UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

March 18, 2005

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Forrest Cole
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Juneau Ranger District
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Dear Mr. Leeds and Mr. Cole:

This document transmits the National Marine Fisheries Service's (NOAA Fisheries) biological opinion based on our review of the Kensington Gold Project, in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). Your request of November 17, 2004, for formal consultation under section 7 of the Act initiated the consultation procedures that produced this biological opinion.

This biological opinion is based on information provided in the November 17, 2004, Biological Assessment/Biological Evaluation (BA/BE) and the Supplemental Environmental Impact Statement (SEIS) for the Kensington Gold Project, both of which provided background material for the section 7 consultation. Subsequent discussions with the U.S. Forest Service, U.S. Army Corps of Engineers, Coeur d'Alene Mines Corporation, Coeur Alaska, Inc., and Goldbelt, Inc. provided additional information for this consultation. NOAA Fisheries also incorporated information from numerous species experts and the results of literature review into this analysis.

After reviewing the current status of both the eastern and western population of Steller sea lions and the Central North Pacific humpback whale population, the environmental baseline for the action area, the proposed action, and the cumulative effects of other actions on listed species, NOAA Fisheries has determined that the revised Plan of Operations for the Kensington Gold Project, as proposed, is not likely to jeopardize the continued existence of these listed species in the wild, or destroy or adversely modify designated critical habitat found in proximity to the action area. However, because the proposed action is expected to negatively impact individual animals, NOAA Fisheries has included a list of conservation recommendations to minimize such adverse effects to Steller sea lions and humpback whales using the action area. Many of these recommendations are consistent with our previously transmitted recommendations during informal section 7 consultation and Essential Fish Habitat (EFH) consultation.

In formulating this opinion, NOAA Fisheries used the best available information. A complete administrative record of this consultation is on file at the Alaska Regional Office, NOAA Fisheries, Juneau, Alaska.

Sincerely,

James W. Balsiger
Administrator, Alaska Region

Endangered Species Act
Section 7 Consultation - Biological Opinion

Agency:	United States Forest Service United States Army Corps of Engineers Alaska Region
Activities Considered:	Kensington Gold Project Operations
Consultation By:	National Marine Fisheries Service Protected Resources Division Alaska Region
Date:	March 2005

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Approved by:

James W. Balsiger
Administrator, Alaska Region
NMFS

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EXECUTIVE SUMMARY

The United States Forest Service (USFS) and the United States Army Corps of Engineers (ACOE) initiated consultation pursuant to section 7 of the Endangered Species Act (ESA) on November 17, 2004. The National Marine Fisheries Service (NMFS) received letters from USFS and ACOE formally requesting consultation on the effects of activities associated with the Kensington Gold Project on all threatened and endangered species under the authority of NMFS in compliance with section 7(a)(2) of the ESA. The letters were attached to a Biological Assessment/Biological Evaluation (BA/BE) on the Federal action submitted jointly to NMFS by USFS and ACOE.

The term "action area" means "all areas to be affected directly or indirectly by the Federal action, and not merely the immediate area involved in the action" (50 CFR §402.02(d)). As such the action area for this Federal action includes all waters located inside the boundaries of Berners Bay, Alaska.

This document is the product of a consultation pursuant to Section 7(a)(2) of the ESA and implementing regulations found at 50 Code of Federal Regulations (CFR) Part 402. This consultation considers whether the effects of these actions are likely to jeopardize the continued existence of two populations of Steller sea lions, and the North Pacific population of humpback whales with special emphasis on the North Central subpopulation of this species. There are no other listed species found in the action area, or waters adjacent to the action area, under the authority of NOAA. The species of concern in this formal Section 7(a)(2) consultation are:

(i) Western population of Steller Sea Lions (*Eumetopias jubatus*; listed as endangered on May 5, 1997 [62 FR 30772]; critical habitat designated on August 27, 1993 [58 FR 45269])

(ii) Eastern population of Steller Sea Lions (*Eumetopias jubatus*; listed as threatened on November 26, 1990 [55 FR 40204]; critical habitat designated on August 27, 1993 [58 FR 45269])

(iii) North Pacific Humpback Whales (*Megaptera novaeangliae*) listed as endangered upon passage of the ESA of 1973 (16 U.S.C. 1531 *et seq.*)

Listed species within the action area may be affected by several direct and indirect factors as a result of implementing the proposed action: the potential for collisions between transiting vessels and whales; harassment or displacement of whales and sea lions by dock construction activities or vessel operations; disturbance of whale and sea lion prey by dock construction and operation or vessel activity which may cause whales and seal lions to redistribute; an increase in acoustic impacts from vessel noise which could impede whale and sea lion communication or damage or interfere with hearing; the disruption and alteration of normal feeding, resting and other critical behaviors; habitat modification including prey disruption; and ultimately, reduced fitness, leading potentially to population level changes.

Regulations that implement section 7(b)(2) of the ESA require biological opinions to evaluate the direct and indirect effects of federal actions to determine if it would be reasonable to expect them to appreciably reduce listed species' likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution. Section 7 of the ESA and its implementing regulations also require biological opinions to determine if federal actions would destroy or adversely modify critical habitat.

Jeopardy analyses usually focus on the effects of an action on a species' population dynamics. A conclusion of "jeopardy" for an action means that the action could reasonably be expected to reduce appreciably the likelihood of both the survival and recovery of a population, not an individual.

After reviewing the current status of the endangered western population of Steller sea lions, the environmental baseline for the action area, the proposed action, and the cumulative effects of other actions, it is NMFS' biological opinion that the proposed action is unlikely to jeopardize the continued existence of the western population of Steller sea lions.

Given that the eastern population of Steller sea lions is increasing and appears to be robust, it is unlikely that it will experience reductions in reproduction, numbers or distribution in response to the proposed action. After reviewing the current status of the threatened eastern population of Steller sea lions, the environmental baseline for the action area, the proposed action, and the cumulative effects of other actions on the eastern population of Steller sea lions, it is NMFS' biological opinion that the proposed action is unlikely to jeopardize the continued existence of the eastern population of Steller sea lions.

After reviewing the current status of the central North Pacific population of humpback whales, the environmental baseline for the proposed alternatives, the proposed action, and the cumulative effects, it is NMFS' biological opinion that individual whales within the action area may be adversely affected by the proposed action, but the action is unlikely to jeopardize the continued existence of the central North Pacific population of humpback whales.

Adverse modification analyses usually focus on the effects of an action on the physical, chemical, and biological resources that support a population. NMFS has concluded that no adverse modification is expected to the critical habitat of the eastern population of Steller sea lions (namely Benjamin Island, Gran Point, and Met Point). As there is no critical habitat located in or near the action area for the western population of Steller sea lions, and no critical habitat has been designated for the central North Pacific population of humpback whales, NMFS has concluded that the action will not result in adverse modification to critical habitat for these species.

1.0 PURPOSE AND CONSULTATION HISTORY

1.1 Purpose

The Endangered Species Act of 1973 (ESA or Act) (16 U.S.C. 1531-1544), amended in 1988, establishes a national program for the conservation of threatened and endangered species of fish, wildlife, and plants and the habitat on which they depend. Section 7(a)(2) of the ESA, 16 U.S.C. § 1531 et seq., requires that each Federal agency shall insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species, or destroy or adversely modify critical habitat of such species. When the action of a Federal agency may adversely affect a protected species, that agency (i.e., the "action" agency) is required to consult with either the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (FWS), depending upon the protected species that may be affected. For the actions described in this opinion, the action agencies are the United States Forest Service (USFS) and the United States Army Corps of Engineers (ACOE); and the consulting agency is the Alaska Region, NMFS.

These agencies jointly initiated formal consultation pursuant to section 7 of the ESA on November 17, 2004, when NMFS received USFS and ACOE letters requesting formal consultation accompanied by a revised Biological Assessment/Biological Evaluation (BA/BE). Consultation was initiated by USFS and ACOE to address potential impacts to listed marine species related to actions associated with Kensington Gold Project operations. The purpose of this opinion, therefore, is to fulfill the section 7 requirements for consultation on the marine components of the Kensington Gold Project in Berners Bay, near Juneau, Alaska.

This opinion present NMFS' review of the status of the listed species considered in this consultation, the condition of the critical habitat, the environmental baseline for the action area, all the effects of the action as proposed, and cumulative effects (50 CFR 402.14 (g)). For the jeopardy analysis, NMFS analyzes those combined factors to conclude whether the proposed action is likely to appreciably reduce the likelihood of both the survival and recovery of the affected listed species.

The critical habitat analysis determines whether the proposed action will destroy or adversely modify critical habitat for listed species by examining any change in the conservation value of the essential features of critical habitat. This analysis does not rely on the regulatory definition of "adverse modification or destruction" of critical habitat invalidated by the 9th Circuit Court of Appeals (Gifford Pinchot Task Force et al. v. U.S. Fish and Wildlife Service, 378 F.3d 1059). Instead, this analysis focuses on statutory provisions of the ESA, including those in Section 3 that define "critical habitat" and "conservation," in Section 4 that describe the designation process, and in Section 7 that set forth the substantive protections and procedural aspects of consultation.

If the action under consideration is likely to jeopardize the continued existence of an ESA-listed species, or destroy or adversely modify critical habitat, NMFS must identify any reasonable and prudent alternatives for the action that avoid jeopardy or destruction or adverse modification of critical habitat and meet other regulatory requirements (50 CFR 402.02).

1.2 Consultation History

Following a Kensington Gold Project meeting in March 1990, NMFS issued an initial correspondence to the USFS, Juneau Ranger District on April 19, 1990, in response to a request for comments on the meeting. At that time, the applicant was pursuing submarine tailing disposal and the project did not involve dock construction or vessel transit in Berners Bay. NMFS recommended that baseline physical and chemical data be collected, including information on sediments, water quality, circulation, and further assessment of herring spawning and juvenile salmonid rearing in nearshore areas near dock and breakwater facilities. On May 2, 1990, NMFS received a communication from the USFS, Juneau Ranger District requesting that NMFS provide a list of threatened or endangered species potentially affected by the proposed project as an initial step in the ESA consultation process.

A further early communication related to the consultation process involved NMFS' review of the 1991 DEIS for the Kensington Gold Project. In an August 21, 1991, letter to the USFS' Juneau District Ranger, NMFS expressed concern about impacts of contaminants to fish populations and the effects of helicopter and ferry traffic associated with the project on Steller sea lions.

An August 6, 2003 letter to NMFS from the USFS' Juneau Ranger District indicated they had received a proposal from Coeur d'Alene Mines Corporation (Coeur) to modify their approved 1998 Plan of Operation for the Kensington Gold Project. The USFS requested that NMFS confirm the presence of Steller sea lions and humpback whales as threatened and endangered species in the project area, and further requested initiation of formal consultation. NMFS met with the USFS' contractor, Tetra Tech, during fall/winter 2003 to discuss the development of a BA/BE and the general process for ESA consultation. A meeting summary memorandum from Tetra Tech to NMFS dated September 30, 2003, noted that formal consultation would be necessary if the project could not be modified because adverse effects to listed species were likely. The memorandum also stated that an incidental take statement would be issued as an outcome of formal consultation, and that Coeur would need to apply for an MMPA authorization for anticipated incidental harassment of marine mammals.

In May 2004, the USFS prepared a draft BA/BE that addressed potential impacts to humpback whales and Steller sea lions. At that time, NMFS was not able to proceed with formal consultation because the proposed action was not adequately described - a preferred alternative had not been selected, and the BA/BE lacked the required background information. Likewise, the draft SEIS did not specify a preferred alternative, thus NMFS could not evaluate the proposed action under section 7.

On October 1, 2004, NMFS met with USFS, ACOE, Alaska Department of Natural Resources (ADNR), Coeur, and Goldbelt, Inc. to discuss general ESA and MMPA requirements related to the proposed action as part of ongoing informal consultation. On October 21, 2004, these parties met again to determine if mitigation measures could be adopted that would adequately protect listed marine species from the anticipated impacts of the proposed action and thus forego the need for formal consultation. However, the action agencies and applicant did not adopt NMFS' recommendations to minimize adverse affects to listed species at this time. At this meeting, NMFS reiterated that the agency would not be able to proceed with formal consultation without revisions to the BA/BE to include a complete description of the proposed action.

On November 1, 2004, NMFS received a letter from ACOE stating that they had reviewed the proposed action and determined that is was 'not likely to adversely affect' listed species. Based on their determination, ACOE concluded that formal consultation on the proposed construction of two marine moorage facilities in Berners Bay was unnecessary. However, ACOE also requested that NMFS proceed with formal consultation if NMFS' determination did not concur with their 'not likely to adversely affect' finding. On November 17, 2004, NMFS received a revised Biological Assessment/Biological Evaluation (BA/BE) from USFS and ACOE and letters jointly requesting formal consultation pursuant to the ESA. With the receipt of the revised BA/BE, NMFS determined the information provided was adequate to initiate formal consultation.

On December 3, 2004, NMFS sent a letter to USFS and ACOE disagreeing with the conclusion of the BA/BE that the proposed action (construction of docks at Cascade Point and Slate Creek Cove; crew shuttle transport between Cascade Point and Slate Creek Cove docks; and barge/tug transit in and out of Berners Bay docking at Slate Creek Cove) was not likely to adversely affect Steller sea lions and humpback whales. NMFS' conclusion that the proposed action may adversely affect these ESA listed species was based upon the potential for disturbance to these species and possible disruption of their prey base as a result of crew shuttle transit and dock location/construction. Further, under ESA section 7 consultation guidance, a 'not likely to adversely affect' determination is only appropriate when all effects on listed species are expected to be discountable, insignificant, or completely beneficial (NMFS 1998).

In the December 3, 2004 letter, and during informal consultation meetings with the action agencies and applicant, NMFS recommended several measures to limit adverse effects to listed marine mammals in Berners Bay and alleviate the need for formal section 7 consultation. Namely, these consisted of avoiding usage of Berners Bay altogether and proceeding with previously permitted helicopter transport; or, if transiting Berners Bay, using an alternate dock location to Cascade Point and suspending vessel operations during the spring eulachon/herring runs. As the action agencies and applicant did not accept these recommendations, formal consultation was initiated on November 17, 2004, pursuant to the request received on November 17, 2004.

An initial meeting was held as part of the formal consultation process on December 9, 2004 to assess information needs and discuss the steps involved in the consultation. NMFS, USFS, EPA, Coeur, Goldbelt Inc., and ADNR attended this meeting. All parties in consultation agreed to hold weekly calls to discuss informational needs and ensure consistent communication during the process.

On December 20, 2004, NMFS received information from Coeur in response to the agency's request for additional data pertaining to the specifications of the Slate Creek Cove docking facility, vessel traffic routes, and herring and marine mammal distributions. At this time, Coeur also submitted an impact analysis for listed species prepared by a contracted expert consultant. On December 27, Coeur submitted further information to NMFS, as well as additional suggested citations for use in the preparation of the biological opinion. In response to a request for information during a January 5, 2005 conference call, Coeur submitted data to NMFS on fuel usage and capacity on January 6, 2005.

During the course of the consultation, NMFS consistently recommended that the action agencies and/or applicant apply for an MMPA authorization to address incidental harassment of marine mammals in association with project activities. Without an MMPA authorization, there is no protection for take under the MMPA. Likewise, an incidental take statement (ITS) cannot be issued with the biological opinion to protect against ESA section 9 take without a corresponding authorization under the MMPA. NMFS also consistently recommended incidental take authorizations throughout informal consultation during 2003.

2.0 DESCRIPTION OF THE PROPOSED ACTION

2.1 The Proposed Action

The proposed action considered in this biological opinion involves the activities of two federal agencies. The ACOE proposes to authorize Goldbelt Inc. to place dredged or fill materials into waters of the United States pursuant to section 404 of the Clean Water Act and section 10 of the Rivers and Harbors Act to construct a marine terminal at Cascade Point in Berners Bay, and the Coeur D'Alene Mines Corporation and Coeur Alaska's (Coeur) to construct a marine terminal at Slate Creek Cove in Berners Bay. The USFS proposes to approve an amendment to Couer's Plan of Operations for the Kensington Gold Project pursuant to the National Forest Management Act consistent with the 1997 Tongass Land Forest Management Plan.

The proposed action, known as the Kensington Gold Project, involves the development of an underground gold mine located approximately 48 km north of Juneau, Alaska. The mine site is located in the Tongass National Forest adjacent to Berners Bay, a sheltered saltwater bay and estuary. The Kensington Gold Project involves the construction of two marine terminals, one at Slate Creek Cove on the north side of the bay and one at Cascade Point on the south side of the bay, and ferry transit across the bay multiple times daily to transport crew and supplies to and from the mine. The straight-line distance between the marine terminals is approximately five nautical miles. In addition, barge traffic would enter and exit the bay to transport the mine's ore concentrate four times a week. After a two-year construction period, mining will occur for a projected period of ten years. The major components of the action are summarized below (for a complete description of the proposed action, readers should refer to the USFS 2004 Final Supplemental Environmental Impact Statement on the Kensington Gold Project and the 2004 Biological assessment/Biological evaluation prepared by the USFS).

2.1.1 Description of Ore and Mining Process

The ore body extends from the surface to a depth of approximately 3,000 feet and is irregular in both shape and distribution of gold. Ore will be hauled by truck to the mill site located near the Jualin mining area. After crushing, the ore will be transferred to a grinding circuit. Following grinding, oversized material will be returned to the head of the grinding operation, while undersized material will be separated into coarse and fine materials using centrifugal cyclones. From the cyclones, heavy material will go to a gravity concentrator and light material will go to a conditioning tank that feeds a flotation circuit. Concentrate from the gravity concentrator and the flotation circuit will be dewatered, and approximately 700 tons per week of concentrate will be transported from the site. From 2,000 tons of ore per day, mining and processing will produce approximately 400 tons of waste rock per day and approximately 7.5 million tons of tailings over the lifetime of the proposed project (EPA draft NPDES Permit 2004).

2.1.2 Construction Phase

Marine traffic during construction will consist of a variety of vessel types, including small and large landing craft, barges, and crew transport shuttle. One barge per day is estimated to dock at the Slate

Creek Cove marine terminal to deliver supplies and materials, and a crew shuttle vessel would operate during the construction period between Slate Creek Cove and Cascade Point. Construction is predicted to last intermittently for 14-18 months. In-water marine terminal construction activities will be suspended from March 15 to June 30 to accommodate marine mammal aggregations foraging on eulachon and herring in Berners Bay during this time. During the marine terminal construction window (July 1-March 14), the BA/BE states that in-water activities such as pile driving and dredging would not occur when listed species were within 1,000 feet, as determined by an on-site NMFS-approved observer.

Landing Craft/Barges

During construction, small landing craft will transport cargo and personnel between marine terminals outside Berners Bay and Cascade Point, Slate Creek Cove, or Comet Beach in Berners Bay. The vessels are expected to be 32 ft long x 20 ft wide x 4 ft draft and cruise at 22 knots (Coeur, pers comm., 2005). They will carry a combination of small cargo and up to 6 passengers. The small landing craft will be unloaded either by hand or using a small forklift. It is expected that small landing craft will make up to four round trips per day until the dock facilities are complete.

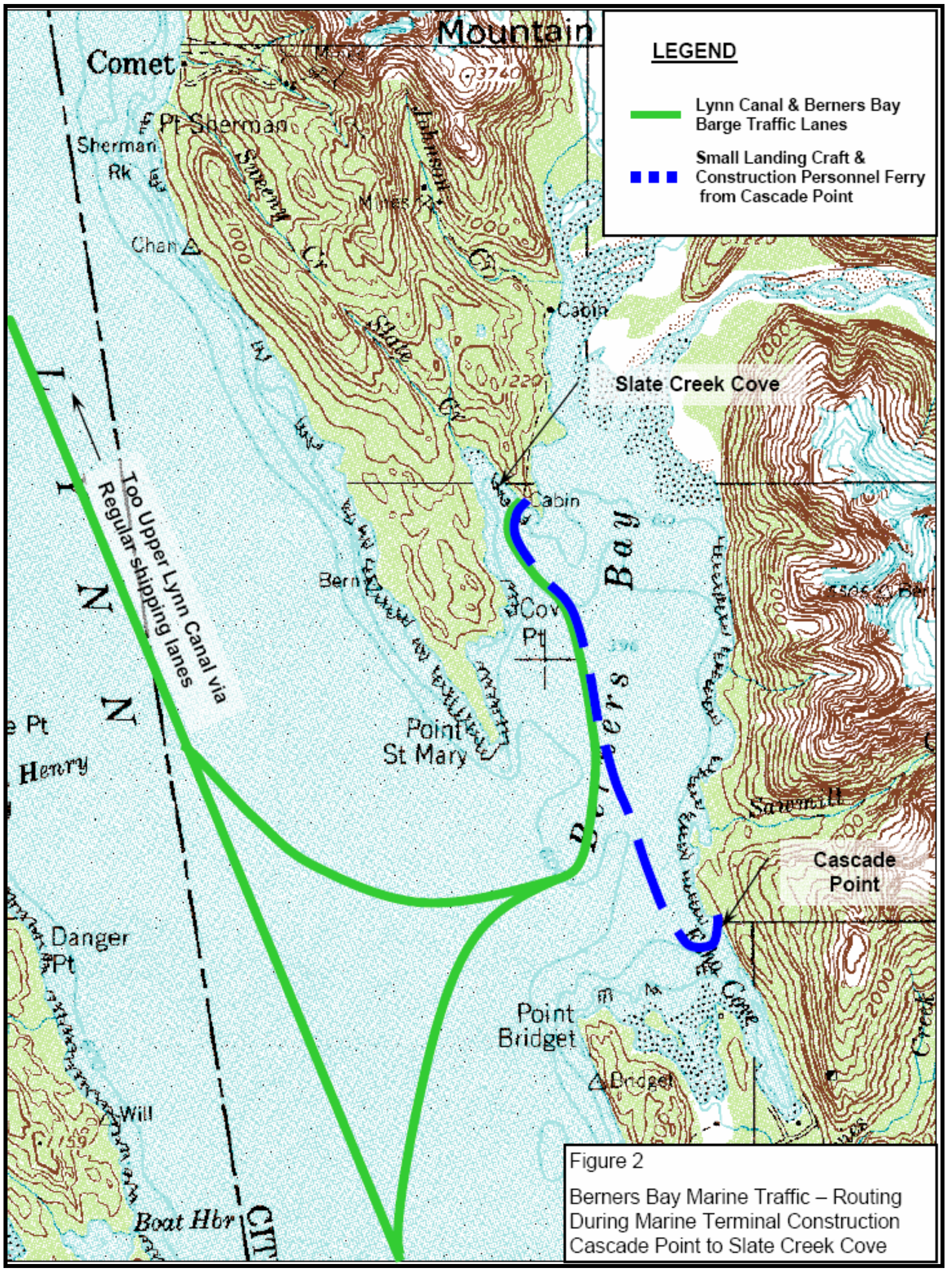
Large landing craft will pick up freight in Auke Bay for delivery to Slate Creek Cove and Comet Beach. The large landing craft will be used as long as construction activities do not block access to the existing ramp at Slate Creek Cove. The vessels will be on the order of 80 ft long x 20 ft wide x 6 ft draft and cruise at 6–8 knots (Coeur, pers comm.). They will have a 2,000-gallon fuel capacity and will burn diesel fuel. The large landing craft may make up to 3 trips per week until the Slate Creek Cove marine terminal is complete. Afterwards, the large landing craft will likely only operate between Auke Bay and Comet Beach via Lynn Canal. These vessels will carry small equipment and supplies as well as some small amounts of gasoline and lubricants in barrels, and will be unloaded with a forklift or front-end loader with fork attachments.

Tug Boat/Ramp barges will be typical of those utilized in Southeast Alaska and will be operated by local companies. These vessels will follow well-established shipping lanes either north bound or south bound from the project area. The ramp barges may make up to three trips per week from Juneau, Alaska to Slate Creek Cove during the initial contractor mobilization. After the initial mobilization, the vessels may only land at Slate Creek Cove once per week until the marine terminal there is completed.

Due to the islands and reefs in Lynn Canal south of Point Bridget, local barge providers follow a strictly defined route in Lower Lynn Canal. After leaving Juneau, northbound barges sail through Stephens Passage between Douglas and Admiralty Islands. Once past Portland Island and Auke Bay, the barges pass between Point Lena and Shelter Island. Depending on the amount of other marine traffic in the area, the barges pass either between Sentinel Island and Poundstone Rock or between Lincoln Island and Poundstone Rock. From there, they sail mid-channel between Poundstone Rock and Lincoln Island. Once past Vanderbilt Reef, it is a mid channel passage to Upper Lynn Canal north of Berners Bay. This route puts the barge traffic a minimum 1.4 miles west of the Steller sea lion haulout at Benjamin Island in Lynn Canal.

Barge traffic originating from outside Berners Bay (typically northbound from Juneau) will leave the well established Lynn Canal shipping lanes and turn in to Berners Bay approximately half way between Point St. Mary and Point Bridget (Figure 2.1) at a maximum speed of 10.5 knots. The mid-point distance between Point St. Mary and Point Bridget is approximately 1¾ miles. As the barges come within ½ -1 mile of the Slate Creek Cove marine terminal, the tugs will come along side the barge until it is landed at the beach. The route will be reversed on the return trip to Lynn Canal shipping lanes.

Figure 2.1. Proposed vessel routes for tug, barge, and crew shuttle (L. Russell, pers. comm.)



Helicopter Use

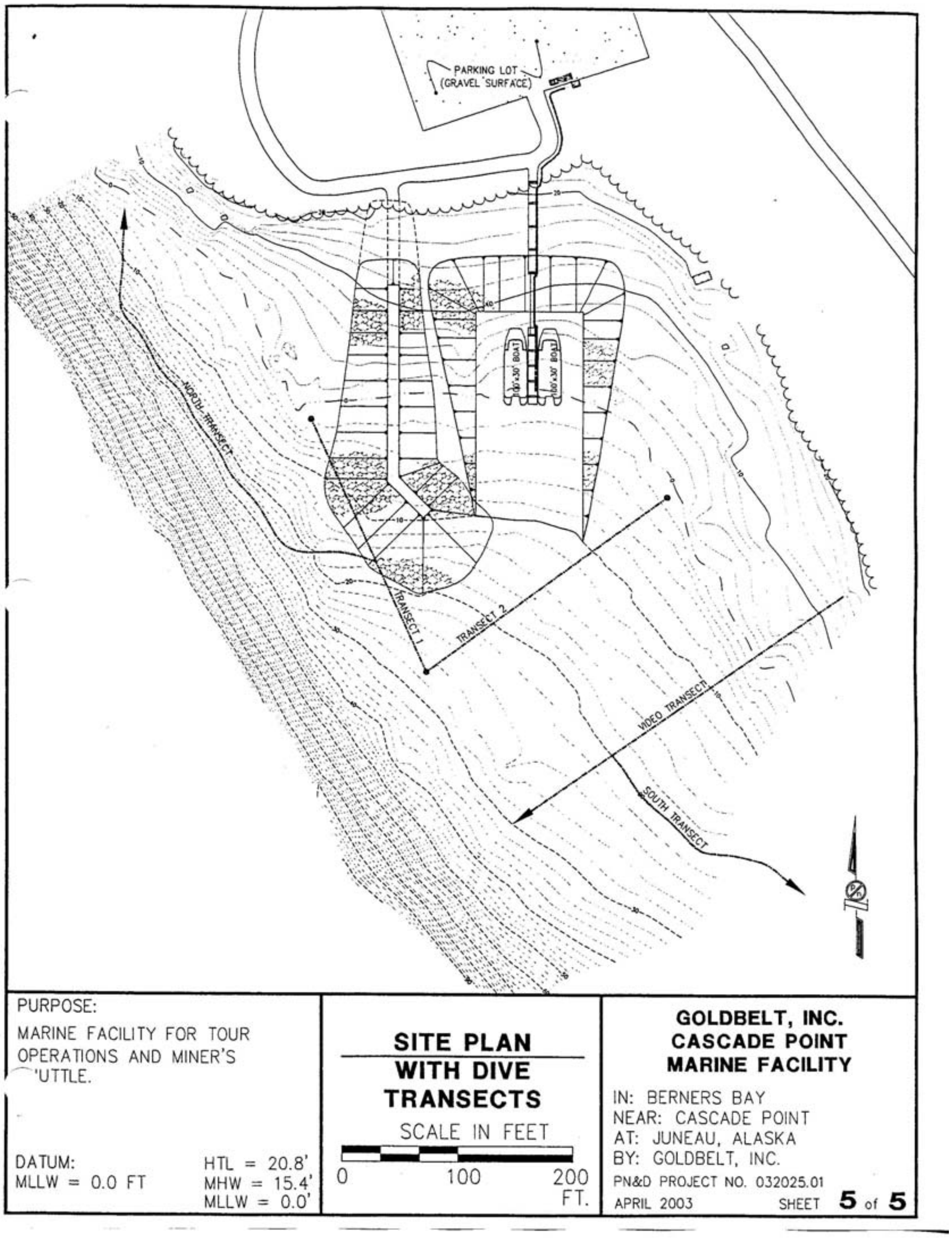
Helicopters are proposed to transport construction crews during the building of the tunnel between the Kensington 850-foot portal and the Jualin Mine. Helicopters would leave from the Juneau Airport and land at Comet Beach. A total of 12-14 trips a month would be made during the construction period, which is expected to last 14-18 months.

Cascade Point Dock

The dock at Cascade Point will be located on the northern end of Echo Cove at 134°56'15.986"W, 58°41'55.878"N. Goldbelt, Inc. proposes to discharge dredged and fill materials into waters surrounding the site in conjunction with the construction of a dock and breakwater at Cascade Point. The dock complex would include a rock-filled breakwater, a dredged area containing a floating dock, and a parking area and turnaround, pedestrian access dock, aluminum gangway, and removable float (Figure 2.2). The breakdown of activities associated with this project is as follows:

- Approximately 23,000 cubic yards of material would be dredged from within an approximate 70,000 square foot area below the High Tide Line. All dredging would occur from a barge. Dredged material would be stockpiled, segregated, transported and placed in the breakwater with the use of a large shovel mounted on a barge.
- Approximately 6,000 cubic yards of fill would originate from an upland quarry site. The applicant states that the fill material from the upland source would be clean gravel and rock, free from fines and petroleum products.
- Between the marine dredged material and the upland fill, approximately 29,000 cubic yards of fill material would be discharged below the High Tide Line to construct a breakwater measuring approximately 125 feet wide by 425 feet long.
- The breakwater would affect approximately 1.3 acres of beach and intertidal habitat. The dredged area would encompass an additional 1.4 acres of disturbance. Dredging would remove material to 10 ft below mean low water line.
- A moorage structure consisting of approximately 20 galvanized steel pilings, supporting a 120-foot long rigid dock, an 80-foot gangway, and a 100-foot float would be constructed. The float would be constructed of timbers over a galvanized steel pipe float frame.
- An approximate 2.5-mile road extension to this area has been permitted.

Figure 2.2. Proposed Cascade Point marine facility (L. Russell, pers. comm.)



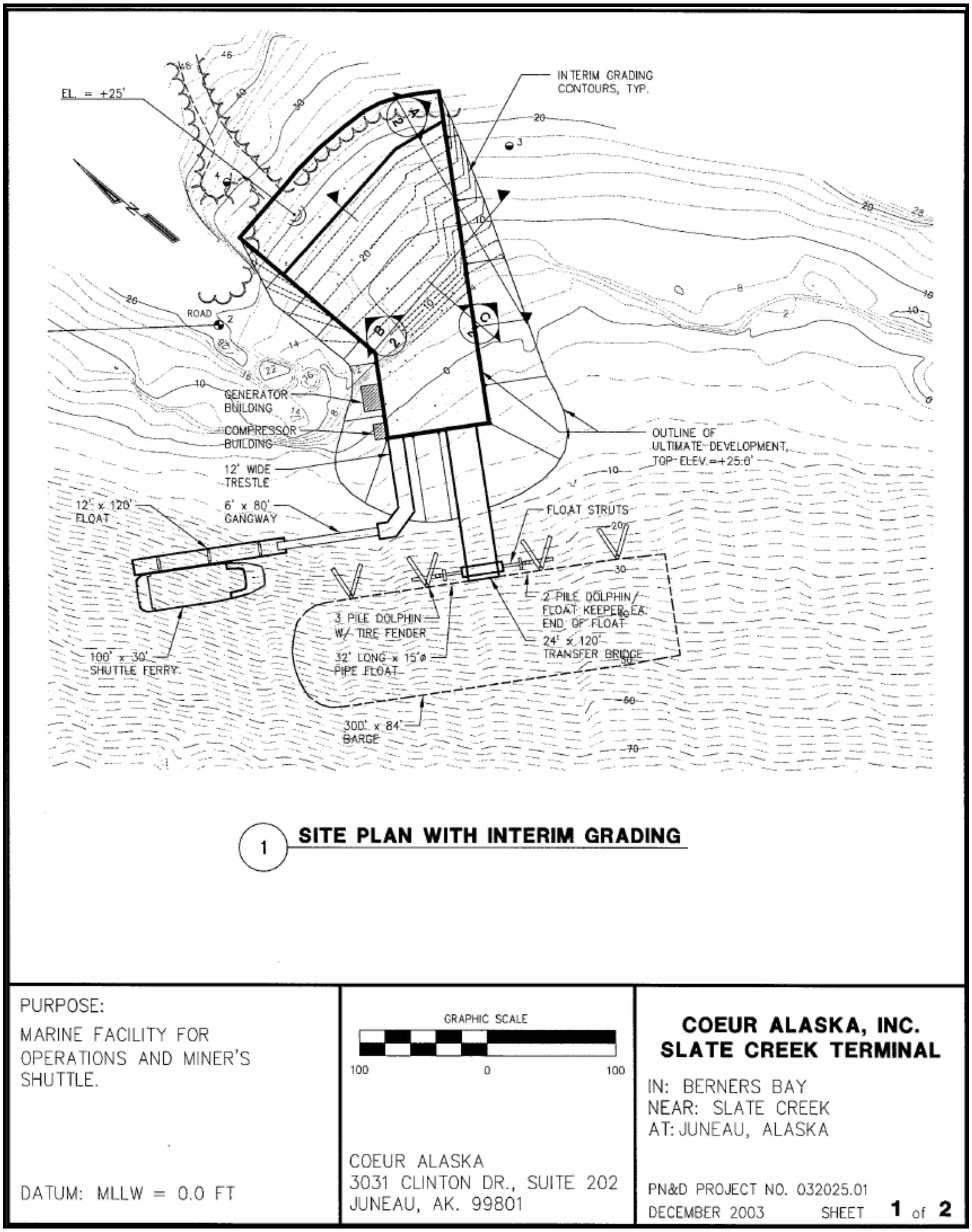
Slate Creek Cove Dock

The dock proposed for the northern shore of Berners Bay to access the Kensington mine would be built at the end of the existing road to the Jualin Mine on the eastern shoreline of Slate Creek Cove, approximately 1,856 ft. north from the northeastern tip of the Cove (Tetratech, pers comm. December 16, 2004). The dock would consist of the following (Figure 2.3):

- An earth fill ramp
- 40' x 60' heavy duty platform
- 12' x100' light duty dock
- 24' x 120' transfer bridge with mechanical hoist and breasting/mooring dolphins
- A building housing a generator
- A compressor building
- 6' x 80' gangway
- 12' x 100' removable float

There is no breakwater proposed for the Slate Creek Cove docking facility and no dredging is required. However, approximately 19,000 cubic yards of fill material covering 3.6 acres would be placed in intertidal and subtidal habitats. Loading and unloading of barges would be accomplished using a roll-on/roll-off forklift transfer system. The facility would be lighted only while boats are being loaded or unloaded.

Figure 2.3. Proposed Slate Creek Cove marine facility (L. Russell, pers. comm.)



2.1.3 Operations Phase

Vessel Transit

Three vessel types are expected to operate in the action area: a ferry to shuttle crew and supplies between the south and north shores of Berners Bay; barges to transport fuel and supplies into Berners Bay and to transport ore concentrate out of the bay; and tugs to accompany the barges.

Barge Specifications

- The barges will be 360'long x 100'wide x 22' deep and are expected to have a draft of 5 feet. Four barges per week, arriving from outside Berners Bay, would dock in Slate Creek Cove to deliver fuel and supplies. Diesel fuel will be transported in 6,500-gallon isotainers. Approximately nine isotainers would be delivered to the Slate Creek Cove terminal weekly.
- The operation is expected to produce 100 tons of flotation concentrate daily, to be shipped to an off-site processing facility outside southeast Alaska in five sealed 4' x 8' x 20' concentrate containers holding 20 tons each. The ore concentrate would be shipped out of Berners Bay from Slate Creek Cove approximately four to five times per month.
- Barges would take approximately 30 to 45 minutes to cross the bay from Lynn Canal and would remain at Slate Creek Cove for several hours to load and/or unload.

Tug Specifications

- Tugs (Titan class) will be 100'long x 35'wide x 20'deep with a draft of 18 ft and a cruising speed of 9 knots. Tugs have an 110,000-gallon fuel capacity and will burn diesel fuel.

Ferry Specifications

- The crew ferry will be 75'long x 20'wide. The ferry is a mono-aluminum hull weighing 90-100 tons and drawing 7.5 ft of water. It has a passenger capacity of 149 and would cruise at approximately 18 knots, except for two to three weeks during the herring/eulachon runs in April and May when transit would be reduced to two to three roundtrips per day at reduced operating speeds of 12-13 knots.
- At the speed of 18 knots, the crossing is expected to take approximately 15 minutes between the Cascade Point and Slate Creek Cove docking facilities. At the reduced speed of 12-13 knots, transit across the bay is estimated at 23 minutes. The ferry would use three diesel engines fueling three propellers. The fuel capacity for this vessel is 1,600 gallons (diesel). The project proposes ferry operation three to five times daily (round trip shuttles of crew and supplies meaning six to ten crossings daily) between Cascade Point and Slate Creek Cove on weekdays; on weekends, two round trips are expected to take place.
- Route proposed is a straight line across Berners Bay between docks at Cascade Point and Slate Creek Cove.
- Crew shuttle crossings are currently scheduled to depart Cascade Point at 5:00 am, 3:00 pm, 6:00 pm, and 1 am on weekdays and 5:00 am and 6:00 pm on weekends. Under this schedule, the crew shuttle would be underway for approximately two hours per day on weekdays and one hour per day on weekends.

Fueling

Only the crew shuttle will be fueled at the Cascade Point dock. Marine fueling of other Kensington Gold Project transport vessels will occur at the Auke Bay dock or another Coast Guard approved facility. No vessel fueling will take place at the Slate Creek Cove dock, except in the case of emergency situations or for reasons of worker safety. No fuel storage will occur at either dock site; a fuel truck from Juneau will be used to fuel the crew shuttle vessel. In advance of the eulachon and herring spawning periods, the applicant will store sufficient fuel to support mine operations for 30 days in a secure, bermed, upland location in order to reduce or eliminate fuel barging during this sensitive time period.

Additional Actions

The applicant will fund a NMFS-approved observer to accompany the crew ferry pilot. The observer will assist in determining the most reasonable daily route across Berners Bay to minimize the potential of encounters or incidental take of marine mammals.

Discharge

Issuance is pending of a National Pollutant Discharge Elimination System (NPDES) Permit from the United States Environmental Protection Agency (EPA) to Coeur Alaska, Inc. for the Kensington Gold Project related to proposed discharges to East Fork Slate Creek and on-going, previously permitted discharges to Sherman Creek and Lynn Canal. Of these, only the discharge from East Fork Slate Creek overlaps with the action area and is thus analyzed in this opinion.

The proposed tailings storage facility would discharge to East Fork Slate Creek at latitude 58º 49’ 58” North and longitude 134º 57’ 58” West. Receiving waters are perennial creeks located at the base of Lions Head Mountain in the Kakuhan Range of the Coast Mountains. Slate Creek flows south/southeast from Lions Head Mountain to the west side of Berners Bay and provides drainage to an area of approximately 2,600 acres.

Tailings slurry from the mill would flow through a 3.5-mile pipeline to a tailings storage facility (TSF) impoundment in the basin of Lower Slate Lake. The storage facility would accommodate 4.5 million tons (60 percent of the tailings produced by mine operation), while backfill for the mine would use approximately 3.0 millions tons (40 percent of the total tailings). The TSF inflows would include tailings slurry from mill operations, precipitation, and storm water runoff from upland areas adjacent to the TSF. The slurry would have an average solids content of 55 percent by weight. The discharge from this facility would be combined with natural diverted flows and pumped into the East Fork Slate Creek, which drains into Slate Creek Cove.

EPA has asked the Alaska Department of Environmental Conservation to certify the NPDES permit under section 401 of the Clean Water Act. With respect to the ESA, EPA has indicated that it does not expect the discharges from this facility (in compliance with the requirements of the permit) to adversely affect endangered species in the action area.

2.2 Interrelated and Interdependent Actions

By regulation, the *effects of an action* include the direct and indirect effects of an action on listed species or designated critical habitat, together with the effects of other activities that are interrelated or interdependent with that action. *Interrelated actions* are those that are part of a larger action and depend on the larger action for their justification. *Interdependent actions* are those that have no independent utility apart from the action under consideration (50 CFR 402.02).

The applicant has asserted that there are no actions that are interrelated or interdependent to the proposed action. However, some information has become available during this consultation indicating that Goldbelt, Inc., a local Native corporation organized under the Alaska Native Claims Settlement Act, has plans for additional future uses of the Cascade Point dock, which might constitute interrelated or interdependent activities, the effects of which should be considered in this consultation.

This information consists of statements in public documents associated with the proposed mine project and public statements by state officials. For example, Attachment A of the Alaska DNR's Draft Finding and Decision document for Goldbelt's Proposed Tideland Lease (June 17, 2004) describes the Development Plan for the Cascade Point Marine Terminal Facility (February 2004) and states, "[t]he purpose of the facility is to provide a dock for the Goldbelt sightseeing ship and for the transport of Kensington mine employees." An earlier letter submitted by Earthworks Technology for Goldbelt, Inc. to ACOE (July 2003) as part of Goldbelt's application for an ACOE permit states: "With the installation of marine terminal, Goldbelt would operate tourboats/cruise ships from the Cascade Point dock as an integral part of the effort to expand tourism opportunities in the region."

Nevertheless, the current Conditional Use Permit the City and Borough of Juneau issued to Goldbelt, Inc. restricts use of the Cascade Point terminal to a single shuttle ferry to transport workers to and from the Kensington mine. Further, NMFS received a letter from Goldbelt, Inc., dated December 20, 2004, explaining that, due to restrictions imposed by their City and Borough of Juneau Conditional Use Permit and the absence of specific development plans, "no other use of the [Cascade Point] dock is reasonably certain to occur in the foreseeable future" and that it has "no present plan or intention to use the dock for any other purpose." For the purposes of this consultation, NMFS accepts these statements. However, if the uses of the Cascade Point dock are changed to uses not considered in this biological opinion, those changes might modify the action in a manner that causes an effect to the listed species or critical habitat that was not considered in this biological opinion. This would require the NMFS, the ACOE, and the USFS to reinitiate formal consultation on the action.

2.3 Action Area

"Action areas" are defined as "all areas to be affected directly or indirectly by the Federal action, and not merely the immediate area involved in the action" (50 CFR §402.02(d)). Most activities associated with the marine components of the Kensington Gold Project (construction and operation of two marine terminals, crew shuttle transits, and barge/tug activity) are contained within Berners Bay. NMFS has determined that the entire area encompassed by the bay (rather than just the marine terminal locations and vessel transit routes) is likely to be directly and indirectly affected by the proposed action. As a result, we have considered this discrete body of water as the action area for this consultation. As such, this action area includes all waters located inside the boundaries of Berners Bay, as drawn from Point St. Mary to Point Bridget and along the interior coastline of the bay across the mouths of all entering river systems. NMFS recognizes that listed species and their prey move in and out of Berners Bay. In particular, Steller sea lions likely travel between the bay and their nearby haulouts at Benjamin Island, Gran Point, and Met Point in Lynn Canal. Thus, direct or indirect impacts to individuals as a result of the action may be carried with them when they are not in the action area (nutritional stress, compromised reproduction, hearing loss, injury from vessel strike, etc.). In this opinion, we have analyzed such potential indirect effects (see discussions under Status, Environmental Baseline, and Effects to Listed Resources), such as impacts to prey resources that use both Berners Bay and Lynn Canal. However, we do not believe that indirect impacts to individuals or their prey warrants extension of the action area to include all areas that the individuals may inhabit.

Barge traffic servicing the Kensington Gold Project is the one component of the action that extends outside Berners Bay. Barge traffic to and from the mine will pass within 1¼ mile west of the Benjamin Island haulout. However, it will follow designated shipping lanes that all barge traffic in Lynn Canal follows, and thus will not introduce traffic to the island in closer proximity than that which exists already at baseline conditions. Other than the unlikely event of catastrophic fuel spill, we do not consider the effects of the proposed action to overlap with this area.

Berners Bay is located on the mainland of southeast Alaska on the east shore of Lynn Canal. The bay is approximately 8 km (five miles) long and 4.5 km (three miles) wide, and is located about 48 km northwest of Juneau in a ~390 km^2 (150 square miles) roadless watershed of the Tongass National Forest. The bay is a major estuary in Lynn Canal and is defined at its mouth by Point St. Mary to the north and Point Bridget to the south. One clearwater (Berners) and two glacial (Antler and Lace) rivers feed the bay, and a submarine gully about 100 meters deep begins where the rivers enter Berners Bay and extends to the mouth of the bay (Sigler et al. 2004). A counterclockwise surface current carrying glacial silt to Cove Point and Point St. Mary generally prevails in the bay (Calvin 1977), and eulachon spawn in the lower reaches of all three rivers (Gende et al. 2001; Marston et al. 2002).

Four named rivers and five creeks make up the Berners Bay watershed. They include the Berners, Lace, Antler, and Gilkey rivers; and Slate, Sawmill, Johnson, Davies, and Cowee Creeks. All drain directly into the bay with the exception of the Gilkey River, a tributary of the Antler River; the Berners River, a tributary of the Lace River; and Davies Creek, a tributary of Cowee Creek. The Lace, Antler and Gilkey Rivers are glacial systems, primarily influenced, respectively, by the Meade, Antler, and Gilkey glaciers. In combination, these systems provide spawning and rearing habitat for runs of eulachon; sockeye, coho, pink, and chum salmon; steelhead and cutthroat trout; and Dolly Varden char. A significant portion of the remnant Lynn Canal herring stock spawns in Berners Bay, and the bay also provides habitat for halibut, shrimp, and crab (USFWS 2003; C. Schrader, pers. comm., Gretchen Bishop, pers. comm.).

Although the Juneau road system terminates at Echo Cove, Berners Bay is only accessible by boat. The head of the bay forms very shallow, alluvial tideflats due to silt deposition from the Lace, Antler and Gilkey river systems; thus, this area is only accessible by shallow-draft vessels (e.g., jet or air boat, kayak, canoe) (USFWS 2003).

2.4 Assumptions

NMFS conducted this consultation under a number of assumptions. Largely, these relate to the confirmation that NMFS received from the action agencies and applicant to consider the mitigation measures in the BA/BE as part of the proposed action. Thus, we have incorporated the "proposed mitigation measures" in the BA/BE into the proposed action and have analyzed effects to listed species under the assumption that these will be implemented. These measures include suspension of in-water dock construction activities between March 15 and June 30; limiting crew shuttle speed to 12-13 knots and transits to 2-3 per day during the eulachon and herring spring spawning period; limiting barging of concentrate, supplies, and chemical shipments during this same period; restricting vessel fueling operations when spawning herring are present; surrounding vessels being fueled with a containment boom when fueling between April 15 and June 15; and employing NMFS-approved observers aboard the crew shuttle to minimize marine mammal/vessel interactions.

In addition, NMFS conducted this consultation with the expectation that the applicant, as stated, will refrain from blasting activities during the marine terminal construction window whenever Steller sea lions or humpback whales are within 1,000 feet, as determined by on-site monitoring by a NMFS-approved observer. NMFS also expects the applicant to comply with MMPA and ESA regulations for approaching marine mammals, including the 100-yard minimum approach distance.

NMFS also assumes that the Kensington Gold Project crew shuttle transporting workers to and from the mine site will be the only vessel operating from the Cascade Point dock, based on the information provided in the BA/BE and subsequent communications during consultation. Although the record is contradictory with respect to this assumption (see Interrelated and Interdependent Actions 2.1.3.6), NMFS is only able to consult on information available at the time of consultation. Thus, we have not considered the effects of potential additional use of the Cascade Point dock by tour vessels or other boats and ships. We acknowledge that additional vessel use may occur and may be interrelated and interdependent to the proposed activity. NMFS will need to revisit this issue with the action agencies and applicants in the future if new evidence becomes available that confirms additional use of the Cascade Point dock beyond those considered in this opinion, or if any of the above assumptions not incorporated into the action.

3.0 STATUS OF LISTED RESOURCES

NMFS has determined that the action being considered in the Opinion may adversely affect the following species provided protection under the ESA:

Steller sea lion (*Eumetopias jubatus*)	
• Western Population	Endangered
• Eastern Population	Threatened
Humpback whale (*Megaptera novaeangliae*)	Endangered

The following species summaries were abstracted and compiled from the information found in the Alaska Marine Mammal Stock Assessments, 2003 (Angliss and Lodge 2004); the Glacier Bay Biological Opinion (NMFS 2003); peer-reviewed scientific literature; white papers, unpublished reports, and research summaries from government agencies, academic institutions, non-profit organizations and private industry; and communication with species experts and observers as identified in the literature cited. This information as summarized represents the best scientific and commercial data available.

3.1 Steller Sea Lions (*Eumetopias jubatus*)

3.1.1 Species Description

The Steller sea lion (*Eumetopias jubatus*) is the only species of the genus *Eumetopias*, and is a member of the family Otariidae, order Pinnipedia. The closest relatives of the Steller sea lion appear to be the other sea lion genera, including *Zalophus*, *Otaria*, *Neophoca*, and *Phocarctos,* and fur seals of the genera *Callorhinus* (Northern fur seals) and *Arctocephalus*. Loughlin et al. (1987) provide a brief but informative summary of the fossil record for *Eumetopias*. Repenning (1976) suggests that a femur dated three to four million years old may have been from an ancient member of the *Eumetopias* genus, thereby indicating that the genus is at least that old. *Eumetopias jubatus* likely evolved in the North Pacific (Repenning 1976).

3.1.2 Reasons for Listing

Due to a significant decline in total numbers of 64% over a 30-year period, on November 26, 1990, an emergency rule listed the Steller sea lion as threatened under the ESA (55 FR 40204). On August 27, 1993 (58 FR 45269) critical habitat was designated based on observed movement patterns. In 1997 the Steller sea lion population was split into two separate populations (western and eastern populations) based on demographic and genetic dissimilarities (Bickham et al. 1996, Loughlin 1997b) (62 FR 30772). Population Viability Analysis (PVA) models indicated a continued decline at the 1985-1994 rate would result in extinction of the western population in 100 years or a 65% chance of extinction if the 1989-1994 trend continued (62 FR 24354), therefore the status of the western population was changed to endangered. Although increasing in numbers, the eastern population remained listed as threatened because NMFS believed that the large decline in the overall U.S. population threatened the continued existence of the entire species (62 FR 24354).

3.1.3 Life History

Reproductive Biology

Steller sea lion females reach sexual maturity at three to six years of age; males at three to seven years of age. Females generally reproduce once they reach sexual maturity but males must attain a large size and social behaviors before gaining access to breeding females. Males generally recruit into the breeding population between 9 and 11 years.

Recent estimates of reproductive or birth rates and survival rates are not available for this species or for pinniped species with similar life history and declining population trends. However, from adult females collected in the 1970s and 1980s, a pregnancy rate of 0.63 was estimated for animals in the western population of Steller sea lions (Calkins and Pitcher 1982). Under the assumption of a stable age distribution and stable or increasing population growth, annual survival rates for juveniles were estimated at 0.782, and adult survival rates ranged between 0.841 and 0.930 depending on age from the same animals (York 1994). York (1994) estimated that the decline in Steller sea lions between 1975 and 1985 (5% per year) would be achieved by a 10-20% decline in juvenile survival rates from those estimated in York (1994).

Approximately 60-65% of the females give birth each year at traditional rookery sites throughout Alaska (Calkins and Pitcher 1982). Pupping and breeding occur between late May and early July (Pitcher and Calkins 1981). Females give birth to a single pup and nurse the pup for up to a year or longer. After giving birth, females remain with the pup for 11-14 days and then begin alternating nursing periods on land with periods at sea to forage. Average feeding trips are between 19 hours and three days and nursing periods are about one day (Merrick and Loughlin 1997, Trites and Porter 2002, Milette and Trites 2003). By early August, lactating females and their pups begin moving between rookeries and haulout sites throughout Alaska, following the seasonal movement of their prey. Pups do not accompany their mothers on foraging trips, but do begin complimenting their milk diet with feeding on their own when about nine months of age (L. Rea, pers. comm.). Lactating females are bred shortly after giving birth, and may be pregnant and nursing during the winter and spring.

Steller sea lions are not known to make regular migrations, but they do disperse throughout Alaska during the fall, winter and spring. However, most sea lions remain in the geographic range of the population they originate from. Animals marked as pups on rookeries in the Gulf of Alaska have been sighted in southeast Alaska and British Columbia; some marked in British Columbia have been seen at Cape Saint Elias, Alaska; and some marked in the eastern Aleutians have been seen in eastern Bristol Bay, Alaska (Calkins and Pitcher 1982, Calkins 1986, Loughlin 1997). Raum-Suryan et al. (2002) analyzed resightings of 8,596 pups that were branded from 1975-1995 on rookeries in Alaska. Almost all resightings of young-of-the-year were within 500 km of the rookery where the pup was born. Juvenile animals were seen at much greater distances from their rookery of birth (up to 1785 km), while sightings of adults were generally less than 500 km away from the natal rookery. Less than 2% of all resightings of sea lions branded in the western population occurred in the eastern population. Similarly, fewer than 5% of sea lions branded in the eastern population at Forrester Island were resighted in the western population. Using mtDNA haplotypes determined from fecal samples collected during winter, Ream (2002) found that 98.6% of the animals residing in the geographic region of the western population originated from that population.

Feeding Behavior

Steller sea lions are generalists, feeding on seasonally abundant prey throughout the year. They feed predominately on species that aggregate in schools or for spawning. Prey varies seasonally and geographically. Principal prey species identified from scats include walleye pollock (*Theragra chalcogramma*), Atka mackerel (*Pleurogrammus monopterygius*), Pacific salmon (*Onchorhynchus* sp.) and Pacific cod (*Gadus macrocephalus*) in the western part of the range (Sinclair and Zeppelin 2002). In southeast Alaska, the diet includes walleye pollock, Pacific cod, flatfishes, rockfishes, Pacific herring (*Clupea harengus*), salmon, sand lance, skates, squid, and octopus (Calkins and Goodwin 1988, Trites et al. 2003). Principal prey in British Columbia has included hake, herring, octopus, Pacific cod, rockfish, and salmon (Spalding 1964, Olesiuk et al. 1990). In California and Oregon, rockfish, hake, flatfish, cusk eel, lamprey, other fishes, squid, and octopus have been identified as important prey items (Fiscus and Baines 1966, Jameson and Kenyon 1977, Jones 1981, Treacy 1985). Ephemeral, seasonal prey are also important in local areas, such as the seasonal occurrence of spawning eulachon and Pacific herring in Berners Bay in southeast Alaska that supports up to 7-10% of the southeast Steller sea lion population for about three weeks in April (Sigler et al. 2004, Womble 2004).

Lactating females in the central Gulf of Alaska and Aleutian Islands made short trips to sea during the summer (mean distance 17 km, maximum 49 km) and generally stayed on the continental shelf near their natal rookeries (Merrick and Loughlin 1997). In winter, adult females ranged more widely (mean distance 133 km, maximum 543 km) with some moving to seamounts far offshore. Adult females with satellite transmitters in the Kuril Islands, Russia made short at-sea movements during the summer similar to animals in Alaska (Loughlin et al. 1998).

Immature Steller sea lions exhibit three types of movements: long-range trips (>15 km and > 20 h), short-range trips (< 15 km and < 20 h), and transits to other sites (Raum-Suryan et al. 2004). Long-range trips started around nine months of age and occurred most frequently around the time of weaning while short-range trips occurred daily (0.9 trips/day, *n* = 426 trips). Transit trips began as early as 2.5-3 months of age, occurred more often after 9 months of age, and ranged between 6.5 and 454 km (Loughlin et al. 2003, Raum-Suryan et al. 2004). Some of the transit and short-range trips occur along shore while long-range trips are often offshore as pups develop their foraging skills. Loughlin et al. (1998) also reported that most pups tracked during the winter, made relatively short trips to sea (mean distance 30 km), but one moved 320 km from the eastern Aleutians to the Pribilof Islands.

In summary, the available data from telemetry and tagging studies suggest two types of distribution at sea of Steller sea lions: 1) <20 km from rookeries and haulout sites for adult females with pups, pups, and juveniles, and 2) much larger areas (>20 km) where these and other animals may range to find optimal foraging conditions once they are no longer tied to rookeries and haulout sites for nursing and reproduction. Loughlin (1993) observed large seasonal differences in foraging ranges that may have been associated with seasonal movements of prey, and Merrick (1995) concluded on the basis of available telemetry data that seasonal changes in home range were related to prey availability.

Foraging behavior reflects how an animal meets its nutritional needs. Nutritional requirements vary with sex, age, reproductive status, and season. Nutritional requirements for free-ranging Steller sea lions have not been measured. In captivity, average daily consumption increased from 4-6 kg/day for 1 year olds to

10-13 kg/day at age 5, with males generally eating more than females (Kastelein and Weltz 1990). When females became sexually mature and produced pups, their annual food requirements increased by approximately 30%. An adult male ate 18kg/day on average. The Kastelein and Weltz (1990) study animals were not weighed, but based on age-weight relationships they were fed about 5-6% of their body weight per day. Based on stomach contents of free-ranging Steller sea lions, Calkins (1998) found an average of 15.3 kg of food in the stomachs of six Steller sea lions collected in the central Bering Sea. Calkins (1988) estimated the daily food consumption by an average Steller sea lion to be about 14.3 kg. Winship et al. (2002) developed a bioenergetics model for Steller sea lions that estimated daily food ration of 15.6 kg/day with an average energy density of the diet at 5.09 kJ/gram. The energy content of prey items and consumption estimates has become an increasingly important area of study in light of the nutritional stress hypothesis as an explanation for the population decline. This hypothesis was advanced by Loughlin and Merrick (1989) and asserts that reduced prey availability (due either to natural or anthropogenic sources) at particular times of the life cycle may result in reduced survival or reproductive output. Sigler et al. (2004) used Winship et al. (2002) to estimate the amount of energy provided by the spawning eulachon run in Berners Bay as 9.70 kJ/gram of fish consumed. Thus, eulachon is an energy rich food source for Steller sea lions feeding in Berners Bay during the spring. Sea lions feeding on this species for 3 weeks may increase their energy intake by 91% compared to a normal diet. An energy rich food source such as the eulachon in Berners Bay is an important seasonal energy source for all sea lions feeding in the bay, but particularly for lactating females that require 70% more energy to support lactation.

Diving Behavior

Steller sea lions generally feed at shallow depths. The average dive depth for adult females is 21 m but females can dive in excess of 250 m. Average dive depths for pups in Alaska were 7.7 m with a maximum depth up to 252 m and for yearlings, an average depth of 16.6 m and maximum of 288 m (Loughlin et al. 2003). There is often a diel component (vertical migration in the water column between day and night) to their diving that is consistent with foraging on vertically migrating prey such that diving is shallow at night when prey moves to the surface, and deeper during the day when prey is located deeper in the water column (Merrick and Loughlin 1997, Loughlin et al. 2003).

Vocalizations and Hearing

Comprehensive studies of hearing thresholds of Steller sea lions have not been conducted. A recent study of two animals held in captivity (9 year old male, 7 year old female) showed that the maximum sensitivity of underwater hearing for the male was 77 dB re 1 µPa at 1 kHz (Kastelein et al. in review). The range of best hearing varied from 1 to 16 kHz. The maximum for the female was 73 dB re 1 µPa at 25 kHz and her best hearing was between 16 kHz and 25 kHz. These ranges are similar to California sea lions and northern fur seals (*Callorhinus ursinus*) for which in-air and underwater audiograms indicate peak sensitivities between 15 to 30 kHz. High frequency underwater hearing ranged between 35 and 40 kHz (Ketten 1998). Steller sea lions may habituate to loud noises (Mate and Harvey 1987), although "habituation," in some cases, may actually be the result of hearing damage.

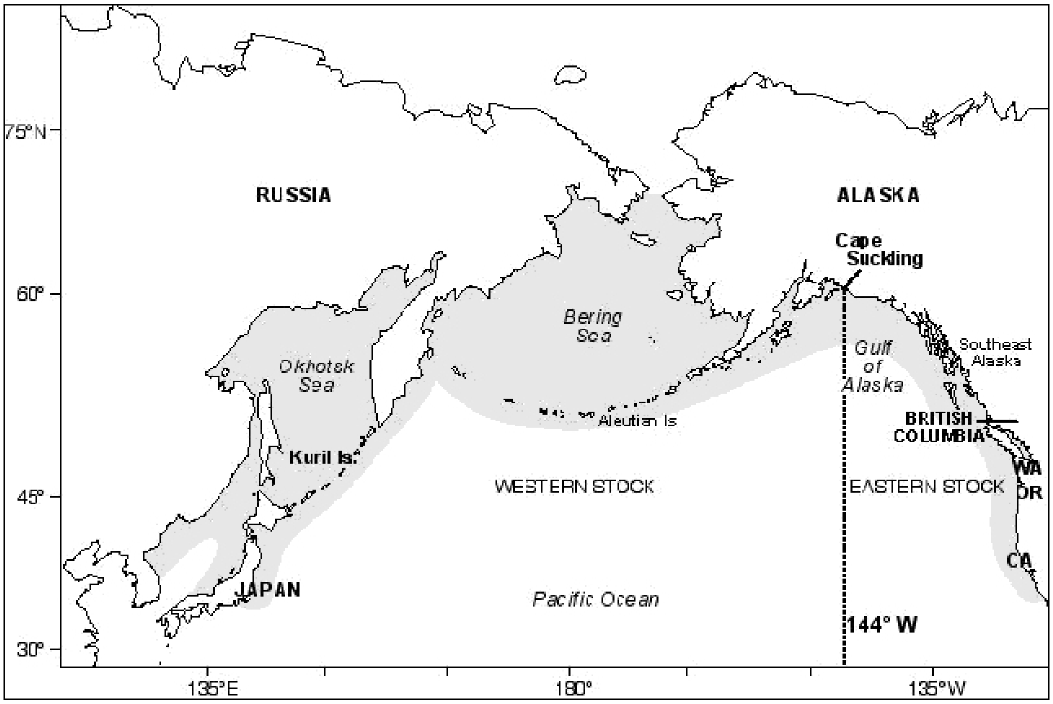
Steller sea lions vocalize underwater in the form of clicks and growls but the frequency range and source level have not been determined (Ketten 1998). For other otariids, most vocalizations are between 1 and 4 kHz and are associated with social behaviors. In-air vocalizations range up to 6 kHz and may be important in communication when animals are ashore. In the California sea lion, individuals have signature calls and range characteristics that are consistent with in-air hearing sensitivities (Ketten 1998).

3.1.4 Population Status

Steller sea lions range along the North Pacific Rim from northern Japan to California (Loughlin et al. 1987). The Gulf of Alaska and the Aleutian Islands are considered the geographic center of the sea lions' distribution (Kenyon and Rice 1961). The species is not known to migrate, but individuals disperse widely outside of the breeding season (late May-early July), thus potentially intermixing with animals from other areas. Despite the wide-ranging movements of juveniles and adult males in particular, exchange between rookeries by breeding adult females and males (other than between adjoining rookeries) appears to be low (NMFS 1995).

The breeding range of the Steller sea lion covers virtually all of the North Pacific Rim from about 34° N to 60°N lat. Within this range, sea lions are found in hundreds of rookeries and haulouts. Rookeries are areas where the animals return annually to breed during the summer, whereas haulouts are used for resting throughout the year. Rookeries can also serve as haulouts outside the breeding season. These rookery and haulout sites can be grouped in rookery/haulout clusters on the basis of politics, geography, demographic patterns, genetics, foraging patterns, or other reasons related to scientific study or management. Geographic distinctions are frequently made on the basis of variable habitat or ecosystem characteristics in differing parts of the range. For example, rookeries and haulouts in the Aleutian Islands are often separated from those in the GOA, and these two areas are again separated from southeastern Alaska and British Columbia. These distinctions may have demographic significance because of variability in ecosystem features such as prey resources.

Figure 3.1. Map of Steller sea lion distribution. Steller sea lions are distributed around the North Pacific Ocean rim from northern Hokkaiddo, Japan through the Kuril Islands and Okhotsk Sea, Aleutian Islands and central Bering Sea, southern coast of Alaska and south to the Channel Islands, California. The species is divided into western and eastern populations at 144° W longitude. Graphic from NMFS' Alaska Regional Office and National Marine Mammal Laboratory website: http://nmml.afsc.noaa.gov/AlaskaEcosystems/sslhome/distrib.htm



Steller sea lions were considered one population until they were reclassified based on the phylogeographic approach of Dizon et al. (1992) (Loughlin 1997). This approach examined distributional data, population dynamics, and genetic differences in mitochondrial DNA to separate the population into two populations. Currently the two populations include a western population that includes animals at, and west of, Cape Suckling, Alaska (144°W) and an eastern population that includes animals east of Cape Suckling, Alaska. Animals from both populations have been observed at haulouts in Lynn Canal at Benjamin Island, Gran Point, Little Island, and Met Point, near the action area (NMFS and ADF&G, unpublished data). For that reason, both populations are considered in this biological opinion.

Western Steller Sea Lion Population

The Western population of Steller sea lions includes all animals at, and west of, Cape Suckling, Alaska (144°W).

Abundance: Assessments of Steller sea lions are based largely on (a) aerial counts of nonpups (juveniles and adults) on rookeries and haulouts, and (b) counts of pups on rookeries in late June and early July. Both kinds of counts are indices of abundance, as they do not necessarily include every site where animals haul out, and they do not include animals that are in the water at the time of the counts. Population size can be estimated by standardizing the indices (e.g., with respect to date, sites counted, and counting method), by making certain assumptions regarding the ratio of animals present versus absent from a given site at the time of the count, and by correcting for the portion of sites counted. Population estimates from the 1950s and 1960s (e.g., Kenyon and Rice 1961, see also Trites and Larkin 1992, 1996) are used with caution because counting methods and dates were not standardized, and the results contain inconsistencies that indicate the possibility of considerable measurement error at some sites in some years. Efforts to standardize methods began in the 1970s (Braham et al. 1980); as a result, counts conducted since the late 1970s are the most reliable index of population status and trends.

The most recent comprehensive estimate (pups and non-pups) of the abundance of the western population of Steller sea lions in Alaska is based on aerial surveys of non-pups in June 2002 and ground based pup counts in June and July of 2001 and 2002 (Sease and Gudmundson 2002). Data from these surveys represent actual counts of pups and non-pups at all rookeries and major haulout sites. During the 2002 survey, a total of 26,602 non-pups were counted at 259 rookeries and haul-out sites, 13,010 in the Gulf of Alaska and 13,592 in the Bering Sea/Aleutian Islands (Sease and Gudmondson 2002). A composite pup count for 2001 and 2002 includes counts from 24 sites in 2002 and from seven sites in 2001. There were 3,727 pups counted in the Gulf of Alaska and 4,450 pups counted in the Bering Sea/Aleutian Islands for a total of 8,177 for the population. Combining the pup count data from 2001 to 2002 (8,177) and non-pup count data from 2002 (26,602) results in a minimum abundance estimate of 34,779 Steller sea lions in the western U.S. population in 2001-2002 (Angliss and Lodge 2004). However, preliminary estimates of non-pups at trend sites indicate an increase from 26,602 in 2002 to 28,730 in 2004 (NMFS unpublished data).

Minimum Population Estimate (Nmin): Results for the total population from the 2004 survey are not currently available. Therefore the best available estimate of the total population of Western Steller sea lions is from Angliss and Lodge (2004). The 2002 count of non-pups (26,602) plus the number of pups in 2001 and 2002 (8,177) was 34,779 and is considered the minimum population estimate for the western population of Steller sea lions in 2001-2002 (Angliss and Lodge 2004).

Population Trend: The first reported trend counts (an index to examine population trends) of Steller sea lions in Alaska were made in 1956-60. The counts indicated that there were at least 140,000 (no correction factors applied) sea lions in the Gulf of Alaska and Aleutian Islands (Merrick et al. 1987). Subsequent surveys indicated a major population decrease, first detected in the eastern Aleutian Islands in the mid-1970s (Braham et al. 1980). Braham et al. (1980) documented declines of at least 50% from 1957 to 1977 in the eastern Aleutian Islands, the heart of what now is the western population. Counts from 1976 to 1979 indicated about 110,000 sea lions (no correction factors applied). The decline appears to have spread eastward to the Kodiak Island area during the late 1970s and early 1980s, and then westward to the central and western Aleutian Islands during the early and mid-1980s (Merrick et al. 1987, Byrd 1989). The greatest declines since the 1970s occurred in the eastern Aleutian Islands and western GOA, but declines also occurred in the central GOA and central Aleutian Islands. Merrick et al. (1987) estimated a population decline of about 50% from the late 1950s to 1985 over a much larger geographical area, the central Gulf of Alaska through the central Aleutian Islands, although this still included a patchwork of regional counts and surveys. The population in the GOA and Aleutian Islands declined by about 50% again from 1985 to 1989, or an overall decline of about 70% from 1960 to 1989 (Loughlin et al. 1992). During the late 1980s the population from the Kenai Peninsula to Kiska Island in the central

Aleutian Islands declined at about 15.6% per year (York et al. 1996).

Between 1991 and 2000, Loughlin and York (2000) reported an average annual decline of 5.4% in non-pup counts at trend sites. From 2000 to 2002, the western population increased by 5.5%. This was the first region-wide increase observed during more than two decades of surveys. Despite this increase, however, the 2002 count was still down 5.4% from 1998 and 36.7% from 1990 (Angliss and Lodge 2004). The count for trend sites in the Gulf of Alaska increased 13.7% from 2000 to 2002, whereas those in the Aleutian Islands showed equivocal change (down 0.8%). The long-term, average decline between 1990 and 2002 is 4.3% per year (Angliss and Lodge 2004). In 2004, there were a total of 28,730 non-pup Steller sea lions counted on the 262 sites surveyed in the range of the western population. Applying a 3-4% increase due to film format differences between 2002 and 2004, NMFS estimates that the western Steller sea lion population increased approximately 6-7% from 2002 to 2004. This is similar to the rate of increase observed between 2000 and 2002 (NMFS, unpublished data).

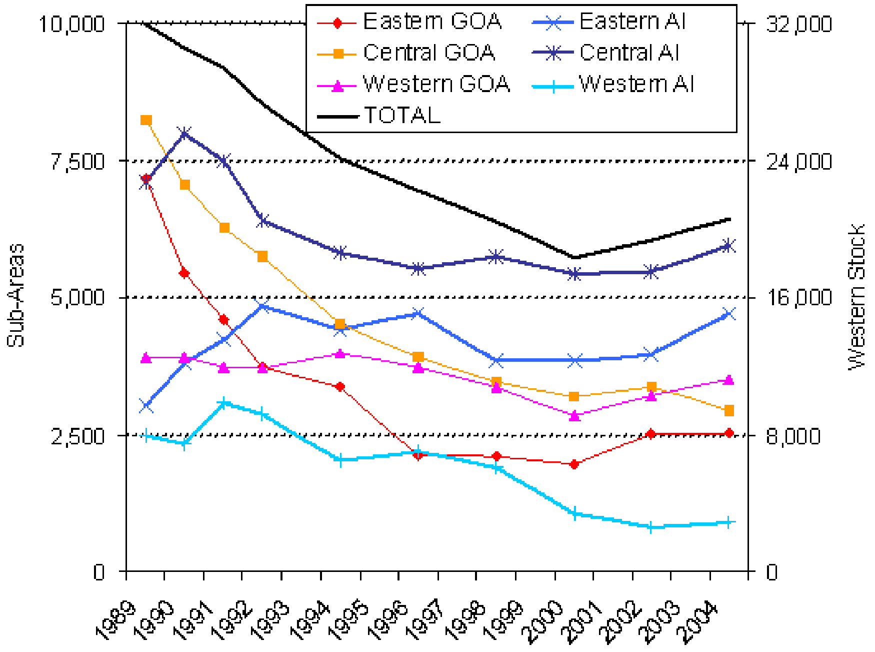
There were regional differences in the trends observed between 2002 and 2004. Trend site counts increased between 2002 and 2004 in the three Aleutian Islands sub-areas (Western, Central and Eastern) and in the western Gulf of Alaska, from the Shumagin Islands through Unimak Pass. However, in the eastern portion of the range of the western Steller sea lion population, trend site counts remained stable (near Prince William Sound in the eastern Gulf of Alaska) or decreased (around Kodiak Island in the central Gulf of Alaska) (NMFS unpublished data).

Table 3.1. Counts of adult and juvenile Steller sea lions observed at rookery and haulout trend sites by year and geographical area for the western U. S. population from the late 1970s through 1998 (NMFS 1995, Sease et al. 2001, NMML unpublished data). Counts from 1976 to 1979 (NMFS 1995) were combined to produce complete regional counts that are comparable to the 1990-02 data. The asterisk identifies 637 non-pups counted at six trend sites in 1999 in the eastern Gulf of Alaska that were not surveyed in 1998 (from Angliss and Lodge 2004).

Area	**Late 1970s**	**1990**	**1991**	**1992**	**1994**	**1996**	**1998**	**2000**	**2002**
Gulf of Alaska	65,296	16,409	14,598	13,193	11,862	9,784	8,937*	7,995	9,097
Bering Sea/Aleutians	44,584	14,116	14,807	14,106	12,274	12.426	11,501	10,330	10,250
Total	109,880	30,525	29,405	27,299	24,136	22,210	20,438*	18,325	19,337

York et al. (1996) conducted population viability analyses for the western population. The results of these analyses indicated that the next 20 years (from the publication of the papers) would be crucial for the western population of Steller sea lions, if the rates of decline observed at that time were to continue. Within this time frame, they determined that the number of adult females in the Kenai-to-Kiska region could drop to less than 5,000. Extinction rates for rookeries or clusters of rookeries could also increase sharply in 40 to 50 years, and extinction for the entire Kenai-to-Kiska region could occur within 100–120 years. In a recent paper by Loughlin and York (2000), they estimated that the population might decline to about 11,797 animals by the year 2020 (based on a bi-annual survey count of 6,528), about a third of current numbers. At that low abundance, current survey techniques would have much higher errors associated with them, and research would be difficult to undertake with few pups or juveniles available for studies with an adequate sample size. It will be at least another 6-8 years before a true reversal in the sea lion decline can be accurately detected. However, for the western Aleutian Islands, any sharp declines could extirpate sea lions from this region.

Figure 3.2. Decline in the western population of Steller sea lions 1989-2004. From NMFS' Alaska Regional Office and National Marine Mammal Laboratory website: http://nmml.afsc.noaa.gov/AlaskaEcosystems/sslhome/DECLINE.HTM



Occurrence of the Western Population in the Action Area: Steller sea lions branded in the western population have been observed at Benjamin Island, Gran Point and Little Island in Lynn Canal, near Berners Bay. Of 348 sightings of branded individuals, 5 animals were from the western population (1.4%) (L. Fritz and L. Jemison, pers. comm.). Thus, few animals from the western population occur in the action area.

Eastern Steller Sea Lion Population

The eastern population of Steller sea lions includes all animals east of Cape Suckling, Alaska (144°W) and includes the action area. Steller sea lions from this population are most likely the ones found in the action area. There are three haulouts in proximity to the action area in Lynn Canal: Benjamin Island, Met Point and Gran Point. In addition, there are three traditional rookeries in southeast Alaska; Hazy

Island, White Sisters near Sitka and Forrester Island near Dixon Entrance. Recently pups were also observed at Graves Rock and Biali Rock. None of the designated rookeries are in the action area.

Abundance: Estimates of Steller sea lion abundance in southeast Alaska are based on aerial surveys performed in June 1996 (Sease et al. 1999, Sease and Loughlin 1999). Data from these surveys represent actual counts of pups and non-pups at all rookeries and major haulout sites in southeast Alaska. In 1996 a total of 14,621 Steller sea lions were counted in southeast Alaska, including 10,907 non-pups and 3,714 pups. Aerial surveys in 1998 and 2000 included the trend sites and other major sites. There were some differences between which major sites were surveyed in 1998 and 2000, so the total counts for each survey are not entirely comparable. The counts for 1998 and 2000 were 10,939 and 12,417, respectively (Sease and Loughlin 1999, Sease et al. 2001). Pup counts totaled 4,160 in 1997 and 4,257 in 1998 (Sease and Loughlin 1999). The total count for southeast Alaska in 1998 was 15,196 (10,939 non-pups plus 4,257 pups); if we assume that the pup count is roughly stable, an estimated count for southeast Alaska in 2000 would be 16,674 (12,417 non-pups plus 4,257 pups) (Angliss and Lodge 2004).

Aerial surveys and ground counts of California, Oregon, and Washington rookeries and major haulout sites were also conducted during the summer of 1996. A total of 6,555 Steller sea lions were counted in California (2,042), Oregon (3,990), and Washington (523), including 5,464 non-pups and 1,091 pups (Angliss and Lodge 2004).

The eastern population of Steller sea lions is a transboundary population, including sea lions from British Columbia rookeries. Aerial surveys were last conducted in British Columbia during 1994 and produced counts of 8,091 non-pups and 1,186 pups, for a total count of 9,277 (Angliss and Lodge 2002). Complete count data are not available for British Columbia in 1996. However, because the number of Steller sea lions in British Columbia is thought to have increased since 1994, the 1994 counts represent a conservative estimate for the 1996 counts.

Combining the total counts for all areas in the eastern population range (southeast Alaska, British Columbia, Canada, Washington, Oregon, and California), the minimum estimated abundance of Steller sea lions in the eastern population is 31,028 (15,196 + 6,555 + 9,277) (Angliss and Lodge 2004). The abundance estimate for the eastern population is based on counts of all animals (pup and non-pup) at all sites and is not corrected for animals missed because they were at sea. A reliable correction factor to account for these animals is currently not available. As a result, this represents an underestimate for the total abundance of Steller sea lions in this population.

Minimum Population Estimate (Nmin): Angliss and Lodge (2004) estimated the minimum population estimate by adding 1998 counts from southeast Alaska (15,196), 1996 counts from Washington, Oregon and California (6,555), and Canadian counts from 1994 (9,277). This resulted in a minimum population estimate for the eastern population of Steller sea lions of 31,028. This count has not been corrected for animals that were at sea, and also uses the 1994 data from British Columbia, which is likely an underestimate of the numbers in Canadian waters.

Population Trend: In southeast Alaska, counts (no correction factors applied) of non-pups at trend sites increased by 30% between 1979 and 2000 from 6,376 to 9,862 (Merrick et al. 1992, Sease et al. 2001) (Table 3.2). Between 1979 and 1997, counts of pups on the three rookeries in southeast Alaska increased by an average of 5.9% per year. Since 1989 pup counts on the three rookeries increased at a lower rate

(+1.7% per year) than for the entire period (Calkins et al. 1999). Sease et al. (2001) reports a slightly lower increase in pup counts (3.3% per year between 1979 and 1997). In British Columbia, counts (no correction factors applied) of non-pups throughout the Province increased at a rate of 2.8% annually between 1971 and 1998 (P. Olesiuk, pers. comm., reported in Angliss and Lodge 2004).

Steller sea lion numbers in California, especially in southern and central California, have declined from historic numbers. Counts in California between 1927 and 1947 ranged between 5,000 and 7,000 non-pups with no apparent trend. Since 1980, counts have declined by over 50%, currently ranging between 1,500 and 2,000 non-pups. At Año Nuevo Island in central California, a steady decline in ground counts started around 1970, resulting in an 85% reduction in the breeding population by 1987 (LeBoeuf et al. 1991). Based on vertical aerial photographic counts conducted at Año Nuevo, pups declined at a rate of 9.9% from 1990 to 1993, while non-pups declined at a rate of 31.5% over the same time period (Westlake et al. 1997). Pup counts at Año Nuevo have been steadily declining at about 5% annually since 1990 (Angliss and Lodge 2004). Limited information suggests that numbers in northern California, Oregon and Washington are stable or increasing (NMFS 1995). Although the central California rookery continues to decline, the rest of the eastern population continues to increase and the prospects for recovery of this population are encouraging.

Table 3. 2. Counts of adult and juvenile Steller sea lions observed at rookery and haulout trend sites by year and geographical area for the eastern U. S. population from the 1982 through 2000 (NMFS 1995, Strick et al. 1997, Sease et al. 1999, Sease and Loughlin 1999; P. Olesiuk, unpublished data; ODF&W unpublished data; Point Reyes Bird Observatory, unpubl. data; Sease et al., 2001). Central California data include only Año Nuevo and Farallon Islands. Trend site counts in northern California/Oregon include St. George, Rogue, and Orford Reefs. British Columbia data include counts from all sites. [Note: There are minor differences between the numbers in Table 3 and the numbers provided to the Steller sea lion recovery team for central California and northern California/Oregon (italicized). Revisions will be completed in 2004.]. From Angliss and Lodge (2004).

Area	**1982**	**1990**	**1991**	**1992**	**1994**	**1996**	**1998**	**2000**	**2002**
Central CA	*511*[1]	*655*	*537*	*276*	*512*	*385*	*208*	*349*	
Northern CA/OR	*3,094*	*2,922*	*3,180*	*3,544*	*2,834*	*2,988*	*3,175*	*n/a*	
British Columbia	4,711	6,109[2]	no data	7,376	8,091	no data	9,818	n/a	n/a
Southeast Alaska	6,898	7,629	8,621	7,555	9,001	8,231	8,693	9,862	9,951
Total	15,214	--	18,754	20,263	21,864	n/a	n/a		

[1] This count includes a 1983 count from Año Nuevo. [2] This count was conducted in 1987.

<u>Occurrence of the Eastern Population in the Action Area</u>: Most of the Steller sea lions in the action area are actively feeding in Berners Bay. Steller sea lions require haulouts for resting between foraging periods, and as there are few areas to haulout in Berners Bay, the foraging animals likely use the nearby haulouts in Lynn Canal (Benjamin Island, Met Point and Gran Point) for resting between feeding trips in the bay. Steller sea lions have been observed to haul out on a small offshore rock on the eastern shore of the mouth of Slate Creek Cove (M. Lea, pers. comm.) and near Cove Point in Berners Bay (J. Womble, pers. comm.).

Steller sea lions branded as pups in the eastern population at the Forrester and Hazy Island rookeries have been observed at Benjamin Island, Gran Point, Met Point, and Little Island in Lynn Canal. Between 2000 and 2004, a total of 343 branded animals from the eastern population were observed at these haulouts. Of those observed, 162 branded animals were observed at Benjamin Island (77 females, 83 males); 136 were observed at Gran Point (57 females, 80 males); 39 were observed at Little Island (14 females, 27 males); and 6 were observed at Met Point (5 females, 1 male) (L. Jemison, pers. comm.). Of the animals observed, 105, 45, and 5 animals were observed nursing or suckling at Benjamin Island, Gran Point, and Little Island respectively. In contrast, only five branded animals from the western stock have been observed at these haulouts. Although no branded animals have been identified in Berners Bay, the evidence presented suggests that most of the animals using Berners Bay are from the eastern population.

3.1.5 Critical Habitat for Steller sea lions

On August 27, 1993 NMFS designated critical habitat for the threatened eastern and endangered western populations of Steller sea lions (58 FR 45269; 50 CFR §226.202). Critical habitat designations are based on primary constituent elements that make the habitat essential for conservation of the species. Primary constituent elements include but are not limited to: roost sites, nesting grounds, spawning sites, feeding sites, seasonal wetland or dryland, water quality or quantity, host species or plant pollinator, geological formation, vegetation type, tide, and specific soil types (50 CFR § 424.12). In the case of Steller sea lion critical habitat, primary constituent elements were not identified specifically as such, but the designation was based on the terrestrial and aquatic needs of the species as described below.

Terrestrial habitat for Steller sea lions

Steller sea lions are land-based marine predators. All of their reproductive and many of their social activities occur on land, but all feeding occurs at sea. Terrestrial habitat includes rookeries where breeding and reproduction take place, and haulouts where resting and socializing occur. Rookeries are often used as haulouts during the non-breeding season, but haulouts are rarely used for breeding or reproduction. Because humans more easily observe terrestrial areas, such habitat is relatively easy to identify based on use patterns. The shoreline, offshore rocks, cliffs, and caves used by sea lions are likely chosen because they offer refuge from terrestrial predators (e.g., are inaccessible to bears), include suitable substrate for reproductive activities (pupping, nursing, mating), resting (haulouts), provide some measure of protection from the elements (e.g., wind and waves), and are in close proximity to prey resources. Generally, the rookery and haulout sites are well scattered along the Alaska shoreline. They provide access to a variety of prey resources that are represented in the scat collections taken from terrestrial sites (Sinclair and Zeppelin 2002).

The effects of disturbance to sea lions resting on rookeries and haulouts have been well documented. On rookeries, human disturbance may disrupt breeding and nursing activities, disrupt social structure, lead to pup abandonment, and possibly increase the likelihood of predation. On haulouts, disturbance can also lead to increased chance of predation and the disruption of the social structure of sea lions. Since the early 1990s and the passage of critical habitat regulations, terrestrial sites have been largely undisturbed by humans. Disturbance is not considered to be a major factor in the continued decline of the species. One of the main concerns in the 1980s was that animals near rookeries and haulouts were being shot from vessels. This is considered to be uncommon today.

Anecdotal information suggests that animals have different tolerances to boat traffic. In some areas sea lions are known to co-exist with fishing vessels, often taking advantage of the presence of nets to catch fish, in other areas tour vessels have been known to come within a few feet of a sea lion haulout with no observed impact on the group. However, there are also anecdotal accounts of smaller cruise vessels sounding a loud horn in order to evacuate a haulout and provide a show for the tourists on board, and other accounts from research vessels indicate that the animals on most haulouts will become nervous when a boat is within 3,000-2,000 feet and abandon the site. In summary, in Alaska, terrestrial habitat essential to the conservation of Steller sea lions appears to be in good physical condition (i.e., no loss of habitat due to construction or other physical degradations), with some concern for disturbance to animals due to encroachment by humans near sites for viewing, research, or intentional harassment.

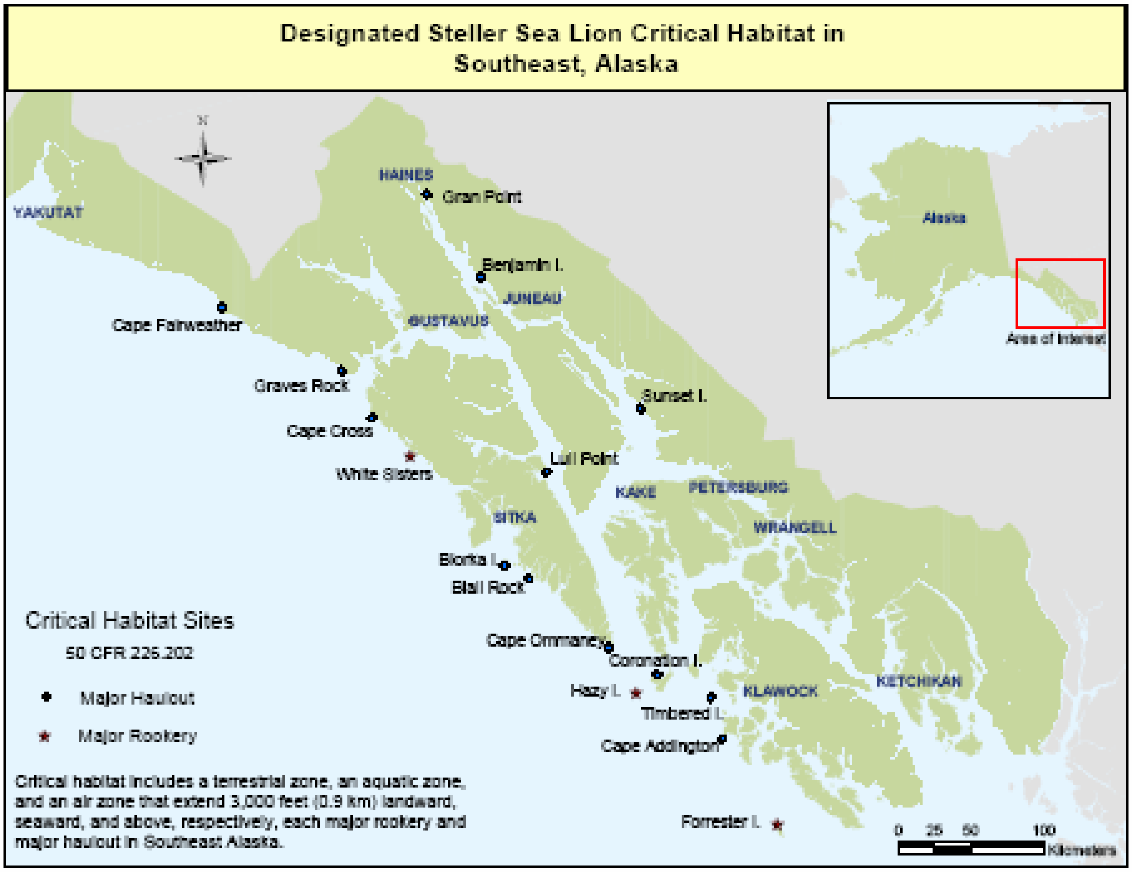
Aquatic-Foraging habitat for Steller sea lions

Prey resources are the most important feature of marine critical habitat for Steller sea lions. Marine areas may be used for a variety of other reasons (e.g., social interaction, rafting or resting), but foraging is the most important sea lion activity that occurs when the animals are at sea.

The at-sea distribution of Steller sea lions is a critical element to any understanding of potential effects of fisheries on sea lions and their critical habitat. Substantial new information has been collected on the at-sea distribution of the western population of Steller sea lions as reported in Loughlin et al. (2003) and NMFS (2001). Although not without limitations (discussed in ADF&G and NMFS 2001), information on location reflects the best scientific information available on the distribution of Steller sea lions in their aquatic habitat. Ideally, location would be combined with dive data to indicate at which locations sea lions are actively foraging. However, this combination of analyses is not yet available. In the absence of this combined information, NMFS must assume that information on location of sea lions does reflect, at least in part, where sea lions forage.

Marine foraging habitat designated as critical for Steller sea lions includes areas immediately around rookeries and haulouts. Haulouts with more than 200 animals on average, and all rookeries, were designated as critical habitat based on evidence that lactating adult females took relatively short foraging trips during the summer and were feeding close to their rookeries and haulouts (20 km or less; Merrick and Loughlin 1997). These areas were also considered to be important because young-of-the-year sea lions took relatively short foraging trips in the winter (about 30 km; Merrick and Loughlin 1997). Pups are just learning to feed on their own during the winter and they cannot travel far to find food, so the availability of prey in the vicinity of rookeries and haulouts is crucial to their transition to nutritional independence.

Figure 3.3 Critical habitat for the eastern population of Steller sea lion. Graphic from the Alaska Regional Office website: http://www.fakr.noaa.gov/protectedresources/stellers/maps/se_ssl_ch.pdf



Description of Steller Sea Lion Critical Habitat in the Action Area

Steller sea lion critical habitat is listed in 50 CFR §226.202. All Steller sea lion rookeries and major haulouts (average > 200 animals) are identified along with associated terrestrial, air, and aquatic zones.

Eastern Population of Steller Sea Lions: There is no critical habitat designated within the action area for the eastern population of Steller sea lions (Figure 3.3). However, Benjamin Island and Gran Point in Lynn Canal are listed as critical habitat and animals using these haul out areas likely use Berners Bay for feeding.

Western Population of Steller Sea Lions: There is no critical habitat designated within the action area for the western population.

3.1.6 Natural Causes of Mortality

Causes of pup mortality are numerous and include drowning, starvation caused by separation from the mother, disease, predation, crushing by larger animals, and biting by other sea lions (Orr and Poulter 1967, Edie 1977). Older animals may die from starvation, disease, predation, subsistence harvests, intentional shooting by humans, entanglement in marine debris, and fishery interactions (Merrick et al. 1987). While disease, subsistence harvests, intentional killing, and entanglement in debris are currently not viewed as significant factors affecting the status of the population, fishery interactions and predation by sharks and killer whales are potential factors that may have contributed to the decline and may impede recovery of the western population of Steller sea lions (NMFS 2001, Estes et al. 1998, Springer et al. 2003)

Predation: The only potentially significant non-human predators of Steller sea lions are killer whales and sharks. There have been several reports of killer whales interacting with and sometimes attacking Steller sea lions (Branson 1971, Frost et al. 1992, Barrett-Lennard et al. 1994). White shark predation on North Pacific pinnipeds has been well documented (LeBoeuf et al. 1982, Ainley et al. 1985, Long et al. 1996), but white sharks occur rarely, if at all, in the range of the western Steller sea lion population. Another large shark, the Pacific sleeper shark, is common in the Gulf of Alaska, Aleutian Islands, and Bering Sea (Orlov 1999). Most Pacific sleeper shark stomachs that have been examined contained remains of fish and invertebrates (Yang and Page 1998, Orlov 1999) but remains of harbor seals and porpoises have also been reported (Bright 1959).

Disease: In Steller sea lions, many anatomical and clinical studies have been performed to determine disease prevalence. The ultimate goal is to determine incidence, interactions with environment, and what role disease may play in the population trend or as an impediment to recovery. Disease is not considered a significant factor in the overall decline of the western population of Steller sea lions (NMFS 1995). However, disease may have contributed to the decline and it could limit recovery of the populations.

3.1.7 Human Activities Affecting the Status of Steller Sea Lions

Direct Effects of Commercial Fisheries on Steller Sea Lions

Steller sea lions are killed incidental to commercial fisheries, both federal groundfish fisheries and state-managed commercial salmon fisheries. The North Pacific Groundfish Observer Program (NMFS GOP) monitors federal groundfish fisheries mortality as part of the bycatch estimation procedures (we ‘estimate’ because we extrapolate from observed hauls to unobserved hauls). This is an ongoing program that produces annual bycatch estimates of marine mammals, as well as other groundfish. NMFS has monitored some state-managed salmon fisheries to obtain estimates of marine mammal incidental catch. This effort has, however, been infrequent and resulted in estimates for the Prince William Sound salmon driftnet (or set net) fishery.

To calculate overall incidental catch of marine mammals (including Steller sea lions) by fisheries, NMFS uses the most recent five-year combined, estimated average of incidental mortality in federal fisheries and adds it to the most recent data from state managed fisheries to arrive at a total number of Steller sea lions killed in commercial fisheries. This number is compared to the potential biological removal (PBR), a threshold for sustainable removals used to manage incidental mortality in commercial fisheries under the MMPA.

Here, we summarize the rate of sea lion mortalities that occur incidental to commercial groundfish fishing based on the NMFS GOP database. Incidental mortality summaries are excerpted from Perez (2004) and Angliss and Lodge (2004).

Six commercial groundfish fisheries operating within the range of the western population of Steller sea lions were monitored by fishery observers during 1998-2003 for incidental mortality: Bering Sea and Aleutian Islands (BSAI) groundfish trawl, longline, and pot fisheries, and Gulf of Alaska (GOA) groundfish trawl, longline, and pot fisheries. Fishery observers did not observe any sea lion mortality in the pot fishery or in the GOA longline fishery during the past five years. The methods for estimating the number of sea lions killed in observed fisheries are described in Perez (2004) and Angliss and Lodge (2004). Combining the mortality estimates from the BSAI and GOA groundfish trawl and longline fisheries with the mortality estimate from the Prince William Sound salmon drift gillnet fishery from previous years results in an estimated mean annual mortality rate in the observed fisheries of 28.0 (CV = 0.65) sea lions per year from this population (Table 3.3). The minimum estimated mortality rate incidental to commercial fisheries is 36.2 (CV=0.65) sea lions per year, based on observer data (28.0) and self-reported fisheries information (5.2) or stranding data (3) where observer data were not available. No observers have been assigned to several fisheries that are known to interact with this population (self-reported data from these fisheries are provided in Table 3.3), making the estimated mortality a minimum estimate.

Table 3.3. Summary of mean annual incidental mortality of Steller sea lions (western U. S. population) in commercial fisheries from 1998 through 2003. Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information. Data from 1998 to 2003 (or the most recent five years of available data) are used in the mortality calculation when more than five years of data are provided for a particular fishery. n/a indicates that data are not available. * Data from the 1999 Cook Inlet observer program are preliminary (from Perez 2004 and Angliss and Lodge 2004).

Fishery name	Years	Data source	Mean annual mortality
Bering Sea/Aleutian Is. (BSAI) groundfish trawl	98-03	NMFS GOP	8.0 (CV = 0.30)
Gulf of Alaska (GOA) groundfish trawl	98-03	NMFS GOP	1.5 (CV = 1.3)
BSIA groundfish longline (incl. misc. finfish and sablefish fisheries)	02	NMFS GOP	4
Prince William Sound salmon drift gillnet	90-91	AMMOP	14.5 (CV = 1.0)
Prince William Sound salmon set gillnet	90	AMMOP	0
Alaska Peninsula/Aleutian Islands salmon drift gillnet	90	AMMOP	0
Cook Inlet salmon set gillnet*	99-00	AMMOP	0
Cook Inlet salmon drift gillnet*	99-00	AMMOP	0
Observer program total			**28.0 (CV = 0.65)**
Alaska Peninsula/Aleutian Islands salmon set gillnet	90-01	self reports	[≥0.75]
Bristol Bay salmon drift gillnet	90-01	self reports	[≥3.5]
Prince William Sound set gillnet	90-01	self reports	[≥0.5]
Alaska miscellaneous finfish set gillnet	90-01	self reports	[≥0.25]
Alaska halibut longline (state and federal waters)	90-01	self reports	[≥0.2]
Strandings related to commercial fisheries	98-03	strand	3
Minimum total annual mortality			**≥36.2 (CV = 0.65)**

The most recent data available for incidental mortality of Steller sea lions in commercial or tribal fisheries within the eastern population is contained in Angliss and Lodge (2004) and is summarized here. Three commercial fisheries in which Steller sea lions were incidentally killed were observed during the period from 1990 to 2001: the California (CA)/Oregon (OR) thresher shark and swordfish drift gillnet, WA/OR/CA groundfish trawl, and Northern Washington (WA) marine set gillnet fisheries. The best data available on the rates of serious injury and mortality incidental to these fisheries are presented in Table 3.4. A mean annual mortality rate of 1.0 (CV = 1.0) was estimated for these fisheries. The minimum estimated mortality rate incidental to commercial fisheries (both U.S. and Canadian) is 3.65 sea lions per year, based on observer data (1.0), self-reported fisheries information (1.25), and stranding data (0.2 + 1.2 = 1.4).

Table 3.4. **Summary of mean annual incidental mortality of Steller sea lions (eastern population) in commercial and tribal fisheries from 1990-2001.** Mean annual mortality in brackets represents a minimum estimate from self-reported fisheries information or stranding data. Data from 1997-2001 (or the most recent five years of available data) are used in the mortality calculation when more than five years of data are provided for a particular fishery. n/a indicates that data are not available (from Angliss and Lodge 2004).

Fishery name	Years	Data source	Mean annual mortality
CA/OR thresher shark and swordfish drift gillnet	96-00	NMFS GOP	0
WA/OR/CA groundfish trawl (Pacific whiting component)	97-01	NMFS GOP	0.8 (CV = n/a)
Northern WA marine set gillnet (tribal fishery)	94-98	NMFS GOP	0.2 (CV = 1.0)
Observer program total			**1.0 (CV = 1.0)**
Southeast Alaska salmon drift gillnet	90-01	self reports	[≥1.25]
Alaska salmon troll	92-01	strand data	[≥0.2]
British Columbia aquaculture predator control program	95-99	permit reports	44
Minimum total annual incidental mortality (includes an estimate of 0.8 fishery-related strandings per year; see text)			3.65 (CV = 1.0)
Minimum total annual mortality (includes intentional mortalities in the BC predator control program)			**47.45 (CV = 1.0)**

Entanglement of Steller sea lions in derelict fishing gear or other materials is not believed to have significant effects on either population. Steller sea lions from the eastern population are also incidentally killed in commercial aquaculture fishing operations in British Columbia, Canada. Between 1995 and 1999, an average of 44 sea lions were killed annually in these operations (Angliss and Lodge 2004).

Subsistence Harvest

Steller sea lions are primarily harvested for subsistence purposes in communities within the range of the western population. Pinniped harvests in southeast Alaska tend to be dominated by harbor seals rather than Steller sea lions. Most Steller sea lions are harvested in the Pribilof Islands, well outside the action area. Estimates of the total number of sea lions harvested (plus struck and lost) during 1992 - 2001 ranged from 163 to 549 per year (Angliss and Lodge 2004). The mean annual harvest was 174 sea lions between 1997 and 2001 (Table 3.5). Evidence indicates that the harvest levels since 1995 have declined.

A very small percentage (<1%) of the statewide subsistence harvest of Steller sea lions was from the eastern population. The total subsistence harvest of Steller sea lions from this population was estimated at 2 animals/year between 1997 and 2001 (Wolfe et al. 2002).

Subsistence hunters in Canada harvest an unknown number of Steller sea lions from the eastern population. The magnitude of the Canadian subsistence harvest is believed to be small. Alaska Native subsistence hunters have initiated discussions with Canadian hunters to quantify their respective subsistence harvests, and to identify any effect these harvests may have on the cooperative management process. Subsistence harvests are not believed to be a significant factor in the population status of Steller sea lions in either population.

Table 3.5 Summary of the subsistence harvest data for the western population of Steller sea lions, 1992-01. Brackets indicate that the 1996 data remain in dispute and the 1997 data are preliminary. Subsistence harvest data were not collected in 1999 (from Angliss and Lodge 2004).

Year	Estimated total number taken (harvest +struck and lost	95% confidence interval	Number harvested	Number struck and lost
1992	549	452-712	370	179
1993	487	390-629	348	139
1994	416	330-554	336	80
1995	339	258-465	307	32
1996	[179]	[158-219]	[149]	[30]
1997	[164]	[129-227]	[146]	[18]
1998	171	130-246	128	43
2000	163	121-244	141	22
2001	198	162-282	156	42
Mean annual take (1997-01)	174			

Illegal Shooting

Illegal shooting of Steller sea lions occurs, but the frequency of occurrence is difficult to estimate. NMFS successfully prosecuted two cases of illegal shooting of sea lions in the Kodiak area in 1998, and two cases in southeast Alaska between 1995 and 1999 (Angliss et al. 2001). Illegal shooting of sea lions was thought to be a potentially significant source of mortality prior to the listing of sea lions as "threatened" under the ESA in 1990. Such shooting has been illegal since the species was listed as threatened. There are no reports of illegal shooting in the action area.

Strandings of Steller sea lions from the eastern population with gunshot wounds occur, along with strandings of animals entangled in gear that is not fishery-related (Angliss and Lodge 2004). Human-related strandings of animals with gunshot wounds from the eastern population occurred in Oregon, Washington, and Alaska in 1996 (2 animals), 1997 (3 animals), 1998 (1 animal), and 1999 (2 animals), resulting in an estimated annual mortality of 2.0 Steller sea lions from this population between 1996 and 1999. This estimate is considered a minimum because not all stranded animals are found, reported, or cause of death determined (via necropsy by trained personnel). In addition, human-related stranding data are not available for British Columbia. Reports of stranded animals in Alaska with gunshot wounds have been included in the above estimates. However, it is not possible to tell whether the animal was illegally shot or if the animal was struck and lost by subsistence hunters (in which case the mortality would have been legal and accounted for in the subsistence harvest estimate). However, one of the two 1996 reports was from Alaska and has been included because there were no subsistence struck and lost reports during that year.

Stranding data also provide information on additional sources of potential mortality. In 2000, four Steller sea lions from the eastern population were entangled in rope or line that was not necessarily related to a commercial or recreational fishery, and one animal was seen entangled in a 14" tire. All of these animals were alive when sighted; the animal entangled in the tire was successfully released. It is not clear whether the occurrence of these interactions in stranding data in 2000 but not in previous years reflects an increase in these types of interactions or an increase in reporting. If the number of interactions of this type were averaged over five years, the “other” interaction rate would be a minimum of one animal per year (from Angliss and Lodge 2004).

Predator Control

Steller sea lions are killed in British Columbia during commercial aquaculture operations. Preliminary figures from the British Columbia Aquaculture Predator Control Program indicated a mean annual mortality of 44 Steller sea lions from this population over the period from 1995 to 1999 (P. Olesiuk pers. comm., reported in Angliss et al. 2002). No such activity occurs in the action area.

Effects of Vessel Activity

Vessels may disturb Steller sea lions while they are in the water feeding or traveling. Their response is to dive and resurface some distance away from the vessel. They may mill around the vessel or disperse. Steller sea lions are also attracted to vessels when food is being captured or processed and some animals become habituated to this method of feeding (illegal shooting may occur in these instances). Although it is possible for a Steller sea lion, particularly a young animal, to be harmed by a collision with a vessel (most likely caught by the propeller), they are generally very agile and successful at avoiding such encounters when in the water. Collisions with vessels are not believed to be a significant source of mortality of Steller sea lions.

Effects of Changes in Ecosystem Dynamics

The decline of Steller sea lions is not well understood. This is partially because the population was not well studied before the decline and thus there is no baseline to compare current population parameters or threats to the population in a historical context. The leading hypothesis for the decline is that competition for prey with commercial fisheries coupled with a large-scale change in oceanographic conditions in the mid-1970s and 1980’s in the Bering Sea and Gulf of Alaska resulted in a decrease in the abundance of prey or the composition of the prey base such that juveniles and reproductive females could not find enough food for survival or reproduction. Other hypotheses are described in the NMFS Steller sea lion Recovery Plan (NMFS 1992). Steller sea lions appear to be fairly restricted in their movements and behavior such that they are limited in their response to a redistribution or reduction of prey near rookeries or haulouts (perhaps beyond 20 nm). This is primarily because mothers must return regularly to rookeries or haulouts to nurse their pups that can only fast for a day or so, and are dependent on their mother’s milk for a year or longer. Thus females must make daily foraging trips throughout the year and their prey resources must be located close to their terrestrial habitat. This limitation in the life history of sea lions makes adult females and juveniles vulnerable to changes in their prey base close to their terrestrial habitat. The survival and reproductive success of these two groups are the primary determinants of the population growth because sea lions are a long-lived, polygynous species. Competition with commercial fisheries for prey or prolonged changes in the prey base are believed to be primary factors influencing the status of Steller sea lions through changes in survival of juveniles and reduced reproduction of adult females. These are currently not issues for sea lions feeding in the action area.

3.1.8 Summary of Steller sea lion Status

Western Steller sea lion population

As noted, Steller sea lions were first listed as threatened under the ESA in 1990 due to a significant unexplained population decline of 64% over a 30-year period. This listing conveyed that the species was likely to become endangered within the foreseeable future throughout all or a portion of its range. In 1997, the species was separated into western and eastern populations, and the western population was listed as endangered. At the time of this listing, the population was considered to be in danger of extinction in all or a portion of its range. PVA models indicated that the western population would be extinct in 100 years if the population trends at that time remained unchanged.

The population has continued to decline at 4.3% annually over the past 15 years. Although in recent years some areas in the range have shown slight increases in the population numbers, the increases are local and are not outside the natural variability of the long-term trends in population estimates. Therefore, the population is still considered to be at risk of extinction within the next 100 years if the current overall declining population trend continues.

The western Steller sea lion population sustains some direct mortalities from bycatch in commercial fisheries, subsistence harvest, illegal shootings, and entanglements in fishing gear. These human activities clearly have an adverse affect to individuals in the western population; however, the population-level consequences of these anthropogenic stressors are low compared to competition for prey with commercial fisheries or natural changes in the availability or abundance of prey. Because of the low number of animals, the population is considered vulnerable to catastrophic and stochastic events that could result in significant declines, threaten viability, and increase the species' risk of extinction. It is important to note that abundance estimates alone cannot be relied upon as accurate measures of population recovery without a long-term understanding of demographic parameters of the population, variability in the population trends and the effects of natural and anthropogenic stressors on the status of the population.

Eastern Steller sea lion population

The eastern population of Steller sea lions was listed as threatened under the ESA in 1990 as a result of significant unexplained population declines of 64% over a 30-year period. Steller sea lions were separated into western and eastern populations in 1997. At this time, the eastern population of Steller sea lions remained classified as threatened under the ESA, meaning that the species was considered likely to become endangered within the foreseeable future throughout all or a portion of its range. Although it has maintained a 1.7% annual increase since 1989, the population sustains some direct mortalities from bycatch in commercial fisheries, subsistence harvest, illegal shootings, predator control activities, and entanglements in fishing gear. These human activities clearly have an adverse affect to individuals in the eastern population; however, the population-level consequences of these anthropogenic stressors are low compared to competition with commercial fisheries for prey or natural changes in prey availability or abundance. The population is considered vulnerable to catastrophic and stochastic events that could result in significant declines, threaten viability, and increase the species' risk of extinction. It is important to note that abundance estimates alone cannot be relied upon as accurate measures of population recovery without a long-term understanding of the demographic parameters of the population, variability in population trends, and the effects of natural and anthropogenic stressors on the status of the population.

3.2 Central North Pacific Humpback Whales (*Megaptera novaeangliae*)

3.2.1 Species Description

The humpback whale (*Megaptera novaeangliae)* belongs to the Order Cetacea, suborder Mysteceti. The mysticeti are baleen whales, named for the comb-like plates (baleen) descending from the roof of the mouth that are used to filter prey. Humpback whales are in the family of rorquals, the Balaenopteridae.

Humpback whales are distributed worldwide in all ocean basins. Two types of migrations may be distinguished: (1) within-season movement through a portion of the summer range, presumably in order to find or follow concentrations of prey; and (2) long-distance migrations between summering and wintering areas (NMFS 1991). Although humpback whales travel to follow prey, they also exhibit a high degree of site fidelity to feeding areas. A recent study found the rate of interchange between Alaska feeding areas (i.e., southeast Alaska, Prince William Sound, the Gulf of Alaska, Kodiak Island, Yakutat Bay, and the Bering Sea) to be less than 1% (Mizroch et al. 2004).

Most humpback whales occur in the temperate and tropical waters of the northern and southern hemispheres in the winter (from 10°-23° latitude). During this period, breeding and reproductive activities are their principal focus; during the warmer months, humpback whales move to northern latitudes where feeding is the principal activity. The historic feeding range of humpback whales in the North Pacific included coastal and inland waters around the Pacific Rim from Point Conception, California, north to the Gulf of Alaska and the Bering Sea, and west along the Aleutian Islands to the Kamchatka Peninsula and into the Sea of Okhotsk (Nemoto 1957, Tomlin 1967, Johnson and Wolman 1984).

Three management units (populations) of humpback whales currently are recognized in the North Pacific. The following units migrate between their respective summer/fall feeding areas to winter/spring calving and mating areas in the North Pacific (Calambokidis et al. 1997, Baker et al. 1998):

> 1) the California/Oregon/Washington and Mexico population, which are found winter/spring in coastal Central America and Mexico and migrate to the coast of California to southern British Columbia in summer/fall (Calambokidis et al. 1989, Steiger et al. 1991, Calambokidis et al. 1993);
>
> 2) the Central North Pacific population, which are found winter/spring in the Hawaiian Islands and migrate to northern British Columbia/southeast Alaska (including Glacier Bay) and Prince William Sound west to Kodiak in summer/fall (Baker et al. 1990, Perry

et al. 1990, Calambokidis et al. 1997); and

3) the Western North Pacific population, which occurs in winter/spring off Japan and, based on Discovery Tag information, probably migrate to waters west of the Kodiak Archipelago (the Bering Sea and Aleutian Islands) in summer/fall (Berzin and Rovnin 1966, Nishiwaki 1966, Darling 1991).

There are currently insufficient data to apply the Dizon et al. (1992) phylogeographic approach to classify any further population structure to humpback whales in the North Pacific.

Humpback whales of the Central North Pacific population spend the winter months in the waters off Hawaii where they are thought to breed and give birth to and nurse their calves. The whales undertake the northward migration to Alaska waters in late winter and generally arrive on the feeding grounds in May, remaining into November before returning to the waters off Hawaii. Some animals, however, remain on the feeding grounds year-round. Humpback whales do not feed while on the wintering grounds off Hawaii.

3.2.2 Reasons for Listing

Humpback whales were listed as endangered under the ESA in 1973 (16 USC 1531 *et seq.*) due to the reduced population size that resulted from significant commercial whaling harvest. At the time of this listing, the population was considered to be in danger of extinction in all or a portion of its range. Historically, both aboriginal and early commercial harpoon whalers harvested an unknown number of humpback whales. Much greater harvest pressure occurred in the 20th century when these animals were subject to heavy commercial exploitation during modern whaling operations. Prior to 1905, there were an estimated 15,000 humpback whales in the entire North Pacific; by 1966, following commercial harvest, the population was estimated to be between 1,000 and 1,200 animals. Measures to protect the humpback whales in the North Atlantic were first taken in 1946 with the establishment of the regulatory International Whaling Commission (IWC), and a ban on non-subsistence hunting followed in 1955. In 1965, the IWC banned the commercial hunting of humpback whales in the Pacific Ocean**.** Soviet whalers, however, continued to harvest humpback whales until 1980 (Perry et al. 1999). Currently, some illegal whaling continues although actual harvest levels are unknown.

3.2.3 Life History

Reproductive Biology

Humpback whale calving in the northern hemisphere generally takes places between January and March. Age at sexual maturity has been estimated to range from 4 to 9 years in females, and the calving interval, though variable, appears to range from 2-3 years. For some females, however, calving may take place on an annual or multi-year basis (up to 5 years) (NMFS 1991). Gestation averages about 12 months and lactation generally lasts close to a year. One female in southeast Alaska was observed with a calf for three consecutive summers, while another was seen with a calf for two summers in a row. Although the specific timing of separation may vary, the majority of calves are weaned after one year (Perry et al. 1999). In the North Pacific, the annual reproduction rate in wintering areas has been estimated at 0.58 calves per year; in summering areas, this rate was estimated at 0.38 calves annually (Perry et al. 1999).

There is no calculated birth rate for humpback whales in Berners Bay or surrounding waters of Lynn Canal. In Glacier Bay, the crude birth rate (calculated as the number of calves divided by total number of whales) of humpback whales has fluctuated over the last 20 years from a low of 4.0% to a high of 18.5%. There does not appear to be a trend in crude birth rate during this 20-year span. In recent years (2001-2002) the crude birth rate was 12.1% and 12.9% respectively, up significantly from the previous three years (Doherty and Gabriele 2002). The number of calves observed in 2002 is the second highest number of calves observed in the study area since 1982 and is significantly higher than the average number of calves per year (6.5) for all years studied.

Feeding Behavior

Humpback whales feed in coastal waters near shore and exhibit a wide range of foraging behaviors. They feed singly or in groups using several different feeding strategies to capture their prey. Some of the common feeding behaviors in southeast Alaska include "browsing" conducted by individual animals, non-synchronized diving behavior and bubble-net feeding. Bubble-net feeding generally involves an assemblage of animals diving near an aggregation of prey, releasing bubbles to concentrate the prey and surfacing through the bubbles to capture the prey. On each lunge, each whale in the group appears to maintain the same position, indicating an organized feeding structure during such maneuvers (Alaska-BC Whale Foundation 1996). Little is known about the underlying social structure of such foraging groups, although research indicates that animals associated with one another through foraging appear to have enduring social bonds and may represent combinations of individuals performing compatible tasks (Sharpe 2002). Ongoing investigations into feeding behavior in southeast Alaska are examining the relatedness of humpback whales in cooperative social groups through genetic analysis (Alaska-BC Whale Foundation 1996).

Humpback whales feed mainly on small schooling fishes such as Pacific herring (*Clupea harengus pallasi*), capelin (*Mallotus villosus*), juvenile walleye pollock (*Theragra chalcogramma*), and sand lance (*Ammodytes hexapterus*); and large zooplankton such as krill (Wing and Krieger 1983, Krieger and Wing 1986, Krieger 1986). The productive temperate waters off Alaska have historically contained large numbers of herring schools and krill patches in inland coastal waters in predictable locations. Humpback whales in Alaska, although not limited to these areas, return to specific feeding locations such as Frederick Sound, Chatham Strait, North Pass, Sitka Sounds, Glacier Bay, Pt. Adolphus, and Prince William Sound, as well as other similar coastal areas. Adult animals typically consume up to 3,000 pounds per day, and generally only forage while on the feeding grounds 6 to 9 months of the year. Should the animals not get enough food during the time spent in Alaska, compensation will not occur in other locations or at other times of the year.

In the region specific to the action area in southeast Alaska, humpback whales typically feed on herring, juvenile walleye pollock, capelin, and sandlance (Wing and Krieger 1983, Krieger and Wing 1984, 1986). In the waters of Lynn Canal, observers have noted single whales usually feeding alone, but occasionally also report cooperative feeding of five or more whales in a single group (Peterson 2001). In Glacier Bay, the availability of prey species appears to vary from year to year, and the number of whales in the park each year is dependent to a great degree on the availability and concentrations of prey in the park each year. Low numbers of whales are believed to correlate with years of low prey availability (NMFS 2003). The same is likely true for whales in Berners Bay and Lynn Canal.

Diving Behavior

Maximum diving depths recorded for humpback whales are approximately 150 meters (but usually less than 60 meters), and dives may last up to 21 minutes (Hamilton 1997, Dolphin 1987). In southeast Alaska, dive times for feeding humpback whales average 2.8 minutes. For non-feeding whales, dive times average 3.0 minutes, and for resting whales dive times average 4.3 minutes (Dolphin 1987). Most humpback whale dive depths are probably relatively shallow due to the fact that their prey is generally found at depths above 300 meters (NMFS 2002).

Vocalizations and Hearing

Hearing in marine mammals is a function of the level of sounds that marine mammals can hear in the absence of ambient noise (hearing thresholds); the ability of the animal to discriminate between different frequencies and intensities; effects of masking (the ability to distinguish signal from ambient); and individual variability. Humpback whales communicate at and respond to low frequency noise, generally in the range of 12Hz to 22 kHz. Frankel (1994) estimated the source level for singing humpback whales at between 170-175 dB. On the breeding grounds, male humpback whales sing long, complex songs that range in frequency from 25 to 5000 Hz and can reach intensities of up to 181 dB (Winn et al. 1970, Thompson et al. 1986). Thompson et al. (1979) estimated source levels of singing whales to average 155 dB and range from 144 dB to 174 dB. These songs appear to have an effective range of six to 12 miles (10 to 20 km). Humpback whales appear to produce a wide variety of sounds during the breeding season, while fewer sounds are produced on the summer feeding grounds. Feeding groups produce distinctive sounds ranging from 20 Hz to 2 kHz, with median durations of 0.2-0.8 seconds and source levels of 175-192 dB (Thompson et al. 1986). Sounds produced on the feeding ground can be characterized as loud, trumpet-like calls, and appear to be used to herd schooling fish and attract other whales to the feeding activity (D'Vincent 1985, Sharpe and Dill 1997, Alaska-BC Whale Foundation 1996).

Anatomical evidence also indicates that baleen whales are adapted to hear low-frequency sounds (Ketten 1998). Observations of whale responses to low frequency sound sources also support this (Richardson and Greene 1993, Richardson et al. 1995). Migrating gray whales would avoid a sound source 50% of the time when the received level was 116-124 decibels (Malme et al. 1984, 1983). However when similar noises were played to feeding humpback whales, they showed no response at received levels up to 120 decibels (Malme et al. 1985). The results of these studies indicate that prolonged exposure to man-made sounds at received levels greater than 120 decibels will elicit a behavioral response from baleen whales (Frankel and Clark 1998). Few studies of humpback whale response to vessels have included specific sound levels where behavioral responses occurred.

3.2.4 Population Status

Abundance: The most recent abundance estimate of humpback whales throughout the North Pacific is based on data collected by nine independent research groups that conducted photo-identification studies of humpback whales in the three wintering areas (Mexico, Hawaii, and Japan). Photographs taken between 1991 and 1993 were used to estimate abundance because samples throughout the entire North Pacific were the largest and most complete during this period. Using Darroch's (1961) method, which utilizes only data from wintering areas, and averaging the 1991-92, 1992-93, and 1991-93 winter release-recovery information resulted in an abundance estimate of 4,005 (CV = 0.095) for the Central North Pacific humpback whale population (Calambokidis et al. 1997). This is the estimate used to assess effects to this listed species by the proposed action. The current annual abundance estimate for the entire North

Pacific population (Central, Eastern, and Western) is 6,010 animals (Calambokidis et al. 1997). Using these estimates, the Central North Pacific population consists of 67% of the total number of whales in the entire North Pacific basin. The current best estimate for adult survival rate in the Central North Pacific population is 0.963 (95% CI: 0.944-0.978) (Mizroch et al. 2004).

Using photographs of the unique markings on the underside of each whales' flukes, there were 149 individual humpback whales identified in Prince William Sound from 1977 to 1993 (von Ziegesar 1992, Waite et al. 1999). The abundance of the Prince William Sound feeding aggregation is thought to be less than 200 whales (Waite et al. 1999). The most recent estimate by Straley et al. (2002) indicated that the annual abundance of humpback whales in southeastern Alaska is around 961 animals. Waite et al. (1999) identified 127 individuals in the Kodiak area between 1991 and 1994, and calculated a total annual abundance estimate of 651 (95% CI: 356-1,523) for the Kodiak region. In the Northern British Columbia region (primarily near Langara Island), 275 humpback whales were identified from 1992 to 1998 (G. Ellis, pers. comm., reported in Angliss and Lodge 2004). These estimates represent minimum estimates for these feeding areas because the study areas did not include the entire geographic region (i.e., the southeast Alaska study area did not include waters to the south of Chatham Strait). In addition, little is known regarding humpback whale abundance where photo-identification effort is typically low, such as the waters between feeding areas, south of Chatham Strait (southeastern Alaska), the eastern Gulf of Alaska and west of Kodiak Island. As a result, the sum of the estimates from these feeding aggregations (approximately 2,100) is considerably less than 4,005 animals.

Minimum Population Estimate: The minimum population estimate for the Central North Pacific population is calculated according to Equation 1 from the PBR Guidelines (Wade and Angliss 1997): The minimum population estimate = $N/\exp(0.842\times[\ln(1+[CV(N)]^2)]^{1/2})$. Using the population estimate (N) of 4,005 and its associated CV(N) of 0.095, the minimum population estimate for this humpback whale population is 3,698 (from Angliss and Lodge 2004).

Current Population Trend: The current population trend for the Central North Pacific population of humpback whales is thought to be increasing. Comparison of the estimate provided by Calambokidis et al. (1997) with the 1981 estimate of 1,407 (95% CI 1,113 - 1,701) from Baker and Herman (1987) suggests that the population has increased in abundance between the early 1980s and the early 1990s. However, the robustness of the Baker and Herman (1987) estimate is questionable due to the small sample size and the opportunistic nature of the survey. As a result, although the data support an increasing population size for this current Central North Pacific population, it is not possible to assess the rate of increase for this entire population (Angliss and Lodge 2004). However, the estimated number of animals in the southeast Alaska portion of this population has increased from estimates in the early and mid-1980s to the substantially higher estimate of 961 in 2000 (Straley 2002). Although a trend for southeast Alaska cannot be estimated, it is clear that humpback whale abundance has increased in recent years, and the available data indicate that the rate of increase between 1979 and 2000 is approximately 0.088 (Angliss and Lodge 2004).

3.2.5 Humpback Whales in Southeast Alaska

Humpback whales in the Central North Pacific show a high degree of fidelity to feeding areas. This fidelity is maternally directed; that is, whales return to the feeding areas where their mothers first brought them as calves (Martin et al. 1984, Baker et al. 1987). Humpback whales in the Central North Pacific population show fidelity to either the southeast Alaska or the Prince William Sound feeding areas. Photographs taken from 1979-1996 indicate that less than 1% of the individual whales photographed in these areas moved between areas. Therefore, while humpback whales in southeast Alaska belong to a much larger population, a smaller group of whales likely returns to the vicinity of the action area from year to year to forage.

Humpback whales in southeast Alaska have been most well studied in Glacier Bay National Park and Preserve. The Park Service has monitored humpback whales in the bay every year since 1985 to document the number of individuals, residence times, spatial and temporal distribution, feeding behavior and interactions with vessels (Doherty and Gabriele 2001). This monitoring program covers most of Glacier Bay and Icy Strait. In Glacier Bay, the current estimate of abundance for animals is 169 (95% CI=97-229) (Straley et al. 2002). The number of whales using the park rises in mid-June, peaks in July and August, then declines again in September, and lowest from October through April (NPS 2003). The overall number of whales in Glacier Bay and Icy Strait combined has generally increased over the last 20 years. In 2002, whales were sighted in the Bay from April through November. Survey effort is somewhat inconsistent; although the effort is consistently higher over the years in the months of June, July and August (Doherty and Gabriele 2002).

The percentage of the Central North Pacific population of humpback whales that occur in the action area and adjacent waters is small compared to the overall range and abundance of the entire population. The most recent estimate of abundance for southeast Alaska is 961 whales (95% CI = 657-1076) (Straley et al. 2002). The Central North Pacific population of humpback whales is estimated at around 4,005 animals (Calambokidis et al. 1997); thus, the Southeast Alaska population represents approximately 24% of the entire Central North Pacific population. This total for the southeast Alaska population, however, represents only animals identified north of Chatham Strait, and is therefore a minimum estimate since there is little photo identification effort in the lower half of southeast Alaska (south of Frederick Sound) (Angliss and Lodge 2004). The current best survival estimate for southeast Alaska humpback whales is 0.957 (95% CI: 0.943-0.967) based on over 31 years of data from over 11 research groups (Mizroch et al. 2004)

3.2.6 Critical Habitat for Humpback Whales

Critical habitat has not been designated for humpback whales anywhere throughout their range.

3.2.7 Natural Causes of Mortality

Little is known about causes of natural mortality in humpback whale populations and natural mortality rates have not been accurately quantified (NMFS 1991).

Disease

As with any wild mammal population, a multitude of infectious (viral, bacterial, parasitic, or mycotic) or toxicological (heavy metal, organochlorine) diseases may affect marine mammals. Toxins are known to affect humpback whales, but the effects of disease on their population trends are unknown. In 1987 and 1988, 14 humpback whales died in Cape Cod Bay from paralytic shellfish poisoning (PSP) as a result of ingesting dinoflagellate saxitoxin-infected Atlantic mackerel (NMFS 1991; Perry et al. 1999). This incident is the only natural mass mortality on record. There are no records of such poisonings occurring in Alaska with this species. In addition, humpback whales are known hosts for the parasite *Crassicauda boopis,* a nematode that may cause arteritis, occlusion of the blood vessels draining the kidneys, congestive kidney failure, and death (NMFS 1991).

Predators
Killer whales prey upon humpback whales, although such attacks are observed relatively infrequently. In Alaska, 15-20% of the photographically identified humpback whales bear scars of killer whale attack (Perry et al. 1999), although the two species are also observed feeding in close proximity without aggressive interactions (NMFS 1991). Younger animals may be more vulnerable to this type of predation during migration when group size is smaller than in summering or wintering areas (Perry et al. 1999). Apparent shark bites have also been documented on adult animals, and observed rake marks on the fins and flippers of calves have indicated attacks by false killer whales (NMFS 1991).

3.2.8 Human Impacts Affecting Humpback Whale Status

Effects of Historic Whaling
The worldwide population of humpback whales was thought to have been in excess of 125,000 animals prior to commercial whaling (NMFS 1991). Approximately 15,000 animals were believed to have been present in the North Pacific prior to 1905, and intensive commercial whaling during the 20th century may have reduced this population to as few as 1,000 before it was placed under international protection by the International Whaling Commission (IWC) in 1965. This estimate likely underestimates the actual kill as a result of the under-reporting of Soviet catches (Yablokov 1994).

Humpback whales are protected from hunting worldwide by the IWC. Humpback whales of the North Pacific basin appear to have been increasing since being placed under the protection of the whaling moratorium. The Central North Pacific population has increased substantially in recent years based on available data; although the rate of that increase is not known because of uncertainty in earlier abundance estimates.

Whaling was considered the primary threat to the worldwide populations of humpback whales when the species was placed under the protection of the IWC. At present, commercial whaling is not considered a significant threat to this species, although some illegal Japanese whaling continues to occur. It is not known currently how many individuals are killed on an annual basis in these commercial harvesting operations.

Direct Effects of Commercial Fisheries on Humpback Whales
Humpback whales are killed incidentally in federal groundfish and longline fisheries and state managed-commercial salmon fisheries. The methods for estimating the number of whales killed in each fishery is the same as that described in Section 3.1.7 for Steller sea lions. The primary source for data on incidental mortalities of humpback whales in commercial fisheries is from the North Pacific Groundfish Observer Program database (NMFS GOP) and Alaska Marine Mammal Observer Program. The incidental mortalities included here are summarized from Perez (2004) and Angliss and Lodge (2004).

Four commercial fisheries within the range of the Central North Pacific humpback whale population have been observed for incidental mortality of humpback whales between 1990 and 2003: BSAI groundfish trawl, GOA groundfish trawl, longline, and pot fisheries. The Hawaii longline/set line fisheries for tuna, swordfish, billfish, mahi mahi, and oceanic shark have also been observed over the period, however no mortalities have been observed in recent years. Average annual mortality from the observed fisheries was 1.5 (CV = 0.47) humpback whales from this population (Table 3.6). An additional source of information on the number of humpback whales killed or injured incidental to fisheries is self-reports and strandings. The estimated minimum mortality rate incidental to commercial fisheries is 5.2 humpback whales per year, based on observer data and self-reports (1.9) (Table 3.6), stranding records traceable to a specific fishery (0.8) and other stranding records indicating mortality or serious injury (2.5) (Table 3.7). This is considered to be a minimum estimate because logbook records (fisher self-reports required during 1990-94) are most likely negatively biased (Credle et al. 1994). In addition, no observers have been assigned to several fisheries that are known to interact with this population, making the estimated mortality rate unreliable. Further, due to limited Canadian observer program data, mortality incidental to Canadian commercial fisheries (i.e., those similar to U.S. fisheries known to interact with humpback whales) is uncertain. Though interactions are thought to be minimal, the lack of data regarding the level of humpback whale mortality related to commercial fisheries in northern British Columbia are not available, again reinforcing the point that the estimated mortality incidental to commercial fisheries is underestimated for this population.

At this time the number of entanglements that might result in serious injury or mortality for humpback whales is not known to be at a level to have population level effects on the Central North Pacific population. While a number of humpback whales have been reported entangled in fishing gear in southeast Alaska in recent years, it is difficult to quantify the impact relative to a specific fishery and to the whales themselves because of insufficient information obtained on these entanglements. Fishing gear interactions could be a significant source of serious injury (and potentially mortality) to humpback whales in southeast Alaska.

Table 3.6: Summary of mean annual incidental mortality of humpback whales (Central North Pacific population) in commercial fisheries from 1990 through 2003. Mean annual mortality in brackets represents a minimum estimate. For a particular fishery, the most recent five years of available data are used in the mortality calculation when more than five years of data are provided. n/a indicates that data are not available (from Perez 2004 and Angliss and Lodge 2004).

Fishery name	Years	Data Source	Mean annual mortality
Hawaii swordfish, tuna, billfish, mahi mahi, oceanic shark longline/setline	90-00	NMFS GOP	0
Bering Sea/Aleutian Is. (BSAI) groundfish trawl	98-03	NMFS GOP	1.5 (CV = 0.47)
Observer program total			**1.5 (CV = 0.47)**
Southeast Alaska salmon drift gillnet	90-01	self reports	[≥0.2]
Southeast Alaska salmon purse seine	90-01	self reports	[≥0.2]
Minimum total annual mortality			**[≥1.9] (CV = 0.47)**

Table 3.7. NMFS AKR stranding records of reported humpback whale entanglements, 1997-2004. (Based on Table 27.3 in the 2003 Stock Assessment Reports [Angliss and Lodge 2004], with edits.) Reports on whale entanglements are collected opportunistically and there is not a standard set of questions to ask when entanglement were reported common to all years, thus the wording in the condition and detail sections varies. The gears listed below could be commercial, subsistence or recreational, and gear type reported was not necessarily confirmed. In the table, 45% (n=23) of the entanglements involved nets, lines, buoys, pot gear, and longline gear targeting unknown species. Gear targeting crab species was involved in 33% of the events (n=17); nets (likely involved in salmon fisheries) were involved in 12% of the events (n=6). Four of the events (8%) involved shrimp gear; one event (2%) involved halibut. An additional 22 reports of humpback entanglements from 1985-1996 are also available in NMFS AKR records. Source: NMFS Standing reports contributed by stranding network members, private citizens, anonymous callers. Table edited February 2005. These data are subject to change. Contact NMFS for most current information.

	Year	**Area**	**Condition**	**Details**
1.	1997	Island of Hawaii	Released alive	Alaska crab pot floats removed by U.S. Coast Guard
2.	1997	Peril Straits, AK	Injured	Entangled in line; attempt to disentangle failed
3.	1997	Juneau	Injured	Tail wrapped in crab pot line
4.	1997	Admiralty Island	Alive; entangled	Line and 2' diameter buoy attached
5.	1998	Maalaea Bay, Lanai	Alive; entangled	Disentangled from gear, but some line remained
6.	1998	Sitka, AK	Alive; entangled	Likely commercial gillnet around flippers
7.	1998	Ketchikan, AK	Injury; status unknown	Salmon purse seiner net (commercial) torn through; thought to have died
8.	1998	Juneau, AK	Entangled	No details available

9.	1998	Wrangell, AK	Alive	Commercial crab pot line and buoy removed
10.	1998	Homer, AK	Alive	Tanner crab pot cut loose
11.	1998	Sitka, AK	Alive	Commercial crab pot line and buoy cut free; line remained in mouth
12.	1998	Ketchikan	Entangled	Swimming freely with line and buoys attached
13.	1998	Petersburg	Released, fate unknown	Likely crab buoys and line; buoy and most line removed.
14.	1999	Homer	Entangled	In crab pot gear; released
15.	1999	Prince of Wales Island	Entangled	In unknown pot gear, released
16.	1999	Hawaii, nk	Entangled, fate unknown	Entangled and trailing line and a float.
17.	1999	Resurrection Bay	Fishery interaction, fate unknown	Caught on halibut hook (100#); fisher cut line.
18.	1999	Sitka	Entanglement, apparently healthy	Line and buoy wrapped around whale; little or nothing dragging.
19.	2000	Lynn Canal	Entangled	Purse seine gear
20.	2000	Skagway	Entangled	Shrimp pot gear removed except for single buoy
21.	2000	Uyak Bay	Entangled	Unknown gear
22.	2001	Hawaii	Injured	Entangled in line/buoy from an AK fishery; released, injured – extent unknown
23.	2001	Resurrection Bay	Entangled, released alive	Swimming freely with multiple lines and buoys attached
24.	2001	Kodiak	Entangled	Attempt to disentangle failed; mother/calf pair
25.	2001	Yakutat	Found dead	Entangled in salmon set gillnet
26.	2001	Bering Glacier	Entangled	Entangled in gill net
27.	2001	Hoonah	Entangled, released	Shrimp pot gear
28.	2001	Lynn Canal	Released alive, fate unknown	Shrimp pot gear
29.	2001	Sitka	Released alive, fate unknown	Longline gear
30.	2001	Resurrection Bay	Released alive	Mixed gear including: line, 3 buoys, a crab pot, 2 floats, 30# anchor, chain, ball of line
31.	2001	Sitka	Entangled, fate unknown	Green net on rostrum
32.	2002	Taku Inlet	Entangled, fate unknown	2 crab pots and line
33.	2002	North Pass	Entangled, fate unknown	Likely crab pot and line
34.	2002	Ketchikan	Entangled, fate unknown	Crab line with buoy
35.	2002	Petersburg	Released, fate unknown	Crab line and buoy
36.	2002	Kupreanof Is	Entangled, fate unknown	Green mesh trawl net
37.	2002	Funter Bay	Self-released, fate unknown	Unknown gear
38.	2002	Ketchikan	Released, fate unknown	2 shrimp pots and line. Mostly removed.
39.	2003	Auke Bay	Self-released, fate unknown	Crab pot, line, buoy.
40.	2003	Auke Bay	Entangled, fate unknown	Likely crab pot line (No trailing gear reported.) Swimming freely.

41.	2003	Prince of Wales Is.	Dead with gear	Two large ropes and unknown fishing net on whale floating dead.
42.	2003	Sitka Sound	Self-released, apparently healthy	Unconfirmed report: commercial fishing gear. Sighted later with no signs of entanglement.
43.	2003	Stephens Passage	Entangled, fate unknown	Trailing line (unknown fishery).
44.	2003	Taku Inlet	Released, fate unknown	Unconfirmed report of gillnet disentanglement
45.	2004	Juneau	Entangled, not released	Two buoys, trailing 250' line
46.	2004	Stephens Passage	Released, fate unknown	Line around body, disentangled.
47.	2004	Kake	Entangled, not released	Lines and buoy (possibly halibut). Did not appear impaired.
48.	2004	Sitka Sound	Entangled, not released	Blue-green net wrapped around body. No photos.
49.	2004	Icy Strait	Entangled, partially released	Line (fishery unknown), partially removed. Trailing buoy.
50.	2004	Icy Strait	Entangled, fate unknown	Possible pot anchored whale; fate unknown.
51.	2004	Keku Strait	Entangled, fate unknown	Line with two buoys; did not appear to be trailing pot (Dungeness crab).

Impacts of Vessel Activity

As stated in the BA/BE, a recent compilation of available vessel collision records to large whales from 1975 to 2002 indicated that humpback whales are one of the most frequently hit species worldwide (Jensen and Silber 2003). Of the database containing 292 records, humpback whales (44 records) were the second most commonly hit species after fin whales (75 records). In Alaska, opportunistic reports of vessel collisions with humpback whales since 1986 have shown an average of one to two humpback whales struck per year (Table 3.8). This is a minimum estimate, as not all whales struck are reported and not all whales struck are identified to species or cause of mortality. The fate of struck animals is also not always determined unless the whale dies immediately upon impact or is discovered as a carcass on the bow of a ship and it can be determined that the strike was the cause of death.

Humpback whale distribution overlaps significantly with the transit routes of large commercial vessels that ply the waters off Alaska. The larger vessels are cruise ships, large tug and barge transport vessels, and oil transport tankers. Cruise ships frequent the inside waters of southeast Alaska, passing through areas used by humpback whales for feeding, such as Glacier Bay National Park and Preserve, Point Adolphus and, adjacent to the action area, the waters of Lynn Canal en route to Skagway and Haines. Tug and barge transport follows much of the traffic pattern of the cruise ships, as they frequent the same coastal communities. Oil transport tankers are generally operating farther offshore where there are presumably fewer concentrations of humpback whales, except for transit through Prince William Sound.

Numerous incidents of vessel interactions with humpback whales have been documented in southeast Alaska. There have also been several incidents that included close approaches and possible harassment by several vessels of different vessel classes including a kayak, a cruise ship and a float plane (Doherty and Gabriele 2002). Researchers also documented an injury to the dorsal fin that likely resulted from a vessel strike. It is likely that injury and mortality of humpback whales will continue into the future as a result of vessel strike.

Generally, there is a direct relationship between the occurrence of a whale strike and the speed of the vessel involved in the collision. Most collisions that have killed or severely injured whales involved vessels greater than 80 meters in length traveling at speeds in excess of 13 knots (Laist et al. 2001). In Jensen and Silber (2003), vessel speed at the time of strike was reported for 58 (19.8%) of the 292 cases. Operating speeds of vessels that struck various species of large whale ranged from 2 to 51 knots with an average speed of 18.1 knots. The average speed resulting in injury or mortality to the whale was 18.6 knots. In Alaska, records show that vessels have struck humpback whales at a range of speeds, from a skiff traveling at 29 knots to vessels drifting or idling (NMFS unpublished data, see Table 3.8). These records indicate that two incidents with associated vessel speeds resulted in death to the animal. One of these fatal collisions occurred in southeast Alaska with a cruise ship traveling at 19 knots; the other, with a container ship traveling at 12-19 knots reported from Anchorage, Alaska.

Additional factors appear to play a role with respect to speed in vessel collisions with whales. It appears that hydrodynamic and spatial factors play an important role in collision dynamics; ship strike incidents are more complex than simply a vessel hitting a whale. Knowlton et al. (1995) conducted a computer simulation study to examine the effects of hydrodynamic forces on the body of a whale from the forces created by pressure fields as water moves around a ship’s hull. The simulation also calculated the movement of the whale in relation to the ship, and found that an initial positive force induced by a passing bow would push a whale away from a ship, while a subsequent negative force would draw the whale back in toward the ship’s path. Although different vessel types exert unique levels of force on whales, the simulation determined that, in general, an increase in speed increases the forces acting on the whale. Thus if the speed of a vessel increases, the whale will be drawn in more quickly. Another simulation (Clyne 1999) examined the characteristics of collision events and analyzed the size, movement and speed of both ships and whales. Results showed a change in relative proportion of whale collisions with different parts of the ship against changes in speed. The study showed that, as speed increased, the proportion of whale collisions 1) decreased with the side of the vessel, 2) stayed relatively the same with the bottom of the vessel, and 3) increased with the bow of the vessel. Thus, it is possible that reductions in speed could mitigate incidents of head-on ship collisions with whales.

Worldwide, collision between ships and whales are associated with a wide variety of vessel types. Records in Jensen and Silber (2003) indicate that large vessels are the most likely class of vessels to hit whales. Almost half the collision records in the database (134 records) include the vessel type. Of these, the vessel category most represented is that of large, ocean-going ships: container/cargo ships, freighters, tankers, cruise ships and ocean liners (45 in total). These numbers likely represent a fraction of actual incidents, as many large ships underway may not be aware that a collision with a whale has occurred and thus do not report the incident. A number of strikes to whales in this data set were also attributed to ferries (16 records).

In Alaska, NMFS implemented regulations on July 2, 2001 that imposed vessel restrictions on approaching humpback whales closer than 100 yards to minimize the potential for harassment and the possibility of collision. Operating at a “slow, safe speed” when near humpback whales was also required. The National Park Service has implemented even greater minimum approach distances in Glacier Bay National Park (1/4 mile in all Park waters) for humpback whales, which likely reduces the whales’ underwater noise exposure and potential for behavioral disturbance. In addition, the Park has passed new vessel management measures that allow speed restrictions of 13 knots to be imposed by Park management on an as-warranted basis in the bay.

Table 3.8. NMFS AKR stranding records recording collisions between humpback and vessels, 1986-2004. This table reflects opportunistic data collection; there is no official system for reporting vessel collisions in Alaska. Thirty-six reports involved vessels and humpback whales colliding, and the level of confirmation varies from thoroughly investigated to unconfirmed reports, involving animals positively identified as humpback whales, and also animals likely to have been humpback whales. For events without necropsies, superscript refers to stranding report confirmation code: 3- well-reported, 2- basic information only, 1- unconfirmed; (-) indicates information not available. Source: Reports contributed to NMFS AKR files by United States Coast Guard, J. Straley, Glacier Bay National Park and Preserve, private Citizens, anonymous callers. Compiled February 2005. These data are subject to change. Contact NMFS for most current information.

			Vessel			
	Year	Area	Type	Length (ft)	Speed (knots)	Details $^{\text{confirmation}}$
1.	1986	Glacier Bay	Charter	65'	5 knots	Alive: fate unknown^{3}
2.	1986	Juneau	Recreational	25'	Anchored	Alive: fate unknown^{2}
3.	1986	Taku Inlet	Recreational	32'	Dead in Water	Alive: fate unknown^{2}
4.	1991	Sitka	Skiff	-	-	Alive: fate unknown^{2}
5.	1993	Sitka	Skiff	18'	-	Alive: fate unknown^{2}
6.	1994	Sitka	Recreational	24'	20 knots	Alive: apparently healthy^{3}
7.	1995	Admiralty Island	Skiff	-	29 knots	Alive: fate unknown^{2}
8.	1995	Craig	Skiff	16'	Drifting	Alive: fate unknown^{2}
9.	1995	Frederick Sound	Charter	28'	-	Alive: apparently healthy (Whale breached onto vessel)^{3}
10.	1995	Shakan Bay	-	90 '	9 knots	Alive: fate unknown (likely humpback)^{2}
11.	1996	Gulf of Alaska	U.S. Coast Guard	378'	15 knots	Alive: fate unknown (possible humpback)^{2}
12.	1996	Juneau	Recreational	26'	20 knots	Alive: fate unknown^{2}
13.	1997	Dixon Entrance	Crusieship	704' LOA	-	Alive: fate unknown (possible humpback) ^{1}
14.	1997	Juneau	Skiff	16'	Drifting	Alive: fate unknown^{3}
15.	1997	Seward	Charter	-	22 knots	Alive: fate unknown (possible humpback)^{3}
16.	1998	Juneau	Catamaran	-	Forward idle	Alive: fate unknown^{3}
17.	1998	Juneau	Charter	24'	15-18 knots	Alive: fate unknown^{2}
18.	1999	Metlakatla	Recreational	-	-	Alive?: fate unknown^{2}
19.	1999	Sisters Island	Sailboat	-	-	Alive: fate unknown ^{2}
20.	1999	Sitka	Sailboat	73'	Anchored	Alive: Injured^{3}
21.	1999	Stephens Passage	Commercial Fishing	34'	Anchored	Alive: fate unknown (possible humpback) ^{2}
22.	1999	Juneau	Cruiseship	951' LOA	19 knots	Dead on ship's bulbous bow^{2}
23.	2001	Anchorage	Container ship	D7 class	12-19 knots	Dead on ship's bulbous bow^{2}
24.	2001	Dixon Entrance	U.S. Coast Guard	110' LOA	12 knots	Alive: fate unknown^{2}
25.	2001	Glacier Bay	-	-	-	Necropsy: Injury consistent with strike (F. Gulland, unpublished necropsy)
26.	2001	Pacific Ocean (Southeast Alaska)	Cruiseship	963' LOA	-	Alive?: fate unknown (possible humpback)^{1}
27.	2002	Fern Harbor	Charter	62'	Neutral Coasting	Alive: apparently healthy, fate unknown^{2}
28.	2003	Auke Bay	-	-	-	Alive: fate unknown (possible humpback)^{3}
29.	2003	Baranof Island	Cruiseship	780' LOA	19 knot (avg.)	Alive?: fate unknown (suspected collision, possible humpback)^{1}
30.	2003	Bering Sea open water	-	-	-	Alive: fate unknown (possible humpback)^{2}
31.	2003	Icy Bay	-	-	-	Necropsy: Injury consistent with strike (NMFS unpublished data)
32.	2003	Sitka Sound	-	-	-	Alive: fate unknown^{3}

33.	2003	Wrangell	Cruiseship	754' LOA	Entering harbor	Alive?: fate unknown (suspected collision) [1]
34.	2004	Benjamin Island	-	-	Drifting	Alive: fate unknown[2]
35.	2004	Glacier Bay	-	-	-	Necropsy: Injury consistent with strike (F. Gulland, unpublished data)
36.	2004	Douglas Island	-	-	-	Necropsy: Injury consistent with possible strike (P. Tuomi, unpublished data)

Subsistence Harvest

Although the harvest of humpback whales is not restricted for the indigenous people of Alaska, humpback whales are not harvested by Alaska Natives.

3.2.9 Summary of Humpback Whale Status

As noted, the Central North Pacific population of humpback whales was listed as endangered under the ESA in 1973 due to commercial exploitation that severely depleted its population. At the time of listing, the population was considered to be in danger of extinction in all or a portion of its range. Since listing and the prohibition on commercial harvest, the Central North Pacific humpback whale population abundance has increased substantially. The current estimate for the Central North Pacific population is 4,005 (CV=0.095), and the best estimate for adult survival rate for this population is 0.963 (95% CI: 0.944-0.978). Although measures of abundance continue to indicate an increasing trend, abundance estimates alone cannot be relied upon as accurate measures of population recovery without a long-term understanding of demographic parameters and variability in the population and the effects of natural and anthropogenic stressors on the status of the population. In addition, the small population may be vulnerable to catastrophic or stochastic events that could result in significant declines and increase the species' risk of extinction.

Currently, direct mortalities from bycatch in commercial fisheries, and injury and mortality from entanglements and vessel collisions threaten animals in this population. Humpback whales continue to be killed in illegal whaling operations, although the extent of harvest remains unquantified. The extent of impact to humpback whales from contaminants in the marine ecosystem is also unknown. Although human activities clearly have an adverse affect to individuals in the population, the population-level consequences of these anthropogenic stressors are not fully understood.

4.0 ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human-caused and natural factors leading to the current status of the species or its habitat and ecosystem within the action area. Environmental baselines for biological opinions include past and present impacts of all state, federal or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR 402.02). 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.

4.1 Oceanographic Dynamics and Physical Processes

Berners Bay is a turbid outwash fjord estuary. Three glacial rivers empty into the northern section of the bay, carrying silt-laden, turbid waters into the estuary. A counterclockwise surface current prevails in the bay, holding much of the glacial plume along the northwest shore (Calvin 1977). This glacial plume washes Cove Point and the eastern side of Point Saint Mary with silt-laden, low salinity water and results in regular deposition of glacial silt near the northern shores of the bay. Throughout much of the year, during periods of glacial melting, the glacial plume is clearly defined. Along the path of the outwash, heavy silt loads generally maintain a high level of turbidity and low level of underwater visibility.

Due to the broad width of the bay's mouth, which runs from Point Saint Mary in the north to Point Bridget in the south, much of the shoreline in the bay is swept by waves from Lynn Canal. Fetch, wide tidal fluctuations and the counterclockwise surface currents amplify this wave action. This surface and subsurface hydrologic energy flushes the shoreline, intertidal, and subtidal zones of the southern portion of the bay, which minimizes the rate and quantity of glacial sediment deposition in the southern and eastern sections of the bay. A slight film of glacial silt on rocks and limited accumulation in crevices have been noted along the eastern and southern shores (Calvin 1977), and a summer subtidal survey found sedimentation of kelp blades (Stekoll undated_a), suggesting that glacial water is occasionally carried throughout the bay.

The substrate composition along the eastern shoreline of Berners Bay is typical of moderate energy sites, with large boulders and rocky outcroppings of bedrock. At the mouths of Sawmill and Cowee Creeks, substrates also include gravel, sand-mud and cobble (Calvin 1977, Harris et al. 2005). In the northern section of the bay, the inner coastlines of Slate Creek Cove and Cove Point are characterized by bedrock and large boulders in the upper zone, and mixed with gravel and sand in the intertidal and subtidal zones.

The bay is approximately 600 feet deep at the mouth with a 100-meter deep submarine trench, the Berners Trench, which runs from Point Saint Mary eastward to the confluence of the Lace and Antler Rivers (Sigler et al. 2004). The Bay shoals steeply along the eastern shoreline of Cove Point. Along the northern portion of the Bay, deposition of glacial sediments gradually reduce the depth of the bay to inches at the head where the Antler and Lace rivers join the bay.

Water Quality and Contaminants

Due to the lack of roadways surrounding Berners Bay and only limited usage of the bay by motorized boat traffic, discharges of petroleum products are minimal. During the spring and summer months, the probability of accidental discharges increases due to seasonal increases in boating activity, but water quality sampling has shown that concentrations of hydrocarbons are at or below detectable limits in the bay (Harris et al. 2005, S. Rice, pers. comm.).

Because of the relative isolation of Berners Bay from urban development and infrastructure, other water quality parameters including fecal coliform, heavy metals, and POPs/PCBs are likely to be at normal concentrations for estuarine waters of southeast Alaska (Harris et al. 2005).

4.2 Biological Characteristics and Processes

4.2.1 Primary and Secondary Productivity

Berners Bay is a regionally important estuary that supports a variety of ecological functions for the natural communities of Lynn Canal and northern southeast Alaska. The intertidal and subtidal habitats of the bay are diverse, with beds of macrophytic algae (*Alaria* and *Laminaria* spp.) along the rocky shoreline throughout much of the bay, with particularly dense stands at Point Bridget, Point Saint Mary (Calvin 1977) and Cascade Point (Calvin 1977, Stekoll 1999, Harris et al. 2005). There are also eelgrass beds on the sandy substrates of Echo Cove (Harris et al. 2005) and patches of coralline algae, *Lithothamnium* sp., along the shorelines throughout much of the bay (Calvin 1977, Harper et al. 2005).

Berners Bay supports a wide variety of invertebrates and fish species that provide the basis for a complex marine food web. Prevalent invertebrate species include *Mytilus edulis* (mussels), *Balanus* sp. (barnacles), euphausiids (krill) and other crustaceans, plus many species of bryozoans, echinoderms, mollusks and crustaceans (Calvin 1977, USFWS 1998, Stekoll 1999, Stekoll Undated, NMFS 2004). Fish, birds and marine mammals living in and around Berners Bay consume adult and larval forms of these organisms.

Each of the nine rivers and creeks and several unnamed tributaries in the watershed are catalogued by the State of Alaska as anadromous streams. These systems provide spawning and rearing habitat for runs of eulachon (hooligan), coho salmon, chum salmon, sockeye and pink salmon, steelhead and cutthroat trout and Dolly Varden char (ADF&G 2005). Berners Bay also provides spawning and rearing habitat for the Lynn Canal herring stock, as well as year-round rearing habitat for thousands of tons of larval and juvenile forage fish, including eulachon, capelin, several species of myctophids and salmonids (Vollenweider, pers. comm.; Harris et al. 2005, ADF&G 2005).

Marine mammals use Berners Bay year-round, with peaks in abundance occurring during spring and early summer (USFWS 2003). Commonly observed species include Steller sea lions, harbor seals, humpback whales, Dall’s porpoises, harbor porpoises, Pacific white-sided dolphins and killer whales (USFWS 2003, Marston et al. 2002, Sigler et al. 2004, Womble 2003, A. Eller, pers. comm, C. Schrader pers. comm., K. Koski, pers. comm.).

4.2.2 Seasonal variability of biological productivity

At the end of winter, the surface layer of the Berners Bay estuary begins to warm. The mixed layer, where temperatures are uniform and plankton and nutrients come together, becomes shallower due to the shifting of a density gradient, the pycnocline. Neither plankton nor nutrients can sink as they are held in the less dense water above the pycnocline. Thus phytoplankton is trapped in the euphotic zone for long periods with an abundance of upwelled nutrients. The increase in light and warmth, combined with the easy availability of nutrients, produces a spring bloom in which phytoplankton are growing and reproducing at peak rates.

This annual phytoplankton bloom provides several key benefits to the natural marine community of Berners Bay. Marine mammal prey resources such as capelin, herring, myctophids and sandlance feed on the abundant phytoplankton and zooplankton (Coyle and Paul 1992). In addition, the presence of the algal bloom near the water's surface reduces visibility, providing cover from predators for spawning herring and their eggs. The input of fresh water from the rivers at the head of the bay lowers surface salinities which provides larval fish with refuge from marine predators such as jellyfish, which cannot tolerate lower salinities.

Coincident with the timing of this annual algal bloom and herring spawn, large schools of adult eulachon begin to congregate in the northern sections of Berners Bay in preparation for their annual spawning run into the Antler and Lace Rivers. The eulachon typically move into the Berners trench sometime in early to mid-March (Marston et al. 2002, Sigler et al 2004). Once the eulachon gather in this portion of the bay, the schools provide a predictable, readily available, nutrient rich food source for Steller sea lions and other marine mammals (Marston et al. 2002, Sigler et al. 2004, Womble 2003, J. Vollenweider, pers comm.).

Each spring the diversity and abundance of wildlife in Berners Bay peaks in correlation with the annual algal bloom, eulachon run, and herring spawn. During this time of year, Berners Bay provides critical foraging resources for several species of marine mammals, including hundreds of Steller sea lions (Marston et al. 2002, USFWS 2003, Womble 2003, Sigler et al. 2004), harbor seals (USFWS 2003, A. Eller 2005 pers comm), humpback whales and other marine mammal species.

Berners Bay and its tidal flats also provide resting and foraging opportunities for dozens of species of migratory seabirds and waterfowl during spring migrations, with thousands of birds congregating and feeding on fish and invertebrates throughout the bay (USFWS 2003). Smaller seasonal increases in migratory bird diversity and abundance are also noted during autumn, particularly in the months of October and November. Higher numbers of migratory birds during spring are likely due to the timing of spring migration coinciding with the rich feeding opportunities provided by the spring eulachon run (Marston et al. 2002), outmigrating salmon smolts, spawning herring and sandlance (USFWS 2003). Bird species that are known to congregate in the bay include surf scoters, white-winged scoters, harlequin ducks, Barrow's goldeneye, mergansers, and several species of loons and gulls (USFWS 2003). Congregations of regionally sensitive bird species are also common in Berners Bay. Such species include: marbled murrelets, nesting trumpeter swans and bald eagles (USFS 2003).

4.3 Marine Mammal Prey Resources Within the Action Area

4.3.1 Herring

Ecological Importance

Pacific herring (*Clupea pallasii*) play a "key role in subarctic Pacific pelagic ecosystems by being in an intermediary trophic position between plankton and consumers of herring such as other fishes, birds and mammals" (Kline 2001). Pacific herring are an important nutritional resource for several species of marine mammals, supporting the nutritional needs of Steller sea lions, humpback whales, and other species through direct consumption as well as secondary consumption, when the mammals feed on other fish species such as pollock and salmon, which also feed on herring. In dietary analyses of Steller sea lion populations foraging in Berners Bay and Lynn Canal, herring have been found as a component of 90% of the animals' diets (J. Vollenweider, pers. comm.). Herring are an important prey resource for marine mammals due to their high lipid concentrations and energy content, measured at around 4.5 to 8.1 kJ/g wet mass (Paul and Paul 1998, Anthony et al. 2000). During their different life stages, herring are also an important prey resource for several Steller sea lion prey species, including: pollock, salmon and Pacific cod.

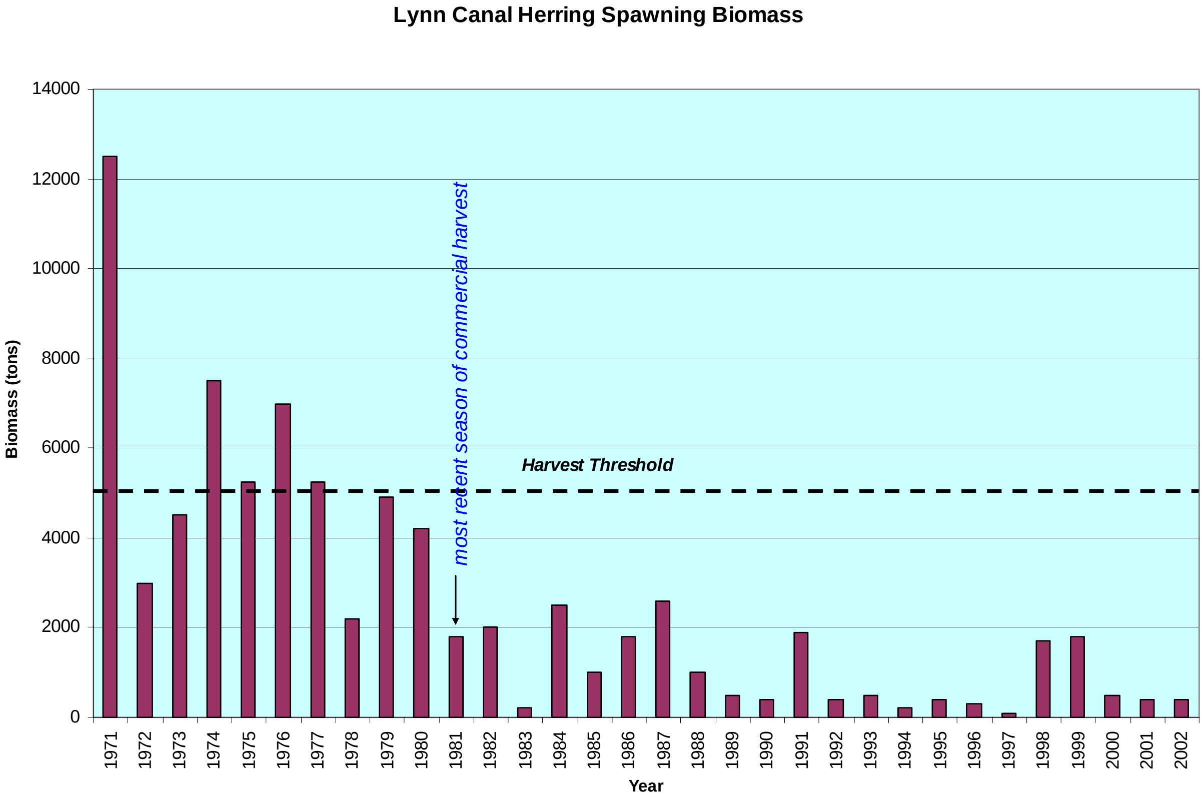
Herring populations, or stocks, are scattered across the region from Lynn Canal to Prince of Wales Island, with the main spawning concentrations occurring in the vicinities of Ketchikan, Craig, Frederick Sound, Sitka, and Auke/Berners Bays (Skud 1959). Population research conducted in southeast Alaska and Prince William Sound suggests that regional herring stocks are comprised of multiple, distinct subpopulations, or races, which are part of a larger regional metapopulation, with potential recruitment occurring between subregions (Rounsefell and Dahlgren 1935, Skud 1959, Brown and Norcross 2001). Recent genetic analysis of satellite mitochondrial DNA loci from 65 Pacific herring sampling locations in British Columbia, southeast Alaska and Washington state found herring spawning in Southeast Alaska to be distinct from those spawning further south in the Queen Charlotte Islands (Beacham et al. 2001). There was little evidence of genetic substructure among the herring stocks examined, but for locations where genetically distinct populations were identified, differences in timing of spawning was the main isolating mechanism and geographic isolation of the spawning population was thought to have an effect in maintaining genetic distinctiveness of the spawning population. Applying the metapopulation model (Levins 1970) to southeast Alaska herring stocks, it is probable that the viability of the Lynn Canal subpopulation that spawns in and around Berners Bay will indirectly impact the viability of other southeast regional herring populations through recruitment, genetic diversity, and sharing of predation pressures from marine mammal populations in northern southeast Alaska waters.

Status of the population

The Lynn Canal herring population has been depressed for the past 20 years (See Figure 4.1). Data on spawning distribution have been collected by Alaska Department of Fish and Game since 1972, which show notable trends in the extent of spawning activity and herring biomass. During the winters of 1972 through 1979, biomass estimates for the Lynn Canal population exceeded 2.27 million kilograms, or approximately 2,500 tons (Carlson 1980). However, since 1981, spawning biomass estimates have been at or below 2,000 tons and the commercial fishery in Lynn Canal has been closed; for 2001-2003, the spawning biomass estimate was less than 1,000 tons and a more precise estimate for 2004 was 743 tons based on survey dives to measure egg density (M. Pritchett, pers comm). Along with declines in biomass estimates, the geographic extent of the population's spawning grounds has also declined. From 1972 to

1989, herring spawn was observed in Auke Bay in 14 out of the 18 years, or 78% of the time. However, 1989 was the last year that herring spawn was observed in Auke Bay, and no spawning activity has been observed south of Yankee Cove for the past 15 years (M. Pritchett, pers comm.). Based on the information available, it seems likely that abandonment of the Auke Bay spawning grounds was caused by a combination of factors, including increased shoreline development in the bay, declines in water quality, and low numbers of herring available to spawn and rebuild the stock (Wing, pers comm.,Koski, pers comm.). Continuing trends in small population size and the lack of steady population growth despite the fishery's closure suggest that a population bottleneck may have occurred.

Figure 4.1. Lynn Canal herring population biomass estimates and commercial harvest threshold. Data provided by Mark Pritchett, Alaska Department of Fish and Game.



Worldwide, declines in herring populations are believed to be the result of a number of factors, including overharvest, habitat loss and/or degradation (particularly spawning habitat), depensatory predation pressures, disease, water pollution, and unfavorable oceanographic conditions (Pearson et al. 1999).

Due to the depressed condition of the Lynn Canal herring stock, any additional factors affecting survival rates or fecundity (reproductive success) for the population in its current state could lead to further significant declines in the Berners Bay/Lynn Canal herring population. Significant declines in this population may also cause a shift in metapopulation dynamics due to reduced recruitment potential and shifts in predation by marine mammals onto other herring populations, as predators may shift their foraging focus to locations outside Lynn Canal with greater herring abundance.

Such shifts in predation, coupled with loss of herring stock recruitment, could affect the abundance of multiple herring populations in the region. Regional declines in herring subpopulations have the potential to affect population dynamics of Steller sea lions, humpback whales, and other marine mammal populations. There are no other herring populations inhabiting Lynn Canal other than the Lynn Canal population; if marine mammals were to lose the prey resource and prey instead upon another population of herring, they would need to move from Lynn Canal to another geographic area inhabited by a herring population. It is likely that herring populations in other areas currently support populations of marine mammals and other wildlife dependent on herring (marine and anadromous fish, seabirds, etc.) and would face increased competition for food resources if the Lynn Canal herring population was reduced or removed.

Herring Habitat Requirements and Occurrence within the Action Area

The distribution of herring in Berners Bay, Auke Bay and Lynn Canal is seasonally variable and is linked to availability, abundance and spatial distribution of food resources. In general, the diet of Pacific herring is predominantly comprised of zooplankton, including euphausiids and barnacle larvae (Coyle and Paul 1992). While many larval and juvenile herring stay in the vicinity of Berners Bay throughout the year, adults and other juveniles migrate south along the shoreline, utilizing foraging habitat around Benjamin Island, Auke Bay, and other points in between (Carlson 1980).

In early spring, herring schools move from their overwintering grounds into the nearshore waters in and around Berners Bay. Typically, adult herring congregate near spawning grounds for several weeks to months before spawning, then disperse to the ultimate spawning site a few days to a few weeks prior to spawning initiation (Haegele and Schweigert 1985). The specific timing of spawn initiation is believed to be dependent on environmental triggers such as temperature, light, and/or chemical cues from other herring (Haegele and Schweigert 1985). The timing and distribution of spawning activity is annually and regionally variable, with spawning typically beginning sometime around April 24th and peaking 2 to 5 days later (M. Pritchett, pers comm.). Hay (1990) suggested that differences in spawn timing of Pacific herring stocks might also be explained by the coincidence of herring spawning times with local zooplankton production cycles, and particularly with the timing of production of copepod eggs, which are the predominant prey resource for larval herring.

Nearly 35 years of spawning data indicate that the exact dates of herring spawn in Berners Bay are variable, occurring sometime between April 18th and May 24th (M. Pritchett, pers comm.). Lynn Canal herring usually spawn over a two to three-week period (Carlson 1980), but spawning in any given location may take as long as five weeks (Skud 1959). Herring spawn typically starts with a period of fairly sparse activity (with few fish spawning), followed by a burst of heavy spawning activity a week to ten days later and tapering off (Haegele and Schweigert 1985).

Herring spawn throughout much of Berners Bay each year, but the exact location of herring spawn tends to vary from year-to-year; the most frequently used spawning sites are the intertidal zones of Point Bridget, Cascade Point, and along the eastern shoreline of the bay, north and south of Sawmill Cove (Pritchett, pers comm.). Spawning herring deposit their eggs in the nearshore intertidal and subtidal zones, primarily on kelp and eelgrass (Haegele and Schweigert 1985, Wespestad and Moksness 1990).

Hatch timing is temperature and light dependent. In the warmer climate of British Columbia, herring eggs hatch after approximately 2 weeks; in Prince William Sound, where water temperature and climate are similar to Lynn Canal, herring eggs hatch in 24 days (Brown & Carls 1998). Pacific herring larvae remain at the site where they hatched unless swept away by ocean currents (Norcross et al. 2001), and they metamorphose into juveniles when they reach a size of 25 to 30mm, which can take from 2 to 3 months (Hourston and Haegele 1980, Hay 1985, Wespestad and Moksness 1990). Although juveniles may move around in and out of the bay, many herring may remain inshore until their first spawning (Hay 1985). Juvenile herring are found in Berners Bay year-round (Eller, pers comm., Sigler, pers comm., Harris et al. 2005) and rely on the bay for resources needed for the first few years of survival.

Figure 4.2. Alaska Pacific herring (*Clupea pallasi*) life history model (based on information provided in Hourston and Haegele 1980, Hay 1985, Wespestad and Moksness 1990, Brown and Carls 1998).

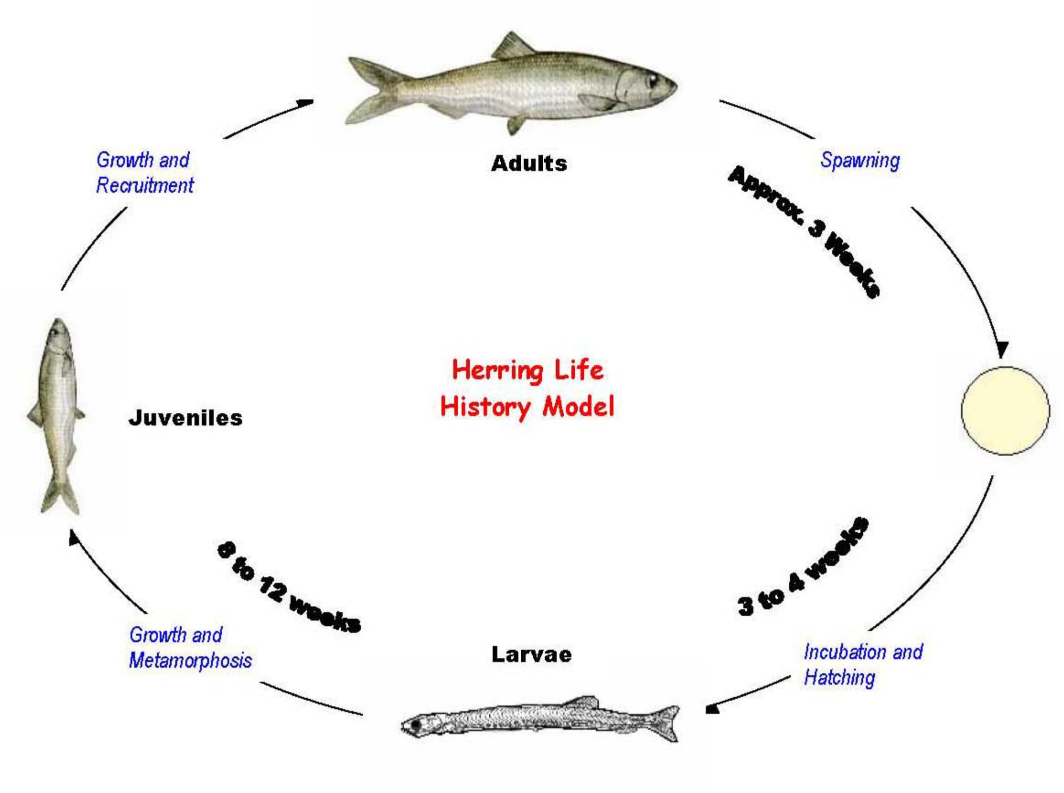
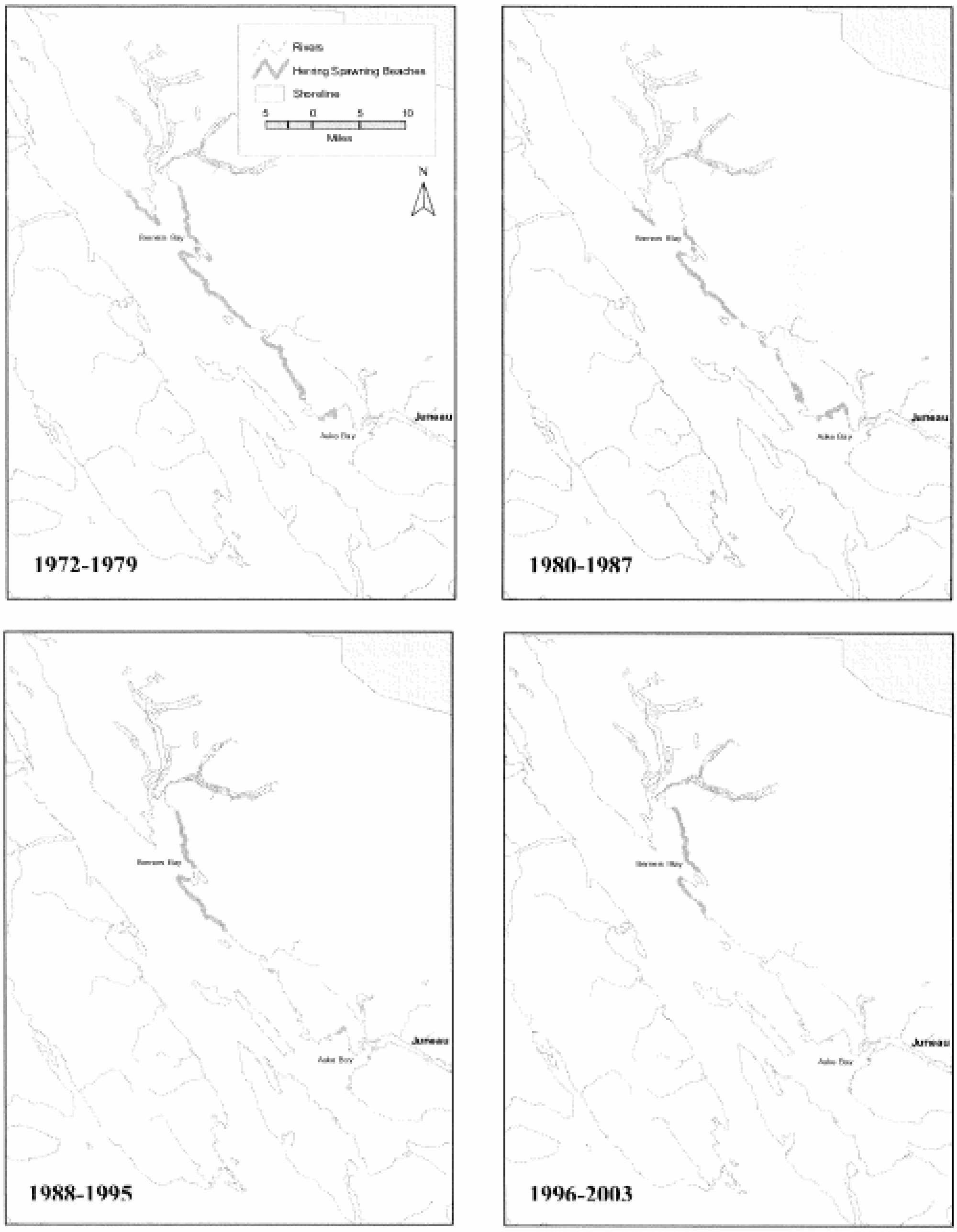


Figure 4.3. Documented spawning locations for Lynn Canal Pacific herring stocks over cumulative 8-year intervals: 1972-1979, 1980-1987, 1988-1995, 1996-2003 (Figure from Williams et al. 2004).



4.3.2 Eulachon

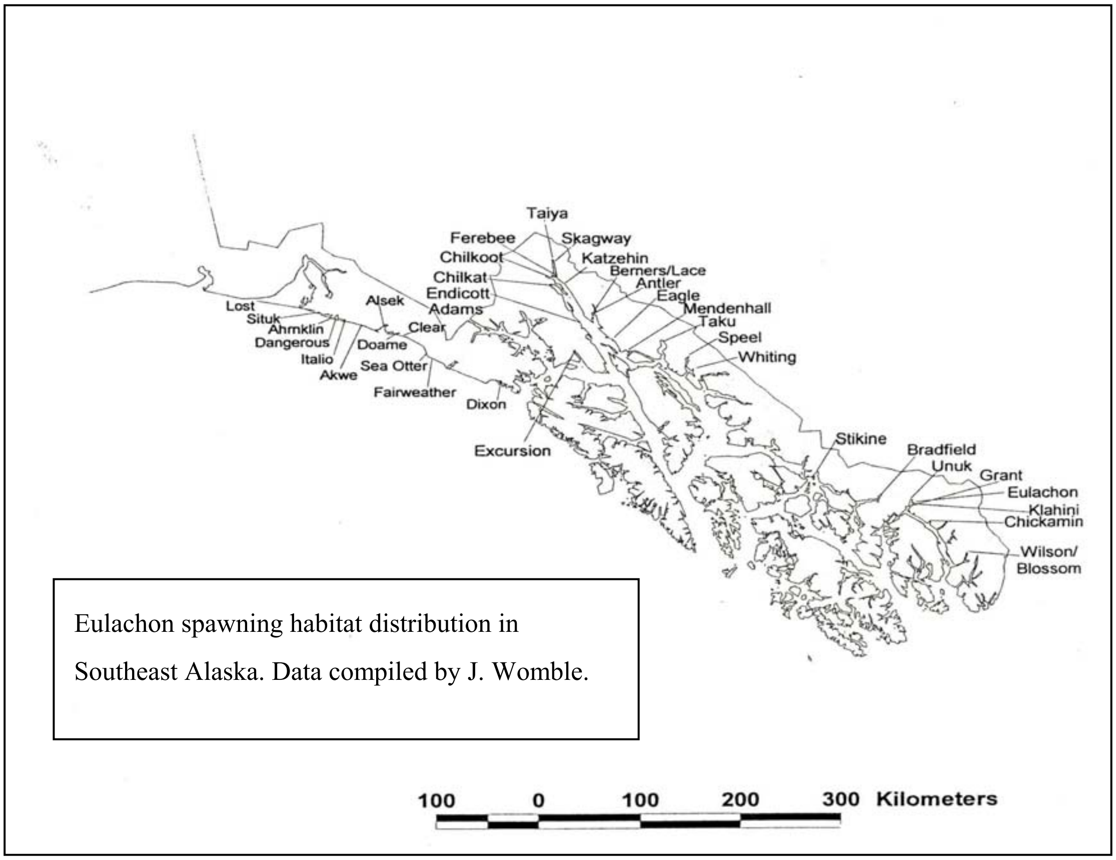
Eulachon are commercially unimportant fish therefore there is less known about this species' basic biology and ecology than is known about most other species of forage fish. Interest in this species has grown recently due to its importance as prey for a variety of other species, including Steller sea lion (Willson et al. 2003). Research is ongoing to determine the duration of stay of eulachon larvae in the surface waters of Berners Bay (A. Eller, pers. comm.) and the distribution of adult and larval herring in Berners Bay as part of a study to determine the prey resources of Steller sea lion (Sigler et al. unpublished data). Spawning runs of eulachon have been reported to occur in as few as 30 rivers or 50-60 rivers, depending on whether individual streams or inlets, bays and major rivers are counted (Hay et al. 1997, Hay in Eulachon Research Council 2000). In Southeast Alaska, eulachon are known to spawn in seventeen freshwater systems, including the Antler, Berners and Lace Rivers in Berners Bay. The three known spawning rivers in Berners Bay can be grouped together as one large run. Research conducted in 1995 to 1997 in Berners Bay documented that eulachon spawning runs began in early May and generally lasted from 10 to 12 days, with some late spawning continuing through the end of May (Marston et al. 2002). Separate research on the Antler River in 2002 documented adult eulachon abundance peaking in late April to early May (K Koski, Undated). Fish were found in the river from April 19 to May 21, although most fish remained in fresh water for only one to three days. Radio telemetry data showed that the maximum migration up the Antler was about 4 km, with most observations clustered in the lower 2 km of the river (A. Eller, unpublished data). While eulachon larvae are rapidly flushed out of their spawning rivers within 48 hours of hatching, their distribution in estuaries indicates a residence, lasting anywhere from weeks to months (McCarter and Hay 1999). This suggests that estuaries are a critical habitat for eulachon larvae and early juveniles. It is possible that eulachon imprint on their home estuary rather than their home streams, which means that the estuarine residence of early life stages of eulachon is important in maintaining population integrity. Larvae of a closely related species, rainbow smelt (*Osmerus morax*) have been studied in the St. Lawrence River estuary (Didson et al. 1989, Laprise and Dodson 1989a, 1989b, Sirois and Dodson, 2000). Larval rainbow smelt achieve retention in turbid waters by employing active tidal vertical migrations. This directed association with turbid waters is of particular interest in relation to eulachon, since of the 17 known eulachon streams in southeast Alaska 15 are influenced by runoff from glaciers, which produce zones of high turbidity.

The Berners Bay eulachon run is an important resource for Steller sea lions because the fish densely aggregate, behave predictably, and are high in energy content, measured at 7.49 kJ/g wet mass (Anthony et al. 2000), 7.9 kcal/g (Payne et al 1999), and 9.7 kJ/gram (Sigler et al. 2004). Schools of eulachon in Berners Bay are also relatively easy targets for cooperative feeding by sea lions. Prior to migrating into the rivers to spawn, the fish aggregate at depths of 40 to 150 meters, which coincides with the depths at which Steller sea lions forage (Loughlin et al. 2003). The spatial structure of Berners Bay restricts the movement of eulachon at the western edge, channeling them into an area where their movements are constrained, which coincides with the locations where Steller sea lion cooperative foraging behavior has been observed many times over several years.

Andrew Eller (UAS) has sampled the surface waters of Berners Bay with surface plankton tows, plankton tows to 10m depth, and vertical tows to a depth of 35 m weekly from June 5 to August, 4, 2004. Small, 6mm smelt larvae (eulachon and capelin) were collected in Slate Creek Cove during June sampling. These larval smelt were found in the same location where adult eulachon congregate for spawning runs supporting the theory that larval eulachon imprint upon their home estuary rather than their home stream, which means that the estuarine residence of early life stages of eulachon could be very important for maintaining eulachon population integrity (McCarter and Hay 1999). This finding means that at least some proportion of larval fish use the waters near the mouth of Slate Creek Cove as a nursery area from June through at least December. Additional hydroacoustic and midwater trawl sampling of the Slate Creek Cove area of Berners Bay is scheduled for the week of March 7, 2005.

Timing of annual eulachon is relatively predictable and usually occurs in April to early May, which coincides with the timing of increased energetic demands of Steller sea lions prior to the breeding and pupping season (Sigler et al. 2004, Winship et al. 2002). However, interannual eulachon biomass estimates were highly variable, declining from approximately 2,034 metric tons in 2002 to only 76 tons in 2003. Pre-spawning aggregations appeared to form in the Bay, moving from the outer part of the Bay near Point St Mary toward the Berners River system. Eulachon schools seemed to be monospecific and were found at depths ranging from 30 m to 130 m. Marston et al. (2002) published research on eulachon runs in the lower reaches of rivers entering Berners Bay that suggested spring runs were an ecological cornerstone species for regional coastal ecosystems and supported large numbers of wildlife species. For Steller sea lions, the frequency of eulachon in scats collected at Benjamin Island between 2001 and 2004 was 8% (J. Vollenweider, pers. comm.). However, in 2002 when the occurrence of eulachon was high, the frequency of occurrence in sea lion scats increased to 16.4% (J. Vollenwieder, pers. comm.).

Figure 4.4. Distribution of eulachon spawning habitat in Southeast Alaska. Figure reprinted from Willson *et al* 2003.



Eulachon spawning habitat distribution in Southeast Alaska. Data compiled by J. Womble.

4.3.3 Capelin

In studies on marine mammal diets, prey quality and prey distribution, capelin is commonly cited as a key forage species (Merrick et al. 1997, Payne et al. 1999, Anthony et al. 2000, Brown 2002). Capelin is a common component of the diets of humpback whales and Steller sea lions living in and around Berners Bay and Benjamin Island (Vollenweider 2004). Capelin provide a moderately high energy resource, with the highest mean lipid content of all small forage fishes – approximately 18% -- and with an energy density of around 4.83 to 5.86 kJ/g wet mass (Anthony et al. 2000).

Research of forage fish diets in Auke Bay and Lynn Canal has shown a seasonal overlap between capelin and herring habitat requirements and diet. The diet of Lynn Canal capelin is predominantly comprised of euphausiid eggs, *Pseudocalanus,* barnacle nauplii, *Calanus spp., Metridia spp., and Centropages abdominalis.* Coyle and Paul (1992) found that in the spring, prior to stabilization of the water column, herring and capelin shared similar foraging habitats and prey resources within the water column. However, as the surface waters warm, a pycnocline develops and a zooplankton assemblage develops near the surface. At this time, herring begin to actively forage on the zooplankton gathered in the surface layer as they move into the intertidal zone. Capelin, on the other hand, continue to forage in the water column and any seasonal variability in diet is linked to prey availability and abundance within that zone.

Capelin have adapted to cycles of environmental productivity by fasting when resources are low during overwintering and spawning periods, then heavily feeding on zooplankton blooms during pre-spawning and post-spawning (Winters 1970). According to studies conducted in the Gulf of Alaska that assessed the nutritional value and energy content of forage fish, capelin had the greatest energy and lipid contents in June, following the spring zooplankton blooms; after that, energy stores decreased dramatically throughout the summer, probably in association with decreasing prey availability and greater energy investment in reproductive requirements and behaviors (Anthony et al. 2000). Because the peak in mean energy content is tied to the spring zooplankton bloom, capelin provide the greatest nutritional value to predators in late spring, which coincides with the peak marine mammal foraging period in Berners Bay and the bay's eulachon run and herring spawn.

Schools of capelin are widely distributed in southeastern Alaska, usually living nearshore and in bays and fjords, especially during summer (Pahlke 1985, Brown 2002). Little research has been conducted on capelin abundance or distribution in Berners Bay. However, it is known that larval and juvenile capelin are present in Berners Bay throughout the year and areas of local abundance have been confirmed in the nearshore zones off of Cove Point and Cascade Point (A. Eller, pers. comm., Harris et al. 2005). In December 2004, NMFS' Auke Bay Labratory staff conducted hydroacoustic and midwater trawl sampling of fish sign detected in Slate Cove heading toward Cove Point. The acoustic sounder detected two layers of fish at 40 to 60 m and at 65 to 75m, trawls to identify these fish sign yielded young-of-the-year (YOY) capelin with YOY herring present and the second trawl produced predominantly YOU eulachon. The acoustic fish signal did not appear along any of the other shores while the research vessel was exiting the bay on the west side (A. Eller, pers. comm.).

4.3.4 Salmon and other prey species

The species of marine and estuarine fish known or expected to use the waters of Berners Bay include walleye pollock, Pacific cod, yellowfin sole, arrowtooth flounder, rock sole, Dover sole and all five species of Pacific salmon – Chinook, coho, sockeye, pink and chum (Harris et al. 2005, M. Sigler, pers comm., Vollenweider, pers comm., NMFS 2004). Although not all life stages of these species are found in Berners Bay, most groundfish species are expected to inhabit intertidal and subtidal habitat as adults, larvae, juveniles and eggs.

Walleye pollock larvae are known to utilize the Bay's waters for rearing, and many important forage species including eulachon, Pacific herring, sand lance and capelin use the bays protected shallows for important rearing habitat during the first year of life (A. Eller, pers comm., D. Csepp, pers. comm.). Sixteen species of anadromous and marine fish were identified from sampling the nearshore habitat at Cascade Point in June of 2004 (Harris et al. 2005). During this study, juveniles of three important forage fish species – capelin, herring, and sandlance – were also captured in Berners Bay. The significance of this finding is highlighted by a similar study in which 41 sites were sampled throughout southeast Alaska but capelin were only found at four of those sites, one of which was in Berners Bay (Johnson et al. 2005).

As discussed in the 1992 FEIS (USFS 1992), Lynn Canal and Berners Bay serve as both rearing areas and migration pathways for juvenile salmonids. The east shore of Lynn canal is a migratory route for all five species of salmon outmigrating from northern Lynn Canal. Tagging studies on Chilkat River coho salmon have documented that these fish migrate from the Chilkat River as smolt and overwinter in Berners Bay prior to migrating to sea (Ericksen 2001). Limited beach seine sampling conducted by NMFS' Auke Bay Laboratory staff in 2004 found an abundance of chum and coho salmon, as well as cutthroat trout and Dolly Varden char, in the nearshore habitat off Cascade Point (Harris et al. 2005). The Berners Bay estuary provides a highly productive, relatively protected rearing area for salmon smolts as they begin their oceanic phase of life. Sockeye salmon smolts, and pink and chum salmon fry may especially benefit from the rich abundance of copepods, euphausiids and other zooplankton and fish larvae in Berners Bay during their first months in marine waters. Thus it is likely that multiple species of salmonids from the streams of the Berners Bay watershed and northern Lynn Canal also use the energy-rich, productive waters of Berners Bay during their early life stages. Adult salmon also use the Bay for foraging and staging prior to spawning in nearby streams and rivers.

4.4 Steller Sea Lion Occurrence in the Action Area

While Steller sea lions are observed year round in Berners Bay, the greatest numbers are present for three to four weeks in April and May when they aggregate to feed on spawning runs of eulachon and herring (Gende 2001, Marston et al. 2002, Sigler et al. 2004, USFWS 2003, Womble et al. in press, pers. comm. with Baker, Eller, Ferry, Hood, Hudson, Hyde, Korhonen, Levine, Libenson, Schrader). Sea lions have been observed in the Bay consistently since the mid 1990s (Marston et al. 2002, Sigler et al. 2004). Based on surveys of local hauling sites (Gran Point, Met Point, Benjamin Island), animals foraging or rafting in the Bay, and population estimates of Steller sea lions, Sigler et al. (2004) estimated that up to 10% of the southeast Alaska Steller sea lion population utilizes this area to feed on the high-energy food sources. Although the availability of prey is brief, the abundance and energy content is so great that it is likely important to the energy budget of sea lions. Because sea lions store energy in the blubber, the consumption of large quantities of energy rich prey over a short period can benefit them for up to five or six weeks after consumption (L. Rea, pers.comm.). Sigler et al. (2004) estimated that Steller sea lions feeding on eulachon could increase the energy content of their diet by 91%. Spring is an energetically demanding time for Steller sea lions. Adult males prepare for prolonged fasting while on breeding territories in the summer, adult females support lactation and pregnancy while replenishing their own energetic stores, and pups gain mass before becoming nutritionally independent from their mothers. Thus, the seasonally predictable, high-energy eulachon and herring spawning runs in Berners Bay are likely an important component to survival and reproductive success of those animals utilizing them.

Cooperative feeding behavior by sea lions has been documented only in Berners Bay. Gende et al. (2001) reported several observations of 75 to 300 Steller sea lions foraging cooperatively on schools of eulachon in late April or early May from 1996 through 1999. Sigler et al. (2004) also noted cooperative foraging along the western shore of Berners Bay in April 2002. When not foraging, sea lions have been observed forming large “rafts” of 10 to 80 sleeping or resting individuals in the middle of the bay (Gende et al. 2001). Steller sea lions have also been observed hauling out south of Slate Creek Cove during late April (J. Womble, pers. comm.) and in Slate Creek Cove (M. Lea, pers.comm.) (Figure 4.5).

The nearest rookery to the action area is Graves Rock, on the outer coast, approximately 90 km from the action area. This is a new rookery in 2002, previously documented as a sea lion haulout only. White Sisters is the largest traditional rookery near the action area. It is about 150 km from the action area. The nearest haulouts are in Lynn Canal: Gran and Met Points at the north end of the Canal, and Benjamin Island, about 14 miles south of Berners Bay. Most of the sea lions observed during peak counts in Berners Bay were either adult or juvenile sea lions (Sigler et al. 2004); however, most sea lions observed at the Benjamin Island haulout at the same time were 10- to 11-month-old pups, and some were still likely dependent upon their mothers’ milk for nutrition (J. Womble, pers. comm.). It is likely that their mothers were feeding in Berners Bay.

Berners Bay is not designated as Critical Habitat for Steller sea lions. Gran Point and Benjamin Island are designated as critical habitat (50 CFR §226.202). Although these haulout sites are not considered in the action area for this consultation, the animals using these haulouts probably feed in Berners Bay and would be affected by the proposed action.

Figure 4.5. Steller sea lion haulouts at Slate Creek Cove and Benjamin Island.

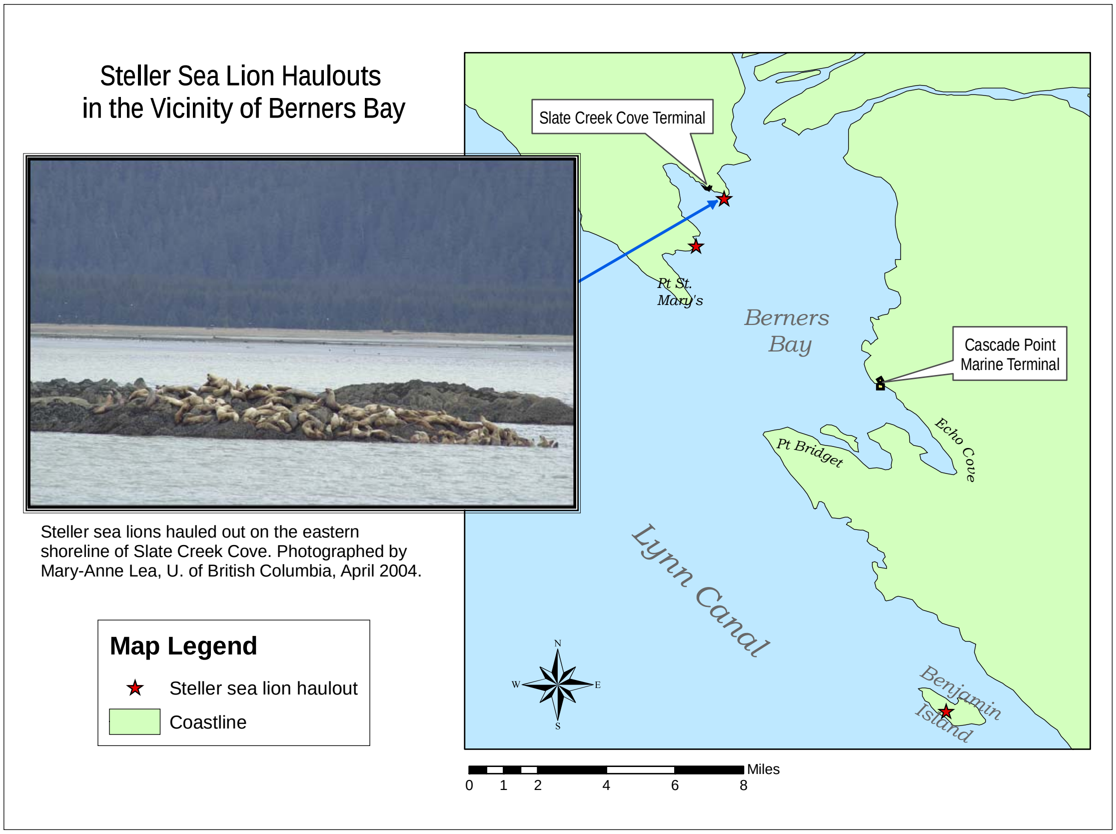
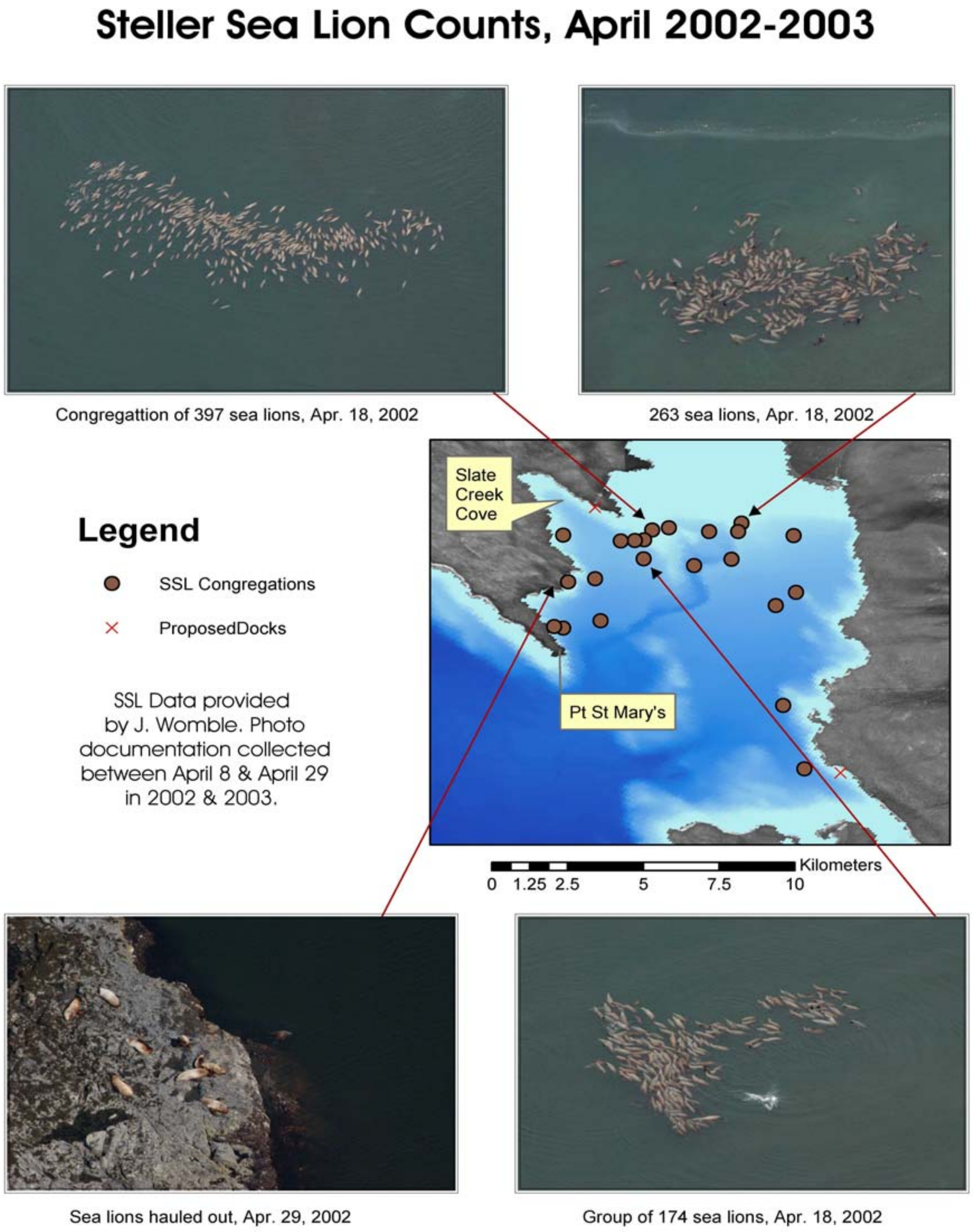


Figure 4.6. Steller sea lion distributions in the action area 2002-2003.



4.5 Humpback Whale Occurrence in the Action Area

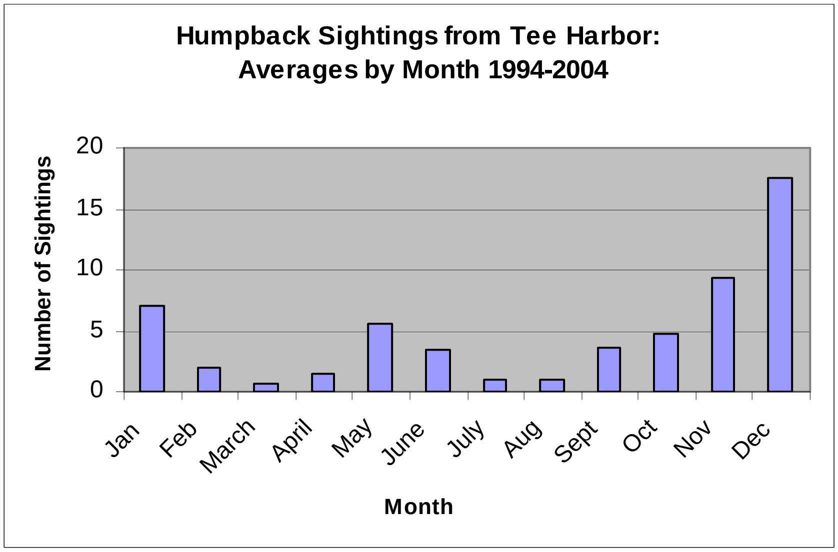
Humpback whales have been documented foraging in Berners Bay (Marston et al. 2002; USFWS 2003; pers. comm. with Baker, Eller, Ferry, Hood, Hudson, Hyde, Korhonen, Levine, Libenson, Schrader, Womble). Generally, small groups of animals or singletons are sighted at any one time in the bay. Although there have not been studies directed specifically at humpback whale usage of Berners Bay, researchers have opportunistically observed humpback whales while studying Steller sea lion or harbor seal populations in the bay. From such sighting information, a maximum of five individuals have been seen in the bay at any one time (J. Womble, pers. comm.). These animals were documented foraging in Berners Bay during the eulachon run and herring spawning in April and May. Recreational users of Berners Bay also have documented animals in the bay from April through November (pers. comm. with Baker, Eller, Ferry, Hood, Hudson, Hyde, Korhonen, Levine, Libenson, Schrader 2004). As recreational users generally are not in the bay during winter months, there are few reports to indicate whether and to what extent the animals may be using the bay during this time of year.

A study in 2000 identified 18 individual adult humpback whales present in the waters of Lynn Canal and northern Stephens Passage, between Young Bay and Benjamin Island, throughout July and August (Peterson 2001). Several of these animals were observed consistently throughout virtually all of July and August, suggesting a period of “residence” in this area during summer months for feeding. Five of these animals were matched through fluke identification as previously sighted in Glacier Bay, Sitka Sound and Frederick Sound (Peterson 2001). Although no fluke identification of humpback whales or tagging studies have been conducted in Berners Bay, it is highly likely that the animals regularly sighted in Lynn Canal are those sighted in the bay itself given that humpback whales generally exhibit a high degree of site-fidelity to preferred feeding areas in southeast Alaska.

Individual humpback whales have been observed in Lynn Canal and the North Pass area during all months of the year (Mizroch et al. 1998, Peterson 2001, T. Quinn pers. comm.). Sightings from the Alaska ferry system over a five-year period from 1993 to 1998 revealed humpback whale presence in southeast Alaska throughout the year (Mizroch et al. 1998). The study indicated increasing numbers of humpback whales in southeast Alaska during April and May, a peak of animals in August, and a sharp decline by October. Distribution was widespread throughout Lynn Canal but appeared to peak in May and June from the western side of Douglas Island northward to Skagway. Many of the sighting locations were near the entrance to Berners Bay, near Point Bridget and Point St. Mary. The shifts in distribution are most likely based on changes in prey availability. Given the timing of the peak of whale sightings, eulachon and or/herring may be target prey species for humpback whales in this area. Although eulachon has never been documented as a forage fish for humpback whales, herring is a known prey item for the whales in southeast Alaska (Krieger and Wing 1984, 1986, Mizroch et al. 1998, Wing and Krieger 1983).

Humpback whale sightings have also been recorded from a stationary location at Tee Harbor over an eleven-year span from 1994-2000, resulting in a long-term data set for humpback whale presence in the waters of Favorite Channel and Lynn Canal (Quinn, pers. comm.). From a residence location, Quinn documented the times when humpback whales were seen or heard blowing or vocalizing. Sightings were estimated to approximately five miles and vocalizations and blows registered from a distance of up to several miles. Throughout this time period, the highest numbers of whales were consistently recorded for the months of November, December, and January (Figure 4.7). On average, sightings were highest in the month of December, with peaks of 32 observations in 1996, 41 in 1997, and 34 in 2002. A smaller peak of sightings was noted in the area during May and June. Early spring and late summer resulted in fewer sightings from this location; it is likely that the whales move out to other areas in Lynn Canal during these months when whale watching vessels typically see them in Saginaw Channel to the west of Shelter and Lincoln Islands. It is also possible that these animals follow prey concentrations to other areas of southeast Alaska, such as Icy Strait, Glacier Bay or Frederick Sound during these months.

Figure 4.7. Humpback sightings 1994-2004 from Tee Harbor. Figure based on data provided by T. Quinn, 2004.



Although Tee Harbor, the source for these sighting data, is located approximately 20 miles south of the action area, humpback whale presence in the waters of Lynn Canal year-round indicates that they are following seasonally abundant transient prey. A humpback whale can easily cover distances of 20 miles or more in a day, particularly while foraging and following a prey source. It is likely that the whales are feeding on the Lynn Canal stock of herring that spawns in Berners Bay during the spring and winters along the shoreline of Lynn Canal south to Auke Bay. Individual whales foraging in Lynn Canal may also forage in Berners Bay year-round and, thus they may be affected by perturbations in the abundance of herring in the action area.

4.6 Natural Factors Affecting the Status of Listed Species in the Action Area

Natural factors that influence the number, distribution, survival and reproductive success of Steller sea lions and humpback whales include climate, oceanography, predation, disease, distribution and availability of prey, and annual life history patterns. Climate and oceanography determine prey distribution and availability and, thus, are closely linked.

4.6.1 Climate and Oceanography

Most scientists agree that the 1976-1977 regime shift dramatically changed environmental and oceanographic conditions in the Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA) (NRC 1996, Benson and Trites 2000). However, there is considerable disagreement on how and to what degree these environmental factors may have affected both fish and marine mammal populations. Productivity of the Bering Sea was high from 1947 to 1976, reached a peak in 1966, and declined from 1966 to 1997. Some authors suggest that the regime shift changed the composition of the fish community and reduced the overall biomass of fish by about 50 percent (Merrick 1995; Piatt and Anderson, 1996). Other authors suggest that the regime shift favored some species over others, in part because of a few years of very large recruitment and overall increased biomass (Beamish 1993, Hollowed and Wooster 1995, Wyllie-Echeverria and Wooster 1998).

Shima et. al. (2000) summarized trends of pinniped populations in the GOA and three other ecosystems that contained pinniped populations, similar commercial harvest histories, environmental oscillations, and commercial fishing activity. Only the GOA pinniped population (western population of Steller sea lions) was decreasing in abundance. They hypothesized that the larger size and restricted foraging habitat of Steller sea lions, especially for juveniles that forage mostly in the upper water column close to land, may make them more vulnerable than other pinnipeds to changes in prey availability. They further reasoned that because of the behavior of juveniles and nursing females, the entire biomass of fish in the GOA might not be available to them. This would make them much more susceptible to spatial and temporal changes in prey, especially during the critical winter time period (Shima et. al. 2000).

If the regime shift impacted the population dynamics of the western Steller sea lion population through changes in prey availability or distribution, it did not have a similar effect on the eastern population. While the western population was declining sharply, the eastern population expanded its range and increased in total number indicating that food and other factors necessary for survival and reproduction was available in sufficient quantities to the eastern population. The eastern population of Steller sea lions has continued to increase at approximately 1.8% per year. The contrast between the population trends of the two populations indicates the importance of local ecosystem processes in survival and successful reproduction.

In the action area, local changes in environmental conditions likely occur seasonally and annually. Steller sea lions and humpback whales using the area have likely encountered natural variability in prey abundance or availability from year to year. However, the consistent presence of animals in the action area each year indicates that the natural fluctuations are not significant enough to alter seasonal use patterns of Steller sea lions or humpback whales using the area.

4.6.2 Disease

There have been no studies on the prevalence of disease in Steller sea lions or humpback whales using Berners Bay. However, disease is not believed to be a significant factor affecting the status of either species in other parts of their ranges and thus, disease is not believed to be a factor affecting the status of listed species in the action area.

4.6.3 Predation

The primary predators of Steller sea lions and humpback whales are killer whales. NMFS is not aware of any instances of predation to listed species in Berners Bay, although killer whales have been sighted in the bay when other marine mammal species were also present. Therefore, predation is not believed to adversely affect the status of Steller sea lions or humpback whales in the action area.

4.6.4 Prey Base

Alterations of the prey base in Berners Bay may affect the population status of listed species by altering the nutritional plane of animals during critical times of the life cycle, and therefore influencing survival or reproductive success of individuals using Berners Bay. Natural changes to the prey base may occur at large or local scales and may be brought about by natural changes in climate and ocean processes or competitive interactions within the ecosystem. The changes may be detrimental or beneficial depending on whether they improve or reduce the nutritional status of the animals.

Steller sea lions rely on a seasonally abundant and annually predictable prey base. Steller sea lions return to the same rookeries and haulouts year after year because they are located near predictable prey resources. Ephemeral prey resources, such as spawning salmon or herring in Berners Bay, are important predictable food sources. In areas where the diet is less diverse, a decrease in the availability or predictability of a single prey for a prolonged period of time or during a critical stage of the life cycle (e.g. weaning), could compromise the survival or reproductive success of individuals. In fact, Steller sea lion diet diversity varies considerably throughout the range and may be an important factor influencing population trends (Merrick et al. 1997, Merrick and Calkins 1996); the more diverse diets are associated with increasing populations.

Berners Bay supports a wide variety of upper trophic level predators throughout the year, but the largest concentration of birds and marine mammals occurs during spring when eulachon and herring spawn in the bay. If the prey base were reduced due to natural factors, competition would increase between all the consumers. Those consumers that did not abandon the area and were poor competitors may experience reduced survival or reproductive success due to a lower nutritional plane.

The effects of nutritional stress have been documented or inferred in many species of pinnipeds (summarized in Trillmich and Ono 1991). Nutritional stress is difficult to measure directly but indices such as pup production, pup weights, and trends in survival of pups, juveniles and adults are generally used to argue the presence of nutritional stress, generally in the form of food shortages. One of the leading hypotheses for the decline of Steller sea lions in the western population is that changes to the prey base in the 1970s and 1980s resulted in nutritional stress of adult females and juveniles. The association of poor body condition and low reproductive rates of Steller sea lions in the Gulf of Alaska between 1970s and 1980s suggested that animals in the 1980s were nutritionally stressed such that they could not successfully reproduce (Pitcher et al. 1998). Low juvenile survival, identified as a primary cause of the decline, may be associated with the inability of juveniles to find sufficient food (York 1994). Therefore, changes in prey base may affect the survival and reproduction of Steller sea lions, possibly to the point of contributing to population declines or impeding recovery. Nutritional stress does not seem to be a current factor in the trend for the eastern population that includes animals in the action area. The population has steadily increased throughout most of the range over the past two decades indicating that sufficient food is available to support survival and reproduction.

4.7 Human Impacts to Listed Species in the Action Area

4.7.1 Commercial Fishing inside the Immediate Action Area

There is a small Dungeness crab and shrimp commercial fishery in Berners Bay and Lynn Canal. Most of the commercial fishing in or near Berners Bay is for Dungeness crab in the summer or spot shrimp in the fall. These are small fisheries with fewer than 10 boats in the crab fishery and fewer than three boats in the shrimp fishery. A herring sac roe fishery was present in Berners Bay until it was closed in 1983. It remains closed due to low stock numbers, which have shown no signs of recovery in over 20 years (USFS 2004b).

The Lynn Canal salmon fishery is primarily a drift gillnet fishery, and much of this fishery occurs near the project area and is centered in the area of Point Sherman. In addition, there is a commercial salmon fishery (troll and drift gillnet) in Berners Bay that is directed at coho salmon returning to the Berners River. Since 1990, the total coho catch from the Berners River has averaged over 21,000 (USFS 2004a).

The indirect effects of fishing on prey availability or disruption of prey patterns are not of significant concern for listed species inside Berners Bay. However, both factors, large-scale prey removal through commercial fishing operations and entanglements in fishing gear, could have some level of impact when animals are outside of the Bay in Lynn Canal and surrounding areas where commercial fishing occurs.

4.7.2 Recreational Fisheries

There are no data on the total number of people fishing recreationally in Berners Bay, although several dozen guided fishing trips to the bay were recorded between 1997-2001. A much larger proportion of recreational fishers fish in locally owned, privately launched vessels (USFS 2004a). Recreational fisheries in Berners Bay are small-scale fisheries that use equipment that does not pose a threat to Steller sea lions or humpback whales in the action area.

4.7.3 Vessel Activity

Ferries, cruise ships, commercial fishing vessels, and recreational vessels including motorized craft, kayaks, and canoes transit Lynn Canal. Recreational use in Berners Bay and Lynn Canal has grown since the early 1990s, likely due to increased tourism and development of public use cabins. According to the Alaska Department of Community and Economic Development, the total number of vacation/pleasure visitors to Alaska has risen 51 percent from 1993 to 2001. This is particularly true for cruise ship visitation to southeast Alaska; cruise ship passengers passing through Juneau rose by 59 percent from 1996 to 2002 (USFS 2004b). The increase in cruise ship numbers affects the amount of vessel traffic passing through Lynn Canal, adjacent to the action area.

Data from USFWS wildlife and human use survey in Berners Bay from 2000-2002 indicate that human use is concentrated on the eastern shore of Berners Bay. Use was relatively constant through the summer and fall months and minimal in the winter (USFWS 2003). A number of boaters camp overnight on the beach in Slate Creek Cove, while an estimated 12-20 airboats from Juneau use Berners Bay to access the rivers to the north or privately owned cabins. In addition, kayakers commonly use Berners Bay; it is estimated that five to ten groups of kayaks launch on a typical summer weekend day from Echo Cove. Other estimates include 100 to 200 kayakers renting kayaks to take into Berners Bay from a local outfitter over the course of the summer; six guided group kayak trips per year. Most kayakers access the bay for day-use and travel the eastern shoreline of the bay, while others camp or stay overnight in the public use cabins during multi-day trips. A few commercial outfitters also provide guided tours in the bay and bring clients in by boat or plane for fishing or wildlife viewing (USFS 2004b). In addition, research vessels periodically use the bay, particularly during the spring eulachon run when investigating marine mammals and forage fish. The Juneau Audubon Society also sponsors an annual wildlife-viewing trip into Berners Bay during the spring.

According to the SEIS (USFS 2004b), Berners Bay receives 30 to 35 boats on a typical weekend day and 60 to 65 boats on a high-use weekend day. However, these numbers appear to be significantly inflated, as they are based on numbers of boat trailers at the Echo Cove launch and parking lot, rather than counts of vessels in the bay itself. Many boat owners use the Echo Cove launch as a departure point for Lynn Canal and other areas. Although it is difficult to quantify how many vessels regularly use Berners Bay during spring and summer months, it can be concluded that motorized vessel activity in the bay is generally limited. Boat traffic during the winter is negligible due to weather conditions and the irregular maintenance of the road to Echo Cove, which frequently becomes impassable due to snow and ice conditions.

No vessel collisions with humpback whales or Steller sea lions have been documented in the action area. However, the listed species are subject to heavy vessel traffic in waters adjacent to the action area (e.g. whale-watch, recreational, ferry, cruise ship, and commercial fishing vessels). During an assessment of humpback whale vessel interactions in Lynn Canal in 2000, about 350 transiting vessels and 300 trolling vessels operated close to these whales in the geographic regions of North Pass, Shelter Island and Young Bay (Peterson 2001). Thus, cumulative impacts of vessel activity on listed species are a concern for animals moving between the water bodies of Lynn Canal and Berners Bay. Under current baseline conditions, however, vessel traffic is not considered a significant threat to listed species in the action area.

4.7.4 Existing Noise Levels in the Action Area

Sources of underwater ambient noise in the action area likely include wind and surface waves, rain, hydrostatic pressure changes from currents and tides, and the biological sounds of organisms. Such noises can be at the surface and at depth, intermittent or frequent, depending on the intensity of the sound source generation.

Underwater anthropogenic noise is also present in the action area, likely intermittent rather than constant based on limited vessel use of Berners Bay. In general, vessels lengths ranging between 5 and 34 m using outboard engines produce source levels estimated at 145 to 170 dB re 1 µPa @ 1 m and noise frequencies from 37 to 6300 Hz (Richardson et.al. 1995). Large outboard engines can produce source levels up to 175 dB re 1 µPa @ 1m. As noted above, although it is difficult to quantify how many vessels regularly use Berners Bay in a given year, it is clear that current activity is limited to seasonal tourism, recreation and commercial fishing. It is reasonable to assume that marine mammals foraging in Berners Bay are exposed to noise levels from current vessel use, though at what distances and source levels, is unknown. There is no evidence available indicating that vessel presence in the action area is adversely impacting listed species at this time.

4.7.5 Land Disturbance

In the action area, ephemeral haulouts are located at the mouth of Slate Creek Cove and at Pt. St. Mary. There is no data available on whether current or historic recreational and research activities have caused sea lions to be disturbed from these haulouts in Berners Bay. To date, NMFS has not received reports of disturbance to Steller sea lions or humpback whales in Berners Bay; such incidents, if they do occur, are considered to have minimal effect at present on individuals in the action area.

5.0 EFFECTS OF THE FEDERAL ACTION

Pursuant to Section 7(a)(2) of the ESA (16 U.S.C. §1536), federal agencies are directed to ensure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of their critical habitat. This biological opinion assesses the direct and indirect effects of the proposed Kensington Gold Project operations for USFS and ACOE as the federal action agencies. In Section 2 of this biological opinion, NMFS provided an overview of the proposed action in the action area that might negatively affect listed species.

In this biological opinion, NMFS assesses the probable direct and indirect effects of the proposed action on two populations of Steller sea lions and their designated critical habitat, and the Central North Pacific population of humpback whales, a species for which critical habitat has not been designated. The purpose of the assessment is to determine if it is reasonable to expect that the proposed action can have direct or indirect effects on threatened and endangered species that appreciably reduce their likelihood of surviving and recovering in the wild, or appreciably diminish the value of designated critical habitat for both the survival and recovery of threatened and endangered species in the wild.

5.1 Approach to the Assessment

NMFS generally approaches jeopardy analyses through several steps. The first step identifies those aspects of proposed actions that are likely to have direct and indirect effects on the physical, chemical, and biotic environment of an action area. As part of this step, we identify the spatial extent of these direct and indirect effects, which includes changes in the spatial extent over time. The second step of our analyses identifies the listed resources that are likely to co-occur with these effects in space and time and the nature of that co-occurrence (these represent our *exposure analyses*). In this step of our analyses, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to an action's effects and the populations or subpopulations those individuals represent. Once we identify which listed resources are likely to be exposed to an action's effects and the nature of that exposure, we evaluate the available literature to determine how those listed resources are likely to respond given their exposure (these represent our *response analyses*).

The final steps of our analyses — establishing the risks those responses pose to listed resources — are different for listed species and designated critical habitat (these represent our *risk analyses*). Because individual organisms are the entities that live, die, develop, mature, migrate, and reproduce (or, for our purposes, fail to do so), our assessments begin by identifying the probable risks to the individual organisms that are likely to be exposed to an action's effects (we measure these risks using an individual's "fitness" or the individual's probability of surviving to age *x* and its probability of reproducing at age *x*).

When listed plants or animals exposed to an action's effects on the environment are expected to experience reductions in fitness, we would expect the action to reduce the abundance, reproduction rates, or growth rates (or variance in these measures) of the populations the individual's represent (see Stearns

1992). Reductions in one or more of these variables (or one of the variables we derive from them) is a *necessary* condition for reductions in a population's viability, which is itself a *necessary* condition for reductions in a species' viability. On the other hand, when listed plants or animals exposed to an action's effects on the environment are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent (for example, see Anderson 2000, Beatty and Mills 1979, Brandon 1978, Stearns 1992).

If we conclude that listed plants or animals are not likely to experience reductions in their fitness, we would conclude our assessment. If, however, we conclude that listed plants or animals are likely to experience reductions in their fitness, we would analyze the consequences of this reduction on the viability of the populations the individual's represent (measured using changes in the populations' abundance, reproduction, spatial structure and connectivity, growth rates, or variance in these measures). In this step of our analyses, we use the population's base condition (established in the *Environmental Baseline* and *Status of Listed Resources* sections of this opinion) as our point of reference. Finally, we consider the consequences of any changes in population viability on the viability of the species those populations comprise. Changes in a species' reproduction, numbers or distribution are used to estimate the species' viability. In this step of our analyses, we use the species' status (established in the *Status of the Species* section of this opinion) as our point of reference.

In this consultation, we assume that most of the sea lions using Berners Bay originate from five rookeries in southeast Alaska (Forrester Island complex, Hazy Island, White Sisters, Graves Rock or Biali Rocks). Furthermore, we assume that animals feeding in Berners Bay use only Benjamin Island, Gran Point, Met Point, and Little Island as haulouts while feeding in the bay. We begin this assessment by determining whether these sea lions are likely to experience reductions in fitness as result of their exposure to individual stressors produced by the proposed action or the entire suite of stressors the proposed action represents (that is, the industrialization of Berners Bay). If we conclude that the Steller sea lions exposed to the action's effects on the environment are likely to experience reductions in fitness, we need to analyze the consequences of this reduced fitness on the rookeries those sea lions represent (these rookeries represent the "subpopulations" whose viability serves as the point of reference for the second step of our effects analyses). If these rookeries can be expected to experience reductions in their viability (measured as reductions in reproduction, numbers, or pre-clinical indicators of such reductions — such as shifts in age structure, gender ratios, growth rates, etc.), then we would consider the consequences of those changes on the entire eastern population of Steller sea lions (e.g. rookeries in southeast Alaska, British Columbia, Washington, Oregon, and California) (for the purposes of consultations, these sea lions constitute a "species") whose viability serves as the point of reference for our jeopardy analyses. Likewise, we would follow this same assessment process to consider effects on the fitness and viability of the western population of Steller sea lions.

In this consultation, humpback whales using Berners Bay are assumed to orginate from the Central North Pacific population of humpback whales. We then follow the logic outlined above for Steller sea lions to determine how the effects of the action will impact the viability of the Central North Pacific population of humpback whales.

If we conclude that the Steller sea lions and humpback whales exposed to the action's effects on the environment are not likely to experience reductions in fitness, we will conclude our analyses because we would not expect the action to have adverse consequences on the viability of the populations those animals represent if the action is not likely to affect the fitness of the animals themselves (for example, see Anderson 2000, Beatty and Mills 1979, Brandon 1990, Stearns 1992).

For designated critical habitat, our analyses will depend on whether the critical habitat designation identifies primary constituent elements. If a designation contains primary constituent elements, our analyses begin by identifying whether and how those elements are likely to respond to an action's direct and indirect effects on the environment (if a designation does not contain primary constituent elements, our analyses begin by identifying the habitat variables that give the designated area conservation value for the listed species). Once we identify the responses of the habitat's constituent elements, we identify the consequence of those responses on the conservation value of the designated area; for the purposes of consultation, 'conservation value' means the value of the designated area for the 'conservation' (as it is defined by section 3 of the Endangered Species Act of 1973, as amended) of the listed species. The conservation value of this critical habitat is established in the *Status of Listed Resources,* and provides the point of reference for this step of our analyses.[1]

5.2 Evidence Available for the Assessment

We compiled information from scientific and commercial sources on the status and behavior of Steller sea lions and humpback whales in relation to the action area and action activities. The information was obtained from the Alaska Stock Assessment Reports (Angliss and Lodge 2004); Steller sea lion Recovery Plan (NMFS 1992), Humpback whale Recovery Plan (NMFS 1991); NMFS SEIS on Steller sea lion Protection Measures (NMFS 2001a); several section 7 consultation biological opinions on actions affecting Steller sea lions (NMFS 2000, 2001b, 2003a, 2003b); peer-reviewed scientific literature; white papers, unpublished reports, and research summaries from government agencies, academic institutions, non-profit organizations, and private industry; and communication with species experts and observers as identified in the reference section.

5.3 Elements of the Proposed Action that Pose Potential Risk to Listed Resources

Several elements of the activities that would result from the issuance of the proposed permits for the Kensington Gold Project will produce direct and indirect effects on the natural environment of the action area that are relevant to this effects analysis. These elements include increases in vessel traffic in Berners Bay, noise associated with that increased vessel traffic and the construction of two docks, alteration of the prey base of Berners Bay, potential discharges of heavy metals and other pollutants from mine operations, and an increase risk of petroleum spills from increased vessel traffic.

The following narratives summarize aspects of the construction and operations phases of the proposed Kensington Gold Project that pose direct potential risks to Steller sea lions and humpback whales. We follow these summaries by identifying the co-occurence of listed species with these direct effects and the nature of that co-occurrence (these represent our *exposure analyses*). Once we identify which listed

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[1] This analysis does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 C.F.R. 402.02, recently at issue in Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service, 378 F.3d 1059 (9th Cir. 2004).

resources are likely to be exposed to an action's effects and the nature of that exposure, we evaluate the available literature to determine how those listed resources are likely to respond given their exposure (these represent our *response analyses*). After we complete our exposure and response analyses for these direct effects, we will repeat this process to examine the potential indirect effects of the Kensington Gold Project that will primarily result from alterations of the prey base in Berners Bay.

5.4 Timing, Duration and Frequency of Action

5.4.1 Construction Phase

The construction phase of the action is projected to last 14-18 months. During this time, the following activities will take place: 12 to 14 helicopter trips/month for building of the tunnel, one barge per day to transport supplies to the construction crews of various structures, and crew shuttles two to five times per day at morning, afternoon/early evening, and late evening. The BA/BE states that no in-water construction activities will take place between 15 March and 30 June to avoid impacts to Steller sea lions and humpback whales using the area. The expected noise produced by these activities is listed in Table 5.1.

Construction related noise is expected to result from the use of helicopters, diesel-powered generators, quarry blasting, construction vehicles, and vessel transit. Noise levels are predicted to be 72 dBA directly beneath a helicopter flying at 2,000 feet, and noise perceived at Cove Point from a helicopter overhead is projected to be 62 dBA. Noise from barge unloading, above water, at Slate Creek Cove is estimated to be approximately 48 dBA to a receiver on a boat moored off Cove Point. Periodic blasting may occur to produce road fill and base no more than once a day for the 14-18 month duration of construction. Blasting could measure up to 84.2 dBA off Cove Point and be heard across the bay at the Berners Bay Cabin. According to the BA/BE, during the marine terminal construction window, blasting activities would not occur when humpback whales or Steller sea lions are within 1,000 feet, as determined by on-site monitoring using a NMFS-approved observer. In addition, the BA/BE states that construction equipment will have noise control devices, and that additional noise reduction measures will be incorporated (i.e., instituting speed limits, controlling helicopter altitudes, implementing flight path requirements, refraining from compression braking on haul roads from the Slate Creek Cove dock to the mining site).

The noise levels provided in the BA/BE and during consultation were measured *in-air*, rather than *in-water*. These levels are relevant to assess noise effects for Steller sea lions surfacing or hauled out. When animals are underwater, sound is perceived differently. Sound pressure waves move much faster in water than in air, so noise levels measured in air must be increased 26 dB to the noise referenced in air (NOAA 2005). Air and water sound pressures also differ in units of reference pressure; in air, the reference pressure is 20 µPa @ 1m and in water the reference pressure is 1 µPa @ 1 m. It is also important to note that sound pressures are measured on a logarithmic scale (NOAA 2005). To account for the difference between air and water noise levels, NMFS has provided conversions in the far right column in table 5.1.

Table 5.1. Noise levels predicted during the construction period (L. Russell, pers. comm., and NMFS conversions):

Location	Equipment Type	Typical In-Air Noise Level (dBA) at 50 feet (re 20 µPa @ 1m)	Typical In-Water Noise Level (dBA) at 50 feet (re 1 µPa @ 1m)
On-water	Crane (Movable)	75 – 88	101 - 114
	Air Compressor	75 – 87	101 - 113
	Welder (Diesel)	72 – 82	98 - 108
Onshore	Compactor	72	98
	Front End Loader	81 – 84	107 –110
	Bulldozer	82	108
	Excavator	81	107
	Dump Truck	85 – 87	111 - 113

5.4.2 Operations Phase

According to the BA/BE, at the proposed operating speed of 18 knots (outside the April/May eulachon/herring window when speed will be reduced to 12-13 knots), the crew shuttle is expected to take 15 minutes to cross the bay six to ten times a day. If listed species were in the bay year-round, taking the more precautionary approach of ten trips (five roundtrips) daily as an upper limit estimate, the duration of exposure to vessel traffic from the crew shuttle would be 2.5 hours a day (10 crossings x 15 min); 17.5 hours a week.

During the April/May window, transits will be reduced to two or three roundtrips daily at a reduced speed of 12-13 knots. At the slower speed, the Berners Bay crossing is expected to take approximately 23 minutes; thus, the expected duration of exposure would be reduced to 2.3 hours daily (6 crossings x 23 min), 16.1 hours a week. The BA/BE states that the reduced transit schedule will apply for two or three weeks; assuming that this mitigation measure may last three weeks, annual exposure time from the crew ferry would total 905.8 hours ([17.5 hours x 49 weeks] + [16.1 x 3 weeks]). It should be noted that this is likely a minimum exposure estimate, as vessels will continue to be operational for some amount of time on either end of the transit during docking maneuvers.

The SEIS presents a somewhat different scenario stating that crew shuttle crossings are scheduled to depart Cascade Point at 5:00 am, 3:00 pm, 6:00 pm, and 1:00 am on weekdays (four times a day) and 5:00 am and 6:00 pm on weekends (two times a day). Under this schedule, the crew shuttle would be underway for approximately two hours per day on weekdays and one hour per day on weekends. If listed species were in the bay year-round, this results in 12 hours of exposure a week for the majority of the year. The reduced schedule of two or three times a day at reduced speeds for the two or three week forage fish run results in 16.1 hours a week as above. Under this scenario, annual exposure time from the crew ferry would total 636.3 hours ([12 hours x 49 weeks] + [16.1 x 3 weeks]).

Listed species in Berners Bay will also be exposed to barge and tug vessel transit. The incoming barge would deliver fuel and supplies four times per week, entering the bay from Lynn Canal and crossing the bay in 30-45 minutes. Using the upper time estimate from this information, if listed species were in the bay, their exposure time to the incoming barge/tug traffic would be 1.5 hours a day; 10.5 hours a week. In addition, barges carrying ore concentrate out of the bay 4-5 times per month would result in exposure time of 7.5 hours per month (1.5 hours x 5). Thus, barge/tug traffic in total results in 49.5 hours of exposure per month or an annual total of 594 hours.

Barges will dock for two or three hours at Slate Creek Cove for loading and unloading. This adds to the noise exposure window for listed species, particularly for Steller sea lions that may be hauled out at the mouth of the cove. Docking noise would thus result in 63 hours of exposure per month at Slate Creek Cove ([16 times per month incoming x 3 hours] + [5 times per month outgoing x 3 hours]), for an annual total of 756 hours.

Noise during marine operations will include crew shuttle, barge, and tug transit, loading and unloading of supplies and personnel, and onshore transportation activity that could be perceived by animals in nearby waters. The crew shuttle is expected to produce 80 dBA of noise in-air (combination of mechanical noises and wind/water resistance) as perceived at 50 feet, measured at the middle of the bow at full speed. Because the crew shuttle has not been purchased for this project, the applicant was not able to provide precise noise measurements underwater for this vessel. Examples from Richardson et al. (1995) of source levels of noise (in-water) from small boats with outboard engines range from 151 dB re 1 µPa @ 1m in a 12 m fishing boat underway at 7 knots to 159 dB re 1 µPa @ 1m for a 34 m vessel powered by a twin diesel engine. Large outboard engines can produce source levels up to 175 dB re 1 µPa @ 1m. Noise source levels for larger vessels such as supply ships (length category of 55-85 m), diesel-powered with two propellers, are generally 170-180 dB re 1 µPa @ 1m. The crew shutter is described as a three diesel engine vessel with three propellers (Section 2.1.3). Based on the values by Richardson et al. (1995) for similar vessels, we would expect in-water noise from the crew shuttle to be less than 180 re 1 µPa @ 1m.

Although precise noise levels were not provided for tugs operating in the action area, average source levels of noise (in-water) measured for tugs pulling empty barges range from 145 to 166 dB re 1 µPa @ 1m (Richardson et al. 1995). In addition to the vessel noise, the greatest noise levels during operations are expected to be from haul trucks (94 dBA at 50 feet in-air) and barge unloading (89 dBA at 50 feet in-air).

5.5 Exposure of Listed Species to the Direct Effects of the Proposed Action

Exposure analyses have three purposes in consultations. First, we conduct exposure analyses to identify the physical, chemical, and biotic phenomena produced by an Action. Second, we conduct these analyses to estimate the spatial and temporal distribution of those phenomena in the environment. Third, we conduct exposure analyses to estimate any overlap between threatened and endangered species and designated critical habitat in space and time. To fulfill the purposes of this last part of these analyses, we try to identify the number, age, gender, and condition of the individuals that are likely to be exposed, the populations those individuals represent, the duration of any exposure, the frequency of that exposure, and exposure concentrations.

5.5.1 Steller Sea Lions

As indicated in earlier sections of this document, Steller sea lions occur in the action area throughout the year with the greatest number occurring in the spring. Steller sea lions use haulouts near Berners Bay consistently between October and May each year and animals are likely to be foraging in Berners Bay whenever prey is available in the bay. Some animals also use two haulouts in Berners Bay, Slate Creek Cove and Cove Point primarily in the spring. Thus, some number of Steller sea lions will likely be exposed to construction and operation activities year round. However, outside of the springtime, it is likely that most animals are foraging elsewhere and fewer animals will be exposed to the construction and operation activities. From supplemental information provided by the applicant, the construction of the Slate Creek Cove marine terminal will take place about 1,800 feet from the seasonal haulout site for Steller sea lions. The haulout site is used by juveniles, adult females and males, and appears to be used only during the peak of the eulachon and herring spawning in April and May. There is little information on the number of animals that use the haulout site or how frequently they use it. A small number of animals were observed in 2003 hauled out at Pt. St. Mary to the south of Slate Creek Cove. This haulout site is not immediate to the construction zone, but noise from construction activities may carry across from the opposite shore and be perceived by hauled out animals. Steller sea lions are not known to haulout near the Cascade Point marine terminal site.

The western population of Steller sea lions is estimated at 34,779 animals (Angliss and Lodge 2004). The eastern population is estimated at 31,028, of which 16,674 animals are from southeast Alaska, which includes the action area (Angliss and Lodge 2004). The southeast Alaska region represents 54% of the eastern population of Steller sea lions. Based on branding studies, animals from the western population rarely use the action area. Of 348 identifiable animals using haulouts in Lynn Canal near Berners Bay, only 1.4% were from the western population, the remaining 98.6% were from the eastern population branded in southeast Alaska (L. Jemison, pers. comm.). No animals branded in northern California or southern Oregon have been observed in Lynn Canal (L. Jemison, pers. comm.).

The proposed crew shuttle route across the bay, an almost straight line from Cascade Point to Slate Creek Cove terminal site, will take the ferry directly through areas where large aggregations of sea lions have been observed to cooperatively feed (Gende et al. 2001, Sigler et al. 2004). Based on data collected in 2002 and 2003, the mean distance of large groups of sea lions relative to the proposed transit lane is between 100 and 250 meters. The distribution of Steller sea lions is likely to be variable depending on the distribution of prey, however it is clear that the proposed transit lane passes through an area where prey and sea lions tend to concentrate.

Individual sea lions have a low likelihood of constant exposure to noise and vessel traffic associated with construction activity and ferry, barge and tug operations because it is unlikely that they remain resident in the bay for extended periods of time. Individual sea lions are more likely to be exposed to these activities intermittently for a day or several days while foraging; at most, a sea lion might be exposed regularly over several months if the animal used the action area for an entire foraging season. Sea lions are most likely to forage in Berners Bay and move between the bay, Lynn Canal, and surrounding waters to haulout and feed, rather than become resident in the action area. As a result, individual sea lions are likely to be exposed to the construction or operation activites intermittently throughout a year.

5.5.2 Humpback Whales

Individual humpback whales overwinter in southeast Alaska, and are seen in Lynn Canal during all months of the year (see Section 4.5). Although we only have records of humpback whale observations in Berners Bay from April through November, we can assume that some of these individuals also use the bay during the remaining winter months given that they are observed consistently within 20 miles of the action area, in particular during the months of December, January and February (T.Quinn, pers. comm.). Given that a lack of data about humpback whales in Berners Bay is not evidence of absence, it is reasonable to assume that these animals may be exposed to construction activities associated with the action in any month of the year. However, as humpback whales likely are feeding on overwintering herring and following the prey as it moves out of Berners Bay along the coast in Lynn Canal and Auke Bay, whales may not be as likely to occupy the action area in winter months. If the quantity, quality, or distribution of the forage fish is altered by the construction activities through degradation of fish habitat, it could have adverse effects on individual humpback whales using Lynn Canal even if the whales were not directly exposed to construction and operations in the action area.

As indicated previously in this document, the Central North Pacific population of humpback whales is estimated at around 4,005 animals (Calambokidis et al. 1997), and the southeast Alaska population is estimated at around 961 animals (Straley et al. 2002). This total for the southeast Alaska population, however, represents only animals identified north of Chatham Strait, and is thus a minimum estimate since there is little photo-identification effort in the lower half of southeast Alaska) (Angliss and Lodge 2004).
Only a fraction of these animals are likely to forage in and travel through the waters of northern Lynn Canal and Berners Bay. As described in Section 4.6, there has been little effort directed at investigating the humpback population near Juneau that forages in the waters of Lynn Canal and Berners Bay. To date, only 18 humpback whales have been photographically identified as unique individuals in Lynn Canal (Peterson 2001). These animals represent 1.9 % of the 961 animals identified in northern southeast Alaska, and 0.045% of the entire Central North Pacific humpback population.

Like Steller sea lions, individual humpback whales have a low likelihood of being constantly exposed to construction activity and ferry, barge and tug operations in a single year. Although humpback whales in southeast Alaska exhibit site fidelity to their foraging areas (i.e., Glacier Bay, Prince William Sound, Sitka Sound), they also appear to move between foraging sites within a foraging area rather than remain in a single location (i.e., Glacier Bay whales identified in Lynn Canal). A likely scenario may be that individual animals forage in Berners Bay, then move between the bay, Lynn Canal, and surrounding waters rather than becoming resident in the action area. As a result, individual humpback whales are likely to be exposed to construction or operation activities for a day or several days rather than for an entire foraging season.

5.6 Response Analyses to the Direct Effects of the Proposed Action

Response analyses are designed to identify how listed resources are likely to respond or react after being exposed to an action's direct and indirect effects on the environment. "Responses" include physical, behavioral, and physiological reactions of individual animals, including acute responses like being wounded or dying upon exposure; physiological responses like reduced fecundity or increased spontaneous abortion rates, or reduced vitality that makes them more susceptible to disease or future dysfunction; behavioral responses like abandoning a territory or a site. Response analyses, then, consist of any acute, chronic, or latent reactions in individual members of listed species that are likely to be exposed to an action's effects.

Each of the different, potential stressors associated with the proposed action is likely to produce a different suite of responses (for example, noise elicits different responses than alteration of an animal's prey base). Therefore, we separately evaluate the probable responses of listed species to each potential stressor.

5.6.1 General Responses of Marine Mammals to Noise

Man-made noise underwater can cover a wide range of frequencies and level of sound, and the way in which a species responds depends on the frequency range it can hear, the level of sound, and the sound spectrum (Nedwell et al. 2004). Responses to noise include behavioral changes, habituation, temporary hearing impairment, and permanent physical damage to the animal. Noise can also mask biologically important signals such as intraspecific vocalizations among whales or sea lions, or the sounds of predators or prey. The impacts of noise are manifested at the level of the individual, in either short-term or long-term changes in the individual that may or may not be measurable *(*i.e., obvious gross behavioral changes or undetected physiological changes). Impacts of noise can also be manifested in long-term changes at the level of the population(s) if they reduce the survival or reproduction of many individuals.

As stated in the BA/BE, cetaceans in general show avoidance behavior to sounds starting around 110 dB re 1µPa @1m, and more intense sounds can have physiological impacts or cause physical damage. Temporary Threshold Shift (TTS), a temporary shift in the hearing threshold due to exposure to sounds that exceed the natural threshold, occur when animals are exposed to loud instantaneous sound or to a prolonged sound that exceeds their threshold level. This temporary loss of hearing sensitivity is fully recoverable and is not considered to be an injury because no irreversible cell damage or death is involved. For marine mammals, the level has been set at 180 dB re 1 µPa @ 1m (NOAA 2005). Sounds greater than this level are likely to cause temporary or permanent hearing damage. Permanent Threshold Shift (PTS) is a loss of hearing sensitivity (even in a narrow range of frequencies) that is not fully recoverable. PTS is considered to be an injury because irreversible cell death is involved. No data for PTS in any marine mammal currently exist, so PTS is generally estimated from the onset of TTS.

NMFS is currently developing acoustic criteria to define levels of noise that negatively affect marine mammals. The lower threshold for behavioral response is currently 160 dB re: 1µ Pa for pulsed received noise and 120 dB re: 1µ Pa for continuous noise (NMFS 2005). The impact of these noise levels will change depending on the frequency of the sound, and the response will be species-specific but also specific to individuals. From experimental studies on pinnipeds, dolphins and beluga whales, it appears that behavior begins to change, sometimes noticeably, at sound exposure levels lower than those causing the onset of TTS (180 dB re 1 µPa @ 1m). It is not clear whether this holds true for all species or all sound types, but for the test species studied, it was not uncommon for them to exhibit aberrant behavior at sound pressure levels at least 12 dB below the levels resulting in TTS onset (Finneran et al. 2002, Kastak et al. 1999).

Increased input of sound into the water column as a result of the proposed action may alter marine mammal behavior. If the noise is above-water, pinnipeds will generally dive and resurface often vocalizing if in water. If on land, they will usually depart from haulouts into the water, swim with their heads above water and vocalize, or dive. If the sound persists, animals may vacate an area until the sound disappears. In- water noise may elicit diving and resurfacing often with vocalizations and departure from the area near the sound source. However, pinnipeds may follow or retreat from vessels depending on the source of the sound (i.e. may follow a fishing boat that is discarding fish or retreat from a fast-moving recreational vessel) (Loughlin 2004, P. Gearin pers. comm.). Several studies in Hawaii noted humpback whale behavioral changes in the presence of vessels. Whales surfaced without exhaling, spent less time at the surface, had longer dive intervals, dove without raising their flukes, reduced their swim speed, and altered their direction (Bauer and Herman 1986, Green and Green 1990). In 1981 and 1982, Baker and Herman (1989) conducted a study of vessel impact on humpback whales in southeast Alaska and concluded that changes in whale behavior were significantly correlated with vessel speed, size, number and proximity. The most sensitive indicators of vessel disturbance in the study were changes in the whales' respiratory behavior and orientation. In 2000, a study assessing humpback whale behavioral response to vessel activity near Juneau, Alaska, reported few cases of whale avoidance behavior in response to boats, but noted greater variability in surface interval timing and in numbers of blows per surfacing when whale watching vessels were present (Peterson 2001). However, based on these findings, the author found it difficult to conclude that existing vessel activity was disrupting the behavioral patterns of humpback whales near Juneau, Alaska.

Determining the significance of noise disturbance to marine mammals remains a challenge for science. A workshop held by the National Research Council (NRC) in 2004 examined the threshold for *biologically significant* effects of noise on marine mammals; that is, noise from an action that affects the ability of an animal to grow, survive, and reproduce. These also can have population-level consequences and affect the viability of the species. The NRC recommended that a predictive model be developed to determine the biological significance of behavioral change in response to noise. The consensus of participants in the workshop was that at least a decade would be required to have the data and understanding to turn such a conceptual model into a functional tool (NRC 2005).

5.6.2 Responses of Steller Sea Lions to Noise Generated by the Proposed Action

The SEIS states that the ferries, which will have three diesel engines and three propellers, are reported to generate 80 dB of noise (in-air) and the sound footprint for these shuttles ranges from 60 dB to 40 dB based on distance from the ferry. In contrast, Richardson et al. (1995) reports that a two diesel engine vessel may produce between 170 and 180 dB re 1 µPa in water. Because of the discrepancy between these two studies for similar vessels, we take the conservative approach and discuss the response of Steller sea lions to noise generated from the vessel activity based on a maximum footprint of 180 dB re 1 µPa in-water. In-water noise levels thought to elicit a behavioral response from Steller sea lions are >160 dB re 1 µPa for pulsed noise and 120 dB dB re 1 µPa for continuous noise; levels high enough to cause damage to their hearing are >180 dB re 1 µPa (NMFS 2005). Because sea lions are skittish by nature, it is likely that loud, pulsed, frequent or unfamiliar noises, such as blasting or driving pilings, are likely to disrupt resting sea lions or animals foraging near the sound source. Steller sea lions would likely abandon haulouts, or dive if resting or foraging in the water, if disturbed by construction activities. Generally, animals return to their previous behavior within an hour or so of a disturbance (Porter 1997), however they may abandon an area for longer periods of time if the disturbance continues. Because there is a paucity of information on how Steller sea lions react to construction noise, a conservative approach is warranted. The proposed action to cease in-water construction operations between March 15 and June 30, when significant numbers of animals are using Berners Bay, would reduce the chance that Steller sea lions would be negatively impacted by dock construction noise.

However, sea lions would be exposed to above-water noise from construction year-round for 14-18 months. Based on available information, the noise levels produced by dock construction (72 to 88 dB in air) activities fall below those thought to result in physiological damage to Steller sea lions (NMFS 2005). With respect to dock construction, this exposure would be most likely to have an effect near the Slate Creek Cove site for sea lions hauled out during the eulachon and herring runs in April and May. Although there would be no underwater noise from construction to directly affect diving or feeding, above-water noise would expose these animals to all noises from barge unloading/offloading, front end loaders, bulldozers, helicopters, etc. as detailed earlier in Sections 2 and 4.

The cooperative feeding behavior unique to Steller sea lions using Berners Bay likely involves visual and vocal cues among participants. Noise from vessel traffic and vessel transit could interfere with one or both of these cues, making the group less successful at foraging. Presumably, the behavior of the animals aggregates the prey such that it is easier for sea lions to capture them. The synchronicity of the diving likely relates to aggregating the prey. Thus if animals are forced to dive out of synchrony because of a vessel approach, it may compromise their success at capturing prey on the next foraging event. Because the applicant states that vessels will be transiting the area in brief periods of 15 to 20 minutes, vessel disturbance is unlikely to cause a permanent disruption to the cooperative feeding behavior. It may however, result in fewer successful foraging attempts.

In most of their range, Steller sea lions are exposed to some level of vessel noise and traffic. Steller sea lions may be disturbed from haulout sites, rookeries, or in the water by close approach of vessels or noise. Steller sea lions may respond by retreating into the water if hauled out, vocalizing, and swimming with their heads above water. They continue this behavior until the threat is gone. Land disturbance can cause mortality if it occurs during the breeding season when pups are too young to avoid the stampede of adults to the water. Pups may be crushed or sustain trauma that eventually leads to death. Repeated disturbance of California sea lions from haulouts or rookeries may lead to permanent abandonment of those areas (S. Melin, unpublished data) and it's likely that Steller sea lions may respond in a similar manner. However, Steller sea lions, like other coastal pinnipeds, can become habituated to human disturbance such that it no longer causes a response. For example, in Kodiak harbor, Alaska, Steller sea lions haulout on the breakwater and vessels, including tour boats, can approach within yards of the animals without causing a response, if they approach slowly (P. Gearin, pers. comm.).

As noted earlier, Steller sea lions are present throughout the year in Berners Bay, so it is likely that some individuals will be affected by the construction activities, above and below water, and by operation activities. From the available information, NMFS believes that although noise from construction or operation activities may cause temporary disruption or displacement of resting or foraging animals, it is unlikely to be sustained long enough to adversely affect the fitness of individuals.

5.6.3 Responses of Humpback Whales to Noise Generated by the Proposed Action

Humpback whales have been known to react to low frequency industrial noises at estimated received levels between 115 and 124 dB (Malme et al. 1985) and to conspecific calls at received levels as low as

102 dB (Frankel et al. 1995). However, Malme et al. (1985) found no clear response to playbacks of drill ship and oil production platform noises at received levels up to 116 dB re 1µ Pa, and studies of reactions to airgun noises were inconclusive (Malme et al. 1985).

Lien et al. (1993) studied reactions of humpback whales in response to explosions and drilling off Newfoundland and found two humpback whales trapped in fishing gear after the explosions had severely damaged ear structures similar to blast injury in humans. While the whales showed no dramatic behavioral reaction to these harmful sounds, the authors cautioned that whales' visible short-term reactions to loud sounds may not be a valid measure of the degree of impact of the sound. The above finding has implications for any underwater blasting that might occur as part of marine terminal construction in Berners Bay.

Humpback whales are known to tolerate loud noises when sufficient prey is present. Thus, individuals subjected to potentially harmful noise may stay in a productive foraging area because of their overriding need for prey. Todd et al. (1996) found evidence of hearing damage in two dead whales that remained in an area to forage despite being exposed to potentially harmful sound levels. Therefore it should not be assumed that the presence of animals in an area is an indication that the activities in the area have no impact.

Potential Hearing Losses in Humpback Whales

As noted in the previous section, the SEIS states that the crew shuttle will have three diesel engines and three propellers, which will generate 80 dB of noise (in-air); the sound footprint for these shuttles is reported from 60 dB to 40 dB based on distance from the ferry. In contrast, Richardson et al. (1995) reports that a two diesel engine vessel may produce between 170 and 180 dB re 1 µPa in water. Because of this discrepancy between similar vessels, we take the conservative approach and discuss the response of humpback whales to noise generated from the vessel activity based on a maximum footprint of 180 dB re 1 µPa in-water.

The current understanding of hearing in baleen whales, including humpback whales, is based on anatomical evidence, studies and behavioral observations, and extrapolations from other marine mammals. Field observations of the responses by whales to sounds have set thresholds for detection of sounds by baleen whales (see Section 3.2.3). However, it is not possible to determine at what point the whale heard the sounds but did not respond. Responses vary with behaviors; the same frequency might result in a response from migrating whales whereas feeding whales do not respond at all, or the response may not be detectable to researchers. In addition, whales' responses to various types of sounds (e.g. vessel noise, oil exploration, military sonar) at equivalent sound levels may be quite different. In-water noise levels thought to elicit behavioral responses from humpback whales are >160 dB re 1 µPa for pulsed noise and >120 dB dB re 1 µPa for continuous noise; levels high enough to cause damage to their hearing are >180 dB re 1 µPa (NMFS 2005).

In a recent study in Glacier Bay, the acoustic effects of vessels on humpback whales were modeled using measured vessel sound signatures from an acoustic monitoring program; vocalizations, ambient noise and oceanographic parameters from Glacier Bay; and estimations of whale hearing abilities, called audiograms (Erbe 2003). Although TTS is difficult to predict given the uncertainty about whales' normal hearing thresholds, the model estimated that humpback whales would experience 4.8 dB TTS after 20 minutes of exposure to sounds generated by small crafts within 100 meters or cruise ships within 4 km of the whale. The vessel sounds modeled were not loud enough to induce permanent threshold shift (PTS) after a single exposure. PTS due to repeated exposure to vessel noise is impossible to predict for humpback whales because it has never been documented and there are no available data on any marine mammals. However, TTS should be considered as a possibility if humpback whales were exposed to vessel sounds in close proximity for a sufficiently long period to induce such temporary loss.

Based on what is known regarding hearing loss in whales, NMFS concludes that the expected level of noise generated by the crew shuttle, barges, and tugs would have negligible to minor effects on the hearing of humpback whales. We do not expect the proposed action to cause permanent hearing damage to whales. It is possible that temporary threshold shifts may occur, but this is a reversible condition and the long-term effects would be minimal or nonexistent. Further, although vessel noise may likely result in disturbance to humpback whales on a regular basis, the duration and intensity of effect would not be sufficient to cause injury or mortality to individuals.

Behavioral Responses of Humpback Whales to Increased Vessel Noise

Because the noise associated with a vessel increases as distance from the vessel decreases, it is difficult to distinguish whether marine mammals are reacting to the noise of the vessel or some other aspect of the vessel (i.e. presence, speed, size, wake, maneuvers). Here, we discuss behavioral responses of whales to vessels in general because most studies do not separate responses to noise and increased vessel traffic. In section 5.6.5, we further discuss vessel activity, with particular reference to risk of collision.

Habituation

Reactions to sounds by marine mammals are variable. Watkins (1986) indicated that the primary cause of whales' reaction to vessels was to underwater sound from the vessel. The study found some degree of habituation to relatively "non-disturbing" stimuli. Whales near shore, where vessel traffic occurred, became less wary of boats and vessel noise over time and the animals appeared to be less easily disturbed by vessel traffic. This appeared to be particularly the case with humpback whales. It should be noted, however, that the conclusions drawn in this study did not result from controlled experiments on the impact of human activity on humpback whales.

Research has suggested that noise may cause humpback whales to avoid or leave feeding or nursery areas (Jurasz and Jurasz 1979). Other research has suggested that humpback whales may become habituated to vessel traffic and its associated noise. Still other researchers suggest that humpback whales may become more vulnerable to vessel strikes once they habituate to vessel traffic (Swingle et al. 1993, Wiley et al. 1995) (see Section 5.6.5 for further discussion of vessel traffic impacts). While measurable startle responses might diminish with time, this does not necessarily indicate that a negative impact has not occurred. Vessels could still cause physiological stress impacts or could disrupt prey aggregations forcing whales to spend a greater amount of time and energy foraging (section 5.7 discusses the effects of the proposed action on listed species' prey).

Alteration of Behavior

The BA/BE states that loud underwater noise (>125 dB re 1uPa @ 1m) from high-speed (18-20 knot) ferries (e.g., crew shuttle boats) could disturb marine mammals. It also states that the proposed operation of a crew shuttle boat in Berners Bay could generate noises above 130 dB, and behavioral responses of exposed whales are expected as a result. NMFS agrees that behavioral responses may occur and provides the following discussion on humpback whales and vessel noise.

Baker and Herman (1989) conducted controlled studies on the impact of vessel traffic on humpback whales in Glacier Bay and in the Frederick Sound area of southeast Alaska. They examined responses to obtrusive, unobtrusive, and "passby" conditions created by different vessel classes. In that study, respiratory behaviors were the most sensitive indicators of response to a vessel. The obtrusive condition resulted in a striking increase in the frequency of blows when the whale was near the surface and an increase in the longest submergence observed (Baker and Herman 1989). The effects declined as the activity of the vessel moderated during the unobtrusive and "passby" conditions. Within the 400 m range of influence, vessel operations accounted for 27.5% of the variance in the blow intervals of whales.

Baker and Herman (1989) also noted the tendency of humpback whales to orient in the direction of a vessel as it approached, and then to turn away at a perpendicular as the vessel reached its closest point of approach. The percentage of whale movement devoted to avoidance behavior increased from 15% at a distance from the vessel of 4000 m to 27% at a distance from the vessel of 1000 m. Some of the other factors examined were difficult to analyze due to the infrequency and variability of the behaviors. Of note, however, is that predictable behavioral reactions were evident up to a distance of 4000 m from the vessel.

Baker and Herman (1989) also observed changes in aerial behavior and pod composition with the proximity and presence, respectively, of vessels. The presence of large vessels was correlated with changes in pod composition; aerial behavior occurred with a 50% probability when vessels approached within 478 m of the focal pod. Baker and Herman concluded that humpback whales exhibit a considerable degree of short-term changes in their behavior in response to vessel traffic.

Other studies on humpback whales in their wintering grounds indicate some changes in behavior in response to vessels. Corkeron (1995) showed that animals dove more often in the presence of vessels when the vessels were within 300 m of the animal. Mother-calf pairs almost never dove when vessels were absent yet did so when vessels were present, spending significantly more time submerged or traveling and potentially incurring energetic costs. For non-calf pods, the rates at which certain behaviors (e.g., roll, lunge, fluke and flipper activity, and breaching) occurred were significantly different when vessels were present than when vessels were absent. Bauer et al. (1993) found that smaller humpback whale pods with calves were more affected by vessel activity than were larger pods without calves.

In an example involving another baleen whale species, Richardson et al. (1985) observed strong avoidance reactions of bowhead whales to approaching vessels in arctic waters. Some bowheads reacted strongly to the presence of vessels by orienting and swimming rapidly away from the vessel. There was a highly significant orientation away from the vessel when the vessel's engine was engaged. The orientation away from the vessel was significant at a distance from the vessel of <900 m. Significantly more whales also moved at a moderate to fast speed away from the vessel when the vessel was as far away as 4 km. An increase in whale swimming speed was also observed as vessel distance decreased to <2 km. Bowheads also exhibited significantly shorter surfacing times with fewer respirations per surfacing when the vessel was within 4 km. Some disruption of social groups was also observed in response to vessel approaches. The authors of this study note that bowheads responded to vessels more dramatically and consistently than to other human disturbances.

The effects of vessel noise or traffic are likely to be more acute when a vessel is near an animal, diminishing with the vessel's increased distance from the whale. However, given that humpback whale reactions have been evident up to 4 km (2.5 miles) away from a vessel, and bowhead whales have reacted to vessels as far away as 4 km, whales in Berners Bay may alter their behavior to the presence of vessels at any distance within the contained area of the bay because the ensonified space is approximately 3-5 miles in any direction. Such behavioral responses may include more frequent dives, longer dive durations, increased respiratory behavior, or changes in pod compositions in the presence of these vessels. Ultimately, this translates into energy being spent on avoidance behavior that subtracts from energy available for biologically important behaviors of foraging, traveling, or engaging in social behaviors (e.g. breeding, nursing, etc.).

Although it is difficult to quantify the behavioral effect of noise impacts on humpback whales, based on existing information, we can assume that individual humpback whales may alter their behavior in the presence of the vessels and construction activity associated with the proposed action. Whales may leave the action area if sufficiently disturbed. It is more likely they will leave an area if not actively involved in feeding at the time of the disturbance. Displacement may adversely affect individual animals by requiring additional energy investment to forage elsewhere, and thus may translate into the reduced fitness of an individual. However, given that a relatively small number of whales appear to use Berners Bay (as compared to larger concentrations of animals in Glacier Bay, Point Adolphus, or Frederick Sound), the effects of alterations in behavior, temporary disruption, or displacement are not expected to impact a significant portion of the Central North Pacific population such that the recovery or survival of the species would be compromised.

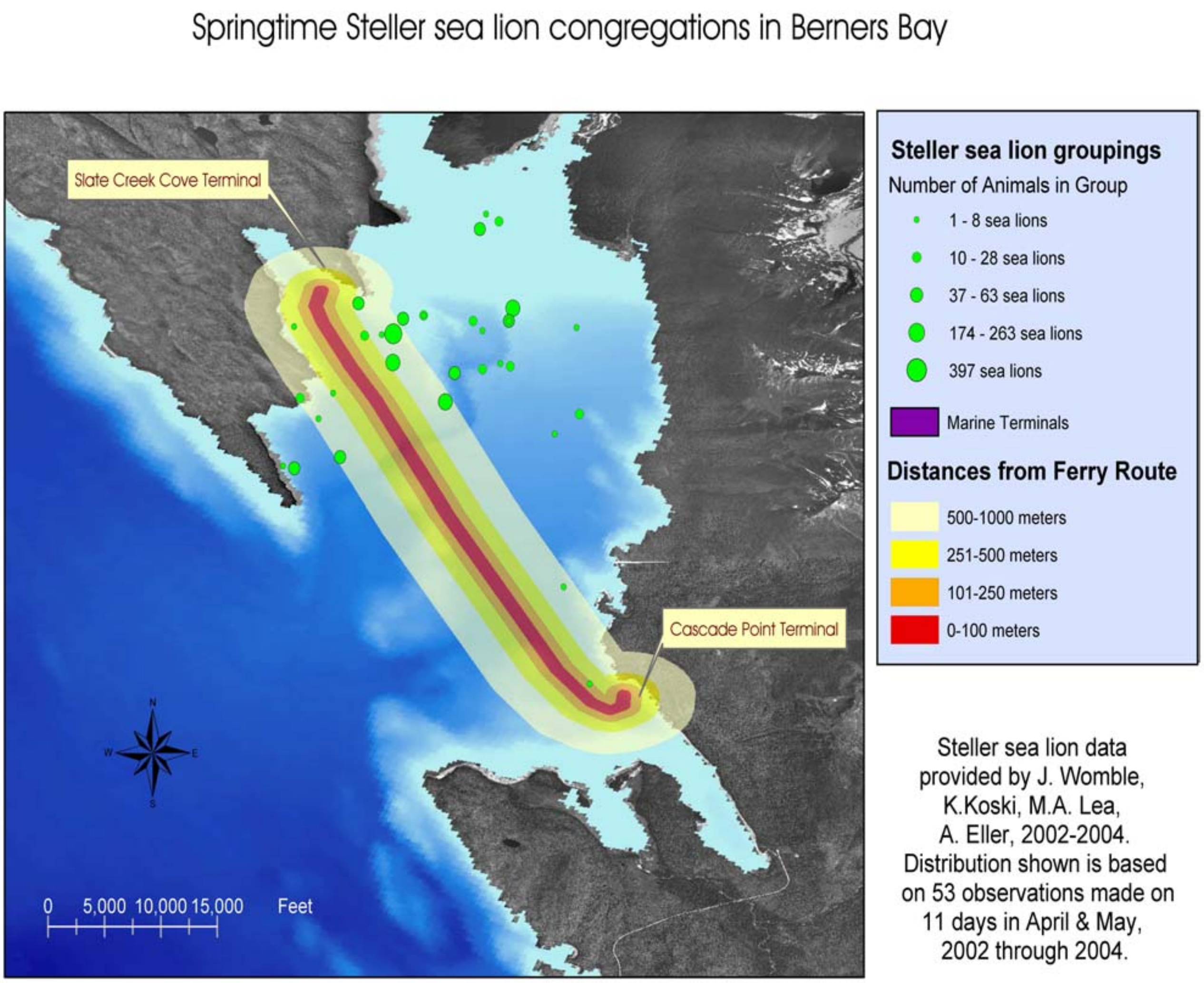
5.6.4 Responses of Steller Sea Lions to Increased Vessel Traffic

The potential direct effects of increased vessel traffic in Berners Bay on Steller sea lions include collisions with vessels and disruption of feeding animals either while in groups or alone. The BA/BE, SEIS, and Coeur's contracted sea lion expert (Loughlin 2004) all state that vessel collisions are possible but unlikely. Based on available information, there is no evidence that Steller sea lions are likely to collide with slow or fast-moving vessels. However, California sea lions have been observed with injuries that are consistent with propellers, gash marks on the lateral surface or rump, or missing flippers (F. Gulland, pers. comm..). The frequency of these incidences is unknown, but the impact is probably not occurring at a population level. Like California sea lions, Steller sea lions are agile and alert and accustomed to vessel traffic. Thus, although possible, NMFS agrees that collisions between Steller sea lions and the crew shuttle, barge or tug are unlikely.

As with noise from vessels, the most likely effect of increased vessel traffic in Berners Bay for Steller sea lions is the disruption of feeding animals. As currently proposed, the transit lane for the ferries and barges will pass within 150 meters of areas where large concentrations of feeding sea lions were observed in 2002 and 2003 (Figure 5.1). The cooperative feeding described by Gende et al. (2001), is unique to this area and is evidence of adaptive feeding behavior that yields a high energetic benefit to individuals engaging in the behavior. There is likely visual and vocal communication among individuals in the foraging group that may be disrupted by a fast-moving ferry passing through. The response of sea lions to passing vessels would likely be to dive if they are resting at the surface or to remain submerged if underwater. They would likely resurface in the same area or some distance away once the vessel passed, depending on the level of response. However, if a change in sea lion behavior resulted in a change in the behavior of their prey such that the prey becomes more difficult to capture, sea lions may be unsuccessful during one or more foraging events while the vessel is in the vicinity of foraging animals. This is further discussed in Section 5.7.2.

As it is unlikely that individual sea lions remain resident in the action area during the winter and spring, it is unlikely that disruption to the cooperative feeding behavior would result in a population level effect. The proposed action to reduce the number of ferry transits during the peak sea lion foraging period, reduce the speed of the ferries to 12-13 knots, have a trained NMFS-approved observer on the vessel, and remain 100 yards from sea lions at all times will be helpful to reduce the likelihood of negatively affecting feeding sea lions. However, it is recognized that sea lions are unpredictable in their movement patterns and it will often be impossible for vessel personnel to anticipate or navigate 100 yards from feeding animals. This is particularly true for large barges and tugs that are less maneuverable than smaller vessels. Disruption of feeding behavior, rafting, or resting sea lions constitutes harassment under the MMPA and needs to be allowed for by obtaining an incidental harassment authorization (IHA) or letter of authorization (LOA) for incidental take under the MMPA.

Figure 5.1. Steller sea lion congregations in Berners Bay 2002-2004 relative to proposed vessel transit route.



Steller sea lion data provided by J. Womble, K.Koski, M.A. Lea, A. Eller, 2002-2004. Distribution shown is based on 53 observations made on 11 days in April & May, 2002 through 2004.

5.6.5 Responses of Humpback Whales to Increased Vessel Traffic

As noted previously, humpback whales using the action area may be affected by increased vessel traffic in the following ways: disruption of normal feeding, resting, and socializing behaviors; disturbance, harassment or displacement; or an increase in the probability of collision.

Many disturbance responses to vessels have been documented and are detailed in Section 5.6.3. A number of studies have been conducted in areas with seasonally high numbers of humpback whales to assess short-term impacts of vessel activity. Studies of vessel impact to marine mammals have most often looked at short-term effects (e.g., measuring disturbance or avoidance behaviors) rather than longer-term or cumulative effects of repeated exposure to numerous vessels over time (e.g., decreased survivability or reproductive effects such as increased birthing intervals which are directly related to productivity). Immediate responses to vessel presence, such as avoidance behavior or changes in dive patterns, can be measured more easily; longer-term effects can often be difficult to define and to measure. Typical measures of a whale's reaction to the presence of a vessel have been visible changes in behavior, such as avoidance reactions or displacement, increased fluke or flipper activity, blow intervals or dive patterns and swimming orientation and speed. These reactions are measurable and can be assumed to have a certain energetic cost. However, animals could also incur an energetic cost through behaviors that are not necessarily measurable (i.e., physiological stress responses such as increased heart rate or pathological conditions).

Humpback whale foraging is likely to co-occur with planned vessel routes. Humpback whales appear to utilize various regions within Berners Bay. They have been sighted along both the southern shoreline from Point Bridget past Sawmill Cove, the northern shoreline from Point St. Mary past Slate Creek Cove, and in the middle of the bay. Given the lack of exact sighting locations, however, it is reasonable to assume that humpback whales are as likely to be feeding or traveling such that they would intercept the straight line path of the crew shuttle ferry along its prescribed route from Cascade Point to Slate Creek Cove, as they would be to be feeding or traveling in other parts of Berners Bay.

Risk of Vessel Collisions to Humpback Whales

Since 1986, opportunistic data on vessel collisions with humpback whales have shown an average of one to two reported humpback whales struck per year in Alaska (Jensen and Silber 2003, NMFS unpublished data). Since 1999, approximately one vessel strike per year has resulted in a known mortality to a humpback whale in southeast Alaska. Contrary to the assertion in the BA/BE that collisions with whales are rare in Alaska, collisions are in fact expected events in southeast Alaska that can generally occur throughout all of the region, peaking during the summer season. All sizes and types of vessels can hit whales (Laist et al. 2001). Records of vessel collisions with large whales in Alaska indicate that strikes have involved cruise ships, recreational cruisers, whale watching catamarans, fishing vessels, and skiffs. Vessel lengths associated with these records ranged from approximately 20 feet to over 250 feet, indicating that all types and sizes of watercraft pose a threat of collision for whales (Jensen and Silber 2003). Cruise ships are of particular concern, as they operate at considerably high speeds and frequent the inside waters of southeast Alaska with routes passing through areas of humpback whale abundance such as Glacier Bay National Park and Preserve, Point Adolphus and, adjacent to the action area, the waters of Lynn Canal. In addition to large ships, which are most likely to cause significant injury or death to humpback whales, smaller tour, charter and private vessels also significantly overlap with inshore humpback whale distribution in Alaska waters. Smaller ships also have the potential to cause disturbance, serious injury, and possibly mortality.

Several incidents of vessel interactions with humpback whales in Glacier Bay have been documented in recent years. In 2001, a dead and pregnant humpback whale was discovered in Park waters. A necropsy determined the whale likely had been killed by blunt trauma, possibly from a large vessel collision. In 2002, one mortality occurred inside Park waters and several additional collisions were documented (Doherty and Gabriele 2002). Other interactions included close approaches and possible harassment by several vessels of different vessel classes including a kayak, a cruise ship and a floatplane. Researchers also documented an injury to the dorsal fin of a whale that could have been caused by a vessel collision/interaction. In 2003, a humpback whale was necropsied that had been first seen at Pt. Manby, Yakutat Bay. The results of that necropsy also indicated that the whale had been killed by blunt trauma as a result of large vessel collision (NMFS unpublished data). In 2004, a humpback whale calf in Glacier Bay was necropsied on Strawberry Island. Severe dislocation of six ribs caused massive bleeding and tissue damage; blunt trauma indicated injury consistent with vessel collision (F. Gulland, pers. comm.). A second incident in 2004 involved a humpback (nursing calf) necropsied on the south end of Douglas Island outside of Juneau. Results of this necropsy showed a severe scapular fracture and again indicated likely collision with a vessel based on blunt trauma to the animal (Tuomi unpublished data).

Generally, there is a direct relationship between the occurrence of a whale strike and the speed of the vessel involved in the collision. Most collisions that killed or severely injured whales involved vessels greater than 80 meters in length traveling at speeds in excess of 13 knots (Laist et al. 2001). The operating speed of 18 knots proposed outside the eulachon/herring spawning period thus could result in injury or mortality to a humpback whale. During the peak humpback foraging period, measures in the proposed action to reduce the number of ferry transits, to slow the speed of the ferries to 12-13 knots, to have a trained NMFS-approved observer on the vessel, and to remain 100 yards from whales at all times will be helpful to reduce the likelihood of negatively affecting the animals. However, it is recognized that humpback whales are unpredictable in their movement patterns and it may be impossible for vessel personnel to anticipate or navigate 100 yards from feeding animals.

It is not known to what extent the increased vessel traffic in the action area will result in humpback whale injury or mortality due to ship strikes. Crew shuttle transport, barges and tugs in Berners Bay will likely result in increased disturbances to whales and pose a higher risk of collision than those posed by baseline conditions**.** The risk of vessel collision is likely to be higher during April and May when whales are drawn to Berners Bay to forage on herring and eulachon. The threat may remain during summer months, as humpback whales have been observed consistently in the bay during this time. Throughout the remainder of the year, the chance of collision is likely to be low given the limited usage of the action area by humpback whales. Although a heightened risk of collision may impact individual humpback whales using the action area, it is unlikely to have population level consequences for the Central North Pacific population.

5.6.6 Responses of Steller sea lions to Dock Structures

It is possible that the construction of dock facilities may benefit Steller sea lions in that they will provide haulout areas not previously available. California sea lions have repeatedly claimed docks, jetties, and breakwaters as their haulouts, often to the detriment of people using the structures and sometimes posing threats to human safety. In some cases, California sea lions and Steller sea lions have habituated to human presence and activities that would normally disturb them (e.g., close vessel approach in Kodiak Harbor, human approach on boat docks). The fact that most animals come from haulouts 14 miles or further from Berners Bay, suggests that if there was a haulout site closer to the feeding source, the animals might use it. This would have the effect of reducing the cost of traveling to and from the feeding area, and therefore provide a greater energy gain for animals using the Berners Bay resources. However, if animals used these structures, negative interaction between humans and sea lions using the docks would likely occur. Under this scenario, the potential for MMPA incidental take is a significant issue and a take authorization under the MMPA is strongly recommended to prevent illegal take and minimize its effects.

5.6.7 Responses of Listed Species to Petroleum Discharges and Spills

Contaminants from Vessel Operations, Fuel Transport and Fueling

It is estimated that more than 93% of petroleum hydrocarbons entering the marine environment come from anthropogenic sources (National Academy of Sciences 1985). The most important anthropogenic source is associated with marine transportation (Neff 1990), which contributes approximately 46% of annual inputs of petroleum hydrocarbons into the marine environment (National Academy of Sciences 1985). Releases that occur during the consumption of petroleum by individual boats, non-tank vessels, cars and runoff from paved urban and suburban areas contribute the majority of all human-introduced petroleum inputs into the marine environment (NRC 2003). Petroleum inputs from these sources occur almost exclusively as slow, chronic releases. Nearly 85 percent of the total petroleum input from anthropogenic sources, or an estimated average of 84,000 tonnes (25 million gallons) of petroleum per year, are introduced to North American waters from these diffuse sources (NRC 2003). Between 1991 and 2001, spills from non-tanker vessels accounted for 53.7% of the total spills reported, which resulted in the spillage of more than 3.56 million gallons of oil (United States Coast Guard 2001). According to the Alaska Department of Environmental Conservation (2003), an average of 21,921 gallons per year of spilled petroleum was reported for southeast Alaska waters over the seven-year period from 1995 through 2002. Non-crude oils, such as diesel and gasoline, were the primary products spilled in 90 percent of all spills, and non-crude oil also comprised 90 percent of the total volume spilled in southeast Alaska (ADEC 2003). Although these figures vary from year to year, as the quantity of fuel transported over water increases and the frequency of transport increases, the likelihood of accidental spills also increases.

In addition to diesel fuel and lube oil, other potentially hazardous materials that will be transported to the Kensington Gold Project site include: lime, cement, hydraulic fluid, oils and greases, anti-freeze, acids, reagents (PAX, MIBC, surfactant, scale inhibitor), polymers and flocculants (USFS 2004b). The applicant has developed and submitted Material Safety Data Sheets and a spill response plan for dealing with such discharges. As stated in the EIS, emergency reporting to Alaska Department of Environmental Conservation is required for releases of hazardous materials other than oil. In the event that any of these materials are released into the waters of Berners Bay, there is the potential for localized, adverse impacts on marine mammals and fish that come in contact with the spill. NMFS does not have sufficient information on the quantities of the materials to be transported, the nature of the containment during transport, the planned storage locations and methods for those materials, or the potential for usage and release of such materials in the aquatic environment in and around Berners Bay to analyze the extent or probability of Steller sea lion or humpback whale exposure to such contaminants. Instead, we have focused our analysis of contaminants on the risks associated with the proposed increases in transport and usage of petroleum products in Berners Bay.

Estimated Increases in Petroleum Transport in Berners Bay

As discussed previously in the *Environmental Baseline* section, it is difficult to quantify the number of vessels that regularly use Berners Bay during spring and summer months, but it can be concluded that motorized vessel activity in the bay is generally limited. However, once the Cascade Point and Slate Creek Cove marine facilities are constructed and the Kensington mine vessel traffic begins, NMFS expects that the amount of fuel transported by vessels in Berners Bay will increase, thereby increasing the probability of fuel spills and associated resource degradation.

As stated in the BA/BE, during the life of the Kensington Gold Project, vessel traffic will increase in the bay by a minimum of four to six transits per day during the height of marine mammal foraging in spring, and will increase by a minimum of six to ten cross-bay transits per day during the rest of the year. The passenger vessel will have a fuel capacity of 1,600 gallons of diesel. In addition, a supply tug and barge with 110,000 gallon diesel fuel capacity will enter the bay four times per week, and will transport nine fuel-filled 6,500 gallon isotainers into Slate Creek Cove once per week.

Therefore, on any given day, Kensington mine operations will add an estimated 170,000 gallons of diesel fuel and 1,200 gallons of lube oil to petroleum products transported into and/or stored in Berners Bay. This fuel and lube oil will be stored in vessel tanks and isotainers, and will be used by vessels, vehicles, and other mine-related machinery that operate in and around the mine and the bay. The SEIS states that "...the risk associated with barge transport of fuel and the risk of a spill during transfer of diesel fuel from the supply barge to the marine terminal are minimal because of the use of the individual containers." However, NMFS is concerned that such a significant increase in the amount of fuel transported into the Bay may increase the probability of accidental spills.

Harper and Morris (2005) calculated the potential length of petroleum residence for Berners Bay and other shorelines in southeast Alaska. This calculation was made using an oil residence index (ORI) based on wave exposure levels and substrate types measured along the shoreline and intertidal zone. Although the actual duration of oil residence following a spill will be dependent on the specific characteristics of the event (i.e. type of oil spilled, location and timing of a spill, and the total volume released), the ORI provides a ballpark estimate of several months to several years residence for oil spilled in and around Berners Bay. Therefore, petroleum spills will have the potential for long-term contamination of the Berners Bay ecosystem and chronic impacts on the living marine resources that utilize the bay.

If anticipated increases in medium to large boat traffic from ancillary use of Cascade Point dock also occur, the likelihood of fuel spills and probability of contaminant exposure will further increase. Without knowing the exact numbers or types of vessels this might include, it is difficult to assess the degree of increased risk this activity will pose.

Petroleum Discharges During Normal Operations

As stated in the BA/BE, discharges of petroleum products are expected to occur during normal operations of the crew shuttle and tug/barge. These discharges may occur at either of the marine terminals or in the bay along the vessel routes. Assuming no major mechanical or structural damage to the vessels using the bay, it is unlikely that the small quantities of hydrocarbons, heavy metals and other petroleum byproducts discharged by diesel engines under normal vessel operations will result in long-term, high concentrations of contamination within the bay as a whole. However, small discharges of diesel fuel during normal vessel operation would likely cover a small surface area with a petroleum sheen, which would then spread rapidly and become diluted by wave action and currents, with many of the hydrocarbons dissipating from the bay within hours to several days.

Similarly, chronic discharges of diesel fuels from boats during docking, idling, and refueling at the marine terminals are more likely to create elevated concentrations of hydrocarbons and heavy metals in the vicinity of those facilities. Presumably, the presence of a breakwater at the Cascade Point facility will reduce the rate of hydrologic flushing in and around the facility by cutting wave action and reducing currents that would otherwise be expected at this site. With reduced rates of flushing and frequent small petroleum releases from fueling activities and idling boats at Cascade Point, it is likely that hydrocarbon concentrations in the water column and sediments near the terminal will be greater than in other parts of the bay.

Petroleum Spills

Larger discharges of petroleum products, such as spills from leaking isotainers, fuel tanks or fueling accidents, have a greater likelihood of causing direct harm to marine mammals due to larger surface area of the sheen, which would increase the risk that an animal will come in direct contact with the fuel. Studies of behavioral responses to oil spills have shown that most cetaceans and pinnipeds will not actively avoid oil sheens (Geraci 1990), probably due to a lack of recognition of the risks associated with them. Therefore, any actions such as vessel fueling, transport of fuel in unsecured containers, or vessels operating or docked with leaking or damaged fuel tanks will increase the risk of a larger fuel spill, thereby increasing the risk of exposure for marine mammals and other wildlife in the bay.

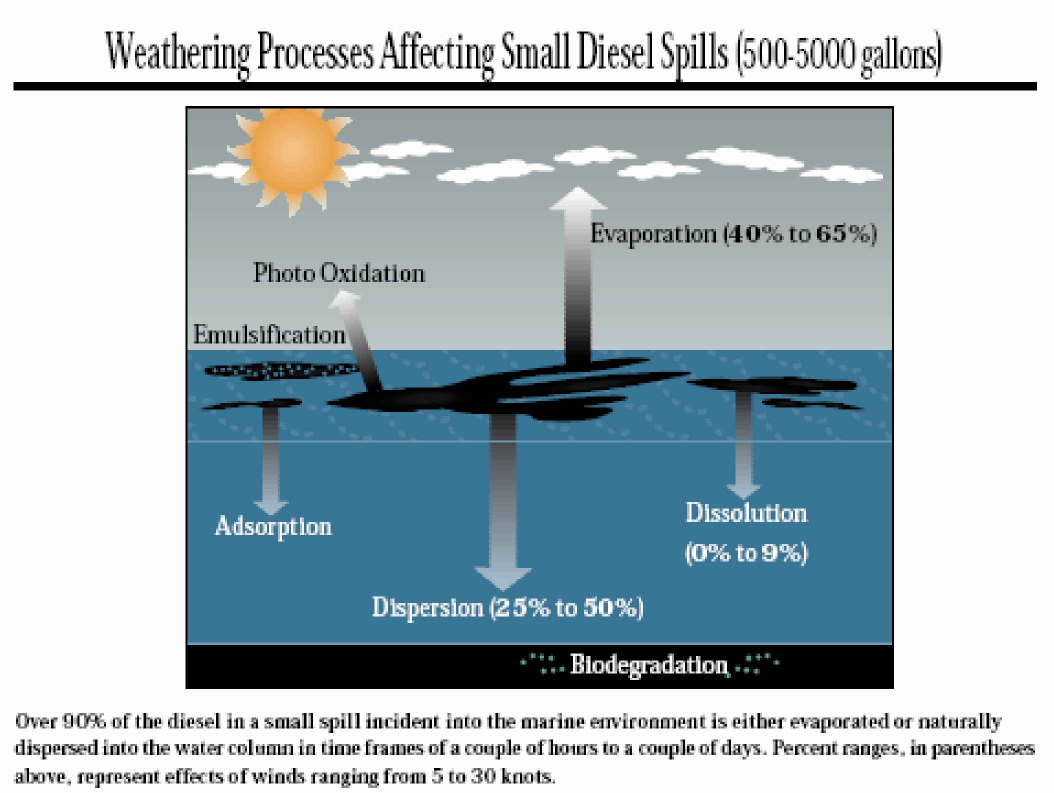
Characteristics of a Diesel Spill

In order to analyze the anticipated risks and effects of diesel spills from Kensington Gold Project activities on the aquatic environment of Berners Bay, we reviewed the known physical and chemical characteristics of diesel spills in the marine environment. The following is a summary of the information provided by NOAA’s National Ocean Service, Hazardous Materials Response and Assessment Division (1998), with NFMS’ analysis on how this information pertains to the Kensington Gold Project:

Diesel fuel is a light, refined petroleum product. When spilled on water, most of the oil will evaporate or naturally disperse within a few days or less (Figure 5.2). This is true for typical spills from small vessels (500-5,000 gallons), even in cold water. Diesel oil is much lighter than water, so once spilled on water, diesel oil spreads very rapidly to a thin film and it becomes very difficult to contain the spill or limit the area of impact. Even when the spill is described as a heavy sheen, it is 0.0004 inches thick and contains about 1,000 gallons per square nautical mile of continuous coverage. Diesel has a very low viscosity and is readily dispersed into the water column when winds reach 5-7 knots or sea conditions are 2-4 feet. Dispersion occurs when the oil is physically mixed into the water column by wave action, forming small droplets that are carried and kept in suspension by the currents. These droplets of dispersed oil contain hydrocarbons and heavy metals that are bioavailable and pose health risks to marine animals that come in contact with them. Diesel oil cannot sink and accumulate on the seafloor as pooled or free oil. However, once dispersed in the water column, oil can adhere to fine-grained suspended sediments, which then settle out and get deposited on the seafloor. This process is more likely to occur near river mouths where fine-grained sediment is carried in by rivers.

Individual, small spills are unlikely to result in measurable sediment contamination; however, larger spills of diesel and chronic small spills, such as those that occur in marinas/harbors, result in higher levels of contaminants in the sediments (McGee et al. 1995). Thus elevated levels of contaminated sediments are anticipated at the Cascade Point and Slate Creek Cove docks.

Figure 5.2. Weathering processes of a small diesel spill. (National Ocean Service 1998)



Over 90% of the diesel in a small spill incident into the marine environment is either evaporated or naturally dispersed into the water column in time frames of a couple of hours to a couple of days. Percent ranges, in parentheses above, represent effects of winds ranging from 5 to 30 knots.

Diesel oil is not very sticky or viscous, compared to black oils. When small spills wash onto the shoreline, the oil tends to penetrate porous sediments quickly (such as gravel, cobble and small boulders). Dependent on the extent of wave action, substrate characteristics and tidal flushing, diesel also tends to be washed off easily by waves and tidal flushing. Thus, shoreline cleanup is usually not needed, but the oil is dispersed and remains biologically available in the nearshore environment. In warm water, diesel oil is readily and completely degraded by naturally occurring microbes, under time frames of one to two months. In colder climates and cold waters (such as those in Lynn Canal and Berners Bay), the rate of degradation can be slower. In terms of toxicity to water-column organisms, diesel is considered to be one of the most acutely toxic oil types (NOS 1998). Fish, invertebrates and seaweed that come in direct contact with a diesel spill may be killed. Although small spills in open water are so rapidly diluted that fish kills have never been reported, fish kills have been reported for small spills in confined, shallow water. Thus small and large spills in the shallow waters of Slate Creek Cove and near the breakwater at Cascade Point will pose hazards to fish, including the prey resources of Steller sea lions and humpback whales. The specific risks of diesel contamination for fish resources are discussed in detail in Section 5.7.5.

Responses of Listed Species to Petroleum Spills

In-situ studies of petroleum spills and effects to marine mammals and forage fish have not occurred in Berners Bay. Therefore, NMFS must evaluate the potential risks of contamination for listed species based on the characteristics of the local environment and the known properties and quantities of fuels and oils to be used in association with the proposed action.

As acknowledged in the BA/BE, an oil spill or even infrequent leakages of small amounts of petroleum at sea pose risks to humpback whales and Steller sea lions and their forage species. Discharge of petroleum products, including lube oils and fuel oils (i.e., diesel and gasoline) into Berners Bay increases the probability that animals will be exposed to and injured by petroleum-associated toxins such as hydrocarbons and heavy metals.

NMFS disagrees with statements made in the BA/BE that suggest that diesel fuel poses little risk to the marine environment. On the contrary, among the refined petroleum products, diesel fuel is considered to be highly toxic (Irwin et al. 1998) because it is enriched in polycyclic aromatic hydrocarbons (Craddock 1977, National Toxicology Program 1986, Clark 1989). Because different species of animals have different physiological reactions to diesel exposure, some invertebrate species experience high mortality while others appear unaffected. Therefore, diesel spills could have ecosystem-level impacts by altering benthic community structure (Carman et al. 1997, Millward et al. 2004), which would affect competition and might affect food availability for higher trophic levels.

Although much of the diesel spilled in a small incident is expected to either evaporate or naturally disperse into the water column within a few days, the rate of weathering is dependent on temperature, light, and other environmental conditions. Once dispersed into the water column or settled into substrates, petroleum compounds such as PAHs and heavy metals will remain bioavailable in lower concentrations, and still pose a risk to marine organisms that come in contact with these compounds. Chronic exposure to diesel spills and latent contamination in the sediments for nearshore species also pose risks to many marine organisms. Therefore, it is incorrect to assume that any diesel spills in Berners Bay will quickly evaporate without posing risks to fish and marine mammals.

Research on the environmental effects of petroleum spills in Alaska and around the world has shown that contact with petroleum products can cause injury and mortality in marine mammals (Geraci and Smith 1976, Jessup and Leighton 1996, Martineau et al. 1988, Martineau et al. 2002, St. Aubin 1990). Injury from these toxins can occur through direct and indirect means of exposure.

Direct exposure occurs when an individual comes in direct contact with the petroleum, usually by surfacing in or swimming through a sheen, or collection of oil. Typically, marine mammals contact oil and fuel spills at the water's surface, where the oil may adhere to the skin, eyes or baleen and they may inhale the volatile hydrocarbons (Harvey and Dalheim 1994). Potential for risks from contamination include dermal irritation and burning (Engelhardt 1987), eye irritation, ingestion through direct contact with oil sheen when feeding or breathing, and ingestion via contaminated prey.

Direct contact with petroleum products can irritate and injure lungs, eyes and other organs, reducing an individual's ability to feed, capture prey or oxygenate blood (Jessup and Leighton 1996). If fur or skin becomes oiled, some species of marine mammals may experience hypothermia and loss of buoyancy (Engelhardt 1983; Jessup and Leighton 1996), which increases stress and can reduce fitness, sometimes resulting in mortalities. Some species of pinnipeds will also absorb hydrocarbons into body tissues and fluids directly through immersion and ingestion (Engelhardt et al 1977). If petroleum products are ingested or inhaled, they may cause injury or damage to an individual's reproductive system, renal system or hepatic enzyme systems (which metabolize toxins and carcinogens) (Jessup and Leighton 1996).

Indirect exposure to petroleum-derived contaminants can occur when marine mammals feed on contaminated fish. Components of petroleum products such as lead and mercury and other heavy metals may be stored in the tissues of fish and bioaccumulate in marine mammals, posing short-term and long-term health risks. Polycyclic aromatic hydrocarbons, which are carcinogenic and mutagenic components of fuel oils (Karcher et al. 1981, Martineau et al. 1998, Carls et al. 1999), are often stored in the muscles of marine vertebrates, making them biologically available to consumers (Hellou et al. 1990, Law and Whinnett 1992, Marsili et al. 2001). Although many animals, especially vertebrates, can metabolize hydrocarbons, metabolism and elimination are not instantaneous and are often incomplete (M. Carls, pers. comm.). Because prey species such as Pacific herring and pink salmon fry store contaminants in their tissues (Carls et al. 1996, Carls et al. 2002), bioaccumulated hydrocarbons and heavy metals can be passed from prey to predators. This transfer is particularly likely in heavily oiled environments and coastal environments exposed to chronic releases of petroleum.

The risks of exposure and extent of injuries to marine mammals depend on a number of variables. Specifically, the effects of petroleum releases are dependent upon: the timing, location and magnitude of the release; the type of fuel released, its physical and chemical characteristics and the toxicity of its components; the scope and duration of an individual's exposure; and the biogeochemical conditions of the affected environment. Reactions to contaminants differ among marine mammal species due to differences in anatomy, physiology, behavior and prey composition. Reactions may also differ among individuals of the same species, dependent on the scope and duration of an individual's exposure, the means of contact – whether ingested, inhaled or exposed externally, as well as life stage and individual fitness.

Studies of the physiologic and toxic effects of petroleum on cetaceans have shown several instances of injury and mortality associated with spills in Alaska and around the world. For example, following the Exxon Valdez spill of crude oil in 1989, biologists documented the carcasses of 25 gray whales, 2 minke whales, 1 fin whale, 3 unidentified whales and 6 harbor porpoises (Geraci 1990). Geraci (1990), reported an incident in Alaska during 1970: "following a spill of light diesel fuel along the Alaskan shore, two killer whales, one sick and one dead, were reported." Reported injuries have included oiled and clogged blow holes (Geraci 1990), skin lesions and damage (Engelhardt 1983), reduction or loss of feeding capabilities due to fouling of baleen plates and fibers (Braithwaite et al. 1983, Geraci and St. Aubin 1980), and potential changes in structure or composition of baleen (St.Aubin et al. 1984). Based on research conducted after the Exxon Valdez oil spill, Calkins et al. (1994) found little conclusive evidence that Steller sea lion mortalities recorded following the spill were caused by oiling. Although mortalities are often reported following a spill, it is difficult to prove that the spill is the primary cause. Instead, it may be a combination of injuries caused by the oiling and pre-existing pathology that cause the mortalities of pinnipeds.

Uncertainty Associated with Evaluating Risks of Petroleum Contamination to Listed Species

The effects of petroleum spills in the marine environment, the bioaccumulation of petroleum residues and bioavailability within food chains, and the effects of incorporation and accumulation of petroleum products in marine mammals and other upper trophic level consumers are largely unexplored (Jessup and Leighton 1996, Hellou et al. 1990). Much of what is known about the toxicity of petroleum to marine mammals is derived from studies of oil spill events, which show the direct impacts of large-scale spills and effects of acute exposure to a spill. However, because oil spill events comprise only 15% of all petroleum releases in the marine environment (Jessup and Leighton 1996), very little is known about the effects of the majority of petroleum oils released into the environment each year. The other 85% of releases include small and large chronic releases from vessels, runoff from onshore industrial sources and roadways, oil production and natural releases. Without much information on the impacts of these other petroleum releases, it is difficult to determine the distribution of contaminants in the marine environment, the species affected, the toxicity of chronic events, or the cumulative effects of chronic exposure on marine mammals (Jessup and Leighton 1996).

Uncertainty exists even within the body of knowledge that exists from oil spill studies. For example, when mortality occurs as a result of exposure to petroleum, a carcass is usually not recovered (S. Rice, pers. comm.) unless it washes ashore or the oiled animal is observed in distress or dying. For example, when studying the impacts of the Exxon Valdez oil spill (EVOS) on harbor seals, researchers noted "relatively few harbor seal carcasses were found following the EVOS. This was not surprising since dead seals usually do not float" (Frost et al. 1994). However, the recorded behavioral response to oiling indicates negative oil impacts: "oiled seals were very lethargic and reluctant to enter the water and they showed little response to human presence" (Frost et al. 1994). Without carcasses, specific mortality counts are impossible, and it is difficult to prove that observed population declines in the spill area are directly related to contamination.

Similarly, many injuries associated with petroleum contamination may not be visibly manifested. Unless direct contamination of an animal is observed (such as oiling on the fur or observations of the animals in an oil sheen), it is difficult to determine the level of an individual's exposure. Internal injuries caused by petroleum exposure are probably not immediately detectable through observation, and could require sampling and testing for evidence of pathology. Therefore, when researchers evaluate the overall effects of a spill on marine mammal fitness and survival, it is likely that mortality and morbidity are actually underestimated.

Unfortunately, because PAHs are fairly rapidly metabolized by the liver tissue and blubber of marine mammals and by many fish species, it difficult to test many marine vertebrates to determine levels of exposure to PAH and the associated carcinogenic and mutagenic compounds – benzene and benzo(a)pyrene (Moore and Dwyer 1974, Fishbein 1984, Neff 1990). Therefore, many animals may be exposed to the toxic effects of PAHs without showing significant concentrations of these compounds in their cells and tissues. However, contrary to suggestions made in the BA/BE, the rapid metabolism of hydrocarbons does not preclude injury of exposed animals. Although PAH contamination is not easily detectable, injuries can occur rapidly between time of exposure and metabolism/excretion (Fishbein 1984, Varanasi et al. 1992). In addition, large numbers of organisms, including many invertebrates, are unable to metabolize aromatic hydrocarbon compounds and will bioaccumulate these contaminants (Lee et al.

1972, Varanasi and Malins 1977, Varanasi et al. 1992). These invertebrates are an integral part of the food chain for many species of fish and mammals that feed in Berners Bay.

NMFS agrees that the protection measures listed in Section 6 of the BA/BE and Appendices A to D of the SEIS should help lessen the contaminant risks associated with normal vessel operations. The relevant protection measures listed in the BA/BE include:

- Marine vessel fueling for the Kensington Gold Project will not take place at the Slate Creek Cove dock (except in emergencies);
- No other vessel fueling, except the Kensington Gold Project crew shuttle, would be fueled at the Cascade Point facility;
- No fuel storage would occur at the site [Cascade Point facility];
- In advance of the eulachon and herring spawning period Coeur will build up onsite fuel inventories (in an upland location, away from the shoreline and any waterbodies to minimize additional risks of contamination of the bay), sufficient to support mine operations for a 30-day period, and reduce or eliminate fuel barging during the eulachon and herring spawning period;
- Coeur's spill prevention, control, and containment (SPCC) plan will be modified and approved by the action agencies, City and Borough of Juneau and ADNR; and
- Coeur will meet with NMFS, ADNR, and ADF&G personnel to review the mitigation measures and monitoring plans a minimum of once per year, or as needed, to review monitoring information addressing the effectiveness of mitigation measures.

Under these circumstances, with assurances that all measures contained in the proposed action to minimize impacts to listed species will be implemented, it is unlikely that the small discharges associated with normal vessel operation will be sufficient to cause direct harm to Steller sea lions or humpback whales. If monitoring shows that measures contained in the proposed action are insufficient to protect Steller sea lions, humpback whales and their prey resources in Berners Bay, the action agency may need to reinitiate formal consultation on the action (see Section 10).

5.6.8 Responses of Listed Species to Discharges from Mine Operations

Responses of marine mammals and their prey to heavy metals

Analysis of ore samples conducted by Coeur in 1994 showed a low level of metal anomalies in the ore deposit (Kensington Venture 1994). According to test results completed for Coeur by Barringer and Lakefield labs, the average concentrations of several metals did not exceed the available detection limits for commercial testing procedures. However, test results have shown higher than average concentrations of some elements, including mercury sulfur, aluminum, lead and copper (220 ppm). Because of the relative homogeneity of the ore deposits (Kensington Venture 1994), it is likely that the tailings will have a similar chemical composition to the ore deposit. With mining activity, the long-term, chronic disposal of tailings into Slate Lake may facilitate the transport of trace elements into the marine environment via Slate Creek, which could raise concentrations of such elements in the proximity of Slate Creek Cove.

Discharge chemistry is a combination of tailings, water character, and the background chemistry of Lower Slate Lake. While state water quality standards are designed to be protective of aquatic life (i.e., not resulting in acute toxicity) under the Clean Water Act, it does not necessarily follow that these standards protect threatened or endangered species under the ESA or Essential Fish Habitat (EFH) under the

Magnuson Stevens Fishery Conservation and Management Act. A reverse osmosis system is planned as a contingency treatment system to reduce aluminum levels and total suspended solids, while also removing other pollutants. However, the SEIS does not contain enough detail on how such a treatment system would be designed, constructed, maintained or monitored for NMFS to review the likely efficacy of such a treatment system (SEIS 2-28).

Elevated levels of heavy metals could have an impact on the fitness and survival of marine mammal prey resources, and consequently listed marine mammal species, if the concentrations exceed levels deemed safe for aquatic species. For example, high concentrations of copper, mercury and lead are of particular concern for larval and juvenile herring (Chapman 1978). Chronic exposure to copper concentrations above 7 ppb in the water column (Sorenson 1991), and 34 ppm in sediments (Johnson et al. 1999) have been shown to cause developmental abnormalities in laboratory research. If mine tailing runoff and associated discharges raise concentrations of these heavy metals in the estuary, there is the potential for these concentrations to exceed safe thresholds, which could reduce prey species fitness, abundance, and availability, thus potentially affecting marine mammals foraging on these resources. Although there is little data available on the direct effects of heavy metals on marine mammals, it can reasonably be inferred that heavy metals sequestered by organisms lower in the food chain (ie. forage fish and zooplankton), will biomagnify when these animals are consumed in quantity by marine mammals. Similar biomagnification and bioaccumulation processes have been found with toxic contaminants like DDT and PCBs. These contaminants, when acquired through the food chain, have been shown to accumulate in the blubber of marine mammals and impair reproductive and immune function in marine mammals (DeLong et al. 1972, Gilmartin et al. 1976, Oshea 1999). In declining populations, decreased genetic diversity and synergistic effects from chemical contaminant toxicity can compound factors that lead to reduced fitness and predisposition to disease (Bickham et al. 2000).

According to the draft NPDES permit, the anticipated untreated water quality from the proposed Tailing Storage Facility (TSF) in East Fork Slate Creek are within EPA standards (Table 5.2). If all best management practices (BMPs) recommended by EPA are implemented - such as reverse osmosis treatment of effluent from the tailings storage facility in Lower Slate Lake throughout the life of the project or other suitable tailings water treatments, followed by proper closure and reclamation (such as capping) of the tailings storage facility upon termination of the project - the aquatic discharges into Slate Creek and Slate Creek Cove should not reach concentrations that are unsafe for marine mammals. However, the trace quantities of heavy metals discharged regularly from Lower Slate Lake into Slate Creek Cove over the life of the project could elevate heavy metal concentrations in the estuary. Slate Creek Cove is a protected abayment that is not well-flushed. Thus, any elevated concentrations of heavy metals might remain in the water column for extended periods or precipitate out and accumulate in sediments. Regular monitoring of water quality and heavy metal concentrations in the sediments and tissues of resident organisms (ie. shellfish) at the mouth of Slate Creek will help ensure the efficacy of the applicant's mitigation measures.

Table 5.2. Anticipated untreated water quality from the proposed tailing storage facility (TSF) in East Fork Slate Creek based on water quality modeling by EPA (EPA draft NPDES Permit 2004).

Projected Untreated TSF Water Quality				
Parameter	Units	Projected TSF Discharge		
		Minimum	Mean	Maximum
Aluminum	ug/L	see below	see below	see below
Ammonia	mg/L	0.128	0.57	0.7
Arsenic	ug/L	0.59	0.82	0.9
Cadmium	ug/L	0.0056	0.025	0.031
Chromium	ug/L	0.94	2.0	2.3
Copper	ug/L	0.68	1.7	1.9
Iron	ug/L	400	760	900
Lead	ug/L	0.12	0.55	0.67
Mercury	ug/L	0.002	0.01	0.01
Nickel	ug/L	0.97	1.8	2.1
Nitrate	ug/L	<10[a]	<10[a]	<10[a]
pH	s.u.	6.5 – 8.5		
Selenium	ug/L	0.13	0.59	0.71
Silver	ug/L	0.02	0.02	0.02
Sulfate	ug/L	24	98	118
TSS	mg/L	see below	see below	see below
TDS	mg/L	114	218	246
Zinc	ug/L	2.8	11	13
a - Values assume continued implementation of the explosives BMP Plan				

5.6.9 Summary of the Direct Effects of the Proposed Action on Listed Species

In the preceding response analyses, we have examined acute, chronic, or latent reactions that may be exhibited by Steller sea lions and humpback whales likely to be exposed to the direct effects of the action (i.e. noise, vessel traffic, discharge, and risk of petroleum exposure). Here we summarize these responses and their predicted impacts to listed species.

Based on characteristic vessel noise signatures from Richardson et al. (1995), we expect that listed species and their prey may be exposed intermittently to in-water source levels of noise from vessel activity ranging from 145 dB to 180 dB re 1 µPa @ 1m. In-water construction noise levels are expected to range from 98 to 113 dBA re 1 µPa @ 1m as perceived at 50 ft. As noted, individual sea lions and humpback whales have a low likelihood of constant exposure to noise and vessel traffic associated with construction activity and ferry, barge and tug operations because it is unlikely that they remain resident in the bay for extended periods of time (i.e. several months), and much of construction activity will be conducted when fewer animals are in the bay (1 July through 15 March). As the level for temporary threshold shift (TTS) has been established at 180 dB for marine mammals (NMFS 2005), it is possible that TTS may occur in listed species as a result of exposure to the louder sounds associated with the proposed action. This is a reversible condition, however, and the duration and intensity of effect would not be sufficient to cause injury or mortality to individuals.

Sea lions are accustomed to vessel traffic and its associated noise, as it is a component of their habitat throughout their range. Thus, they are adept at avoiding vessels and are unlikely to be struck by a vessel transiting through Berners Bay. Based on numerous records of collision, however, humpback whales do not appear to avoid vessels as successfully as sea lions. Crew shuttle, barge and tug transits in Berners Bay pose a higher risk of collision for humpback whales than those posed by baseline conditions**.** The risk of vessel collision is likely to be higher during April and May when whales use Berners Bay to forage on herring and eulachon, but the reduction in transits across the bay and a slower operating speed should reduce the likelihood of collisions. Throughout the remainder of the year, the chance of collision is likely to be lower given the limited usage of the action area. Population level consequences are not predicted for either listed species as a result of the increased vessel noise or traffic with respect to Kensington Gold Project operations.

We expect the proposed action to increase disturbance to humpback whales and Steller sea lions. Research has shown that humpback whales have exhibited behavioral changes in the presence of vessels, including greater variability in the number of blows per surfacing, increased dive intervals, and changes in swim speed, pod composition, and direction of travel. Steller sea lions cooperatively feeding in Berners Bay may be disrupted by passing vessels, possibly resulting in fewer successful foraging attempts by individuals. Such behavioral alterations in the presence of the crew shuttle, barges, or tugs may result in an individually incurred energetic cost, and may even cause individuals to leave the action area if sufficiently disturbed. Displacement may adversely affect individual animals by requiring additional energy investment to forage elsewhere, and thus may translate into the reduced fitness of an individual. However, the effect of such displacement, if it were to occur, is not expected to be of a magnitude to impact a significant portion of the population of any of the three listed species using the action area. Although individual humpback whales and Steller sea lions may be disturbed or otherwise adversely affected by the direct effects of the action, the recovery or survival of these species would not be compromised.

Direct and indirect exposure of the Berners Bay environment to petroleum products may occur through the course of normal vessel operations or accidental spills. As discussed in Section 5.6.7, petroleum components can be highly toxic and pose risks to individual humpback whales and Steller sea lions that come in direct or indirect contact with the contaminant. However, based on the information we have available, we do not anticipate that normal operations will create petroleum concentrations sufficient to affect long-term fitness of individual Steller sea lions or humpback whales. In the event of a large petroleum spill, however, listed species could be directly harmed by petroleum exposure, resulting in loss of fitness. In addition, chronic small petroleum spills or large-scale spills pose indirect risks to marine mammals through exposure and bioaccumulation via contaminated prey. This indirect exposure may result in adverse consequences to individual humpback whales and Steller sea lions (see Section 5.7.5 for further discussion of hydrocarbon effects to marine mammal prey base). However, this exposure would not be expected to have a population-level effect for either listed species, nor compromise their survival and recovery.

If heavy metals biomagnify through the food chain, chronic exposure may cause developmental abnormalities and impaired reproductive and immune function in marine mammals. However, if heavy metal concentrations and water quality levels are consistent with those projected under EPA's NPDES draft permit, discharge from the tailings storage facility into Slate Creek and Slate Creek Cove are not expected to reach unsafe levels for marine mammals. Thus, we do not predict fitness level consequences to listed species.

5.7 Response Analyses of Indirect Effects of the Proposed Action

The preceding narratives describe the probable *direct* effects of the Kensington Gold Project on the action area and the responses of listed species to those effects. The narratives contained in this section of the Opinion identify the *indirect* effects of the proposed action that will primarily result from alterations of the prey base in Berners Bay on listed species. As before, these analyses first describe the response of prey species to the proposed action. We follow this by identifying the listed species that are likely to be affected by these indirect effects and the nature of those effects (these represent our *exposure analyses*). Then we determine how those listed resources are likely to respond given their exposure (these represent our *response analyses*).

5.7.1 Exposure of Marine Mammal Prey to the Proposed Action

Several species of prey of Steller sea lions and humpback whales occur in the action area throughout the year. These species include: Pacific herring, eulachon, capelin, walleye pollock and salmonids. Pacific herring, eulachon, capelin, and juvenile salmonids are found year-round in the nearshore habitats of Berners Bay. Schools of adult eulachon and Pacific herring use the bay in large concentrations (hundreds to thousands of tons) during the early to mid-spring spawning aggregations. Because the remnant Lynn Canal Pacific herring stock spawns only in and around Berners Bay, the shorelines provide important habitat for this species during egg and larval life stages in spring and early summer. Adult salmonids also use the bay prior to their spawning migration into surrounding rivers and streams in the watershed. Thus, some number of prey individuals will likely be exposed to construction and operation activities year round, both at the marine terminal sites and along the vessel paths.

The proposed crew shuttle route across the bay, an almost straight line from Cascade Point to the Slate Creek Cove terminal site, will take the ferry directly through areas where large schools of eulachon and herring are known to aggregate prior to spawning in March and April. Individual adult herring and eulachon schools are likely to be exposed to vessel activities repeatedly throughout the spring months as the schools stage along the shoreline near Slate Creek Cove and Cascade Point in preparation for spawning. In addition, many individuals of the different prey species are likely to be exposed repeatedly to some form of disturbance, whether from boat noise, boat wake, or changes in water quality and habitat in and around the marine terminals (Table 5.3).

Table 5.3. Seasonal Variability in Impacts of Disturbance on Prey Species' Fitness

Life Stage	Prey Species	Timing of Exposure	Source of Disturbance	Impacts of Disturbance
Eggs	Herring, capelin	Spring	Vessel Activity – vessel wake; fuel spills; Marine Terminals – habitat alteration (changes in wave energy, beach morphology, sedimentation patterns, substrate); contaminant runoff	Decreased probability of survival; increased probability of developmental deformities; reduced individual/population fitness
Larvae	Herring, eulachon, capelin	Spring/ Summer	Vessel Activity – vessel wake; vessel noise; fuel spills Marine Terminals – habitat alteration (impacts on temperature, salinity, turbidity, water quality); contaminant runoff	Decreased probability of survival; reduced individual/population fitness
Juveniles	Herring, eulachon, capelin, salmonids	Year-round	Vessel Activity – vessel wake; vessel noise and visual disturbance; fuel leakage and fuel spills Marine Terminals – habitat alteration (changes in wave energy, beach morphology, sedimentation patterns, substrate); contaminant runoff	Short-term alteration of schooling behavior; changes in prey distribution and availability; docks may provide increased shelter/cover for both juveniles and their predators; potential impacts and fitness
Adults	Herring, eulachon, capelin, salmonids, pollock	Spring	Vessel Activity – vessel wake; vessel noise and visual disturbance; fuel leakage and fuel spills Marine Terminals – degradation and loss of known spawning habitat, alteration of spawning site access along the shoreline	Short-term alteration of schooling behavior; changes in prey distribution and availability; Reduced energy budgets during critical pre-spawning aggregations→ reductions in individual fitness; Loss of spawning habitat

5.7.2 Responses of Marine Mammal Prey to Vessel Activity

Acute and chronic effects of increased vessel activity on prey species' behavior

Researchers have definitively documented that schooling fish demonstrate avoidance reactions to vessel traffic (Olsen 1971, Soria et al. 1996, Pitcher et al. 1996), with active avoidance of the vessel occurring at a range of 150 meters, or approximately 500 feet away (Pitcher et al. 1996). Lateral avoidance behavior, where schools of fish shift away from the source and direction of the disturbance, is typically triggered by vessel noise. The distance at which disturbance will occur is dependent on the alarm hearing threshold of the fish, their flight speed, environmental conditions such as turbidity and temperature, and the amount of perceived disturbance (i.e., noise, boat wake) produced by the vessel (Soria et al. 1996, Mitson and Knudsen 2003). Vertical avoidance behavior by herring and capelin schools has also been well documented (Pitcher et al. 1996, Soria et al. 1996, Vabρ et al. 2002), with evidence that rapid approach (speed greater than 10 knots) by research vessels invokes a similar response to that of fast-moving, schooling predators, both of which can cause herring to dive steeply and display predator avoidance behaviors such as dispersal or alterations in the shape and density of the school. A vertical avoidance response is often the result of visual triggers or a combination of gradually increasing noise and visual disturbances as the vessel approaches (Soria et al. 1996). Consequent losses of feeding time and the energy spent shifting, diving and reassembling the schools are real biological costs for evading these perceived dangers (Pitcher et al. 1996).

With the increase in vessel traffic in Berners Bay associated with the proposed action, particularly near remnant core spawning habitat, it is likely that schools of herring will be impacted by the increased noise and wake associated with vessels transporting crews and supplies across the bay. Risks of disturbance are expected to be highest during the spring because at the end of winter adult herring move into the shallow, nearshore environment (Norcross et al. 2001). Herring essentially do not feed while overwintering, and their energy resources are directed toward reproductive processes during this critical period in their life cycle. Energy required to avoid vessels, in addition to that expended in avoiding actual predators, may be diverted away from reproductive functions and could reduce both survival and fecundity of pre-spawning adult fish. Because herring often stage in the nearshore habitat for several weeks prior to spawning (Carlson 1980), they are likely to be in close proximity to vessels, particularly near Cascade Point, Slate Creek Cove, and the deepwater canyon running through the center of Berners Bay.

Cascade Point is a documented herring spawning area, with spawn occurring at the site in 8 of the past 33 years, or 24% of the time (M. Pritchett, pers. comm.). Herring also spawned just north of Cascade Point and South of Sawmill Cove in 10 years during that time period, which is 30% of the time (M. Pritchett, pers. comm.). Thus in any given year the estimated probability that herring will spawn at or near Cascade Point is slightly greater than 50%. Because the proposed crew shuttle route to service the Kensington mine runs from Cascade Point northward to Slate Creek Cove, the vessels will be traveling along or through this spawning corridor, with the potential to disturb herring schools just prior to or during spawning, on an annual basis.

Eulachon, capelin and herring also use the intertidal habitats at and around Cascade Point and Slate Creek Cove as nursery habitat during their larval and juvenile life stages. Their presence has been documented throughout the year in Berners Bay (J. Vollenweider, pers. comm.), and juveniles of all three species plus salmon smolts have been captured at Cascade Point during summer sampling (Harris et al. 2005). Juvenile osmerids (eulachon and capelin) and herring have been sampled by hydroacoustic trawling and pelagic trawling near Slate Creek Cove during the winters of 2003 and in December of 2004 (Sigler et al. unpublished data). Therefore, it is likely that these prey species utilize Cascade Point and Slate Creek Cove habitats year-round during different life stages.

Availability of high quality, undisturbed habitat and food resources are critical to survival during the early life stages of fish. For example, herring larvae have extremely high mortality rates, which can exceed

99% (ADF&G 1985). These mortalities are attributable to predation, environmental stresses during egg incubation and after hatching, and food availability (ADF&G 1985). Therefore, it is the larval stage that determines the strength and abundance of each given year-class of herring (Hourston and Haegele 1980). With already low survival rates under natural conditions, it is likely that herring survival rates will be even lower when spawning and larval rearing habitats are degraded around the two proposed marine facilities due to changes in water quality, sedimentation, hydrology, noise, and other anthropogenic disturbances during construction and operation of the proposed action.

At the Cascade Point facility and in the path of transiting vessels, increased stress and energy diverted to avoidance behaviors are the most likely adverse effects of vessel noise, wake, and visual disturbances to fish. Over the long term, if dock use increases in association with planned commercial, tourism and residential development of Echo Cove, then the cumulative effects of the increased noise and vessel traffic may cause juvenile schooling fish like herring and eulachon to abandon the habitat around Cascade Point. Increased vessel activity during spring months may also cause adult herring to avoid their remnant spawning grounds near Cascade Point, similar to how these fish have abandoned their traditional spawning grounds in Auke Bay coincident with increased shoreline development activities and vessel traffic (Williams et al. 2004).

Temporal Variability in Disturbance of Prey

Throughout the year, herring schools often follow a diel vertical migration pattern, spending daylight hours near the sea floor, then moving upward through the water column during the evening to feed (ADF&G 1994). Therefore, boat noise and boat wake are more likely to disrupt or adversely affect herring behavior in the evening, when natural behavioral patterns move them closer to the surface and therefore closer to the source of disturbance (Thomas and Thorne 2001).

Steller sea lions have been observed following a similar diel pattern of foraging, with deeper foraging dives during the day and shallower dives at night (Thomas and Thorne 2001), presumably to maximize prey encounters and optimize foraging efforts. Because the prey stays closer to the surface in the evening, the marine mammals are foraging at shallower depths in the evening. Therefore, any boat disturbance that disrupts and alters prey behavior may also affect Steller sea lion foraging success.

Limited research has shown that schooling fish typically exhibit short-term responses to vessel disturbance, with changes in behavior diminishing within a few minutes after the removal of the stimulus (Olsen 1971, Pitcher et al. 1996). Long-term or learned avoidance responses to vessels have not been documented, which suggests that vessels transiting Berners Bay may not cause schooling herring to abandon nearshore habitats in the bay. However, the vessel traffic for the Kensington Gold Project will introduce additional hours of potential disturbance daily to schooling fish and their predators, possibly disrupting Steller sea lion and humpback whale foraging and causing increased expenditures of energy by both predators and prey.

5.7.3 Responses of Marine Mammal Prey to Noise

Fish are able to detect and respond to a wide variety of sounds. Species differ in the range of frequencies, or bandwidth, and in the threshold sound pressure levels they are able to detect. Many behavioral and physiological investigations of fish hearing show that a number of species, and perhaps all, have the same basic acoustic capabilities as other vertebrates, including mammals (Popper et al. 2003, Ladich and

Popper 2004). The addition of human-generated sounds to the background noise of a fish's environment can make that environment so loud that fish are not able to detect important signals such as those indicating presence of predators (Hasting and Popper 2005). Fish can be divided into two groups – hearing generalists and hearing specialists. Herring fit into the latter group, and their greater hearing capability is due to specialized extensions of the swim bladder that enters the cranial capsule and lies close to the inner ear (Moyle and Cech 1988). This adaptation allows herring to detect and respond to signals up to 4000 Hz with thresholds that are 20dB lower than fish with general hearing capability and is thought important for schooling behavior and detecting predators and other hazards (Whitehead 1985). This sensitive hearing capability also makes herring more vulnerable to interference from anthropogenic noise sources due to its increased dependence on sound detection as a means of avoiding predation.

5.7.4 Responses of Marine Mammal Prey to Proposed Dock Facilities

Cascade Point Marine Facility

According to the BA/BE, the footprint of the marine facility at Cascade Point will be approximately 2.7 acres, which includes the breakwater, docks, boat ramp and gangways. Because the life of the Kensington Gold Project is a minimum of ten years, and Goldbelt, Inc. has applied for a 25-year tideland lease from the State of Alaska (ADNR 2004), NMFS anticipates that the construction of this marine facility will cause long-term or permanent alteration of the site. The intertidal zone of Cascade Point is characterized by a diverse intertidal and subtidal assemblage of macrophytes (kelps), invertebrates and fish species (USFWS 1998, Stekoll 1999, NMFS 2004, Harris et al. 2005). It is also a documented spawning site for the Lynn Canal herring stock (M. Pritchett, pers. comm.) and a documented rearing site for chum and coho salmon fry, juvenile Pacific herring, walleye pollock, Pacific cod, and multiple species of sculpin (Harris et al. 2005). Therefore, it is important for NMFS to consider the effects that the development of a marine facility will have on these marine mammal prey resources.

The construction of the proposed facility will permanently alter hydrology at the site, affecting wave action, tidal flushing and lateral flows of currents along the shoreline at the site. Effects of the breakwater may include: reduced sediment flushing; reduced sediment transport along the shoreline on either side of the breakwater; changes in sediment deposition at the site and along the shore; reduced flushing of contaminant and nutrient runoff; changes in turbidity; and localized changes in temperature and salinity. Many of these conditions are likely to decrease the suitability of the site for large-bladed kelp species (M. Stekoll, pers. comm.) and their associated community assemblages. In addition, vessel activity at the dock and around the facility may also cause increased turbidity in shallow waters, uproot and displace aquatic macrophytes (kelp) and cause behavioral disturbance of fish, as discussed in Section 5.7.2.

The long-term presence of docks and vessels at the facility will likely alter the composition and structure of the vegetative community at Cascade Point. Specifically, the dredging of the intertidal zone and construction of the breakwater will result in the loss of approximately 350 linear feet of kelp habitat (USFS 2004a), or approximately one acre. The presence of shade created by vessels, the breakwater, and the docks will further impact submerged vegetation by reducing the availability of light. Increased shading of the intertidal zone will reduce the available light for phytoplankton, macrophytes, and other submerged aquatic vegetation that are important resources for juvenile fish including spawning and rearing herring.

Overall, the combined changes in site hydrology, local water conditions and light availability are likely to change the structure and composition of the submerged vegetative community at Cascade Point. Changes in the plant community may in turn affect the likelihood of utilization by spawning and rearing herring and other forage fish and adversely affect spawning success at and near the site.

The applicant has suggested that the breakwater will provide surrogate substrate for the colonization of the diverse kelp community that is degraded or lost on-site, based on research conducted on an artificial reef in Puget Sound (Wyllie-Echeverria et al. 2003). However, several key differences exist between the design of a breakwater and an artificial reef (T. Wyllie-Echeverria, pers. comm.). A breakwater sits partially above the water's surface and is exposed to wave action, whereas the reef was fully submerged and did not significantly alter local site hydrology. In addition, the artificial reef was designed to enhance and restore habitat, while a breakwater is designed to alter nearshore hydrology to support marina facilities. Despite the apparent success in colonization noted during the first two years of follow-up monitoring of the artificial reef, researchers found that the extent of colonization declined in subsequent years (T. Wyllie-Echeverria, pers. comm.).

It is possible that an intertidal suite of species would establish on the seaward portions of the seawall (T. Wyllie-Echeverria, pers comm., M. Stekoll, pers comm.), with colonization by species such as *Fucus gardneri*, *Alaria marginata* or other macroalgaes that are already present along the shoreline elsewhere in the bay. If conditions are adequate, there may also be colonization by *Laminaria* spp., *Nereocystis* or *Desmarestia* spp. The likelihood of successful colonization of the breakwater by macroalgaes is dependent on a number of factors, including hydrologic conditions, size, shape and treatment of materials used in constructing the breakwall, substrate composition and grazing pressures (M. Stekoll, pers. comm.).

Ideally, if the rate and degree of flushing along the outside of the breakwater are consistent with conditions along the shoreline to the north, then the hydrologic conditions should be adequate to allow colonization of the breakwater by species capable of supporting successful herring spawn. Because many macrophytes require well-flushed site conditions but the amount of flushing will be much lower on the inside (southeastern), submerged portion of the breakwater, it is unlikely that section will be suitable for kelp colonization. Some macroalgae species like *Laminaria saccharina* and *Nereocystis luetkeana* are highly sensitive to pollution by petroleum products (Antrim et al. 1995, O'Clair et al.1996), so vessel leaks or spills near the breakwater and marine facility may also affect the rate of colonization and persistence of those species.

If water quality and hydrology are adequate for colonization by macroalgaes, then substrate composition may be the greatest limiting factor in colonization success. Perennial algaes such as *Laminaria* spp. require moderate-sized rock substrates that provide sufficient surface complexity and stability for the algae to attach and develop a holdfast (M. Stekoll, pers comm.). Because breakwaters are designed to alter the natural hydrologic regime and minimize wave action along the shoreline, enhancement of marine habitats or mitigation of habitat loss are not typical design considerations. For example, a structure designed with a moderate slope and intermixed small and large rock substrate would better simulate the natural conditions of the nearshore environment, and the attention to surface complexity in breakwater design could encourage colonization (M. Stekoll, pers. comm.). If the breakwater proposed for Cascade Point is designed to include these parameters, the structure will improve the likelihood of colonization and mitigation of habitat loss. Long-term, scientific monitoring of kelp colonization and finfish utilization would enable the applicant and action agencies to assess the efficacy of the breakwater as

surrogate intertidal and subtidal habitat for marine mammal prey resources.
If the breakwater does not mitigate for the loss of Cascade Point intertidal habitat, the development of this site would result in a permanent loss of at least one acre of spawning habitat for Lynn Canal herring. In addition, spawning habitats adjacent to Cascade Point will likely be impacted by habitat alteration and degradation. These losses of spawning habitat may impact spawning production and herring biomass in Berners Bay and Lynn Canal. Although it is possible that the herring would shift elsewhere to spawn, there is no documented instance where dislocated spawners have shifted to a new spawning location (Trumble 1983). Additionally, Pacific herring often exhibit homing behavior, with some herring returning to the same spawning grounds year after year, though some may change spawning areas between years (Hay et al. 2001). Therefore, herring that are dislocated from the Cascade Point spawning site might seek out suitable habitat elsewhere in the bay, or they may attempt to spawn on the breakwater or within the degraded Cascade Point terminal site. Without sufficient information on herring behavior and their ability to adjust to changes in spawning habitat, it is impossible to predict with certainty how their behavior will be modified. The extent to which the loss of current spawning habitat at Cascade Point might cause additional population-level declines in herring biomass is also unknown but the possibility of such impacts should not be discounted.

Slate Creek Cove Marine Facility

The proposed location for the Slate Creek Cove marine terminal provides overwintering and year-round rearing habitat for juveniles of several prey species, including capelin, eulachon, herring, and salmon (J. Vollenweider, pers. comm.) The intertidal and subtidal habitats of Slate Creek Cove also provide foraging habitat for outmigrating juvenile salmonids and larval eulachon, and adult pre-spawner eulachon and herring school in the deep waters near Slate Creek Cove during early April prior to moving into their spawning habitats (A. Eller pers. comm.). Although the construction of the proposed Slate Creek Cove facility will require less habitat alteration than the Cascade Point facility, we expect that it will modify nearshore habitat at the site and pose similar risks to marine mammal prey resources, particularly during the juvenile lifestage of forage fish species. Specifically, the construction of the proposed dock facility will alter shoreline and intertidal hydrology at the site, with the potential to affect wave action and flushing along the shoreline, though without a breakwater, the structures at this facility are expected to have less impact on such site characteristics than the proposed Cascade Point facility and breakwater.

Once the facility is constructed, vessel activity at the dock and around the facility may cause increased turbidity, noise and behavioral disturbance of fish, as well as increased risk of exposure to petroleum spills and chronic hydrocarbon contamination. Vessel movements to and from the Slate Creek marine terminal may also temporarily or chronically disturb these prey resources, increasing stress in individuals and reducing individual prey fitness. Overall, the adverse affects of the proposed Slate Creek Cove marine terminal are not likely to be as great as at Cascade Point because the facility would be sited on a steeply sloping shore with limited intertidal habitat and no known forage fish spawning habitat.

5.7.5 Responses of Marine Mammal Prey to Petroleum Spills and Leakage

Hydrocarbon contamination from petroleum pollution has long been recognized as one of the most potentially harmful categories of pollution to marine biota (Martin and Richardson 1991). Increased boating activity increases the probability that either acute or chronic hydrocarbon contamination will occur. Although small spills may seem inconsequential, cumulatively they can cause significant damage to the marine environment. As noted in Section 5.6.7, petroleum products are toxic and contain organic chemicals such as polycyclic aromatic hydrocarbons (PAHs) and heavy metals. Diesel fuel has more than 100 hydrocarbon compounds that harm fish larvae, shellfish and other marine organisms. Leaking of hydrocarbon products from vessels, fuel spills and storage structures is a threat to both spawning adults and developing herring larvae. Very low concentrations of PAHs are known to induce significant adverse effects on fishes including Pacific herring (Carls et al. 1999). Fish eggs and embryos are particularly sensitive to low levels of PAHs due to their high content of lipids that can accumulate PAHs from the water column. Although developing herring embryos are capable of metabolizing some PAHs, these resulting metabolites themselves have been observed to cause a variety of lethal anomalies in developing embryos such as cardiac edema (Incardona et al. 2004).

Chronic discharges of diesel and other fuels from boats during docking, idling, and refueling at the Cascade Point and Slate Creek Cove marine terminals are likely to create elevated concentrations of hydrocarbons and heavy metals in the water column and sediments in the vicinity of those facilities (McMahon 1989, McGee et al. 1995). In addition, the breakwater at the Cascade Point facility will reduce the rate of hydrologic flushing in and around the facility by reducing wave action and currents that would otherwise occur at this site. With reduced rates of flushing and frequent small petroleum releases from fueling activities and idling boats at Cascade Point, it is likely that hydrocarbon concentrations in the water column and sediments near the terminal will be greater than in other parts of the bay. Therefore, it is probable that developing herring eggs and larvae near the Cascade Point marine terminal will be exposed to elevated levels of PAHs. Chronic poisoning of herring can result from these regular, low level inputs of hydrocarbons. This exposure may have detrimental affects to individual herring and the Lynn Canal population as a whole.

A single spill during the critical spawning/incubation/larval rearing period could result in mortality and developmental deformities in large numbers of herring along the shoreline of Berners Bay. A significant petroleum spill in the wrong place at the wrong time is damaging, as demonstrated by the impacts of the Exxon Valdez spill on Pacific herring embryos in Prince William Sound (Carls et al. 2002).

In addition to supporting spawning and developing herring embryos, Berners Bay appears to be a very important nursery area for larval and young-of-the-year herring, capelin and eulachon (M. Sigler, pers. comm., A. Eller, pers. comm.). Recent survey work completed by NMFS' Auke Bay Laboratory has identified large dense schools of juvenile osmerids (capelin and eulachon) and herring located at depths of 50 to 70 meters between Point Saint Mary and Slate Creek Cove in Berners Bay during winter surveys. Additional work by Andrew Eller, UAS, has found juvenile eulachon overwintering near Slate Creek Cove, where these fish are likely to imprint for their return to the rivers of Berners Bay to spawn as adults. Through underwater camera tow surveys at Sawmill Cove, NMFS (2004) also documented the presence of a school of juvenile herring. These young fish are also vulnerable to the toxic effects of PAHs and heavy metals found in petroleum products.

5.7.6 Summary of the Proposed Action on Prey Species

The Kensington Gold Project has the potential to adversely affect marine mammal prey in the following ways: 1) construction of the marine facilities may degrade or destroy *rearing* habitat; 2) construction of the marine facility at Cascade Point may degrade or destroy *spawning* habitat; 3) the breakwater and boat traffic near the Cascade Point facility may degrade adjacent herring spawning habitat; 4) vessel traffic, noise, and changes in shoreline structure and intertidal habitat may alter the behavior of schooling adult fish and rearing juveniles in Berners Bay; 5) disturbance may increase individual stress and fitness; 6) in-water structures and boat traffic may alter shoreline migration patterns, shifting the fish into areas where predation risks are greater (i.e., schooling along the edge of the breakwater, where fewer escape routes are available); 7) vessel fuel leakage, contaminant spills, pollutant runoff and increased shoreline development of the Bay may impair water quality, particularly in areas where vessel activity and development are concentrated. Such impacts may happen alone or in tandem with other impacts. The overall effect of these stressors on prey resources depends on the frequency, magnitude, duration, and timing of disturbance. The extent of impacts on prey will also depend on the sensitivity of individual species and different lifestages and whether the impacts occur alone or affect the animals as a suite of multiple stressors.

If the loss and degradation of habitats are compounded by additional stressors such as increased disturbance during larval and juvenile development, exposure to hydrocarbons and other contaminants or increased predation, the adverse effects to individual eulachon, capelin, salmon, pollock or other prey species may be extended out to the population level, affecting fitness and population dynamics in the Bay.

NMFS is concerned that the Lynn Canal herring stock is particularly susceptible to adverse impacts from the Kensington Gold Project because of the current condition of the population, its life history and its reliance on Berners Bay during all lifestages, particularly during spawning and larval development. As discussed in Section 4.3.1, the Lynn Canal herring population is a keystone species in the marine ecosystem of Lynn Canal. Herring are an integral component of the food web and are consumed by a wide variety of vertebrate species at different trophic levels. The Lynn Canal herring population is an important, year-round prey resource for Steller sea lions, humpback whales and other marine mammals that utilize Lynn Canal habitats. Specifically, this population supports the Steller sea lions that haulout and forage around Benjamin Island, Gran Point and Met Point. The herring are also consumed by sea lions foraging in Auke Bay during the winter months and in Berners Bay during the spring. The humpback whales commonly seen around North Pass, Shelter Island and Berners Bay feed on Lynn Canal herring and this forage fish is an important component of their diet throughout the year. Herring are also preyed upon by other fish species – during the larval and juvenile life stages, they are consumed by salmon, pollock, and other nearshore fish, which are also marine mammal prey resources. Further declines in the herring population could have cascading effects on the Lynn Canal food web, with affects on the fitness of other fish, marine mammals, and seabirds.

5.7.7 Summary of the Indirect Effects of the Proposed Action on Listed Species

Feeding in the productive waters of Alaska (including the action area) represents a critical component in the life history of humpback whales and Steller sea lions. Although not limited to southeast Alaska or the action area, humpback whales and Steller sea lions return annually to specific feeding locations in southeast Alaska such as Frederick Sound, Chatham Strait, North Pass, Sitka Sound, Glacier Bay, Point

Adolphus, and Lynn Canal, as well as other coastal areas because they provide seasonally abundant, predictable food resources. As mentioned in the previous sections, construction of two docks, a breakwater and other structures and activities associated with the proposed action may alter the availability and abundance of humpback whale and Steller sea lion prey in the action area.

Nutritional stress, due to competition with commercial fisheries and simultaneous natural changes to the prey base, has been considered as a factor in the decline of the western Steller sea lion population. Adult females had lower reproduction and pups were smaller in the 1980s compared to the 1970s, possibly due to a reduction in their food supply (Pitcher and Calkins 1982). However, the changes in the prey base were range-wide and therefore animals did not have access to other prey resources within their foraging range. It is possible that listed species may experience nutritional stress if the prey in Berners Bay was reduced or unavailable because individual sea lions or whales may be forced to expend more energy in foraging efforts for the same amount of prey captured, or may have to travel to new areas to feed. These behavioral changes would require n energetic cost and if substantial, could impact the energy available for reproduction or other biologically important activities. As a result, long-term negative effects to individuals from the proposed action may occur that might not be detectable from short-term studies. Therefore, as noted previously, it should not be assumed that the regular presence of animals in an area is an indication that the activities in the area have no negative impact on individuals.

However, because the prey in Berners Bay is primarily an ephemeral prey resource, it is more likely that sea lions and humpback whales would compensate for a change in the prey base in Berners Bay by traveling to other nearby foraging areas in southeast Alaska rather than suffer the consequences of reduced food intake. The increasing eastern population of Steller sea lions in southeast Alaska suggests that there is prey available for this species throughout the foraging range. Thus, NMFS believes that, although individual sea lions may experience a reduction in fitness due to a change in the prey base in Berners Bay from the proposed action, it is unlikely that changes in the prey base, whether temporary or permanent, would adversely affect the viability of the eastern population. Likewise, although individual humpback whales could experience a reduction in fitness, population level consequences are not expected for the Central North Pacific population.

5.8 Effects of the Action on Listed Species' Critical Habitat

As there is no critical habitat designated within or near the action area for the western population of Steller sea lions, we have not conducted a critical habitat analysis for this species with respect to the proposed action. Critical habitat has not been designated for humpback whales anywhere throughout their range; therefore, none will be affected.

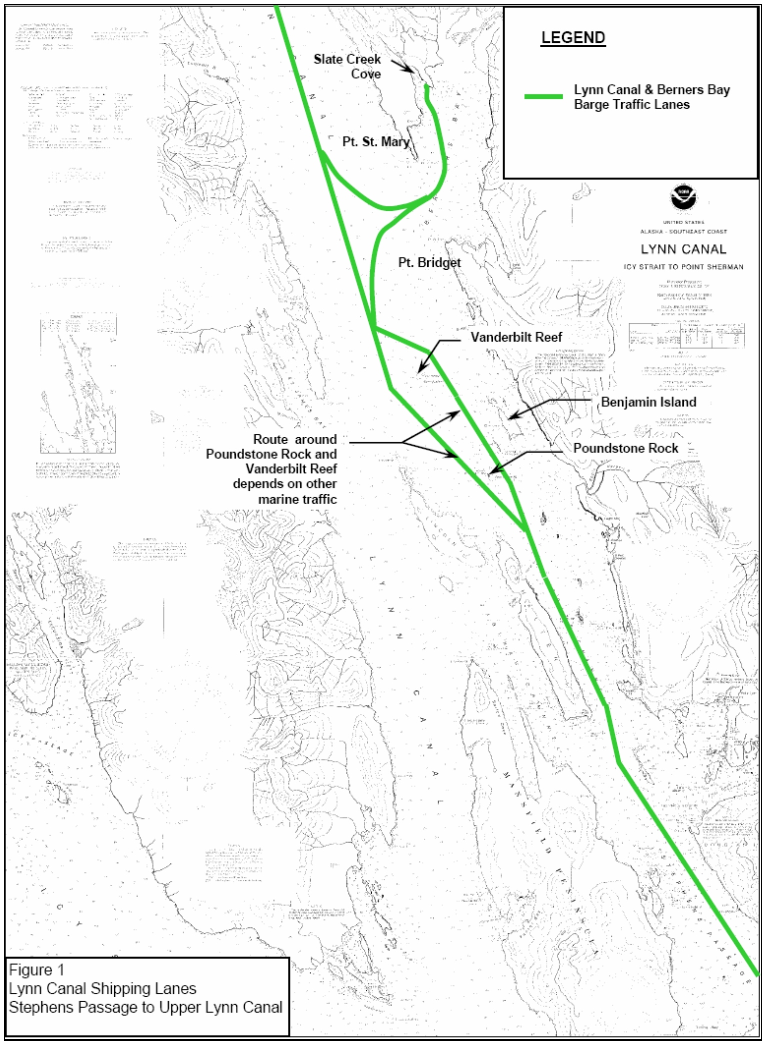
We have analyzed the habitat variables that give the designated critical habitat for the eastern population of Steller sea lions its conservation value. Both terrestrial and marine components of habitat are crucial to these animals for reproduction, socializing, and foraging activities. All of their reproductive and many of their social activities occur on land, but all feeding occurs at sea. Shoreline, offshore rock, and cliff areas chosen by sea lions offer refuge from terrestrial predators, and suitable substrate for reproductive activities (pupping, nursing, mating) and resting. They also provide some measure of protection from the elements and are in close proximity to prey resources. Marine foraging habitat around rookeries and haulouts is important to lactating females throughout the year because they feed within 20 nm of these areas while caring for their pups. The areas are also important to pups and juveniles that have not yet developed the physiological capabilities to travel long distances in search of food.

Although critical habitat for the eastern population of Steller sea lions has not been designated in Berners Bay, we have considered the impacts of activities associated with the proposed action to critical habitat at Benjamin Island and Gran Point, in close proximity to Berners Bay. Benjamin Island is located 14 nm south of the mouth of Berners Bay and is a primary hauling site for animals foraging in Berners Bay. Gran Point lies at the north end of Lynn Canal, approximately 27 nm from Berners Bay. All direct operations associated with the proposed action are contained in Berners Bay, except for barge traffic, which will traverse Lynn Canal. From the BA/BE and the SEIS, it is estimated that barge traffic servicing the Kensington mine will include 4-5 barges per month transporting ore and 4 barges per week transporting fuel and supplies. The proposed routes for the barges will pass by Benjamin Island as they travel north and southbound in designated shipping lanes in Lynn Canal; they will not pass near Gran Point (Figure 5.3).

As noted in Section 2.1.2, the number of islands and reefs in Lynn Canal south of Point Bridget cause local barge providers to follow a very strict route in Lower Lynn Canal. Once past Auke Bay, barges travel between Point Lena and Shelter Island. Depending on the amount of other marine traffic in the area, the barges pass either between Sentinel Island and Poundstone Rock or between Lincoln Island and Poundstone Rock. From there, they sail mid-channel between Poundstone Rock and Lincoln Island. Once past Vanderbilt Reef, it is a mid channel passage to Upper Lynn Canal north of Berners Bay. This route puts the barge traffic a minimum 1.4 miles west of Benjamin Island. Because the barge traffic will be using designated shipping lanes while passing Benjamin Island in Lynn Canal, it is unlikely that this aspect of the proposed action would affect Steller sea lion critical habitat at this location or Gran Point. Under normal operating conditions, barge traffic is not expected to reduce the habitat value of critical habitat (i.e., disrupt breeding, foraging, or nursing activities; increase predation; reduce access to prey).

However, a fuel spill or leakage near Steller sea lion critical habitat could result in impact to the quality of the habitat. Such an event could affect Steller sea lion critical habitat at Benjamin Island and Gran Point by fouling terrestrial habitat and/or by contaminating foraging habitat. Similarly, a large fuel spill in Berners Bay could also negatively affect critical habitat through transport of contaminants by current patterns out of the bay into Lynn Canal. However, under normal operating conditions such events are not expected to occur in association with the proposed action, but rather as the consequence of an accident or catastrophic event. NMFS expects that the applicant will follow the Spill Response Plan and Best Management Practices Plan in the BA/BE, which will minimize the likelihood of a spill that would adversely affect Steller sea lion critical habitat in Lynn Canal. As a result, NMFS does not expect the proposed action to reduce the conservation value of critical habitat.

Figure 5.3. Barge transport routes in Lynn Canal. (L. Russell, pers. comm.)



5.9 Effects of Industrial Development of the Action Area

Our response analyses have examined the effects of the marine components of the Kensington Gold Project to Steller sea lions and humpback whales using the action area. In preceding and subsequent sections (5.9 and 5.11), we summarize and synthesize the expected impacts to these listed species from the activities associated with the proposed action. The impacts of individual stressors are not necessarily equal to the collective stressors of the proposed action and additional actions that may occur in the action area. In other words, listed species likely to experience reductions in fitness as a result of their exposure to individual stressors produced by the proposed action may be even more at risk from the entire suite of stressors that the proposed action, and other related actions represent. The system in Berners Bay that listed species are an integral component of, and depend upon, has remained largely undisturbed as a wilderness area in recent history. The quality of this intact natural system is likely responsible for its heavy use by forage fish, Steller sea lions, humpback whales, harbor seals, and various species of seabirds.

The system now faces industrial development. Currently, the elements of industrialization facing Berners Bay as a result of the proposed action include construction of two marine docking facilities; operation of a daily crew shuttle and weekly/monthly tug and barge transit; and mining discharge from the East Fork of Slate Creek. As discussed, these activities introduce habitat modification, vessel traffic, noise, artificial light, the potential for heavy metals and other pollutant discharge, and the risk of oil spill to a relatively undisturbed system. Additional Federal, State, local and private commercial activities are planned for this area. Within the context of a biological opinion, NMFS cannot analyze all potential effects that current and future actions, related or unrelated to the proposed action, may have on listed species. It is important, however, to note that the proposed action may be the first of many subsequent actions that will change the conditions listed species are exposed to. Once structures are established, it is unlikely they will be dismantled, and thus they will provide platforms of opportunity for further development. It is not possible to predict all the future uses an action area may incur; however, in this case, given the establishment of transportation facilities and infrastructure, it is likely that industrial development and infrastructure may have long-term consequences for listed species' habitat in Berners Bay.

For example, the threats posed to Steller sea lions and humpback whales from vessel traffic and noise in the action area would be amplified if tour vessels, commercial ferries, barges, and other pleasure craft become more numerous due to increased development of the Berners Bay shore. More interactions between wildlife and humans would result. Planned road and bridge development will further increase human uses in the action area, with attendant increases in noise, pollution, recreational use, fishing pressure, etc., and interactions with listed species and important prey species will increase. Simply maintaining winter road access to the Echo Cove boat launch and/or the Cascade Point dock will result in increased winter use of Berners Bay, which is currently limited due to weather and a lack of easy access. In sum, infrastructure development in a largely undeveloped place such as Berners Bay will fundamentally change the site's wilderness character and values for wildlife and people with far-ranging future effects that are not possible to accurately predict.

5.10 Cumulative Effects

Cumulative effects include the effects of future State, tribal, local or private actions, not involving Federal activities, that are reasonably certain to occur in the action area considered in this biological opinion (50 CFR 402.02). 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. Past and present impacts of non-federal actions are part of the environmental baseline discussed in section 4 of this biological opinion. Cumulative effects that reduce the capacity of listed species in the action area to meet their biological requirements increase the risk to the viability of the species, and consequently increase the risk that the proposed action on the species or its habitat will result in jeopardy (NMFS 1999).

5.10.1 Subsistence harvest of Steller Sea Lions

The subsistence harvest of Steller sea lions by Alaska natives results in direct mortalities that are expected to continue into the foreseeable future. These takes represent the highest level of known direct mortality from an anthropogenic source. The primary areas of subsistence harvest are in the western population of Steller sea lions, outside the action area. Subsistence harvest in the action area does occur but is considered a negligible source of mortality in the eastern population.

5.10.2 Juneau Access Road

In an effort to improve transportation between communities of northern Lynn Canal and Juneau, the Department of Transportation and Public Facilities has proposed the Juneau Access Improvements Project as part of the Statewide Transportation Improvement Program for 2004-2006. The State of Alaska and the Federal Highways Administration issued a draft EIS for the project on January 11, 2005. The Preferred Alternative includes construction of a 68.5-mile long highway from the end of Glacier Highway at Echo Cove, around Berners Bay, and along the eastern coast of Lynn Canal and Taiya Inlet to Skagway.

As part of the Kensington Gold Project, the public road from Slate Creek Cove to the Jualin Mine will be upgraded in order to provide access between the mine and the Slate Creek Cove dock. Funds are being contributed from the State of Alaska’s Industrial Development and Export Authority (AIDEA) and would thus ensure state access to the Slate Creek Cove dock. It follows that the Department of Transportation and Public Facilities could use the dock in two ways: 1) to provide interim ferry shuttle service during construction of an East Lynn Canal highway north of Slate Creek Cove; and 2) to provide temporary winter ferry service when the East Lynn Canal highway is closed for extended periods for avalanche control (Juneau Access Improvements Project SEIS 2005). This additional use of the Slate Creek Cove dock would result in more vessel transits across Berners Bay, and these may involve the use of high-speed ferries. During winter months, impacts would be expected to be minimal to listed species; during spring and summer months, however, when concentrations of listed species are found in the action area, ferry traffic servicing state road construction represents an additional source of disturbance to foraging Steller sea lions and humpback whales.

If the east Lynn Canal road is built, access to the mine for work crews and some supplies could be by road, eliminating the majority of marine impacts of the project. As funding for the road is not currently available, it is unknown if a road would be constructed and become usable during the projected ten-year lifespan of the proposed mine.

5.10.3 Echo Cove Master Plan

Goldbelt, Inc. prepared the Echo Cove Master Plan in 1996 for 1,500 acres of corporation-owned land at the end of the Juneau road system. An EIS was developed in conjunction with this Plan for a proposed gravel access road from Echo Cove to Cascade Point, and the USFS completed its Record of Decision in 1998. Goldbelt has received easements to cross USFS land, USFS special use permits, and a U.S. Army Corps of Engineers 404 permit for construction of the proposed road. Under the Roads to Resources program, the State of Alaska is funding construction of the Cascade Point Road as part of its effort to foster industrial development (Juneau Access Improvements Project SEIS 2005).

The management plan includes development of 10 percent of Goldbelt land at Echo Cove, including a 40- acre commercial development site at Cascade Point, located three miles north of the end of Veteran's Memorial Highway. The community at Cascade Point is planned to support the following development objectives: a) high-speed ferries to Haines and Skagway (capacity 150 people and 40 vehicles; several hundred feet in length); b) tourism, including tour boat excursions; c) fishing industry support, including dock loading, ice, water and fuel; d) possible housing and support for future mining. The Cascade Point development would include a road, dock, visitor parking, residential housing, grocery, service station, and public lodge (restaurant, waiting area for ferry service, staff support space). The long-term plan may also include development of a school, library and civic structure for public safety. The community is expected have a population of up to 200 residents (Echo Cove Master Plan 1996).

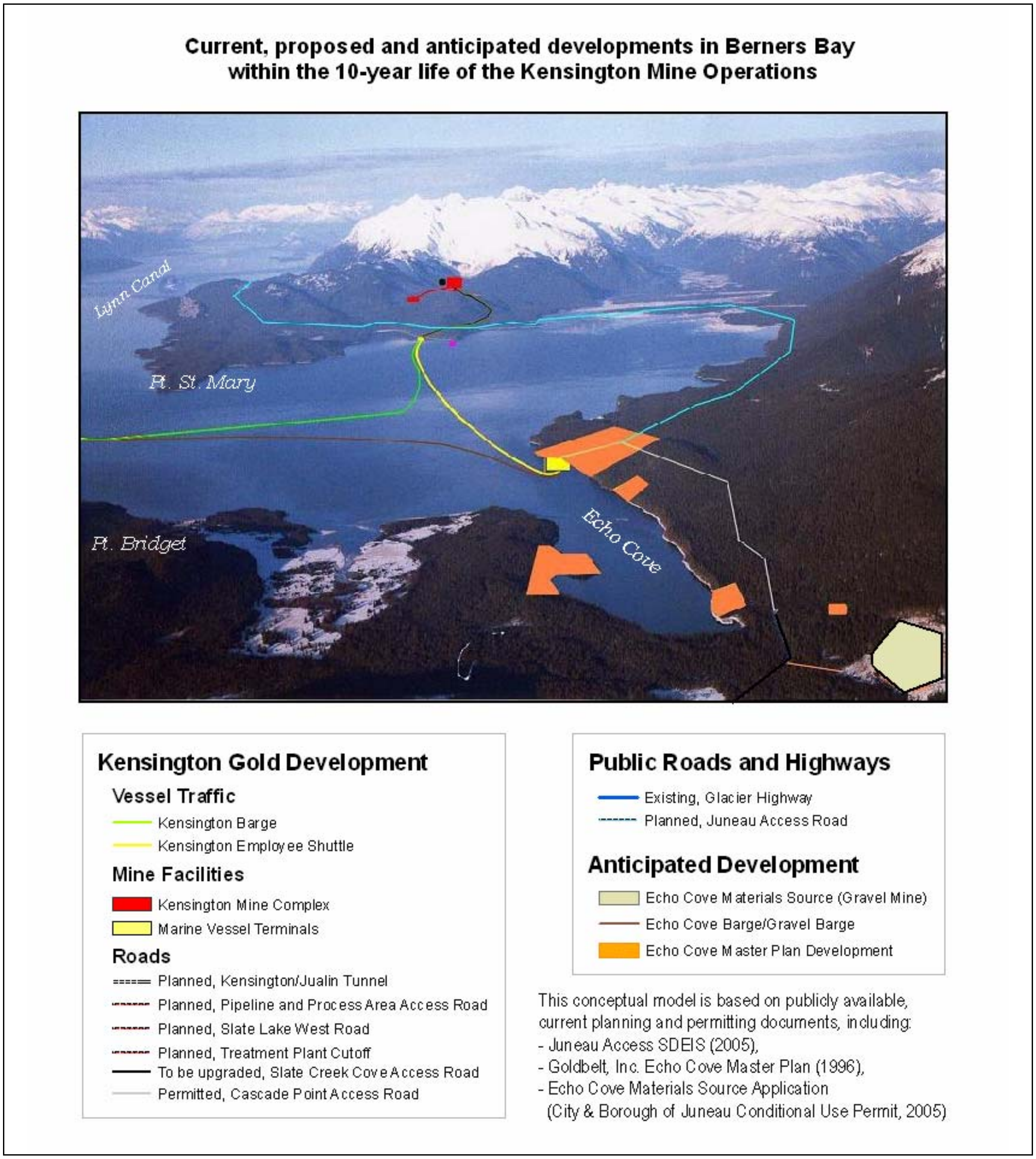
This development would introduce additional vessel traffic into Berners Bay, and has the potential to adversely affect water quality near Cascade Point from non-point source runoff and septic outfalls, which in turn may affect sensitive spawning habitat for the Lynn Canal/Berners Bay herring population. Such effects are likely to exacerbate the effects of the proposed action if concurrent (i.e., within the ten year span of projected mine operation).

5.10.4 Echo Cove Materials Source

A City and Bureau of Juneau Conditional Use permit has been applied for to develop and operate a gravel pit and rock quarry at mile 43 of Veteran's Memorial Highway (at Echo Cove) on lands owned by Goldbelt, Inc.. This rock and gravel mining operation would involve excavating, crushing, screening and barging up to 1.6 million cubic yards of gravel and 2.1 million cubic yards of rock from the site. Goldbelt's agent, Channel Construction, Inc. has stated that the Cascade Point dock would be used to barge 75% of this gravel, approximately 20,000 tons per year, to local markets. This use is not permitted under the current City and Bureau of Juneau Conditional Use permit for the Cascade Point facility and was not included in the project description of the proposed action being analyzed in this Biological Opinion. It is probable that the Cascade Point marine terminal would need to be modified to accommodate gravel barges for shipping these rock products. A draft Storm Water Pollution Prevention Plan, as required by the EPA's NPDES permit has been developed to address sedimentation and runoff anticipated to result from this project.

This development would introduce additional vessel traffic into Berners Bay and at Cascade Point. It is not known but supposed that modifications to the Cascade Point marine terminal would need to be made to accommodate gravel barges. These additional modifications could increase the size of the facility, increase the amount of dredging needed, and add to the industrial nature of planned developments in Berners Bay.

Figure 5.4. Graphical representation of current development, proposed development and reasonably foreseeable non-federal development in the Action Area.



This conceptual model is based on publicly available, current planning and permitting documents, including:
- Juneau Access SDEIS (2005),
- Goldbelt, Inc. Echo Cove Master Plan (1996),
- Echo Cove Materials Source Application (City & Borough of Juneau Conditional Use Permit, 2005)

5.11 Synthesis and Integration of Potential Effects of the Proposed Action on Listed Species and Critical Habitat

The proposed Kensington Gold Project would result in the construction and operation of two docks on either side of Berners Bay; repeated vessel transits across the bay; and discharge of materials from the East Fork of Slate Creek into Slate Creek Cove. The current projected duration of the action is ten years. Increases in vessel traffic would occur for at least this period of time. Construction of dock facilities is projected to take 14-18 months, but these facilities, once established, will be permanent. Although the construction time period is finite, direct effects to listed species and/or indirect effects to their habitat and prey are likely to have long-term consequences from these activities.

5.11.1 Steller Sea Lions

A maximum of about 2,200 Steller sea lions have been estimated in the action area at any one time (Sigler et al. 2004). These sea lions represent animals from both the endangered western population and the threatened eastern population, although only a few of the Steller sea lions in the action area will be from the endangered western population. We assume that most of the Steller sea lions in the action area are from haulouts on Gran Point, Met Point, and Benjamin Island and represent animals from five rookeries in the southeast Alaska subpopulation of the eastern Steller sea lion population.

Daily transits by the crew shuttle and consistent transit of barges and tugs through Berners Bay will be new sources of disturbance in Berners Bay. However, individual sea lions have a low likelihood of being exposed to construction activity and ferry, barge and tug operations in a single year. They are more likely to be exposed to these activities for a day or several days; at most, a sea lion might be exposed for several months if the animal remained in the action area for an entire foraging season. As a result, individual sea lions are likely to be exposed to these activities occasionally each year.

Steller sea lions are skittish by nature, so loud, pulsed, frequent or unfamiliar sounds, such as blasting or driving pilings, are likely to disturb sea lions resting or foraging near the sound source. These sea lions will probably react to these sound sources by diving into the water if they are out of the water, or diving below the water’s surface if they are already in the water. Generally, these animals can be expected to return to their previous behavior within an hour or so of the disturbance (Porter 1997). However, their tolerance for this kind of disturbance will depend on its continuity: Steller sea lions may abandon a haulout for longer periods of time if a disturbance continues.

The proposed action is expected to alter the ecology and distribution of adult and juvenile forage fish in Berners Bay, which poses potential risks to Steller sea lions. The hydrology of the bay at Cascade Point will be permanently altered by the proposed action: wave action is likely to change along with tidal flushing, turbidity, and current flows; reduced sediment transport; and localized changes in temperature and salinity. The physical construction and operation of a Cascade Point marine facility is expected to alter the structure and composition of the vegetative community, temporarily or permanently, such that value of this area to herring and other forage fish will decline dramatically. Over the long term, the aggregate effects of habitat modifications and increased noise and vessel traffic may cause juvenile schooling fish to abandon shoreline rearing habitat within the action area. Without these shoreline habitats, these forage fish may not be able to use Berners Bay, reducing the prey base for Steller sea lions within the Bay and within Lynn Canal.

Most of the Steller sea lions that use Berners Bay come from haulouts 14 miles or more from the Bay. If suitable, alternative foraging areas were available closer to their haulouts, they would be more likely to forage in those areas than in Berners Bay. However the number of sea lions that regularly occupy Berners Bay throughout the year and the predictable quantities of high energy forage fish available in the bay suggests that these sea lions choose to forage in the bay, rather than in alternative foraging areas nearby.

The direct and indirect effects of the Kensington Gold Project are expected to disturb Steller sea lions foraging in Berners Bay and may have longer-term consequences for the forage base of the bay and Lynn Canal. The disturbance responses associated with direct effects of mine activities (i.e., vessel traffic and noise) are expected to have short duration; they are likely to result in acute stress responses (e.g., physiological and hormonal changes in animals that are normally associated with fight or flight responses), but not likely to impair the health of sea lions by depleting their energy reserves. However, indirect effects of the action (i.e., foraging habitat modification, reduction in prey) may result in a depletion of energy reserves for some individuals if the prey base is permanently altered. For example, in response to a reduction in the availability of herring or eulachon, Steller sea lions may have to behaviorally compensate by dedicating more time to foraging on species with less energetic value, which may result in a greater expenditure of energy for the same or less energy gain (McEwen and Lasley 2002), or by relocating to other areas to feed which would also incur an energetic cost.

Although we acknowledge that some individuals feeding in Berners Bay may suffer reduced fitness due to the indirect effects of the action, we do not expect that a large proportion of Steller sea lions using Berners Bay would suffer reduced fitness (that is, their response to the proposed action is not expected to reduce a sea lion's probability of surviving to age *x* and its probability of reproducing at age *x*) and therefore do not expect a subpopulation effect. This is because the effects of the action on the prey base are largely uncertain and the behavior of sea lions is such that they would likely adjust their behavior to accommodate changes in the prey base as described above. Furthermore, any individuals that suffered reduced fitness would likely be distributed throughout the five rookeries of the southeast Alaska subpopulation and thus the effects to the subpopulation would be dampened (i.e. it is unlikely that the animals that suffer fitness consequences would all come from the same rookery in the same year or over years). In addition, this population is known to experience high annual variability in total numbers (CV of 11% for non-pup counts. L. Fritz, pers. comm.) and any effects of the action on individual fitness would likely not exceed the natural variability in the subpopulation. Because we do not expect the action to have adverse consequences on the viability of the subpopulations that sea lions in the action area represent, we would not expect the eastern population of Steller sea lions to experience reductions in reproduction, numbers, or distribution that might appreciably reduce their likelihood of surviving and recovering in the wild.

We do expect that the action will result in incidental harassment of Steller sea lions, as defined in the Marine Mammal Protection Act, even though mitigation measures are in place. These measures will simply reduce the likelihood of incidental harassment by direct take but will not resolve the likelihood of incidental harassment in the form of harm through modification to habitat (in this case foraging habitat of sea lions). Therefore, as noted throughout this document and reiterated in the Incidental Take Statement (ITS) in Section 8.0 of this opinion, we strongly recommend that the action agencies obtain an incidental harassment authorization from NMFS.

5.11.2 Humpback Whales

About 18 humpback whales have been identified in Lynn Canal, but only a portion of these whales appear to forage in Berners Bay at any given time (the largest number of whales observed in the bay at one time is five). It is not clear whether most or all humpback whales using Lynn Canal "rotate" through Berners Bay which would expose most or all of these whales to the direct and indirect effects of the proposed action during any given year.

The greatest risk the proposed action poses to humpback whales is the risk of collisions that kill or seriously injure a whale. The use of observers during vessel operations and the slow vessel speeds (speeds will be limited to 12-13 knots) during the spring foraging period should eliminate two of the primary factors associated with ship strikes.

Sounds generated by construction and vessel operations associated with the proposed action occur in frequency ranges and at decibel levels that overlap with those humpback whales use to communicate. Nevertheless, we do not expect humpback whales to be physically injured or harmed by the sounds associated with the proposed mine. Instead, we expect humpback whales in Berners Bay to detect and avoid the crew shuttle, barges, or tugs: in other bays of similar size, humpback whales appear to co-exist with similar, anthropogenic sound levels.

As we discussed previously, the proposed action is expected to alter the ecology and distribution of juvenile and adult forage fish in Berners Bay, which poses potential risks to the humpback whales that forage in the bay. Over the long term, the aggregate effects of increased noise and vessel traffic may cause juvenile schooling fish to abandon shoreline habitat within the action area. Without these shoreline habitats, these forage fish may not be able to use Berners Bay, reducing the prey base for humpback whales within the bay and Lynn Canal.

The direct and indirect effects of the Kensington Gold Project are expected to disturb humpback whales foraging in Berners Bay and may have longer-term consequences for the forage base of the bay and Lynn Canal. The disturbance responses associated with mine activities are expected to have short duration; they are more likely to result in stress responses (physiological and hormonal changes in animals that are normally associated with fight or flight responses or responses to environmental stress), but not likely to impair the health of whales by depleting their energy reserves. Because any stress responses in humpback whales would occur while they are foraging, if a whale experienced abnormal levels of stress, it may be able to compensate for the increased energy demand resulting from the stress by dedicating more time to foraging (McEwen and Lasley 2002).

We recognize that individual whales may alter their behavior as a result of the proposed action, and in some cases reduced fitness of individuals may result (that is, their response to the proposed action is not expected to reduce a whale's probability of surviving to age *x* and its probability of reproducing at age *x*). Because only a small number of whales are known to use the action area, we do not expect that any effects from the action would affect population viability. If we do not expect an action to have adverse consequences on the viability of the subpopulations or foraging groups that humpback whales in the action area represent, we would not expect the Central North Pacific population of humpback whales to experience reductions in reproduction, numbers, or distribution that might appreciably reduce their likelihood of surviving and recovering in the wild.

6.0 CONCLUSION

After reviewing the current status of the endangered western population of Steller sea lions, the environmental baseline for the action area, the proposed action(s), and the cumulative effects of other actions, it is NMFS' biological opinion that *the proposed action is not likely to jeopardize the continued existence of the western population of Steller sea lions*. Critical habitat for this population has been designated in multiple locations west of Cape Suckling, Alaska, however this action does not affect that area and no destruction or adverse modification of that critical habitat is anticipated.

After reviewing the current status of the threatened eastern population of Steller sea lions, the environmental baseline for the action area, and the cumulative effects of other actions on the eastern population of Steller sea lions, it is NMFS' biological opinion that individual Steller sea lions within the action area may be adversely affected, but that *the proposed action is not likely to jeopardize the continued existence of the eastern population of Steller sea lions*. Critical habitat for this population has been designated in multiple locations throughout southeast Alaska; however, no critical habitat exists in the immediate action area. NMFS does not anticipate that critical habitat near the action area will be destroyed or adversely modified as a result of the proposed action.

After reviewing the current status of the endangered Central North Pacific population of humpback whales, the environmental baseline for the action area, the proposed action, and the cumulative effects, it is NMFS' biological opinion that individual whales within the action area may be adversely affected, but that *the proposed action is not likely to jeopardize the continued existence of the Central North Pacific population of humpback whales*. No critical habitat has been designated for this species, therefore, none will be affected.

7.0 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA 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. 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 section 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 ESA; provided that such taking is in compliance with the terms and conditions of an incidental take statement. Regulations at 50 CFR 402.14 (i)(1) state that where the Service concludes that an action (or the implementations of any reasonable and prudent alternatives) and the resultant incidental take of listed species will not violate section 7(a)(2), and, in the case of marine mammals, where the unintentional and incidental taking is authorized pursuant to section 101(a)(5) of the Marine Mammal Protections Act of 1972 (MMPA), the Service will provide with the biological opinion a statement concerning incidental take.

However, because no MMPA section 101(a)(5) authorization has been applied for and issued for the proposed action, this opinion does not include an incidental take statement at this time. Once the action agencies or applicant apply for and are issued regulations or authorizations under section 101(a)(5), NMFS will amend this opinion to include an incidental take statement. Any take related to the proposed action occurring without an incidental take statement may result in a violation of the ESA.

8.0 CONSERVATION RECOMMENDATIONS

In addition to section 7(a)(2), which requires agencies to ensure that proposed projects will not jeopardize the continued existence of listed species, section 7(a)(1) of the ESA places a responsibility on all Federal agencies to utilize their authorities in furtherance of the purposes of the Act by carrying out programs for the conservation of endangered species. Conservation Recommendations are discretionary activities designed to minimize or avoid adverse effects of a proposed action on listed species or critical habitat. Due to potential adverse effects on herring spawning habitat of the Lynn Canal Pacific herring population that may in turn negatively impact listed species, NMFS maintains its earlier recommendation, proposed during both informal section 7 consultation and EFH consultation, to use an alternative dock location to Cascade Point, preferably outside Berners Bay, to facilitate transportation of crews to the mine. The following conservation measures are also recommended for Steller sea lions, humpback whales, and the habitat they depend upon in the action area.

1) Any crew shuttle transits across Berners Bay during the eulachon run and herring spawning periods of April and May should be suspended. NMFS recommends use of other transportation routes during this time to minimize adverse effects on listed species and their prey base. This is consistent with the measure under consideration in the final State Tidelands Lease of the Cascade Point dock facility to prohibit vessel operation from the Cascade Point terminal from the time pre-spawning aggregations of herring are observed around the dock facility until spawning has been completed. A similar measure is contained in the EFH Assessment (B-13), which states that, “Potential impacts on herring spawning from dock operations would be minimal assuming that the State of Alaska requires no use of the facility during the herring spawning period and no fueling for an extended period (i.e. through the eggs hatching). In addition, NMFS recommends that Coeur limit disturbance from vessel noise, lights, and other sources that may discourage herring from utilizing spawning habitat in the vicinity of Cascade Point.

2) Fueling of vessels at the Cascade Point marine terminal should be prohibited from the time pre-spawning aggregations of herring are observed around the dock facility until herring eggs have hatched. This is consistent with the measure under consideration in the final State Tidelands Lease of the Cascade Point dock facility to limit fueling during this time to a U.S. Coast Guard approved facility outside Berners Bay such as Auke Bay.

3) Dock facilities should serve only the Kensington Gold Project and public or other private uses should be entirely restricted in order to protect and avoid additional cumulative impacts to marine mammal populations in Berners Bay.

4) Construction should not occur between March 15 and June 30 to minimize potential noise impacts to marine mammals. NMFS is concerned that further impacts to marine mammals may occur from construction during spring and summer. NMFS recommends that near-water construction occur during winter months when fewer marine mammals are present.

5) NMFS recommends the use of appropriate in-water noise control measures (e.g., mufflers, bubble curtains) or other technology for construction equipment and activities to minimize the effects of construction noise. NMFS also recommends the use of the additional noise reduction measures described in the BA/BE (e.g., instituting speed limits, controlling helicopter altitudes, implementing flight path requirements, refraining from compression braking on haul roads from the Slate Creek dock to the mining site).

6) In-water construction should occur outside of appropriate timing windows that protect outmigrating juvenile salmonids, and spawning and rearing marine forage fish. Pile driving noise associated with construction is complex because sounds are produced in shallow water near shore with numerous boundaries, and these sounds, in turn, may interact with sound traveling in the substrate. Although models would have to be developed to precisely predict noise levels, and sound attenuation, incorporating substrate type and density, pile type and size, type and size of hammer, water depth, etc., evidence indicates that hollow steel piles of greater than 14 inch diameter, driven with an impact hammer into rocky substrates, can produce sound energy damaging to teleost fishes. Therefore, we also recommend using vibratory hammers whenever and wherever practicable except for the final few minutes needed to proof piles when an impact hammer must be used.

7) As included in the SEIS' Best Management Practices, NMFS recommends the use of silt curtains or other methods to prevent sedimentation of coastal habitat areas from construction activities.

8) A marine biologist should monitor construction activities' effects on marine mammal behavior to ensure that impacts on marine mammals will be minimal. Monitoring results should be submitted to NMFS and USFS annually to determine if protection requirements have been met.

9) Vessel traffic should be minimized after dark, especially during spring eulachon/herring runs when Steller sea lions and humpback whales are most likely to be foraging near the surface and along the route of the crew shuttle, increasing the likelihood of disturbance to both predators and prey from vessel noise and presence. As prey are closer to the surface in the evening, marine mammals are believed to be foraging closer to the surface in the evening. Thus, boat noise and boat wake are more likely to disrupt or adversely affect herring and marine mammal behavior at this time. In addition, operating at night compromises the ability of the vessel operator to see marine mammals and avoid disturbance or collision.

10) Vessels should be operated year-round at speeds not exceeding 13 knots. Known records of ships strikes show that most strikes to whales have occurred at speeds above 13 knots.

11) Quieting technologies should be adapted to vessels associated with the Kensington Gold Project, particularly the crew shuttle, to minimize noise disturbance to listed species and their prey in the action area.

12) As the proposed action increases vessel traffic in an area where disturbance and collision risk

have been minimal in the past, NMFS recommends that vessel-operating procedures be monitored and evaluated to determine if they are effective at protecting sea lions and whales in the waters of Berners Bay.

13) NMFS recommends that a marine mammal observer monitor crew shuttle operations during the entire year, beyond simply the April/May time period, to ensure that impacts on marine mammals are minimized and properly mitigated. Monitoring results should be submitted to NMFS and USFS annually to determine if protection requirements have been met.

14) NMFS recommends that USFS and ACOE should complete the spill prevention, control, and containment plan for approval by NMFS and other relevant agencies that addresses the potential for catastrophic spill (i.e., in the event that a 6,500 diesel fuel isotainer was to leak or rupture during transport, loading, or offloading). Prevention of and detection and immediate response to such an emergency should be well defined.

15) Many of the “mitigation measures” in the BA/BE are actually monitoring activities rather than actions to minimize the impact of the proposed action. Likewise, in the Final SEIS, the Transportation Mitigation Policy and Best Management Practices Plan include the following monitoring priorities: monitoring water quality for the presence of hydrocarbons in Berners Bay; mapping submerged aquatic vegetation between Echo Cove and Cascade Point; monitoring and documenting colonization and habitat value of the breakwater; and, monitoring and documenting herring spawning activity and location(s) in Berners Bay. While NMFS supports these priorities, it is not clear how any of these activities will translate into mitigation rather than simply information collecting. Thus, in the interests of listed species and the ecosystem they depend upon, NMFS recommends that monitoring be directed toward adaptive management. We further recommend that our agency and other natural resource agencies be able to independently review collected data to assess impacts. If impacts are detected from project activities, USFS and ACOE should consult with NMFS to determine how to adjust the action effectively.

16) Very little baseline data is available on humpback whale abundance, distribution and foraging behavior in Berners Bay or the adjacent waters of Lynn Canal. More information is available about Steller sea lions in this region, but much is still unknown regarding their distribution, behavior and habitat use patterns. In addition, little shoreline monitoring has been conducted to determine, for instance, whether kelp species will successfully colonize the breakwater to provide suitable surrogate habitat for rearing and spawning prey species at Cascade Point where original vegetation was removed. To better understand the direct and indirect impacts to the listed species and their prey using these waters, NMFS recommends that Coeur support such research efforts in the action area throughout the course of the Kensington Gold Project, and use best available technology to design any breakwater structure so that the probability of recreating productive herring spawning habitat is maximized.

NMFS requests notification of the action agencies’ decisions regarding implementation of these conservation recommendations.

9.0 REINITIATION - CLOSING STATEMENT

This concludes formal consultation on activities associated with Kensington Gold Project operations as described in the USFS and ACOE BA/BE. 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 agency action that may affect listed species or designated critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or designated critical habitat not considered in this opinion (such as additional construction or vessel activities in Berners Bay); or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, the action agency must immediately reinitiate formal consultation on the action.

10.0 REFERENCES

Alaska-BC Whale Foundation. 1996. http://www.sfu.ca/biolgoy/berg/whale/abcwhales.html.

Alaska Department of Environmental Conservation (ADEC). 2003. Statewide Summary of Oil and Hazardous Substance Spill Data (Fiscal Years 1996-2002). Provisional Report. Division of Spill Prevention and Response, Juneau, AK. 148pp.

Alaska Department of Fish and Game (ADF&G). 1985. Pacific herring, *Clupea pallasi.* Alaska habitat management guide, Southcentral Region, Volume 1: Life histories and habitat requirements of fish and wildlife. State of AK. Department of Fish and Game, Division of Habitat, Juneau, AK. 11pp.

Alaska Department of Fish and Wildlife (ADF&G). 1994. Pacific herring. *In* Wildlife Notebook Series. Available online http://www.adfg.state.ak.us/pubs/notebook/fish/herring.php

Alaska Department of Fish and Game (ADF&G). 2005. Anadromous Waters Catalog and Atlas. http://www.sf.adfg.state.ak.us/SARR/FishDistrib/anadcat.cfm

Alaska Department of Natural Resources (ADNR). 2004. Goldbelt, Inc. Proposed Tideland Lease, ADL 107152. Division of Mining, Land and Water, Juneau, AK. 13pp.

Alaska Department of Transportation (DOT). 2005. Juneau Access Improvements Project Supplemental Environmental Impact Statement.

Ainley, D. G., R. P. Henderson, H. R. Huber, R. J. Boekelheide, S. G. Allen, and T. L. McElroy. 1985. Dynamics of white shark/pinniped interactions in the Gulf of the Farallones. Memoirs of the Southern Calif. Acad. Sci. 9:109-122.

Anderson, J. J. 2000. A vitality-based model relating stressors and environmental properties to organism survival. Ecol. Mon. 70:445-470.

Angliss, R. P. and K. L. Lodge. 2002. Alaska Marine Mammal Stock Assessments, 2002. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-133, 224 pp.

Angliss, R. P. and K. L. Lodge. 2004. Alaska Marine Mammal Stock Assessments, 2003. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-144, 237 pp.

Angliss, R. P., Lopez, A., and DeMaster, D. P. 2001. Draft Alaska Marine Mammal Stock Assessments, 2001. National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115. p. 181.

Anthony, J. A., D. D. Roby, and K. R. Turco. 2000. Lipid content and energy density of forage fishes from the northern Gulf of Alaska. J. Exp. Mar. Bio. Ecol. 248: 53–78.

Antrim, L.D., R.M. Thom, W.W. Gardiner, V.I. Cullinan, D.K. Shreffler and R.W. Bienert. 1995. Effects of petroleum products on bull kelp (*Nereocystis luetkeana*). Mar. Biol. 122:23-31.

Army Corps of Engineers (ACOE). 2004. Public Notice for Application for Permit, Ref. No. POA-1997-245-2, waterway no. Berners Bay 4, at1 (June 21, 2004).

Baker, B. 2004. Personal communication. Email to Aleria Jensen on December 29, 2004.

Baker, C. S. and L. M. Herman. 1987. Alternative population estimates of humpback whales (*Megaptera novaeangliae*) in Hawaiian waters. Can. J. Zool. 65:2818-2821.

Baker, C. S. and L. M. Herman. 1989. Behavioral responses of humpback whales to vessel traffic: Experimental and opportunistic observations. Technical Report No. NPS-NR-TRS-89-01. Final report to the U.S. National Park Service, Alaska Regional Office, Anchorage, Alaska.

Baker, C. S., L. M. Herman, A. Perry, W. S. Lawton, J. M. Straley, A. A. Wolman, G. D. Kaufman, H. E. Winn, J. D. Hall, J. M. Reinke, and J. Ostman. 1986. Migratory movement and population structure of humpback whales (*Megaptera novaeangliae*) in the central and eastern North Pacific. Mar. Ecol. Prog. Ser. 31:105-119.

Baker, C. S., A. Perry, and L. M. Herman. 1987. Reproductive histories of female humpback whales (*Megaptera novaeangliae*) in the North Pacific. Mar. Ecol. Prog. Ser. 41:103-114.

Baker, C. S., S. R. Palumbi, R. H. Lambertsen, M. T. Weinrich, J. Calambokidis, and S. J. O'Brien. 1990. Influence of seasonal migration on geographic distribution of mitochondrial DNA haplotypes in humpback whales. Nature 344:238-240.

Baker, C. S., L. Medrano-Gonzalez, J. Calambokidis, A. Perry, F. Pichler, H. Rosenbaum, J. M. Straley, J. Urban-Ramirez, M. Yamaguchi, and O. von Ziegesar. 1998. Population structure of nuclear and mitochondrial DNA variation among humpback whales in the North Pacific. Mol. Ecol. 7:695-707.

Barrett-Lennard, L. G., K. Heise, E. Saulitis, G. Ellis, and C. Matkin. 1994. The impact of Killer whale predation on Steller sea lion populations in British Columbia and Alaska. Report to North Pacific Universities Marine Mammal Research Consortium, 66 p. Fisheries Centre, Univ. British Columbia, Vancouver, B.C., Canada, V6T 1Z4.

Bauer, G. B. and L. M. Herman. 1986. Effects of vessel traffic on the behavior of humpback whales in Hawaii. Unpublished report. National Marine Fisheries Service, Honolulu.

Bauer, G. B., J. R. Mobley, and L. M. Herman. 1993. Responses of wintering humpback whales to vessel traffic. J. Acous. Soc. Amer. 94:1848.

Beachan, T. D., J. F. Schweigert, C. MacConnachie, K. D. Le, K. Labaree, and K. M. Miller. 2001. Population structure of herring (*Clupea pallasi*) in British Columbia: an analysis using microsattelite loci. Canadian Science Advisory Secretariat. Fisheries and Oceans Science. ISSN 1480-4883 Ottowa, 2001 http://www.dfo-mpo.gc/csas/.

Beamish, R. J. 1993. Climate and exceptional fish production off the west coast of North America. Can. J. Fish. Aquat. Sci. 50:2270-2291.

Beatty, J. and S. Mills. 1979. The propensity interpretation of fitness. Phil. Sci. 46:263-288.

Benson, A. J. and A. W. Trites. 2002. Ecological effects of regime shifts in the Bering Sea and eastern North Pacific Ocean. Fish and Fisheries 3:95-113.

Berzin, A. A. and A. A. Rovnin. 1966. The distribution and migrations of whales in the northeastern part of the Pacific, Chukchi and Bering Seas. Izvestiya Tikhookeanskogo Nauchno-Issledovatel'skogo Institut Rybnogo Khozyaistva I Okeanografii 58:179-207. (Translated by Bureau of Commercial Fisheries, U. S. Fish and Wildlife Service, Seattle, 1968, pp. 103-136. *In* K. I. Panin (ed.), Soviet Research on Marine Mammals of the Far East.)

Bickham, J. W., J. C. Patton, and T. R. Loughlin. 1996. High variability for control-region sequences in a marine mammal: Implications for conservation and biogeography of Steller sea lions (*Eumetopias jubatus*). J. Mammal. 77:95-108.

Bickham, J. W., S. Sandhu, P. D. N. Hebert, L. Chikhi, and R. Athwal. 2000. Effects of chemical contaminants and genetic diversity in natural populations: Implications for biomonitoring and ecotoxicology. Mol.Bio.Gen. 463:33-51.

Braham, H. W., R. D. Everitt, and D. J. Rugh. 1980. Northern sea lion decline in the eastern Aleutian Islands. J. Wildl. Manage. 44:25-33.

Braithwaite, L. F., M. G. Aley, and D. L. Slater. 1983. The effects of oil on the feeding mechanism of the bowhead whale. Final report. Contract No. AA 851-CTO-55. Prepared for the U.S. Department of Interior by Brigham Young University, Salt Lake City, UT.

Brandon, R. 1990. Adaptation and environment. Princeton University Press; Princeton, New Jersey.

Branson, J. 1971. Killer whales pursue sea lions in Bering Sea drama. Com. Fish. Rev. 33:39-40.

Bright, D. B. 1959. The occurrence and food of the sleeper shark, *Somniosus pacificus*, in a central Alaska Bay. Copeia 1959:76-77.

Brown, E. D. 2002. Life history, distribution, and size structure of Pacific capelin in Prince William Sound and the northern Gulf of Alaska. – ICES J. Mar. Sci. 59:983–996.

Brown E. D. and M. G. Carls. 1998. Pacific herring (*Clupea pallasi*). Restoration notebook, Exxon

Valdez Oil Spill Trustee Council. 8 pp.

Brown, E. D. and B. L. Norcross. 2001. Effect of herring egg distribution and environmental factors on year-class strength and adult distribution: preliminary results from Prince William Sound, Alaska. Pp 335-45, *In* F. Funk, J. Blackburn, D. Hay, A.J. Paul, R. Stephenson, R. Torensen and D. Witherell (eds.), Herring: Expectations for a new millennium. Univ. of Alaska Sea Grant, AK-SG-01-04, Fairbanks. 800 pp.

Byrd, G. V. 1989. Observations of northern sea lions at Ugamak, Buldir, and Agattu Islands, Alaska in 1989. Unpubl. rep., U.S. Fish and Wildlife Service. Alaska Maritime National Wildlife Refuge, P.O. Box 5251, NSA Adak, FPO Seattle, WA 98791.

Calambokidis, J., G. H. Steiger, J. C. Cubbage, K. C. Balcomb III, and P. Bloedel. 1989. Biology of humpback whales in the Gulf of the Farallones. Report to Gulf of the Farallones National Marine Sanctuary, San Francisco, CA by Cascadia Research Collective, 218½ West Fourth Avenue, Olympia, WA. 93 pp.

Calambokidis, J., G. H. Steiger, and J. R. Evenson. 1993. Photographic identification and abundance estimates of humpback and blue whales off California in 1991-92. Final Contract Report 50ABNF100137 to Southwest Fisheries Science Center, P.O. Box 271, La Jolla, CA 92038. 67 pp.

Calambokidis, J., G. H. Steiger, J. M. Straley, T. Quinn, L. M. Herman, S. Cerchio, D. R. Salden, M. Yamaguchi, F. Sato, J. R. Urban, J. Jacobson, O. Von Zeigesar, K. C. Balcomb, C. M. Gabriele, M. E. Dahlheim, N. Higashi, S. Uchida, J. K. B. Ford, Y. Miyamura, P. Ladrón de Guevara, S. A. Mizroch, L. Schlender, and K. Rasmussen. 1997. Abundance and population structure of humpback whales in the North Pacific basin. Final Contract Report 50ABNF500113 to Southwest Fisheries Science Center, P.O. Box 271, La Jolla, CA 92038. 72 pp.

Calkins, D. G. 1988. Marine mammals. Pages 527-558, *in*: D. W. Hood and S. T. Zimmerman (eds.), The Gulf of Alaska: Physical environment and biological resources. NOAA Ocean Assessments Div., Anchorage, AK.

Calkins, D. G. 1998. Prey of Steller sea lions in the Bering Sea. Biosphere Cons. 1:33-44.

Calkins, D. G., and K. W. Pitcher. 1982. Population assessment, ecology and trophic relationships of Steller sea lions in the Gulf of Alaska. U.S. Dep. of Commer., NOAA. OCSEAP Final Report 19 (1983), pp. 445-546.

Calkins, D. G., E. Becker, T. Spraker, and T. Loughlin. 1994. Impacts on Steller sea lions, from Marine Mammals and the Exxon Valdez Oil Spill. T.R. Loughlin, Ed. Academic Press. San Diego, CA.

Calkins, D. G., D. C. McAllister, K. W. Pitcher, and G. W. Pendelton. 1999. Steller sea lion status and trend in southeast Alaska: 1979-1997. Mar. Mam. Sci. 15:462-477.

Calvin, N. I. 1977. A qualitative description of the intertidal plants and animals of Berners Bay, southeastern Alaska. Syesis 10:11-24.

Carls, M. G. 2005. Alaska Fisheries Science Center, NMFS, Juneau, AK. Personal communication. Email to Erika Phillips on January 18, 2005.

Carls, M. G., A. C. Wertheimer, J. W. Short, R. M. Smolowitz, and J. J. Stegeman. 1996. Contamination of juvenile pink and chum salmon by hydrocarbons in Prince William Sound after the Exxon Valdez oil spill. Am. Fish Soc. Symp. 18:593-607.

Carls, M. G., S. D. Rice and J. E. Hose. 1999. Sensitivity of fish embryos to weathered crude oil: Part I. Low-level exposure during incubation causes malformations, genetic damage, and mortality in Pacific herring (*Clupea pallasi*). Environ. Tox. Chem. 18:481-493.

Carls, M. G., G. D. Marty, J. E. Hose. 2002. Synthesis of the toxicological impacts of the Exxon Valdez oil spill on Pacific herring (*Clupea pallasi*) in Prince William Sound, Alaska, U.S.A. Can. J. Fish. Aquat. Sci. 59:1 20.

Carlson, H. R. 1980. Seasonal distribution and environment of Pacific herring near Auke Bay, Lynn Canal, Southeastern Alaska. Trans. Amer. Fish. Soc. 109: 71-78.

Carman, K. R., J. W. Fleeger, and S. M. Pomarico. 1997. Response of a benthic food web to hydrocarbon contamination. Limn.Ocean. 42:561-571.

Caughley, G. and A. Gunn,. 1996. Conservation biology in theory and practice. Cambridge, Mass., Blackwell Science.

Chapman, G. A. 1978. Toxicities of Cadmium, Coipper, and Zinc to Four Juvenile Stages of Chinook Salmon and Steelhead. Trans. Am. Fish. Soc. 107(6):841-847.

City and Borough of Juneau. 2004. Minutes from the April 20,2004 Committee of the Whole, Planning Commission Meeting. Juneau, Alaska. 4pp.

Clark, R. B. 1989. Chapter 3: Oil Pollution. *In* Marine Pollution. Oxford University Press, Oxford, Great Britain. Pp. 33-64.

Clyne, H. 1999. Computer simulations of interactions between the North Atlantic right whale (*Eubalaena glacialis*) and shipping. Masters Thesis, Napier University.

Cooney, R. T, J. R. Allen, M. A. Bishop, D. L. Eslinger, T. Kline, B. L. Norcross, C. P. Mcroy, J. Milton, J. Olsen, V. Patrick, A. J. Paul, D. Salmon, D. Scheel, G. L. Thomas, S. L. Vaughan, and T. M. Willette. 2001. Ecosystem controls of juvenile pink salmon (*Onchorynchus gorbuscha*) and Pacific herring (*Clupea pallasi*) populations in Prince William Sound, Alaska. Fish. Oceanogr. 10(Suppl. 1):1–13.

Corkeron, P. J. 1995. Humpback whales (*Megaptera novaeangliae*) in Hervey Bay, Queensland: Behaviour and responses to whale-watching vessels. Can. J. Zoo. 73:1290-1299.

Coyle, K. O. and A. J. Paul. 1992. Interannual differences in prey taken by capelin, herring, and red salmon relative to zooplankton abundance during the spring bloom in a southeast Alaska embayment. Fish. Oceanogr. 1:294-305.

Craddock, D. R. 1977. Acute toxic effects of petroleum on Arctic and Subarctic marine organisms. *In* Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms, Volume II: Biological Effects. D.C. Malins, ed. Academic Press, Inc. New York, NY. 500 pp.

Csepp, D. 2005. Fisheries Research Scientist, National Marine Fisheries Service, Alaska Science Center, Auke Bay Laboratory. Personal communication with Susan Walker on January 9, 2005. Research cruise data sheets provided from winter 2004 and December 2005.

D'Vincent, C. G., R. M. Nilson, and R. E. Hanna. 1985. Vocalization and coordinated feeding behavior of the humpback whale in southeastern Alaska. Scientific Reports of the Whales Research Institute 36:41-47.

Darling, J. D. 1991. Humpback whales in Japanese waters. Ogasawara and Okinawa. Fluke identification catalog 1987-1990. Final Contract Report, World Wide Fund for Nature, Japan. 22pp.

Darroch, J. N. 1961. The two-sample capture-recapture census when tagging and sampling are stratified. Biometrika 48:241-260.

DeLong, R. L., W. G. Gilmartin, and J. G. Simpson. 1973. Premature births in California sea lions: association with high organochlorine pollutant residue levels. Science 181:1168-1170.

DeMaster, D. P., S. Atkinson, and R. D. Dearborn. 2001. Is It Food? II Workshop Summary. Unpublished summary from May 30-31, 2001 Is it food? II Workshop, Alaska SeaLife Center, Seward, AK.

Dizon, A. E., C. Lockyer, W. F. Perrin, D. P. DeMaster, and J. Sisson. 1992. Rethinking the stock concept: a phylogeographic approach. Conserv. Biol. 6:24-36.

Dodson, J. J., J. C. Dauvin, R. G. Ingram, and B. d'Anglejan. 1989. Abundance of larval rainbow smelt (*Osmerus mordax*) in relation to the maximum turbidity zone and associated macroplanctonic fauna of the Middle St. Lawrence Estuary. Estuaries, 12:66-81.

Doherty, J. L. and C. M. Gabriele. 2001. Population characteristics of humpback whales inGlacier Bay and adjacent waters: 2001. Gaustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

Doherty, J. L. and C. M. Gabriele. 2002. Population characteristics of humpback whales inGlacier Bay and adjacent waters: 2002. Gaustavus, AK: National Park Service, Glacier Bay National Park and Preserve.

Dolphin, W. F. 1987. Ventilation and dive patterns of humpback whales *Megaptera novaeangliae*, on their Alaskan feeding grounds. Can. J. Zoo. 65:83-90.

Earthworks Technology. July 2003. Response to letter dated June 20, 2003, Cascade Point COE 404 Permit Application, submitted for Goldbelt, Inc.

Earthworks Technology, Inc. 2004. Development Plan for the Cascade Point Marine Terminal Facility. Submitted tor Goldbelt, Inc. Boise, Idaho. 20pp.

Edie, A. G. 1977. Distribution and movements of Steller sea lion cows (*Eumetopias jubatus*) on a pupping colony. M.S. Thesis, University of British Columbia, Vancouver B.C., 81 p.

Eller, A. 2005. Personal communication -- emails provided to Aleria Jensen on December 14, 2004 and January 25, 2005.

Eller, A. 2005. Personal communication and information provided to Susan Walker.

Engelhardt, F. R. 1983. Petroleum effects on marine mammals. Aquat. Tox. 4:199-217.

Engelhardt, F. R. 1987. "Assessment of the Vulnerability of Marine Mammals to Oil Pollution." Fate and Effects of Oil in Marine Ecosystems. *In* J. Kuiper, and W. J. Van Den Brink. Eds.) Proceedings of the Conference on Oil Pollution Organized Under the Auspices of the International Association on Water Pollution Research and Control (IAWPRC) by the Netherlands Organization for Applied Scientific Research. TNO Amsterdam, 23-27 Feb. 1987, The Netherlands Martinus Nijhoff Publishers, Boston, MA.

Engelhardt, F. R., J. R. Geraci, and T. G. Smith. 1977. Uptake and clearance of petroleum hydrocarbons in the ringed seal, *Phoca hispida*. J. Fish. Res. Board Can. 34:1143-1147.

Erbe, C. 2003. Assessment of bioacoustic impact of ships on humpback whales in Glacier Bay, Alaska. Report submitted to Glacier Bay National Park and Preserve, Gustavus, Alaska.

Erickson, R. P. 1999. Abundance of Coho Salmon in the Chilkat River in 1999. Alaska Department of Fish and Game, Fishery Data Series No. 99-29, Anchorage.

Erickson, R. P. 2001. Smolt Production and Harvest of Coho salmon from the Chilkat River, 1999-2000. Alaska Department of Fish and Game, Fishery Data Series No. 01-17, Anchorage.

Estes, J. A., M. T. Tinker, T. M. Williams, and D. F. Doa. 1998. Killer whale predation on sea otters linking oceanic and nearshore ecosystems. Science 282: 473-476.

Ferry, E. 2004. Personal communication. Email to Aleria Jensen on December 30, 2004.

Finneran, J. J., C. E. Schlundt, R. Dear, D. A. Carder, S. H. Ridgway. 2002. Temporary shift in masked hearing threasholds in odonotocetes after exposure to single underwater impulses from a seismic watergun. J Acoust. Soc. Amer. 111:2929-2940.

Fiscus, C. H. 1961. Growth in the Steller sea lion. J. Mamm. 47:195-200.

Fiscus, C. H., and G. A. Baines. 1966. Food and feeding behavior of Steller and California sea lions. J. Mamm. 42:218-223.

Fishbein, L. 1984. An overview of environmental and toxicological aspects of aromatic hydrocarbons. Sci. Total Environ 40:189-218.

Ford, J. K. B., G. Ellis, and K. C. Balcomb. 1994. Killer whales: the natural history and genealogy of *Orcinus orca* in British Columbia and Washington State. Univ. of British Columbia Press, Vancouver, B.C., and Univ. of Washington Press, Seattle, WA. 102 pp.

Fowler C. W. and Baker, J. D. 1991. A review of animal population dynamics at extremely reduced population levels. Rep. Int. Whaling Comm. 41:545-554.

Frankel, A. S. 1994. Acoustic and visual tracking reveals distribution, song variability, and social roles of humpback whales in Hawaiian waters. Doctoral Disertation, University of Hawaii. University Microfilms, Inc.

Frankel, A. S., and C. W. Clark. 1998. Results of low-frequency *m*-sequence noise playbacks to humpback whales in Hawaii. Can. J. Zoo. 76:521-535.

Frankel, A. S., J. Mobley, and L. Herman. 1995. Estimation of auditory response threasholds in humpback whales using biologically meaningful sounds. Pages 55-70. In: R.A. Kastelein, J.A. Thomas, P.E. Nachtigall (editors). Sensory Systems of Aquatic Mammals. De Spil Publication, Woerden, Netherlands.

Frost, K. J., R. B. Russell, and L. F. Lowry. 1992. Killer whales, *Orcinus orca*, in the southeast Bering Sea: Recent sightings and predation on other marine mammals. Mar. Mamm. Sci. 8:110-119.

Frost K. J., L. F. Lowry, E. H. Sinclair, J. V. Hoef, and D. C. McAllister. 1994. Impacts on distribution, abundance, and productivity of harbor seals. *In* T.R. Loughlin (ed). Marine mammals and the Exxon Valdez. Academic Press, San Diego. 395 pp.

Gende, S. M., J. N. Womble, M. F. Willson, and B. H. Marston. 2001. Cooperative foraging by Steller sea lions, *Eumetopias jubatus*. Can. Field Nat. 115:355-356.

Geraci. J. R. 1990. Physiological and Toxic Effects on Cetaceans. *In* Sea Mammals and Oil: Confronting the Risks. J. R. Geraci and D. J. St. Aubin (eds.) Academic Press, San Diego, CA.

Geraci, J. R. and T. G. Smith. 1976. Direct and indirect effects of oil on ringed seals (*Phoca hispida*) of the Beaufort Sea. J. Fish. Res. Board Can. 33:1,976-1,984.

Geraci, J. R. and D. J. St. Aubin. 1980. Offshore petroleum resource development and marine mammals: A review and research recommendations. Mar. Fish. Rev. 42:1-12.

Geraci, J. R. and D. J. St. Aubin. 1982. Study of the effects of oil on cetaceans. Final Report for Contract Number AA-551-CT9-29, U.S. Dept of Interior, Bureau of Land Management, Washington, D.C. 274 pp.

Gilmartin, W. G., R. L. DeLong, A. W. Smith, J. C. Sweeney, B. W. DeLappe, R. W. Risebrough, L. A. Griner, M. D. Dailey, and D. B. Peakall. 1976. Premature parturition in the California sea lion. J. Wildl. Diseas. 12:104-114.

Goldbelt, Inc. 2004. Letter to National Marine Fisheries Service on December 20, 2004.

Green, M. L. and R. G. Green. 1990. Short-term impact of vessel traffic on the Hawaiian humpback whale (*Megaptera novaeangliae*). Presented at the Annual Meeting of the Animal Behavior Society, June 1990, Buffalo, NY, 9 pp.

Haegele, C. W. and J. F. Schweigert. 1985. Distribution and characteristics of herring spawning grounds and description of spawning behavior. Can. J. Fish. Aquat. Sci. 42 (Suppl. 1):39-55.

Hamilton, P. K., G. S. Stone, and S. M. Martin. 1997. Note on a deep humpback whale (*Megaptera novaeangliae*) dive near Bermuda. Bul. Mar. Sci. 61:491-494.

Harper, J. and M. Morris. 2005. ShoreZone mapping data summary, Southeast Alaska. Prepared for NOAA, National Marine Fisheries Service by Coastal and Ocean Resources Inc. and Archipelago Marine Research, Ltd., Sidney, B.C. 70pp.

Harris, P. M., S. W. Johnson, L. Holland, J. F. Thedinga, and A. D. Neff. 2005. DRAFT REPORT. Hydrocarbons and Fisheries Habitat in Berners Bay, Alaska: Long-term Monitoring Associated with the Kensington Gold Mine. Auke Bay. ABL, AFSC, NMFS, NOAA 11305 Glacier Hwy., Juneau.

Harvey, J. T. and M. E. Dalheim. 1994. Cetaceans in Oil. *In* Marine mammals and the Exxon Valdez. T.R. Loughlin (ed). Academic Press, San Diego. 395 pp.

Hastings, M. C. and A. N. Popper. 2005. Effects of Sound on Fish. Subconsultants to Jones and Stokes Under California DOT Contract No. 43A0139, Task Order 1. Jones and Stokes, 2600 V Street Sacramento, CA 95818. 82 pp.

Hay, D. E. 1990. Tidal influence on spawning time of Pacific herring (*Clupea harengus pallasi*). Can. J. Fish. Aquat. Sci. 47:2390-2401.

Hay, D. 1995. The mysterious eulachon. The Westcoast Fisherman (March): 47.

Hay, D. E. and P. B. McCarter. 2000. Status of the Eulachon (*Thaleichthys pacificus*) in Canada. Department of Fisheries and Oceans Canada, Canadian Stock Assessment Secretariat, REsearch Document 2000-145. Ottawa. 92 pp.

Hay, D. E., P. B. McCarter, and K. Daniel. 1999. Pacific herring tagging from 1936-1992: A reevaluation of homing based on additional data. Can. Stock Ass. Secret. Res. Doc. 99/176.

Hay, D. E., P.,B. McCarter, and K.,S. Daniel. 2001. Tagging of Pacific herring *Clupea pallasi* from 1936-1992: a review with comments on homing, geographic fidelity, and straying. Can. J. Fish. Aquat. Sci. 58:1356-1370.

Haynes, T. L. and R. J. Wolfe. 1999. Ecology, harvest, and use of harbor seals and sea lions: Interview materials from Alaska native hunters. Alaska Department of Fish and Game, Technical Paper No. 249.

Hellou, J., G. Stenson, I. H. Ni, and J. F. Payne. 1990. Polycyclic aromatic hydrocarbons in muscle tissue of marine mammals from the Northwest Atlantic. Mar. Poll. Bul. 21:469-473.

Hollowed, A. B., and W. S. Wooster. 1995. Decadal-scale variations in the eastern Subarctic Pacific: II. Response of Northeast Pacific fish stocks. In Climate Change and Northern Fish Populations. Can. Spec. Pub. Fish. Aquat. Sci. 121:373-385.

Hood, K. 2004. Personal communication. Conversation with Aleria Jensen on January 5, 2004.

Hoover, A. A. 1988. Steller sea lion, *Eumetopias jubatus*, p. 159-194. *In* J. W. Lentfer, editor, Selected marine mammals of Alaska. Species accounts with research and management recommendations. Marine Mammal Commission, 1625 I St., N. W., Washington DC 20006.

Hourston, A. S. and C. W. Haegele. 1980. Herring on Canada's Pacific Coast. Can. Spec. Publ. Fish. Aquat. Sci. 48: 23pp.

Hudson, J. 2005. Personal communication. Email to Aleria Jensen on February 3, 2005.

Hyde, J. 2004. Personal communication. Email to Aleria Jensen on December 30, 2004.

Incardona, J. P., T. K. Collier, and N. L. Scholz. 2004. Defects in cardiac function precede morphological abnormalities in fish embryos exposed to polycyclic aromatic hydrocarbons. Tox. App. Pharm. 196:191-205.

International Pacific Halibut Commission (INPFC). 2000. Pacific halibut stock assessment and fishery evaluation. Appendix A in 2000 Groundfish Stock Assessments and Fishery Evaluation Reports, North Pacific Fishery Management Council, Anchorage AK (www.fakr.noaa.gov/npfmc/safes/).

Irwin, R. J., M. VanMouwerik, L. Stevens, M. D. Seese, and W. Basham. 1997. Environmental Contaminants Encyclopedia. National Park Service, Water Resources Division, Fort Collins, CO. Available online at www.nature.nps.gov/hazardsafety/

Jameson, R. J., and K. W. Kenyon. 1977. Prey of sea lions in the Rogue River, Oregon. J. Mamm. 58:672.

Jemison, L. 2005. Research Scientist, Alaska Department of Fish and Game. Personal communication with Sharon Melin and Aleria Jensen on January 6, 2005. Emails with requested data January 10, 18, 20, 2005.

Jensen, A. S., and G. K. Silber. 2003. Large Whale Ship Strike Database. U.S. Dep. Commerce, NOAA Technical Memorandum NMFS-F/OPR-25, 37 pp.

Jessup, D. A., and F. A. Leighton. 1996. Oil pollution and petroleum toxicity to wildlife. In Noninfectious Diseases of Wildlife. A. Fairbrother, L. N. Locke and G. L. Hoff, eds. Ames, Iowa: Iowa State University Press. pp. 141-156.

Johnson, J. H., and A. A. Wolman. 1984. The humpback whale, *Megaptera novaeangliae*. Mar. Fish. Rev. 46:30-37.

Johnson, L. L., S. Y. Sol, G. M. Ylitalo, T. Hom, B. French, O. P. Olson, T. K. Collier. 1999. Reproductive injury in English sole (*Pleuronectes vetulus*) from the Hylebos Waterway, Commencement Bay, Washington. J. Eco. Stress Recov. 6:289-310.

Johnson S. W., A. D. Neff, and J. F. Thedinga. 2005. DRAFT An Atlas on the Distribution and Habitat of Common Fishes in Shallow Nearshore Waters of Southeastern Alaska. Auke Bay Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA Juneau Alaska.

Jones, R. E. 1981. Food habits of smaller marine mammals from northern California. Proc. Calif. Acad. Sci. 42:409-433.

Jurasz, C. M. and V. Jurasz. 1979. Feeding modes of the humpback whale, *Megaptera novaeangliae*, in southeast Alaska. Scientific Report of the Whales Research Institute of Tokyo 31:69-83.

Karcher, W., A. Nelson, R. Depaus, J. van Eijk, P. Glaude, and J. Jacob. 1981. New results in detection, identification and mutagenic testing of heterocyclic polycyclic aromatic hydrocarbons. *In* Chemical analysis and biological fate: Polynuclear aromatic hydrocarbons. M. Cooke and A.J. Dennis, eds. Battelle Press, Columbus, OH.

Kastak, D., R. J. Schusterman, B. L. Southall, C. J. Reichmuth. 1999. Underwater temporary threshold shift induced by octave-band noise in three species of pinniped. J. Acoust. Soc. Am. 106:1142-1148.

Kastelein, R. A., and F. C. Weltz. 1990. Distribution, abundance, reproduction and behavior of Steller sea lions (*Eumetopias jubatus*) in Prince William Sound, Alaska. Aquat. Mamm. 15:145-157.

Kastelein, R. A., R. van Schie, W. C. Verboom, and D. de Haan. In review. Underwater hearing sensitivity of a male and a female Steller sea lion (*Eumatopias jubatus*). J. Acoust. Soc. Am.

Kensington Venture. 1994. Geochemical Characterization of the Kensington Gold Deposit.

Kenyon, K. W., and D. W. Rice. 1961. Abundance and distribution of the Steller sea lion. J. Mamm. 42:223-234.

Ketten, D. R. 1998. Marine Mammal Auditory Systems: a summary of audiometric and anatomical data and its implicaitons for undrewater acoustic impacts. NOAA-TM-NMFS-SWFSC-256. NOAA, NMFS, La Jolla, California.

Kline, T. C. Jr. 2001. Trophic position of Pacific *herring* in Prince William Sound, *Alaska*, based on their stable isotope abundance. In Herring, Expectations for a New Millennium. pp. 69-80. Lowell Wakefield Fisheries Symposium Series [Lowell Wakefield Fish. Symp. Ser.]. no. 18.

Knowlton, A. R., F. T. Korsmeyer, J. E. Kerwin, H. Y. Wu, and B. Hynes. 1995. The hydrodynamic effects of large vessels on right whales. NMFS Contract No. 40EANFF400534.

Koski, K. V. Undated. Index of abundance and spawning habitat requirements of eulachon, a key forage fish for Steller sea lions. Interim Research Report, 02FF-10. NMFS, Auke Bay Laboratory, Juneau, AK. 6pp.

Koski, K. V. 2004. NMFS, AK Fisheries Science Center, Auke Bay Laboratory, Juneau, AK. Personal communication – meeting and photographic data provided to Erika Phillips, December 30, 2004.

Krieger, K. and B. L. Wing. 1984. Humpback whale prey studies in southeastern Alaska, Summer 1983. Northwest and Alaska Fisheries Center, Auke Bay Laboratory, Auke Bay, AK, 42 pp.

Krieger, K. and B. L. Wing. 1986. Hydroacoustic monitoring of prey to determine humpback whale movements. NOAA Technical Memorandum NMFS F/NWC-98, 62 pp.

Korhonen-Penn, I. 2004. Personal communication - emails to Aleria Jensen on January 6, 2005 and January 10, 2005.

LGL. 2003. LGL Alaska Research Associates, Acoustic Memorandum, in NPS (2003), Appendix C. 22 pp.

Ladich, F. and A. N. Popper. 2004. Parallel evolution in fish hearing organs. In: Evolution of the vertebrate auditory system, edited by G.A. Manley, A.N. Popper, and R. R. Fay (Springer-Verlag, New York), 98-127.

Laist, D. W., A. R. Knowlton, J. G. Mead, A. S. Collet, and M. Podesta. 2001. Collisions between ships and whales. Mar. Mam. Sci. 17:35-75.

Laprise, R. and J. J. Dodson. 1989a. Ontogeny and importance of tidal and vertical migrations in the retention of larval smelt (*Osmerus mordax*) in a well-mixed estuary. Mar. Ecol. Prog. Ser. 55:101-111.

Laprise, R. and J. J. Dodson. 1989b. Ontogenetic changes in the longitudinal distributions of two species of larval fish in a turbid well-mixed estuary. J. Fish. Biol. 35(Suppl. A):39-47.

Law, R. J. and J. A. Whinnett. 1992. Polycyclic aromatic hydrocarbons in muscle tissue of harbour porpoises (*Phocoena phocoena*) from UK waters. Mar. Poll. Bul. 24:550-553.

Lea, M-A. 2004. Doctoral Fellow, University of British Columbia, Vancouver, Canada. Personal communication email to Sharon Melin on December 10, 2004.

Lea, M-A. and B. Wilson. In Review. Techniques for real-time, active tracking of sea lions. Alaska Sea Grant, Sea Lions of the World Symposium.

Le Boeuf, B. J., M. Riedman, and R. Keyes. 1982. White shark predation on pinnipeds in California coastal waters. Fish. Bull. U.S. 80:891-895.

LeBoeuf, B. J., K. Ono, and J. Reiter. 1991. History of the Steller sea lion population at Año Nuevo Island, 1961-1991. Southwest Fish. Sci. Center Admin. Rep. LJ-91-45C. U.S. Dep. Commer., La Jolla, CA.

Lee, R. F., R. Sauerheber, and A. A. Benson. 1972. Petroleum hydrocarbons: uptake and discharge by the marine mussel *Mytilus edulis*. Science 177:344-6.

Levine, M. 2004. Personal communication. Email to Aleria Jensen on December 28, 2004.

Levins, R. 1970. Extinction. Some Mathematical Questions in Biology. M. Gerstenhaber (ed.). American Mathematical Society, Providence, RI. Pp 77-107.

Libenson, S. 2005. Personal communication. Email to Aleria Jensen on January 4, 2005.

Lien, J., S. Todd, P. Stevick, F. Marques, and D. Ketten. 1993. The reaction of humpback whales to underwater explosions: orientation, movements, and behavior. J. Acoust. Soc. Amer. 94:1849.

Livingston, P. A. 1993. Importance of predation by groundfish, marine mammals and birds on walleye pollock, Theragra chalcogramma, and Pacific herring, Clupea pallasi, in the eastern Bering Sea. Mar. Ecol. Prog. Ser. 102:205-215.

Long, D. J., K. Hanni, P. Pyle, J. Roletto, R. E. Jones, and R. Bandar. 1996. White shark predation on four pinniped species in central California waters: geographic and temporal patterns inferred from wounded carcasses. Pages 263-274, *in*: A. P. Klimley and D. G. Ainley (eds.), Great white sharks, the biology of *Carcharadon carcarias*. Academic Press, San Diego, CA.

Loughlin, T. R. 1993. Status and pelagic distribution of otariid pinnipeds in the Bering Sea during winter. OCS study, MMS 93-0026. U.S. Department of the Interior, Anchorage, AK, 58 pp.

Loughlin, T. R. 1997a. Trip report on Steller sea lion studies in the Aleutian Islands June 6-28, 1997. Unpublished report, 10 p. Available Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle WA 98115.

Loughlin, T.R. 1997b. Using the phylogeographic method to identify Steller sea lion stocks. Mol. Gen. Mar. Mamm. Spec. Pub. 3:159-171.

Loughlin, T.R. 2004. Contract Report to Coeur, Alaska. Attachment C, December 17, 2004.

Loughlin, T. R., and R. L. Merrick. 1989. Comparison of commercial harvest of walleye pollock and northern sea lion abundance in the Bering Sea and Gulf of Alaska, p. 679-700. In Proceedings of the International Symposium on the Biology and Management of Walleye Pollock, Nov. 14-16, 1988, Anchorage, Alaska. Alaska Sea Grant Report 89-1. Available Alaska Fisheries Science Center, 7600 Sand Point Way NE., Seattle WA 98115.

Loughlin, T. R., D. J. Rugh, and C. H. Fiscus. 1984. Northern sea lion distribution and abundance: 1956-1980. J. Wildl. Manage. 48:729-740.

Loughlin, T. R., and R. Nelson, Jr. 1986. Incidental mortality of northern sea lions in Shelikof Strait, Alaska. Mar. Mamm. Sci. 2:14-33.

Loughlin, T. R., M. A. Perez, R. L. Merrick. 1987. *Eumetopias jubatus*. Mamm. Spec. 283:1-7.

Loughlin, T. R., A. S. Perlov, and V. A. Vladimirov. 1992. Range-wide survey and estimation of total number of Steller sea lions in 1989. Mar. Mamm. Sci. 83:220-239.

Loughlin, T. R., A. S. Perlov, J. D. Baker, S. A. Blokhin, and A. G. Makhnyr. 1998. Diving behavior of adult female Steller sea lions in the Kuril Islands, Russia. Bios. Cons. 1:21-31.

Loughlin, T. R., and A. E. York. 2000. An accounting of the sources of Steller sea lion, *Eumatopias jubatus*, mortality. Mar. Fish. Rev. 62:40-45.

Loughlin, T. R., J. T. Sterling, R. L. Merrick, J. L. Sease, and A. E. York. 2003. Immature Steller sea lion foraging behavior. Fish. Bull. 101:566-582.

Magurran, A. E. and Pitcher, T. J. 1987. Provenance, shoal size and the sociobiology of predator evasion behaviour in minnow shoals. Proc. Roy. Soc. Lon. B 229:439–465.

Malme, C. I., P. R. Miles, C. W. Clark P. L. Tyack, and J. E. Bird. 1983. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior. Available from Bolt, Beranek and Newman, 10 Moulton Street, Cambridge, MA 02238

Malme, C. I., P. R. Miles, C. W. Clark P. L. Tyack, and J. E. Bird. 1984. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior. Phase II. Available from Bolt, Beranek and Newman, 10 Moulton Street, Cambridge, MA 02238

Malme, C. I., P. R. Miles, P. L. Tyack, C. W. Clark and J. E. Bird. 1985. Investigations of the potential effects of underwater noise from petroleum industry activities on feeding humpback whale behavior. Available from Bolt, Beranek and Newman, 10 Moulton Street, Cambridge, MA 02238.

Marsili, L., A. Caruso, M. C. Fossi, M. Zanardelli, E. Politi and S. Focardi. 2001. Polycyclic aromatic hydrocarbons (PAHs) in subcutaneous biopsies of Mediterranean cetaceans. Chemosphere 44: 147-154.

Marston, B. H., M. F. Willson, and S. M. Gende. 2002. Predator aggregations during eulachon *Thaleichthys pacificus* spawning runs. Mar. Ecol. Prog. Ser. 231:229-236.

Martin, A. R., S. K. Katona, D. Mattila, D. Hembree, and T. D. Waters. 1984. Migration of humpback whales between the Caribbean and Iceland. J. Mamm. 65:330-333.

Martin, M. and B.J. Richardson. 1991. Long term contaminant biomonitoring: Views from southern and northern Hemisphere perspectives. Mar. Poll. Bull. 22:533-537.

Martineau, D., A. Lagace, P. Beland, R. Higgins, D. Armstrong, and L. R. Shugart. 1988. Pathology of stranded Dl from the St. Lawrence Estuary. J. Comp. Pathol. 98:287-312.

Martineau, D., S. DeGuise, M. Fournier, L. Shugart, C. Girard, A. Lagace, and P. Beland. 1994. Pathology and toxicology of Beluga whales from the St. Lawrence Estuary, Quebec, Canada. Past, present and future. Sci. Total Environ. 154:201-215.

Mate, B. R., and J. T. Harvey. 1987. Acoustical Deterrents in Marine Mammal Conflicts with Fisheries. ORESU-W-86-001. Oregon State University Sea Grant College Program, Corvallis,OR.

McCarter, P. B. and D. E. Hay. 1999. Distribution of spawning eulachon stocks in the central coast of British Columbia as indicated by larval surveys. PSARC P99-8, 48 p.

McEwen, B. and E.N. Lasley. 2002. The End of Stress as We Know It. The Joseph Henry Press, Washington, DC. 285 p.

McGee, B. L., C. E. Schlekat, D. M. Boward, and T. L. Wade. 1995. Sediment contamination and biological effects in a Chesapeake Bay marina. Ecotox. 4:39-59.

McMahon, P. 1989. The impact of marinas on water-quality. Water science and technology 21(2): 39-43.

Merrick, R. L. 1995. The relationship of the foraging ecology of Steller sea lions (*Eumetopias jubatus*) to their population decline in Alaska. Ph.D. Dissertation, University of Washington, Seattle. 171 p.

Merrick, R. L. and D. G. Calkins. 1996. Importance of juvenile walleye pollock, _*Theragra chalcogramma*, in the diet of Gulf of Alaska Steller sea lions, *Eumetopias jubatus*, p. 153-166. In R. Brodeur, editor, Ecology of juvenile walleye pollock _*Theragra chalcogramma*, U.S. Department of Commerce, NOAA Technical Report NMFS 126, Seattle, WA.

Merrick, R. L., and T. R. Loughlin. 1997. Foraging behavior of adult female and young-of-the-year

Steller sea lions (*Eumetopias jubatus*) in Alaskan waters. Can. J. Zool. 75:776-786.

Merrick, R. L., T. R. Loughlin, and D. G. Calkins. 1987. Decline in abundance of the northern sea lion, *Eumetopias jubatus*, in 1956-86. Fish. Bull. U.S. 85:351-365.

Merrick, R. L., D. G. Calkins, and D. C. McAllister. 1992. Aerial and ship-based surveys of Steller sea lions in southeast Alaska, the Gulf of Alaska, and Aleutian Islands during June and July 1991. U.S. Dep. Commer, NOAA Tech Memo. NMFS-AFSC-1. 37p.

Merrick, R. L., R. Brown, D. G. Calkins, and T. R. Loughlin. 1995. A comparison of Steller sea lion, *Eumetopias jubatus*, pup masses between rookeries with increasing and decreasing populations. Fish. Bull. 93:753-758.

Merrick, R. L., K. Chumbley, and G. V. Byrd. 1997. Diet diversity of Steller sea lions (*Eumatopias jubatus*) and their population decline in Alaska: a potential relationship. Can. J. Fish. Aquat. Sci. 54:1342-1348.

Milette, L. L. and A. W. Trites. 2003. Maternal attendance patterns of lactating Steller sea lions (*Eumetopias jubatus*) from a stable and a declining population in Alaska. Can. J. Zool. 81:340-348.

Millward, R. N., K. R. Carman, J. W. Fleeger, R. P. Gambrell, and R. Portier. 2004. Mixtures of metals and hydrocarbons elicit complex responses by a benthic invertebrate community. J. Exp. Mar. Biol. Ecol. 310:115-130.

Mitson, R. B. and H. P. Knudsen. 2003. Causes and effects of underwater noise on fish abundance estimation. Aquat. Living Resourc. 16:255-263.

Mizroch, S. A., L. Shaw, K. Laidre, and K. Brix. 1998. Seasonal distribution of marine mammals based on observations from the Alaska State Ferries. 18 pp.

Mizroch, S. A., L. M. Herman, J. M. Straley, D. Glockner-Ferrari, C. Jurasz, J. Darling, S. Cerchio, C. Gabriele, D. Salden, O. von Ziegesar. 2004. Estimating the adult survival rate of central North Pacific humpback whales (*Megaptera novaeangliae*). J. Mamm. 85:963-972.

Moore, S. F. and R. L. Dwyer. 1974. Effects of oil on marine organisms: a critical assessment of published data. Water Res. 8:819-827.

Moyle, P. B. and J. J. Cech, Jr. 1988. Fishes: an introduction to ichthyology. Prentice-Hall, Inc. New Jersey 07632.

National Academy of Sciences. 1985. Oil in the Sea. Natl. Academy Press, Washington, D.C.

National Marine Fisheries Service (NMFS). 1991. Recovery plan for the humpback whale (*Megaptera novaeangliae*). Prepared by the humpback recovery team for the National Marine Fisheries Service, Silver Spring, Maryland. 105 pp.

National Marine Fisheries Service (NMFS). 1992. Recovery Plan for the Steller Sea Lion (*Eumetopias jubatus*). Prepared by the Steller Sea Lion Recovery Team for the National Marine Fisheries Service, Silver Spring, MD. 92 pp.

National Marine Fisheries Service (NMFS). 1995. Status review of the United States Steller sea lion (*Eumetopias jubatus*) population. Prepared by the National Marine Mammal Laboratory, AFSC, NMFS, NOAA, 7600 Sand Point Way NE, Seattle, WA 98115. 61 pp.

National Marine Fisheries Service (NMFS). 1998. Final Endangered Species Act Section 7 Consultation Handbook: Procedures for Conducting Section 7 Consultations And Conferences.

National Marine Fisheries Service (NMFS). 2000. Section 7 consultation on the authorization of the Bering Sea and Aleutian Islands groundfish fishery under the BSAI FMP and the authorization of the Gulf of Alaska groundfish fishery under the GOA FMP. Office of Protected Resources, NMFS. Nov. 30, 2000.

National Marine Fisheries Service (NMFS). 2001a. Steller sea lion Protection Measures Final Supplemental Environmental Impact Statement. NMFS Alaska Region, Juneau Ak.

National Marine Fisheries Service. 2001b. Endangered Species Act-section 7 consultation, Draft Biological Opinion and Incidental Take Statement, August 2001. Appendix A to the Draft SEIS for Steller Sea Lion Protection Measures, August 2001.

National Marine Fisheries Service (NMFS). 2002. Final Rule regarding the Taking and Importing of Marine Mammals; Taking Marine Mammals Incidental to Navy Operations of Surveillance Towed Array Sensor System Low Frequency Active Sonar, publ. 67 FR 46712, July 16, 2002.

National Marine Fisheries Service (NMFS). 2003a. Endangered Species Act section 7 final biological opinion on proposed vessel quotas and operating requirements for Glacier Bay National Park and Preserve. Alaska Regional Office, NMFS. August 5, 2003. 76 p.

National Marine Fisheries Service (NMFS). 2003b. Supplement to the Endangered Species Act section 7 consultation biological opinion and incidental take statement of October 2001. Alaska Regional Office, NMFS, Juneau, AK. June 19, 2003. 186 p.

National Marine Fisheries Service (NMFS). 2004. Berners Bay dive survey, Juneau, AK.

National Marine Fisheries Service (NMFS). 2005. Federal Register Notice of Public Scoping and Intent to Prepare an Environmental Impact Statement [to analyze new acoustic criteria for MMPA ‘take’ guidelines], Vol. 70, no. 7, January 11, 2005.

National Ocean Service. 1998. NOAA Fact Sheet: Small Diesel Spills (500-5000 gallons). Online publication of the Hazardous Materials Response and Assessment Division, Office of Response and Restoration, National Oceanic and Atmospheric Administration, Seattle, WA.

http://response.restoration.noaa.gov/oilaids/diesel.pdf

National Research Council (NRC), Committee on the Bering Sea Ecosystem. 1996. The Bering Sea Ecosystem. National Academy Press, Washington, D.C.

National Research Council (NRC), Ocean Studies Board, Marine Board, Divisions of Earth and Life Studies and Transportation Research Board. 2003. Oil in the Sea III: Inputs, Fates and Effects. National Academy Press, Washington, D.C. 265pp.

National Research Council (NRC), Ocean Studies Board. 2005. Marine Mammal Populations and Ocean Noise: Determining When Noise Causes Biologically Significant Effects. National Academy Press, Washington, D.C., 126 pp.

NOAA Ocean Explorer 2005. Explorations; Sounds in the Sea: Background, Understanding Ocean Acoustics. S. Nieukirk, Acoustic Monitoring Project, NOAA Pacific Marine Environmental Laboratory. http://oceanexplorer.noaa.gov/explorations/sound01/background/acoustics/acoustics.html

National Park Service (NPS). 1995. Glacier Bay National Park and Preserve, Vessel Management Plan and Environmental Assessment, NPS, Alaska Region, May 1995.

National Park Service. 2003. Draft Environmental Impact Statement, Vessel Quotas and Operating Requirements. Glacier Bay National Park and Preserve, Alaska; National Park Service, Department of the Interior. March 2003.

National Toxicology Program. 1986. Toxicology and carcinogenesis studies of marine diesel fuel and Jp-5 Navy fuel. National Toxicology Program Technical Report Series, No. 310. U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health, Research Triangle Park, NC. 208pp.

Nedwell, J. R., B. Edwards, A. W. H. Turnpenny, and J. Gordon. 2004. Fish and marine mammal audiograms: A summary of available information. Subacoustech Report Reference: 534R0214.

Neff, J. M. 1990. Composition and Fate of Petroleum and Spill-Treating Agents in the Marine Environment. In *Sea Mammals and Oil: Confronting the Risks*, ed. J.R. Geraci and D.J. St. Aubin. Academic Press, Inc., San Diego, CA.

Nemoto, T. 1957. Foods of baleen whales in the northern Pacific. Sci. Rep. Whales Res. Inst. Tokyo 12:33-89.

Nishiwaki, M. 1966. Distribution and migration of the larger cetaceans in the North Pacific as shown by Japanese whaling results. Pp. 172-191, *In* K. S. Norris (ed.), Whales, Dolphins and Porpoises, University of California Press, Berkeley, CA. Academic Press, New York.

Norcross, B. L., E. D. Brown, R. J. Foy, M. Frandsen, S. M. Gay, T. C. Kline Jr., D. M. Mason, E. V. Patrick, A. J. Paul, and K. D. Stokesbury. 2001. A synthesis of the life history and ecology of juvenile and Pacific herring in Prince William Sound, Alaska. Fish. Ocean. 10(Suppl.1):42-57.

O'Clair, R. M., S. C. Lindstrom, and I. R. Brodo. 1996. Southeast Alaska's Rocky Shores. Seaweeds and Lichens. Plant Press, Auke Bay, AK. 152 pp.

Olesiuk, P. F., and M. A. Bigg. 1990. Seals and sea lions on the British Columbia coast. Unpublished manuscript, 12 p. Available Dep. Fish. Oceans, Fisheries Research Branch, Pacific Biological Station, Nanaimo, B.C., Canada.

Olsen, K. 1971. Influence of vessel noise on behaviour of herring. *In* Modern Fishing Gears of the World, pp. 291–294. Ed. by H. Kristjonsson, Fishing News Books, London.

Olsen, K, Agnell, J., Pettersen, F., Lovik, A. 1983. Observed fish reactions to a surveying vessel with special reference to herring, cod, capelin, and polar fish. In: Nakken, O., Venema, C.S. (Eds.), Symposium on Fisheries Acoustics, Bergen, Norway. FAO Fish. Rep. 300, 139-149.

Orlov, A. M. 1999. Capture of especially large sleeper shark *Somniosus pacificus* (Squalidae) with some notes on its ecology in the northwestern Pacific. J. Ichth. 39:548-553.

Orr, R. T. and T. C. Poulter. 1967. Some observations on reproduction, growth, and social behavior in the Steller sea lion. Proc. Cal. Acad. Sci. 35:193-226.

O'Shea, T. J. 1999. Environmental contaminants and marine mammals. In: Reynolds III, J.E., Rommel, S.A. (Eds)., Biology of Marine Mammals. Smithsonian Institution Press, Washington, DC, pp. 485-536.

Pahlke, K. A. 1985. Preliminary studies of capelin (*Mallotus villosus*) in Alaskan waters. Alaska Department of Fish and Game, Informational Leaflet, 250. 64 pp.

Paul, A. J. and J. M. Paul. 1998. Spring and summer whole-body energy content of Alaskan juvenile Pacific herring. Alaska Fishery Research Bulletin 5(2): 131-136.

Payne, S. A., B.A. Johnson, and R. S. Otto. 1999. Proximate composition of some northeastern Pacific forage species. Fish. Ocean. 8:159–177.

Pearson, W. H., R. A. Elston, R. W. Bienert. 1999. Why did the Prince William Sound, Alaska, Pacific Herring (Clupea pallasi) fisery collapse in 1993 and 1994? Review of Hypotheses. Can. J. Fish. Aquat. Sci. 56:711-737.

Perry, A., C. S. Baker, and L. M. Herman. 1990. Population characteristics of individually identified humpback whales in the central and eastern North Pacific: a summary and critique. Rep. Int. Whal. Comm. (Spec. Issue 12):307-317.

Perry, S. L., D. P. DeMaster, and G. K. Silber. 1999. Special Issue: The Great Whales: History and Status of Six Species Listed as Endangered Under the U.S. Endangered Species Act of 1973. Mar. Fish. Rev. 61(1).

Popper, A. N., R. R. Fay, C. Platt, and O. SAnd. 2003. "Sound detection mechanisms and capabilities of teleost fishes." In: Sensory Processing in Aquatic Environments, edited by S.P. Collins and N.J. Marshall. Springer-Verlag, New York, pp. 3-38.

Porter, B. 1997. Winter ecology of Steller sea lions (*Emetopias jubatus*) in Alaska. M.S. thesis. University of British Columbia, British Columbia, Canada. 84 p.

Perez, M. 2004. Analysis of marine mammal bycatch data from the trawl, longline, and pot groundfish fisheries of Alaska, 1998-2003, defined by geographic area, gear type, and target groundfish catch species. Draft NOAA Technical Memorandum NMFS-AFSC, December 2004. 151 p.

Peterson, H. A. 2001. Whale behavioral responses and human perceptions: an assessment of humpback whales (*Megaptera novaeangliae*) and vessel activity near Juneau, Alaska. Masters Thesis. Nicholas School of the Environment, Duke University. 50 pp.

Piatt, J. F. and P. J. Anderson. 1996. Responses of common murres to the Exxon Valdez oil spill and long-term changes in the Gulf of Alaska ecosystem. Amer. Fish. Soc. Symp. 18:720-737.

Pitcher, K. W., and D. G. Calkins. 1981. Reproductive biology of Steller sea lions in the Gulf of Alaska. J. Mamm. 62:599-605.

Pitcher, K. W., D. G. Calkins, and G. W. Pendleton. 1998. Reproductive performance of female Steller sea lions: an energetics-based reproductive strategy? Can. J. Zool. 76:2075-2083.

Pitcher, T. J., O. A. Misund, A. Fernö, B. Totland, and V. Melle. 1996. Adaptive behaviour of herring schools in the Norwegian Sea as revealed by high-resolution sonar. – ICES J. Mar. Sci. 53:449–452.

Pritchett, M. 2005. Alaska Dept. of Fish & Game. Personal communication – email and information provided to Susan Walker on February 1, 2005.

Quinn, T. 2004. Personal communication – conversation and information given to Aleria Jensen on December 23, 2004.

Raum-Suryan, K. L., K. W. Pitcher, D. G. Calkins, J. L. Sease, and T. R. Loughlin. 2002. Dispersal, rookery fidelity and metapopulation structure of Steller sea lions (*Eumetopias jubatus*) in an increasing and a decreasing population in Alaska. Mar. Mamm. Sci. 18:746-764.

Raum-Suryan, K. L., M. J. Rehberg, G. W. Pendleton, K. W. Pitcher, and T. S. Gelatt. 2004. Development of dispersal, movement patterns, and haul-out use by pup and juvenile Steller sea lions (*Eumetopias jubatus*) in Alaska. Mar. Mam. Sci. 20:823-850.

Ream, R. R. (2002). Molecular Ecology of North Pacific Otariids: Genetic assessment of northern fur seal and Steller sea lion distributions. Ph.D. Thesis. University of Washington, Seattle. 135 p.

Rea, L. 2005. Steller Sea Lion Research Leader, Alaska Department of Fish and Game. Personal communication with Sharon Melin, January 10, 2005.

Repenning, C. A. 1976. Adaptive evolution of sea lions and walruses. Syst. Zool. 25:375-390. National Research Council, Committee on the Bering Sea Ecosystem. 1996. The Bering Sea Ecosystem. National Academy Press, Washington, D.C.

Rice, S. D. 2005. NMFS Auke Bay Laboratory. Personal communication – email to Erika Phillips on January 18, 2005.

Richardson, W. J. and C. R. Greene Jr. 1993. Variability in behavioral reaction thresholds of bowhead whales to man-made underwater sounds. J. Acoust. Soc. Amer. 94 (3, Pt. 2):1848.

Richardson, W. J., R. A. Davis, C. R. Evans, P. Norton. 1985. Distribution of bowheads and industrial activity, 1980-1984. pg. 255-306 In: WJ Richardson (ed.), Behavior, disturbance reponses and distribution of bowhead whales *Balaena mysticetus* in the eastern Beaufort Sea, 1980-1984. OCS Study MMS 85-0034. Rep. from LGL Ecol. Res. Assoc., Inc., Bryan, TX, for U.S. Minerals Management Service, Reston, Virginia. 306 pp. NTIS PB87-124376.

Richardson, W. J., C. R. Greene Jr., C. I. Malme, D. R. Thomson. 1995. Marine Mammals and Noise, Academic Press, New York. 576 pp.

Rounsefell, G. A and E. H. Dahlgren. 1935. Races of herring, *Clupea pallasii* in southeastern Alaska. Bull. Bureau of Fish. US Department of Commerce, Washington DC. Vol. XLVIII, Bulletin 17:119-141.

Russell, L. 2004. Personal communication. Email to Aleria Jensen on December 17, 2004 and December 27, 2004.

Schrader, C. 2005. Personal communication. Email to Aleria Jensen on January 6, 2005.

Schrader, S. 2005. Personal communication. Email to Aleria Jensen on January 10, 2005.

Sease, J. L. and C. J. Gudmundson. 2002. Aerial and land-based surveys of Steller sea lions (*Eumetopias jubatus*) from the western stock in Alaska, June and July 2001 and 2002. NOAA Tech. Memo. NMFS-AFSC-131. 45 pp.

Sease, J. L. and T. R. Loughlin. 1999. Aerial and land-based surveys of Steller sea lions (*Eumetopias jubatus*) in Alaska, June and July 1997 and 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-100, 61 p.

Sease, J. L., J. M. Strick, R. L. Merrick, and J. P. Lewis. 1999. Aerial and land-based surveys of Steller sea lions (*Eumetopias jubatus*) in Alaska, June and July 1996. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-99, 43 pp.

Sease, J. L., W. P. Taylor, T. R. Loughlin, and K. W. Pitcher. 2001. Aerial and land-based surveys of Steller sea lions (*Eumetopias jubatus*) in Alaska, June and July 1999 and 2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-122, 52p.

Sharpe, F. A. 2002. Social foraging of the southeast Alaskan humpback whale, *Megaptera novaengliae*. Dissertation Abstracts International Part B: Science and Engineering, 62:3872.

Sharpe, F. A. and L. M. Dill. 1997. The behavior of Pacific herring schools in response to artificial humpback whale bubbles. Can. J. Zool. 75:725-730.

Shima, M., A. B. Hollowed, and G. R. VanBlaricom. 2000. Response of pinniped populations to directed harvest, climate variability, and commercial fishery activity: A comparative analysis. Rev. Fish. Sci. 8:89-124.

Sigler, M. 2005. Personal communication in Memorandum for the Record from S. Ignell, Minutes of Auke Bay Lab Project Managers Meeting, NMFS, March 7, 2005.

Sigler, M. F., J. N. Womble, and J. J. Vollenweider. 2004. Availability to Steller sea lions *(Eumetopias jubatus*) of a seasonal prey resource: a pre-spawning aggregation of eulachon (*Thaleichthys pacificus*). Can. J. Fish. Aquat. Sci. 61:1475-1484.

Sinclair, E. and T. Zeppelin. 2002. Seasonal and spatial differences in diet in the western stock of Steller sea lions (*Eumetopias jubatus*). J. Mammal. 83:973-990.

Sirois, P. and J. J. Dodson. 2000. Influence of turbidity, food density and parasites on the ingestion and growth of larval rainbow smelt (*Osmerus mordax*) in an estuarine turbidity maximum. Mar. Ecol. Prog. Ser. 193:167-179.

Skud, B. E. 1959. Herring tagging experiments in southeastern Alaska. Fish. Bull. 63:19-32.

Skud, B. E. 1962. Herring tagging experiments in southeastern Alaska. Fish. Bull. Bureau of Commercial Fisheries 63:19-32.

Slotte, A. 1996. Relations between seasonal migrations and fat content in Norwegian spring spawning herring, with emphasis on methodological aspects (*Clupea harengus L.*). ICES C,M. 1996/H:11.

Sorenson, J. P. 1991. The Interaction of pH, Dissolved Organic Carbon, and Total Copper in the determination of Ionic Copper and Toxicity. Aquat. Tox. 19:13-32.

Soria, M., P. Fréon, and F. Gerlotto. 1996. Analysis of vessel influence on spatial behaviour of fish schools using a multi-beam sonar and consequences for biomass estimates by echo-sounder. ICES J. Mar. Sci. 53:453–458.

Spalding, D. J. 1964. Comparative feeding habits of the fur seal, sea lion and harbour seal on the British Columbia coast. Fish. Res. Board Can. Bull. No. 146. 52 p.

St. Aubin, D. J. 1990. Physiological and Toxic Effects on Pinnipeds. In *Sea Mammals and Oil: Confronting the Risks*, ed. J.R. Geraci and D.J. St. Aubin. Academic Press, Inc., San Diego, CA.

St.Aubin, D. J., R. H. Stinson, J. R. Geraci. 1984. Aspects of the structure and composition of baleen, and some effects of exposure to petroleum-hydrocarbons. Can. J. Zool. 62:193-198.

Stearns, S. C. 1992. The evolution of life histories. New York, New York, Oxford University Press.

Steiger, G. H., J. Calambokidis, R. Sears, K. C. Balcomb, and J. C. Cubbage. 1991. Movement of humpback whales between California and Costa Rica. Mar. Mamm. Sci. 7:306-310.

Stekoll, M. 2005. University of Alaska. Personal communication -- meeting with Erika Phillips and Susan Walker on March 16, 2005.

Stekoll, M. S. Undated a. Subtidal biological survey of Cascade Point. University of Alaska Southeast, Juneau, AK. 14pp.

Stekoll, M. S. Undated b. Biological Survey of Slate Creek Terminal Site, Berner's Bay, Southeast Alaska. University of Alaska Southeast, Juneau, AK. 16pp.

Stokesbury, K. D., J. Kirsch, E. D. Brown, G. L. Thomas and B. L. Norcross. 1999. Spatial distributions of Pacific herring, *Clupea pallasi*, and walleye pollock, *Theragra chal-cogramma*, in Prince William Sound, Alaska. Fish. Bull. U.S. 98:400–409.

Straley, J. M., C. M. Gabriele, and C. S. Baker. 1995. Seasonal characteristics of humpback whales (*Megaptera novaengliae*) in southeastern Alaska. Pages 229-237 in D. R. Engstrom, ed. Proceedings of the Third Glacier Bay Science Symposium, 1993. National Park Service, Anchorage, AK.

Straley, J. M., T. J. Quinn, and C. M. Gabriele. 2002. Estimate of the abundance of humpback whales in southeastern Alaska 1994-2000. Rept to NMFS, NMML, Grant No. G00000756, SFOS02-223, Seattle Washington, October 2001. 22 pp.

Strick, J. M., L. W. Fritz, and J. P. Lewis. 1997. Aerial and ship-based surveys of Steller sea lions *Eumetopias jubatus*) in southeast Alaska, the Gulf of Alaska, and Aleutian Islands during June and July 1994. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-71, 55 pp.

Swingle, W. M., S. G. Barco, and T. D. Pitchford.1993. Appearance of juvenile humpback whales feeding in the nearshore waters of Virginia. Mar. Mamm. Sci. 9:309-315.

Thomas, G. L. and R. E. Thorne. 2001. Night-time predation by Steller sea lions. Nature 411:1013.

Thomas, G. L. and R. E. Thorne. 2003. Acoustical-optical assessment of Pacific herring and their predator assemblage in Prince William Sound, Alaska. Aquat. Living Resourc. 16:247-253.

Thompson, T. J., H. E. Winn, and P. J. Perkins. 1979. Mysticete sounds. Pages 403-431. *In:* H.E. Winn and B.L. Olla (editors). Behavior of Marine Animals. Vol. 3. Cetaceans. Plenum Press; New York, New York.

Thompson, P. O., W. C. Cummings, S. J. Ha. 1986. Sounds, source levels, and associated behavior of humpback whales, southeast Alaska. J. Acoust. Soc. Amer. 80:735-740.

Todd, S., P. Stevick, J. Lienp, F. Marques, and D. Ketten. 1996. Behavioural effects of exposure to underwater explosions in humpback whales (*Megaptera novaeangliae*). Can. J. Zool. 74:1661-1672.

Tomlin, A. G. 1967. Mammals of the USSR and adjacent countries. vol. 9, Cetacea. Israel Program Sci. Transl. No. 1124, Natl. Tech. Info. Serv. TT 65-50086. Springfield, VA. 717 pp. (Translation of Russian text published in 1957).

Treacy, S. D. 1985. Feeding habits of marine mammals from Grays Harbor, Washington to Netarts Bay, Oregon. Pages 149-198 *in*: R. J. Beach, A. C. Geiger, S. J. Jeffries, and B. L. Troutman (eds.). Marine mammals and their interactions with fisheries of the Columbia River and adjacent waters. NWAFC Proc. Rep. 85-04.

Trillmich, F. and K. A. Ono. 1991. Pinnipeds and El Niño: responses to environmental stress. Ecological Studies 88, Springer-Verlag, Berlin, Germany. 293 p.

Trites, A.W. and P.A. Larkin. 1992. The status of Steller sea lion populations and the development of fisheries in the Gulf of Alaska and Aleutian Islands. A report of the Pacific States Marine Fisheries Commission pursuant to National Oceanic and Atmospheric Administration Award No. NA17FD0177. Fisheries Centre, University of British Columbia, Vancouver, British Columbia, Canada V6T 1Z4.

Trites, A. W. and P. A. Larkin. 1996. Changes in the abundance of Steller sea lions (*Eumetopias jubatus*) in Alaska from 1956 to 1992: how many were there? Aquat. Mamm. 22:153-166.

Trites, A. W. and B. T. Porter. 2002. Attendance patterns of Steller sea lions (*Eumetopias jubatus*) and their young during winter. J. Zool. Lon. 256:547-556.

Trites, A. W., D. G. Calkins, and A. J. Winship. 2003. Diets of Steller sea lions (*Eumetopias jubatus*) in southeast Alaska from 1993 to 1999. Unpublished Manuscript.

Trumble, R. J. 1983. Habitat Protection. Pages 113-114 IN K. Buchanan, ed. Proceedings of the Fourth Pacific Coast Herring Workshop, October 1981. Can. Maunscr. Rep. Fish. Aquat. Sci. 151 pp.

United States Coast Guard (USCG). 2003. Pollution Incidents In and Around U.S. Waters, A Spill/Release Compendium: 1969 – 2001. Office of Investigations and Analysis, Washington, D.C. http://www.uscg.mil/hq/g-m/nmc/response/stats/aa.htm

United States Environmental Protection Agency (EPA). 2004. National Pollutant Discharge Elimination System (NPDES) Fact Sheet. NPDES Number: AK-005057-1. June 21, 2004.

United States Forest Service (USFS). 2004. Kensington Gold Project Biological Assessment/Biological Evalution for Threatened, Endangered and Forest Service Sensitive Listed Wildlife Species. Prepared by Tetra Tech, Inc., November 15, 2004.

United States Forest Service (USFS). 2004. Final Supplemental Environmental Impact Statement for the Kensington Gold Project. Prepared by Tetra Tech, Inc., December 2004.

United States Fish and Wildlife Service (USFWS). 1998. Report of field investigations for proposed marine facility in Berners Bay off Cascade Point. Prepared by the Southeast Alaska Ecological Services Office, Juneau, AK. 6 pp.

United States Fish and Wildlife Service (USFWS). 2003. Wildlife and Human Use of the Shoreline and Near-shore Waters of Berners Bay, southeast Alaska: A Preliminary Report. Prepared by the Juneau Fish and Wildlife Office and the Juneau Waterfowl Investigations Office, 7 pp + figures.

Vabø, R., K. Olsen, and I. Huse. 2001. The effect of vessel avoidance of wintering Norwegian spring spawning herring. Fish. Res. 58:59-77.

Varanasi, U. and D. C. Malins. 1977. Metabolism of petroleum hydrocarbons: accumulation and biotranformation in marine organisms. *In* Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms, Volume II: Biological Effects. D.C. Malins, ed. Academic Press, Inc. New York, NY. 500 pp.

Varanasi, U., J. E. Stein, W. L. Reichert, K. L. Tilbury, and S-L. Chan. 1992. Chlorinated and aromatic hydrocarbons in bottom sediments, fish, and marine mammals in US coastal waters: laboratory and field studies of metabolism and accumulation. Pp. 83-115, *In* Walker, C.H. and D.R. Livingstone (eds.), Persistent Pollutants in Marine Ecosystems. Pergamon Press, Oxford, UK.

Vollenweider, J. J. 2004. Variability in Steller sea lion (*Eumetopias jubatus*) prey quality in Southeastern Alaska. Master of Science Thesis, University of Alaska Fairbanks, Fairbanks, AK. 64 p.

Vollenweider, J. 2005. University of Alaska, Fairbanks. Personal communication and data by email to Sharon Melin on January 4 and 11, 2005 and Susan Walker, January 2005.

von Ziegesar, O. 1992. A catalogue of Prince William Sound humpback whales identified by fluke photographs between the years 1977 and 1991. North Gulf Oceanic Society, P. O. Box 15244, Homer, AK. 29 pp.

Waite, J. M., M. E. Dahlheim, R. C. Hobbs, S. A. Mizroch, O. von Ziegesar-Matkin, J. M. Straley, L. M. Herman, and J. Jacobsen. 1999. Evidence of a feeding aggregation of humpback whales (*Megaptera novaeangliae*) around Kodiak Island, Alaska. Mar. Mammal Sci. 15:210-220.

Watkins, W. A. 1986. Whale reactions to human activities in Cape Cod waters. Mar. Mamm. Sci. 2:251-262.

Wespestad, V. G. and E. Moksness. 1990. Observations on growth and survival during the early life history of Pacific herring, Cluea pallasii, from Bristol Bay, Alaska, in a marine mesocosm. U.S. Fish. Bull. 88:191-200.

Westlake, R. L., W. L. Perryman, and K. A. Ono. 1997. Comparison of vertical aerial photographic and ground censuses of Steller sea lions at Año Nuevo Island, July 1990-1993. Mar. Mammal Sci. 13:207-218.

Whitehead, P. J. P., 1985. King Herring: his place amongst the clupeoids. Can. J. Fish. Aqua. Sci. 42 (Suppl. 1):3-20.

Wilderbuer, T. K. and T. Sample. 2000. Arrowtooth flounder. 2000 Groundfish Stock Assessments and Fishery Evaluation Reports for the Gulf of Alaska, North Pacific Fishery Management Council, Anchorage AK (www.fakr.noaa.gov/npfmc/safes/).

Wiley, D. N., R. A. Asmutis, T. D. Pitchford, and D. P. Gannon.1995. Stranding and mortality of humpback whales, *Megaptera novaeanglia*e, in the mid-Atlantic and southeast United States, 1985-1992. Fish. Bull. U.S. 93:196-205.

Willson, M. F., R. H. Armstrong, and M. C. Hermans. 2003. Eulachon: A review of biology and annotated bibliography. Final Report to National Marine Fisheries Service. Juneau, Alaska.

Wing, B. L. 2004. Research Fishery Scientist, Alaska Fishery Science Center, Auke Bay Laboratory Personal. Personal Communication with Susan Walker regarding the history of Pacific herring spawning in Auke Bay from 1960's to present, June 2004.

Wing, B.L. and K. Krieger. 1983. Humpback whale prey studies in southeastern Alaska, summer 1982. Report to the Northwest and Alaska Fisheries Center Auke Bay Laboratory, National Marine Fisheries Service, NOAA, P.O. Box 155, Auke Bay, Alaska, 99821, 60 pp.

Winn, H. E, P. J. Perkins, and L. Winn. 1970. Sounds and behavior of the northern bottlenosed whale. Pages 53-59. *In*: Proceedings of the 7th Annual Conference on the Biology, Sonar and Diving of Mammals. Stanford Research Institute; Menlo Park, California.

Winship, A. J. and A. W. Trites. 2003. Prey consumption of Steller sea lions (*Eumetopias jubatus*) off Alaska: How much prey do they require? Fish. Bull. 101:147-167.

Winship, A. J., A. W. Trites and D. G. Calkins. 2001. Growth in body size of Steller sea lions (*Eumetopias jubatus*). J. Mamm. 82:500-519.

Winship, A. J, A. W. Trites, and D. A. S. Rosen. 2002. A bioenergetic model for estimating the food requirements of Steller sea lions (*Eumetopias jubatus*) in Alaska, USA. Mar. Ecol. Prog. Ser. 229:291-312.

Winters, G. H. 1970. Biological changes in coastal capelin from the over-wintering to the spawning condition. J. Fish. Res. Board Can. 17: 2215-2224.

Wolfe, R. J. and C. Mishler. 1993. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1992. Final report for year one, subsistence study and monitor system (no. 50ABNF20055). Prepared for the NMFS by Alaska Dept. Fish and Game, Juneau, Alaska, 94 p.

Wolfe, R. J. and C. Mishler. 1994. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1993. Final report for year two, subsistence study and monitor system (no. 50ABNF20055). Prepared for NMFS by Alaska Dept. Fish and Game, Juneau, Alaska, 60 p.

Wolfe, R. J. and C. Mishler. 1995. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1994. Final report for year three, subsistence study and monitor system (no. 50ABNF20055). Prepared for NMFS by Alaska Dept. Fish and Game, Juneau, Alaska, 69 p.

Wolfe, R. J. and C. Mishler. 1996. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1995. Final report for year four, subsistence study and monitor system (no. 50ABNF400080). Prepared for NMFS by Alaska Dept. Fish and Game, Juneau, Alaska, 69 p.

Wolfe, R. J. and C. Mishler. 1997. The subsistence harvest of harbor seal and sea lion by Alaska natives in 1996. Technical Paper 241. Draft Final report for year five, subsistence study and monitor system (no. 50ABNF400080). Prepared for NMFS by Alaska Dept. Fish and Game, Juneau, Alaska, 70 p.

Wolfe, R. J. and L. B. Hutchinson-Scarbrough. 1999. The subsistence harvest of harbor seals and sea lions by Alaska Natives in 1998. Technical paper No. 250. Alaska Dept. Fish and Game, Division of Subsistence, Juneau, Alaska.

Wolfe, R. J., J. A. Fall, and R. T. Stanek. 2002. The subsistence harvest of harbor seals and sea lions by Alaska natives in 2001. Alaska Department of Fish and Game, Division of Subsistance Technical Paper No. 273. Juneau, AK.

Womble, J. N. 2003. Seasonal distribution of Steller Sea Lions (*Eumetopias jubatus*) in relation to high-quality ephemeral prey species in southeastern Alaska. Master's Thesis. University of Alaska Fairbanks, Fairbanks Alaska.

Womble, J. 2005. University of Alaska, Southeast. Personal communication. Meeting with Sharon Melin and Aleria Jensen, Juneau, AK, January 5, 2005, and email to Sharon Melin January 6, 2005.

Womble, J. N., M. F. Willson, M. F. Sigler, B. P. Kelly, and G. R. VanBlaricom. In Press. Distribution of Steller sea lions *Eumetopias jubatus* in relation to spring-spawning fish species in southeastern Alaska. Mar. Ecol. Prog. Ser.

Wyllie-Echeverria, T., and W. S. Wooster. 1998. Year-to-year variations in Bering Sea ice cover and some consequences for fish distributions. Fish. Oceanogr. 7:159-170.

Wyllie-Echeverria, T., D. O. Duggins, and S. Wyllie-Echeverria. 2003. Evaluation of an Artificial Rock Reef for Colonization by Macroalgae. Proceedings from the Georgia Basin/Puget Sound Research Conference. Eds. T.W. Droscher and D.A. Fraser. Vancouver, British Columbia.

Wyllie-Echeverria, T. 2005. Personal communication - email provided to Erika Phillips on January 6, 2005.

Yablokov, A. V. 1994. Validity of whaling data. Nature 367:108.

Yang. M-S. and B. N. Page. 1998. Diet of Pacific sleeper shark, *Somniosus pacificus*, in the Gulf of Alaska. Fish. Bull. 97:406-409.

York, A. E. 1994. The population dynamics of northern sea lions 1975-85. Mar. Mamm. Sci 10:38-51.

York, A. E., R. L. Merrick, and T. R. Loughlin. 1996. An analysis of the Steller sea lion metapopulation in Alaska. Chapter 12, Pp. 259-292, *In* D. R. McCullough (ed.), Metapopulations and wildlife conservation.