- Flint, P. L., M. R. Petersen, and J. B. Grand. 1997. Exposure of spectacled eiders and other diving ducks to lead in western Alaska. *Can. J. Zool.*
- Flint, P. L., M. R. Petersen, C. P. Dau, J. E. Hines, J. D. Nichols. 2000. Annual survival and site fidelity of Steller's eiders molting along the Alaska Peninsula. *J. Wildl. Manage.* 64(1):261-268.
- Gabrielson, I.N., and Lincoln, F.C. 1959. *The birds of Alaska*. Harrisburg: Stackpole CO 922 p.
- Gill, R.E., Jr., M.R. Petersen, and P.D. Jorgensen. 1981. Birds of the northcentral Alaska Peninsula, 1976-1980. *Arctic*, 34:286-306.
- Gillham, C.E. 1941. Report of Alaska waterfowl investigations, Lower Yukon River, Chevak, Hooper Bay. Unpubl. Report, U.S. Department of Interior, Fish and Wildlife Service, Juneau, Alaska. Available at the U.S. Fish and Wildlife Service Library, 10911 E. Tudor Road, Anchorage, Alaska 99503.
- Gilpen, M. E. 1987. Spatial structure and population vulnerability, p. 125-139, in M. E. Soule, editor. *Viable populations for conservation*. Cambridge University Press, New York.
- Glegg, G. A., L. Hickman, and S. J. Rowland. 1999. Contamination of limpets (*Patella vulgator*) following the Sea Empress oil spill. *Marine Pollution Bulletin*. Vol. 38. No. 2:119-125.

Goodman, D. 1987. The demography of chance extinctions. Pages 11-34, in M. E. Soule, editor, *Viable populations for conservation*. Cambridge University Press, New York.

Goudie, R. I., and C. D. Ankney. 1986. Body size, activity budgets, and diets of sea ducks wintering in Newfoundland. *Ecology* 67:1475-1482.

Hodges, J. I., J. G. King, B. Conant, and H. A. Hanson. 1996. Aerial surveys of waterbirds in Alaska 1957-94: Population trends and observer variability. U. S. Department of the Interior. National Biological Service.

Holmes, W. N. 1984. *Reviews in environmental toxicology 1*. Editor Ernest Hodgson, North Carolina State University. Elsevier Science Publishers, New York.

Holmes, W. N., J. Cronshaw, and J. Gorsline. 1978. Some effects of ingested petroleum on seawater-adapted ducks (*Anas platyrhynchos*). *Environmental Research*. 17:177-190.

Holmes, W. N., J. Gorsline, J. Cronshaw. 1979. Effects of mild cold stress on the survival of seawater-adapted mallard ducks (*Anas platyrhynchos*) maintained on food contaminated with petroleum. *Environmental Research*. 20:425-444.

Johnsgard, P. A. 1994. *Arena birds, sexual selection and behavior*. Smithsonian Institution Press, Washington and London.

Jones, R. D. 1965. Returns from Steller's eiders banded in Izembek Bay, Alaska. *Wildfowl Trust* 16:83-85.

Kertell, K. 1991. Disappearance of the Steller's eider from the Yukon-Kuskokwim Delta, Alaska. *Arctic* 44:177-187.

Laing, K. 1995. A pilot survey to determine distribution and abundance of Steller's eiders on the Alaska Arctic Coastal Plain. U.S. Fish and Wildlife Service, Migratory Bird Management.

Lande, R., and G. F. Barrowclough. 1987. Effective population size, genetic variation, and their use in population management. Pages 87-123, in M. E. Soule, editor. *Viable populations for conservation*. Cambridge University Press, New York.

Larned, W. W. 1998. Steller's eider spring migration Surveys, 1998. U.S. Fish and Wildlife Service, Migratory Bird Management.

Larned, W. W. 2000a. Steller's eider spring migration surveys, 2000. U.S. Fish and Wildlife Service, Migratory Bird Management.

Larned, W. W. 2000b. Aerial surveys of Steller's eiders and other waterbirds and marine mammals in southwest Alaska areas proposed for navigation improvements by

- the U.S. Army Corps of Engineers, Alaska. U.S. Fish and Wildlife Service, Migratory Bird Management.
- Larned, W. W., and G. Balogh. 1996. Eider breeding population survey, Arctic coastal plain, Alaska, 1992-96. U. S. Fish and Wildlife Service.
- Larned, W. W., B. Butler, and G. Balogh. 1993. Progress report: Steller's eider spring migration surveys southwest Alaska, 1993. U. S. Fish and Wildlife Service, Migratory Bird Management Project.
- Larned, W. W. and T. Tiplady. 1996. Distribution and abundance of sea ducks in Kuskokwim Bay, Alaska, September 1996. Migratory Bird Management, U.S. Fish and Wildlife Service.
- Larned, W. W., T. Tiplady, R. Platte, and R. Stehn. 1999. Eider breeding population survey Arctic coastal plain, Alaska, 1997-98. U. S. Fish and Wildlife Service, Migratory Bird Management.
- Larned, W. W. and D. Zwiefelhofer. 1995. Distribution and abundance of Steller's eiders (*Polysticta stelleri*) in the Kodiak Archipelago, Alaska, March 1994. 18pp.
- Laubhan, M.K. and Metzner, K.A. 1999. Distribution and diurnal behavior of Steller's Eiders wintering on the Alaska Peninsula. *Condor*. 101(3): 694-698.
- Leighton, F. A. 1993. The toxicity of petroleum oils to birds. *Environmental Review*. Vol.1:92-103
- Leighton, F. A., D. B. Peakall, and R. G. Butler. 1983. Heinz-body hemolytic anemia from the ingestion of crude oil: A primary toxic effect in marine birds. *Science*. 220:271-273.
- LGL Alaska Research Associates, Inc. 2000a. Abundance and distribution of Steller's eiders and other waterbirds at False Pass, Alaska, January through March of 2000.
- LGL Alaska Research Associates, Inc. 2000b. Steller's eider and other waterbird numbers and distribution at Akutan Harbor, Alaska, Winter of 1999/2000.
- Maccarone, A.D., and J.N. Brzorad. 1994. Gull and waterfowl populations in the Arthur Kill. Pp. 201-214 *In* J. Burger ed. *Before and after an oil spill: the Arthur Kill*. Rutgers University Press, New Brunswick, NJ.
- Mallek, E. J., and R. J. King. 1999. Aerial breeding pair surveys of the Arctic coastal plain of Alaska. U.S. Fish and Wildlife Service.
- Martin, P. D. and T. Obritschkewitsch. Distribution and abundance of Steller's eiders in northern Alaska. Unpublished Information. U.S. Fish and Wildlife Service.

- Metzner, K. A. 1993. Ecological strategies of wintering Steller's eiders on Izembek Lagoon and Cold Bay, Alaska. A Thesis presented to the faculty of the Graduate School, University of Missouri, Columbia.
- McEwan, E. H. and P. M. Whitehead. 1980. Uptake and clearance of petroleum hydrocarbons by the glaucous-winged gull (*Larus glaucescens*) and the mallard duck (*Anas platyrhynchos*). Canadian Journal Zoology. 58:723-726.
- Murie, O.J. 1959. Fauna of the Aleutian Islands and Alaska Peninsula. U.S. Fish and Wildlife Service, North Amer. Fauna Ser. No. 61. Washington, D.C.
- Petersen, M. R. 1980. Observations of wing-feather molt and summer feeding ecology of Steller's eiders at Nelson Lagoon, Alaska. Wildfowl 31:99-106.
- Petersen, M. R. 1981. Population, feeding ecology and molt of Steller's eiders. Condor 83:256-262.
- Petersen, M.R. and M.J. Sigman. 1977. Field studies at Cape Pierce, Alaska – 1976. P. 633-693. In Environmental Assessment of the Alaskan Continental Shelf, Annual reports of Principal Investigators, V. 4, NOAA, Boulder, CO.
- Petersen, M. R, D. N. Weir, and M. H. Dick. 1991. Birds of the Kilbuck and Ahklun Mountain Region, Alaska. U. S. Fish and Wildlife Service, Anchorage, Alaska.
- Portenko, L.A. 1981. Birds of the Chukchi Peninsula and Wrangel Island. Translation for the Smithsonian Inst. and Nat. Sci. Fnd., Washington, D.C. Anerind Publ. Co., New Delhi, India.
- Quakenbush, L. T., R. S. Suydam, K. M. Fluetsch, and C. L. Donaldson. 1995. Breeding biology of Steller's eiders nesting near Barrow, Alaska, 1991-1994. Technical Report, U.S. Fish and Wildlife Service and North Slope Borough, Department of Wildlife Management.
- Rand, G. M. and S. r. Petrocelli. 1985. Fundamentals of aquatic toxicology. Hemisphere Publishing Corporation, Washington.
- Robertson, G. J. 1997. Pair formation, mating system, and winter philopatry in harlequin ducks. Dissertation, Simon Fraser University, Vancouver, British Columbia, Canada.
- Robertson, G. J., F. Cooke, R. I. Goudie, and W. S. Boyd. 1999. Within-year fidelity of Harlequin Ducks to a moulting and wintering area, p. 45-51. In R. I. Goudie, M. R. Petersen, and G. J. Robertson [eds.], Behaviour and ecology of sea ducks. Canadian Wildlife Service Occasional Paper Series No. 100, Ottawa, Ontario, Canada.

- Rocke, T. E., T. M. Yuill, and R. D. Hinsdill. 1984. Oil and related toxicant effects on mallard immune defenses. *Environmental Research*. (33) 343-352.
- Savard, J. P. L. 1985. Evidence of long-term pair bonds in Barrow's Goldeneye (*Bucephala islandica*). *Auk* 102:389-291.
- Savard, J. P. L. and J. M. Eadie. 1989. Survival and breeding philopatry in Barrow's and common goldeneyes. *Condor* 91:198-203.
- Scribner, K. T., R. L. Fields, S. Talbot, J. Pearce, M. Petersen, and R. K. Chesser. 2000. Sex-biased gene flow in spectacled eiders (Anatidae): Inferences from molecular markers with contrasting modes of inheritance. Submitted to *Evolution* on 6-30-2000.
- Shaffer, M. 1987. Minimum viable populations: coping with uncertainty. Pages 69-86, in M. E. Soule, editor, *Viable populations for conservation*. Cambridge University Press, New York.
- Schmutz, J. A., R. F. Rockwell, and M. R. Petersen. 1997. Relative effects of survival and reproduction on the population dynamics of emperor geese. *Journal of Wildlife Management* 61:191-201.
- Solovieva, D. 1997. Timing, habitat use and breeding biology of Steller's eider in the Lena Delta, Russia. *Wetlands International Seaduck specialist Group Bulletin*.
- Sterns, S. C. 1992. *The evolution of life histories*. Oxford University Press, New York, New York, USA.
- Swarth, H.S. 1934. Birds of Nunivak Island, Alaska. *Pacific Coast Avifauna* No 22. 64 pp.
- Trust, K. A., E. Esler, B. R. Woodin, and J. J. Stegeman. 2000. Cytochrome P450 1A induction in sea ducks inhabiting near shore areas of Prince William Sound, Alaska. *Marine Pollution Bulletin* 40:397-403.
- U.S. Fish and Wildlife Service. 1997. Endangered and threatened wildlife and plants; threatened status for the Alaska breeding population of the Steller's eider. *Federal Register/Vol. 62, No. 112*. 31738.
- Wilk, R.J., K.I. Wilk, and R.C. Kuntz, II. 1986. Abundance, age, composition and observations of emperor geese in Cinder Lagoon, Alaska Peninsula, 17 September – 10 October 1986. USFWS Unpublished Report, King Salmon, AK 41 pp.
- Yamato, O., I. Goto, and Y. Maede. 1996. Hemolytic anemia in wild seaducks caused by marine oil pollution. *J. Wildl. Diseases*. 32(2). Pp. 381-384.

Zydelis, R. and R. Skeiveris. 1997. Increasing conflict between gill-net fishery and Steller's eiders wintering along the Lithuanian coast. Wetlands International Seaduck specialist Group Bulletin.