Designation of Critical Habitat for Southern Resident Killer Whales

Biological Report

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NATIONAL MARINE FISHERIES SERVICE
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Table of Contents

Overview

On November 18, 2005, NOAA Fisheries listed the Southern Resident killer whale Distinct Population Segment (DPS) as "endangered" under the Endangered Species Act (ESA) and a proposal to designate critical habitat was published on June 15, 2006. The ESA requires that critical habitat must be designated for listed species, with public notice and an opportunity for comment.

Southern Resident killer whales (*Orcinus orca*) are long-lived marine mammals and are major predators of salmon and other fishes. Killer whales exhibit advanced vocal communication and live in highly stable social groupings, or pods, led by matriarchal females. Southern Resident killer whales spend a significant portion of the year in the inland waterways of the Strait of Georgia, Strait of Juan de Fuca, and Puget Sound, particularly during the spring, summer and fall. Southern Residents occur in coastal waters off Washington, Oregon and Vancouver Island and are known to travel as far south as central California and as far north as the Queen Charlotte Islands, British Columbia (Figure 1). Information on the range of Southern Residents along the outer Pacific Coast is limited, with only 28 confirmed coastal sightings over the last 30 years (Krahn et al. 2004, NWFSC unpubl. data). This report contains a biological assessment of Southern Resident natural history, movements and habitat use to support a proposed critical habitat designation for Southern Resident killer whales.

Critical Habitat

Critical habitat is defined in section 3 of the ESA (16 U.S.C. 1532(3)) as: (1) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the ESA, in which are found those physical or biological features (a) essential to the conservation of the species and (b) which may require special

management considerations or protection; and (2) specific areas outside the geographical area occupied by the species at the time it is listed upon a determination that such areas are essential for the conservation of the species. The ESA defines "conservation" as the use of all methods and procedures needed to bring the species to the point at which listing under the ESA is no longer necessary.

Section 4(a)(3)(a) of the ESA (16 U.S.C. 1533(a)(3)(A)) requires that, to the maximum extent prudent and determinable, critical habitat be designated concurrently with the listing of a species. Designations of critical habitat must be based on the best scientific data available and the agency must consider the economic, national security, and other relevant impacts of specifying any particular area as critical habitat. Once critical habitat is designated, section 7 of the ESA requires Federal agencies to ensure that they do not fund, authorize or carry out any actions that are likely to destroy or adversely modify that habitat. This requirement is in addition to the section 7 requirement that Federal agencies ensure that their actions do not jeopardize the continued existence of listed species.

During the listing process for Southern Residents, we requested specific information on critical habitat to assist in gathering and analyzing the best available scientific data to support critical habitat designations (69 FR 9809, March 2, 2004; 66 FR 42499, August 13, 2001; and 69 FR 76673, December 22, 2004). We met with comanagers and other stakeholders to review this information and the overall designation process. The proposed rule to designate critical habitat for Southern Residents was published June 15, 2006 (71 FR 34571) opening a public comment period. We received comments on the proposed rule which are addressed in the final rule.

Southern Resident killer whales were designated as a depleted stock under the Marine Mammal Protection Act in May 2003 and a Proposed Conservation Plan was announced on October 3, 2005 (NMFS 2005). The Conservation Plan contains a comprehensive review of Southern Resident natural history, including diet, habitat use and movements. This report summarizes information from that plan regarding killer whale natural history relevant to a critical habitat designation.

Southern Resident killer whales are listed as endangered in the State of Washington and under the Species At Risk Act (SARA) in Canada. Canada has released a Draft National Recovery Strategy for Northern and Southern Resident Killer Whales (DFO Killer Whale Recovery Team 2005) which includes information on 'core areas' for resident killer whales.

Natural History

Killer whales are the world's largest dolphin. The sexes show considerable size dimorphism, with males attaining maximum lengths and weights of 9.0 m and 5,568 kg, respectively, compared to 7.7 m and 3,810 kg for females (Dahlheim and Heyning 1999). Adult males develop larger pectoral flippers, dorsal fins, tail flukes, and girths than females (Clark and Odell 1999). Maximum life span is estimated to be 80-90 years for females and 50-60 years for males (Olesiuk et al. 1990). Animals are black dorsally and have a white ventral region extending from the chin and lower face to the belly and anal region. Each whale has a uniquely shaped and scarred dorsal fin and saddle patch, which permits animals to be recognized on an individual basis, as depicted in photo-identification catalogs, such as those compiled for the northeastern Pacific region (e.g.,

Black et al. 1997, Dahlheim 1997, Dahlheim et al. 1997, van Ginneken et al. 1998, 2000, 2005, Matkin et al. 1999, Ford and Ellis 1999, Ford et al. 2000).

Three distinct forms of killer whales, termed as residents, transients, and offshores, are recognized in the northeastern Pacific Ocean. Although there is considerable overlap in their ranges, these forms display significant genetic differences due to a lack of interchange between member animals (Stevens et al. 1989, Hoelzel and Dover 1991, Hoelzel et al. 1998, Barrett-Lennard 2000, Barrett-Lennard and Ellis 2001, Krahn et al. 2004). Important differences in ecology, behavior, morphology, and acoustics also exist (Baird 2000, Ford et al.2000).

Resident killer whales in the U.S. are distributed from California to Alaska, with four distinct communities recognized: Southern, Northern, Southern Alaska, and Western Alaska. In addition, the presence of resident killer whales has been documented off the coast of Russia (Krahn et al. 2002, 2004). The Southern Resident DPS consists of three pods, identified as J, K, and L pods, that reside for part of the year in the inland waterways of Washington State and British Columbia (Strait of Georgia, Strait of Juan de Fuca, and Puget Sound), principally during the late spring, summer, and fall (Ford et al. 2000, Krahn et al. 2002). Pods visit coastal sites off Washington and Vancouver Island (Ford et al. 2000), but travel as far south as central California and as far north as the Queen Charlotte Islands (Figure 1). Offshore movements and distribution are largely unknown for the Southern Resident DPS.

Detailed studies of social structure in killer whales were conducted in British Columbia, Washington, and Alaska over the past few decades. As a result, much information is now available on group size, structure, and stability, and vocal traits (Ford

1989, 1991, Bigg et al. 1990, Baird and Dill 1996, Matkin et al. 1999b, Baird 2000, Baird and Whitehead 2000, Ford et al. 2000, Miller and Bain 2000, Yurk et al. 2002). Social organization in this region is based on maternal kinship.

Information on reproduction and growth in killer whales comes either from observations of animals held in captivity or from long-term photo-identification studies of the resident whale communities in Washington and British Columbia (Olesiuk et al. 1990). Most mating in the North Pacific is believed to occur from May to October (Nishiwaki 1972, Olesiuk et al. 1990, Matkin et al. 1997). However, small numbers of conceptions apparently happen year-round, as evidenced by births of calves in all months. Gestation periods in captive killer whales average about 17 months (mean ± SD = 517 ± 20 days, range = 468-539 days) (Asper et al. 1988, Walker et al. 1988, Duffield et al. 1995). Mean interval between viable calves is four years (Bain 1990). Newborns measure 2.2-2.7 m long and weigh about 200 kg (Nishiwaki and Handa 1958, Olesiuk et al. 1990, Clark et al. 2000, Ford 2002). Calves remain close to their mothers during their first year of life, often swimming slightly behind and to the side of the mother's dorsal fin. Weaning age remains unknown, but nursing probably ends at 1-2 years of age (Haenel 1986, Kastelein et al. 2003). Mothers and offspring maintain highly stable social bonds throughout their lives and this natal relationship is the basis for the matralineal social structure (Bigg et al. 1990, Baird 2000, Ford et al. 2000).

A matriline is usually composed of a female, her sons and daughters, and offspring of her daughters, and contains up to 17 individuals spanning up to five generations (Bigg et al. 1987, Bain 1988). Members maintain extremely strong bonds and individuals seldom separate from the group for more than a few hours. Residents

spend about 12-15% of their time engaged in socializing (Heimlich-Boran 1988, Ford 1989, Saulitis et al. 2000). Whales become especially vocal while socializing and emit a wide range of whistles and calls heard infrequently during other activities, such as foraging and resting (Ford 1989, Barrett-Lennard et al. 1996, Thomsen et al. 2002). Southern Residents perform a variety of social behaviors including chasing, splashing at the surface, spyhopping, breaching, fin slapping, tail lobbing, head standing, rolling over other animals, and playing with objects such as kelp or jellyfish (Jacobsen 1986, Osborne 1986). Southern Residents exhibit one behavior unique to the group, a greeting ceremony that occurs when pods meet after being separated for a day or more (Osborne 1986, Ford et al. 2000). In contrast, beach rubbing, which involves whales visiting particular beaches to rub their bodies on smooth pebbles in shallow water (Jacobsen 1986), is common among Northern Residents, but has never been observed in Southern Residents or transients (Ford 1989, Ford et al. 2000).

Although there is considerable overlap in the geographic ranges of Southern and Northern Residents, pods from the two communities have not been observed to intermix (Ford et al. 2000). Genetic analyses using nuclear (microsatellite) and mitochondrial DNA indicate that the two communities are most likely reproductively isolated from each other (Hoelzel et al. 1998, Barrett-Lennard 2000, Barrett-Lennard and Ellis 2001). Recent paternity analyses using microsatellite DNA indicate that resident males nearly always mate with females outside of their own pods, thereby reducing the risks of inbreeding (Barrett-Lennard 2000, Barrett-Lennard and Ellis 2001). Distinct vocal repertoires, or dialects, may be a mechanism that guides breeding with individuals outside of natal pods, but within their resident group.

Vocal communication is particularly advanced in killer whales and is an essential element of the species' complex social structure. Like all dolphins, killer whales produce numerous types of vocalizations that are useful in navigation, communication, and foraging (Dahlheim and Awbrey 1982, Ford 1989, Barrett-Lennard et al. 1996, Ford et al. 2000, Miller 2002, Miller et al. 2004). Most calls consist of both low- and high-frequency components (Bain and Dahlheim 1994). The low-frequency component is relatively omnidirectional, with most energy directed forward and to the sides (Schevill and Watkins 1966). The vocal repertoires of killer whale pods are comprised of specific numbers and types of repetitive discrete calls, which together are known as a dialect (Ford 1991). Dialects are complex and stable over time, and are unique to single pods. Call patterns and structure are also distinctive within matrilines (Miller and Bain 2000). Individuals likely learn their dialect through contact with their mother and other pod members (Ford 1989, 1991, Miller and Bain 2000).

As with other delphinids, killer whales hear sounds through the lower jaw and other portions of the head, which transmit the sound signals to receptor cells in the middle and inner ears (Møhl et al. 1999, Au 2002). Hearing ability extends from 1 to at least 120 kHz, but is most sensitive in the range of 18-42 kHz (Szymanski et al. 1999). The most sensitive frequency is 20 kHz, which corresponds with the approximate peak energy of the species' echolocation clicks (Szymanski et al. 1999). Clicks are brief pulses of ultrasonic sound given singly or more often in series known as click trains. They are used primarily for navigation and discriminating prey and other objects in the surrounding environment, but are also commonly heard during social interactions and may have a communicative function (Barrett-Lennard et al. 1996). Barrett-Lennard et al.

(1996) suggested that killer whales share information obtained from echolocation, for example the distance between a whale and its target may be available to other whales in hearing range, but further clarification of this possible function is needed (Baird 2000).

Southern Resident killer whales are known to consume 22 species of fish and one species of squid (Scheffer and Slipp 1948, Ford et al. 1998, 2000, Ford and Ellis 2005, Saulitis et al. 2000) from scale sampling and stomach contents studies. Most published information originates from a single study (Ford et al. 1998, Ford and Ellis 2005) in British Columbia, including southeastern Vancouver Island, that focused primarily on Northern Residents, relied on several field techniques susceptible to bias (e.g., surface observations and scale sampling), and reported on a relatively small sample of observations for Southern Residents. Of the 487 records of apparent fish predation events from 1974-2004, only 68 (14%) observations came from Southern Residents. With these limitations in mind, salmon were found to represent over 96% of the prey during the summer and fall. Chinook salmon (*Oncorhynchus tshawytscha*) were selected over other species, comprising over 70% of the identified salmonids taken. This preference occurred despite the much lower numerical abundance of Chinook in the study area in comparison to other salmonids and is probably related to the species' large size, high fat and energy content and year-round occurrence in the area. Other salmonids eaten in smaller amounts included chum (*O. keta*, 22% of the diet), pink (*O. gorbuscha*, 3%), coho (*O. kisutch*, 2%), and sockeye (*O. nerka*, <1%) salmon, and steelhead (*O. mykiss*, <1%) (Ford and Ellis 2005). This work suggests an overall preference for Chinook salmon during the summer and fall, but also revealed extensive feeding on chum salmon in the fall. Rockfish (*Sebastes* spp.), Pacific halibut (*Hippoglossus stenolepis*),

and Pacific herring (*Clupea pallasi*) were also observed during predation events (Ford and Ellis 2005), however, these data may underestimate the extent of feeding on bottom fish (Baird 2000). A number of smaller flatfish, lingcod (*Ophiodon elongatus*), greenling (*Hexagrammos* spp.), and squid have been identified in stomach content analysis of resident whales (Ford et al. 1998). Additional season specific sampling of predation event remains in 2004 and 2005 also indicated consistent primary selection of Chinook by the Southern Residents (Hanson et al. 2005, NWFSC, unpubl. data).

The conclusion that the southern residents feed primarily on salmon is supported by the toxicology analyses of Krahn et al. (2002), who determined that the ratios of DDT (and its metabolites) to various PCB compounds in the Southern Resident killer whales correspond with those of Puget Sound salmon rather than those of other fish species.

Resident whales spend about 50-67% of their time foraging (Heimlich-Boran 1988, Ford 1989, Morton 1990, Felleman et al. 1991). Groups of animals often disperse over several square kilometers while searching for salmon, with members moving at roughly the same speed (range of 3-10 km/hr, mean = 6 km/hr) and direction (Ford 1989, 2002, Ford et al. 1998). Foraging episodes usually cover areas of 3-10 km^2 and last 2-3 hours, but may extend up to 7 hours. The typical swimming pattern of foraging and traveling killer whales is a sequence of three to five shallow dives lasting 10-35 seconds each followed by a long dive, with surface blows of 3-4 seconds occurring after each dive (Erickson 1978, Morton 1990, Ford and Ellis 1999). Killer whales normally swim at speeds of 5-10 km per hour, but can attain maximum speeds of 40 km per hour (Lang 1966, Erickson 1978, Kruse 1991, Kriete 1995, Williams et al. 2002).

The large sizes of resident pods may benefit members by improving the success rate of locating scattered salmon (Heimlich-Boran 1988, Bigg et al. 1990, Hoelzel 1993). Prey are detected through a combination of echolocation and passive listening (Barrett-Lennard et al. 1996), whereas vision and echolocation are probably used during prey capture. Captive killer whales consume about 3.6-4% of their body weight daily (Sergeant 1969, Kastelein et al. 2003). Food intake in captive animals gradually increases from birth until about 20 years of age (Kriete 1995, Kastelein et al. 2003). Food consumption has also been noted to increase among captive females late in pregnancy or lactating (Kriete 1995, Kastelein et al. 2003). Due to their greater activity levels, wild killer whales presumably have greater food demands than captive individuals (Kastelein et al. 2003). The energy requirements of killer whales are about 85,000 kcal per day for juveniles, 100,000 kcal per day for immatures, 160,000 kcal per day for adult females, and 200,000 kcal per day for adult males (Osborne 1999). Based on these values and an average size for five salmon species combined, Osborne (1999) estimated that adults must consume about 28-34 adult salmon daily and that younger whales (<13 years of age) need 15-17 salmon daily to maintain their energy requirements. These data provide a "rule of thumb" ~25 salmon per day per whale, estimated over all age classes. Extrapolation of this estimate indicates that a Southern Resident DPS of 90 individuals would eat about 820,000 adult salmon annually (Osborne 1999). This does not, however, account for any other prey species and is therefore likely an overestimate of potential salmon consumption. The average fish size in the extrapolation was based on a combination of five species, so the estimate also does not account for consumption of varying amounts of different species of salmon.

Habitat Features

Killer whales frequent a variety of marine habitats that do not appear to be constrained by water depth, temperature, or salinity (Baird 2000). Observations of killer whales suggest that they require clean water, free of barriers to passage, and healthy prey populations.

Killer whales are highly mobile, can cover large distances, and range over a variety of habitats, including inland waters and open ocean coastal areas. The Southern Resident pods can be spread over hundreds of kilometers at any given point. Southern Resident killer whales require open waterways that are free from obstruction to move between important habitat areas, find prey and fulfill other life history requirements. Individual knowledge of productive feeding areas and other special habitats is probably an important determinant in the selection of locations visited and is likely a learned tradition passed from one generation to the next (Ford et al. 1998).

The Southern Residents spend large amounts of time in "core" inland marine waters coinciding with congregations of migratory salmon returning from the Pacific Ocean to spawn in U.S. and Canadian Rivers. The topographic and oceanographic features in these core areas include channels and shorelines used to assist with foraging. Southern Residents are large mammals requiring abundant food sources to sustain metabolic processes throughout the year. Prey availability changes seasonally, and may be a limiting factor when Southern Residents are outside of the core summer areas. Southern Residents may depend on different prey species and habitats throughout the year. The seasonal timing of salmon returns to Southern Puget Sound river systems may influence the movements of Southern Residents out of core summer areas. Whales may

travel significant distances to locate prey aggregations sufficient to support their numbers. Sufficient prey abundance is necessary to support individual growth to reach sexual maturity and reproduction, including lactation and successful rearing of calves. In addition to sufficient biomass of prey species, the prey must also have amounts of contaminants that do not exceed levels that can cause mortality or reproductive failure.

Because of their long life span, position at the top of the food chain and their blubber stores, killer whales accumulate high concentrations of contaminants. Organochlorines, such as PCBs and DDT, and many other chemical compounds including polychlorinated napthalenes, brominated flame retardants, PAHs, dioxins, furans, and heavy metals, are a concern because of their ability to induce immune suppression, reproductive impairment, or other physiological damage, as observed in several species of marine mammals (Albers and Loughlin 2003, Béland et al., 1998; Bergman et al., 1992; De Guise et al., 2003; Jepson et al., 1999; Reijinders, 2003; Ross, 2002).

Killer whales detect prey through a combination of echolocation and passive listening. In addition to a sufficient abundance of prey that have limited contaminant loads, the prey need to be available to the whales. Prey captures have been observed in a variety of habitats in Puget Sound. In addition to echolocation, successful communication between whales may also be involved in cooperative foraging. Sound levels are important for obtaining prey, but are also important for additional forms of communication which could include finding members of their social group, identifying mates, coordinating unique behaviors (i.e., greeting ceremony of the Southern Residents), and navigating.

Physical or Biological Features Essential for Conservation (Primary Constituent Elements)

Joint NMFS/FWS regulations for listing endangered and threatened species and designating critical habitat at section 50 CFR 424.12(b) state that the agencies "shall consider those physical and biological features that are essential to the conservation of a given species and that may require special management considerations or protection (hereafter also referred to as 'Essential Features' or 'Primary Constituent Elements/PCEs')." Pursuant to the regulations, such requirements include, but are not limited to, the following: (1) space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and generally; (5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species. These regulations go on to emphasize that the agency shall focus on essential features within the specific areas considered for designation. These features "may include, but are not limited to, the following: spawning sites, feeding sites, seasonal wetland or dryland, water quality or quantity, geological formation, vegetation type, tide, and specific soil types."

Killer whale habitat utilization is dynamic, and specific breeding, calving or resting areas are not currently documented. Births occur largely from October to March, but may take place in any month (Olesiuk et al. 1990) and therefore potentially in any part of the whale's range. Southern Residents are highly mobile and can travel up to 160km in a 24 hour period (Baird 2000), allowing rapid movements between areas. The

three primary concerns raised as potential factors in the decline of Southern Residents are; prey availability, contaminants/pollution, and vessel effects. There are habitat components for each of these concerns for killer whales which relate to the essential features necessary for killer whale conservation.

Fish are the major dietary component of resident killer whales in the northeastern Pacific, with 22 species of fish and one species of squid (*Gonatopsis borealis*) known to be eaten (Scheffer and Slipp 1948, Ford et al. 1998, 2000, Ford and Ellis 2005, Saulitis et al. 2000). Observations from this region indicate that salmon are the preferred prey (Ford et al. 1998, Ford and Ellis 2005). Foraging areas are dependent on variable temporal and spatial patterns of prey species, particularly migratory salmon. These characteristics present challenges in identifying critical habitat for Southern Resident killer whales. However, several studies are currently underway to fill important data gaps by quantifying habitat use on a finer scale and determining if certain behaviors are more frequently observed in particular habitat areas (NWFSC unpbul. data).

In consideration of the natural history of the Southern Resident killer whales and their habitat needs, the physical or biological features of Southern Resident killer whale habitat proposed in the Federal Register (69 FR 76673, December 22, 2004) were:

(1) Water quality to support growth and development;

(2) Prey species of sufficient quantity, quality and availability to support growth and development;

(3) Sound levels that do not exceed thresholds that inhibit communication or foraging activities or result in temporary or permanent hearing loss; and

(4) Safe passage conditions to support migration and foraging.

NMFS received several comments on the features mentioned in the proposal to list the species and further comments on the proposed rule to designate critical habitat for Southern Resident killer whales. For purposes of the final critical habitat designation, the PCEs are:

(1) Water quality to support growth and development;

(2) Prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth; and

(3) Passage conditions to allow for migration, resting, and foraging.

Geographical Area Occupied by the Species

Photo-identification studies, tracking by boats, and opportunistic sighting networks have provided considerable information on the ranges and movements of southern resident killer whales since the early 1970s. Ranges are best known from late spring to early autumn (May-September), when survey effort is greatest. During this period, all three Southern Resident pods, J, K and L, are regularly present in the Georgia Basin (defined as the Georgia Strait, San Juan Islands, and Strait of Juan de Fuca) (Heimlich- Boran 1988, Felleman et al. 1991, Olson 1998, Osborne 1999).

The Whale Museum in Friday Harbor, WA maintains a table that lists month and pods of whales present in Washington and British Columbia inland waters during that month (Table 1).

Figure1. Geographic range (light shading) of the southern resident killer whale population in the northeastern Pacific. The western pelagic boundary of the ranges is ill-defined. Reprinted Wiles (2004).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976				J,K								
1977												
1978			J,K									
1979											J,K	
1980												
1981				J,K								
1982						J,K				J,K		
1983										J,K	J,K	
1984						J,K						
1985						J,K						
1986					J,K							
1987										J,K	J,K	J,K
1988					J,K							
1989			J,K							J,K	J,K	J,K
1990												
1991					J,K					J,K		
1992												
1993					J,K							
1994										J,L		
1995												
1996										J,K	J,K	
1997										J,L	J,L	J,K
1998											J,K	
1999												
2000												
2001												
2002			J,K,L?									
2003												J,K
2004					J,L	J,L						J,K
2005		J?			J,L							

Only J Pod present		Two pods present, as indicated		J, K, and L pods present		Data not available	

Table 1. Monthly occurrence of the three southern resident killer whale pods (J, K, and L) in the inland waters of Washington and British Columbia, 1976-2005. Pods were recorded as present during a month if they were sighted on at least one day. Data come from a historical sighting archive held at The Whale Museum (2005).

The geographic area represented by this table is the region east of Race Rocks at the southern end of Vancouver Island and Port Angeles on the Olympic Peninsula. While presence during any month may be representative of only one sighting or sightings occurring every day during that month, this table provides an overview of occurrence and differences over time and between pods.

While in inland waters during summer months, all of the pods concentrate their activity in Haro Strait, Boundary Pass, the southern Gulf Islands, the northeastern end of the Strait of Juan de Fuca, and several localities in southern Georgia Strait (Heimlich-Boran 1988, Felleman et al. 1991, Olson 1998, Ford et al. 2000). Pods commonly occur and are observed foraging in areas that salmon frequent, especially during the times of year salmon are migrating to their natal rivers (Heimlich-Boran 1986, 1988, Nichol and Shackleton 1996). Notable concentrations include Haro Strait and Boundary Passage, the southern tip of Vancouver Island, Swanson Channel off North Pender Island, and the mouth of the Fraser River delta, which is visited by all three pods in September and October (Felleman et al. 1991; Ford et al. 2000). These sites are major corridors of migrating salmon.

Individual pods are generally similar in their preferred areas of use (Olson 1998), although some seasonal and temporal differences exist in areas used (Hauser 2006). J, K, and L pods typically arrive in May or June and spend most of their time in inland waters until departing in October or November (Table 1). However, K and L pods make frequent trips lasting a few days to the outer coasts of Washington and southern Vancouver Island during this time period (Ford et al. 2000). During early autumn, southern resident pods, especially J pod, routinely expand their movements into Puget Sound to likely take advantage of chum and Chinook salmon runs (Osborne 1999). Additional studies currently underway have identified finer scale pod differences in seasonal movement patterns and use of core areas (Hauser 2006).

There are no confirmed sightings of Southern Resident killer whales inside Hood Canal. On one occasion in 1995, acoustic recordings from Dabob Bay were identified as

J pod vocalizations (Unger, 1997). During the comment period on the proposed rule we received additional information regarding historical sightings of Southern Residents in Hood Canal. Several sightings from the 1950s and 1970s were confirmed as Southern Residents from recordings, photographs or detailed field notes. In addition there were many anecdotal reports of groups of whales in Hood Canal. We do not consider this sufficient evidence of presence to find Hood Canal "within the geographical area occupied by the species at the time of listing." (Transient killer whales, in contrast, have been observed in Hood Canal on multiple occasions and have remained in Hood Canal for extended periods in the last several years.)

We also do not consider extremely shallow waters of Puget Sound to be within the geographical area occupied by the species. Male killer whales grow to 29.5 feet (9m), and females to 25.3 feet (7.7m), which may limit maneuverability in shallow waters. During the comment period on the proposed rule we received several accounts of Southern Residents using some shallow areas. (This is in contrast to transient killer whales, which enter shallow water to capture seals and sea lions, and Northern Residents, which spend time in shallow water at rubbing beaches.)

During the late fall, winter, and early spring, the ranges and movements of the Southern Residents are less well known. J pod continues to occur intermittently in the Georgia Basin and Puget Sound part of this time (Table 1), but its location during apparent absences is uncertain (Osborne 1999). One sighting of this pod was made off Cape Flattery, Washington, in March 2004 (Krahn et al. 2004). Prior to 1999, K and L pods followed a general pattern in which they spent progressively smaller amounts of time in inland waters during October and November and departed them entirely by

December of most years (Table 1; Osborne 1999). Sightings of both groups passing through the Strait of Juan de Fuca in late fall suggested that activity shifted to the outer coasts of Vancouver Island and Washington (Krahn et al. 2002), although it is unclear if the whales spend a substantial portion of their time in this area or simply transit to other locations.

While there is considerable data on the use of inland waters of Washington, there is very little information on the movements of Southern Resident killer whales off the coast. Areas of activity of all pods are virtually unknown during their absences from inland waters. In the last 30 years of study, there are only 28 confirmed sightings in outside waters (Krahn et al. 2004, NWFSC unpubl. data). While the majority of these sightings were opportunistic, several of these sightings have occurred during the last five years, when effort was increased with dedicated ship surveys and expanded volunteer coastal sighting networks, and the southern and northern boundaries of the range have expanded with new sightings in California and the Queen Charlotte Islands in recent years. While most of the coastal sightings have occurred within 10 miles of shore, their offshore range is unknown. At this time there are few data on how the whales are using offshore areas, however some of the sightings included observations of feeding.

There is an active research effort underway to identify coastal and offshore distribution of Southern Residents. We have increased outreach efforts to gather sighting information from coastal communities, vessel operators and pilots along the coasts of Oregon, Washington, and British Columbia. In addition, researchers are conducting dedicated ship surveys to locate the whales and observe their activities outside of Puget Sound. The research program is a long-term effort, but we hope to greatly increase the

number of coastal observations in the next 5 years. As new information is collected on the coastal and offshore distribution and habitat use, we hope to fill in the data gaps about the important habitat features of these coastal and offshore areas.

NMFS regulations at 50 CFR 424.12(h) state: "Critical habitat shall not be designated within foreign countries or in other areas outside of United States jurisdiction." Although the Southern Residents' range includes inland waters of Canada, we are not designating these areas as critical habitat.

Specific Areas

Several comments received on critical habitat and on the proposed essential features suggested that designating critical habitat was important for the recovery of Southern Resident killer whales and should be designated as soon as possible. Suggestions for critical habitat areas were general and included "most of Puget Sound," "Puget Sound and the Straits of Georgia and Juan de Fuca," and "all internal waters of Washington State."

Within the geographical area occupied by the Southern Resident killer whales there are specific areas that contain the essential habitat features. The inside waters of Washington State can be divided into specific areas based on the habitat features and the use patterns of the Southern Resident killer whales (Figure 2). There are no confirmed sightings of Southern Resident killer whales inside Hood Canal in the Whale Museum data, therefore, Hood Canal is not included in the specific areas.

Southern Resident killer whale sightings data from The Whale Museum (Osborne 2005, The Whale Museum Orca Master 1990-2003) were analyzed to assist in identifying specific areas based on habitat use patterns by the whales. The Whale Museum data are

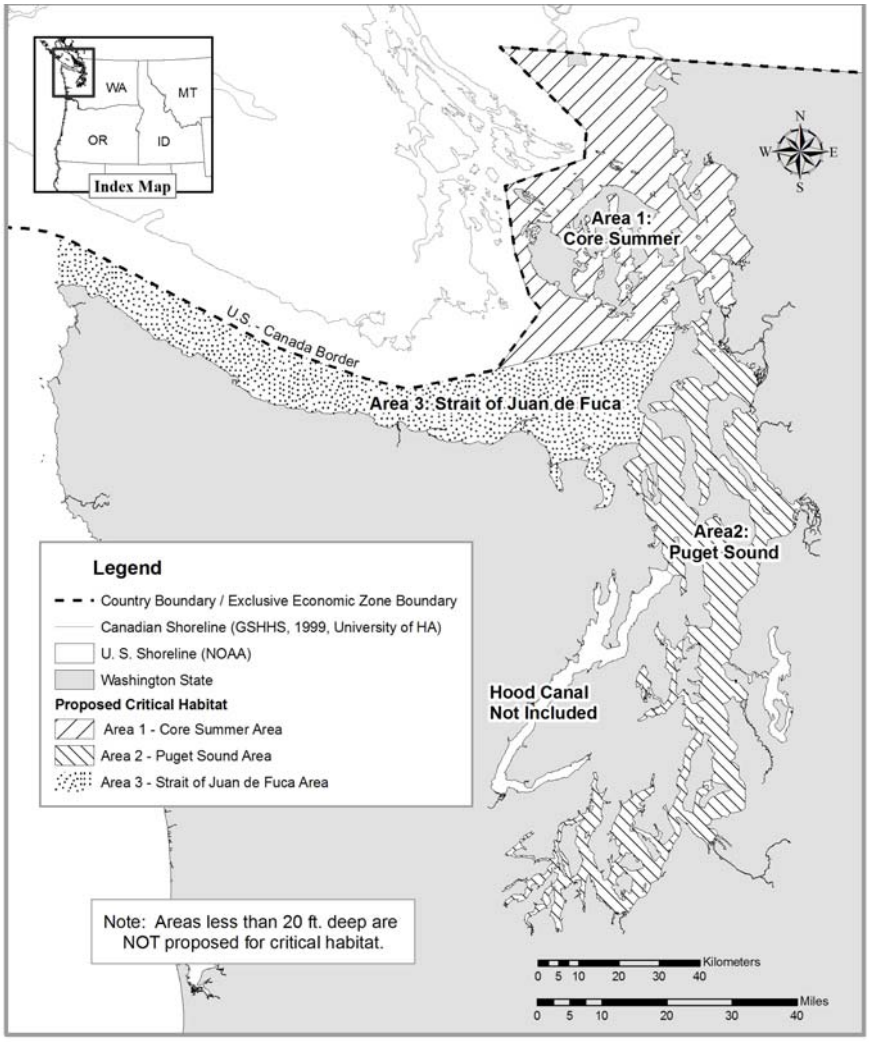

Figure 2. Areas considered for critical habitat for Southern Resident killer whales.

predominantly opportunistic sightings from a variety of sources, including public reports, commercial whale watching industry pager system, Soundwatch, Lime Kiln State Park land-based observations), and from compilations of independent researcher reports. Sightings of Northern Residents, transients and offshore whales are not included in the data set. The data set does not account for level of effort by season or location and therefore, the sampling and data are biased (Osborne 2005), however, there is some information regarding the level of effort. There is greater effort in the summer than in the

winter and the origination of a large number of whale watch vessels from Victoria, B.C. may result in a bias for sightings in the northeastern portion of the Strait of Juan de Fuca relative to the southern and western portions of the strait. Regardless, the 1990-2003 Whale Museum data set is the most comprehensive long-term data available to evaluate broad scale whale distribution in inland waters at this time (total number of sighting records = 22,509). In order to evaluate frequency of use, our analysis of the sightings was limited to one unique location sighting per quadrant per day to reduce the bias introduced by multiple sightings of the same whales in the same location on the same day (total number of unique sightings per day = 11,836). For the majority of the killer whale sightings the location reported was not an exact point location (Lat./Long.) such that all locations were assigned to a center point in a quadrant system (Osborne 2005). Almost half of the data is from the Whale Watch pager system created by the commercial whale watch industry and available to subscribers. A validation of recent pager data revealed greater than 90% accuracy in locating whales (Hauser et al in prep).

From the sightings and other data, we have identified three "specific areas," within the geographical area occupied by the species that contain the PCEs (Figure 1). We considered presence and movements of the whales, behavioral observations and studies and information to verify that one or more of the physical or biological features, or PCEs, can be found in these three specific areas. In some cases where direct data on PCEs was not available, we relied on distribution patterns of the whales to infer presence of PCEs.

Area 1. Core Summer Area - Bordered to the North and West by the US/Canadian border, Area 1 includes the waters surrounding the San Juan Islands, the

U.S. portion of the Southern Strait of Georgia, and areas directly offshore of Skagit and Whatcom counties (Figure 2). Area 1 is important for all pods (J, K and L). Southern Resident killer whales have been sighted in Area 1 during every month of the year, but sightings are more consistent and concentrated in the summer months, June through August (Figure 3). The Whale Museum database from 1990-2003 contains 11,836 unique sightings after duplicate locations on the same date are excluded. 8,508 of these are in US waters and 85% of the U.S. sightings are in Area 1. It is important to recognize that there is extensive sighting effort in Area 1 during the summer months when compared to other areas, however, the strength of the summer use pattern would undoubtedly persist if accounting for sighting effort. Sighting data from 1976-1990, when effort was significantly lower also reflects this pattern (Whale Museum unpbul. data). The largest number of sightings in Washington's inland waters is from Haro Strait off the west side of San Juan Island. There are over 1,200 unique sightings from 1990-2003 in one quadrant (west side of San Juan Island) (Figure 4).

Occurrence in Area 1 coincides with concentrations of salmon and is considered a primary feeding area for Southern Residents. Runs of salmon passing through Area 1 include Chinook, chum, coho, pink, and sockeye salmon, which have all been identified as prey for Southern Residents (Ford et al 1998, Ford and Ellis 2005, NWFSC unpubl. data). The Strait of Juan de Fuca, Haro and Georgia Straits are relatively narrow channels and concentrate salmon returning from the Pacific Ocean to spawn in U.S. and Canadian rivers. In particular, Area 1 lies near the mouth of the Fraser River, which has the largest salmon runs in the Georgia Basin/Puget Sound region (Northcote and Atagi 1997).

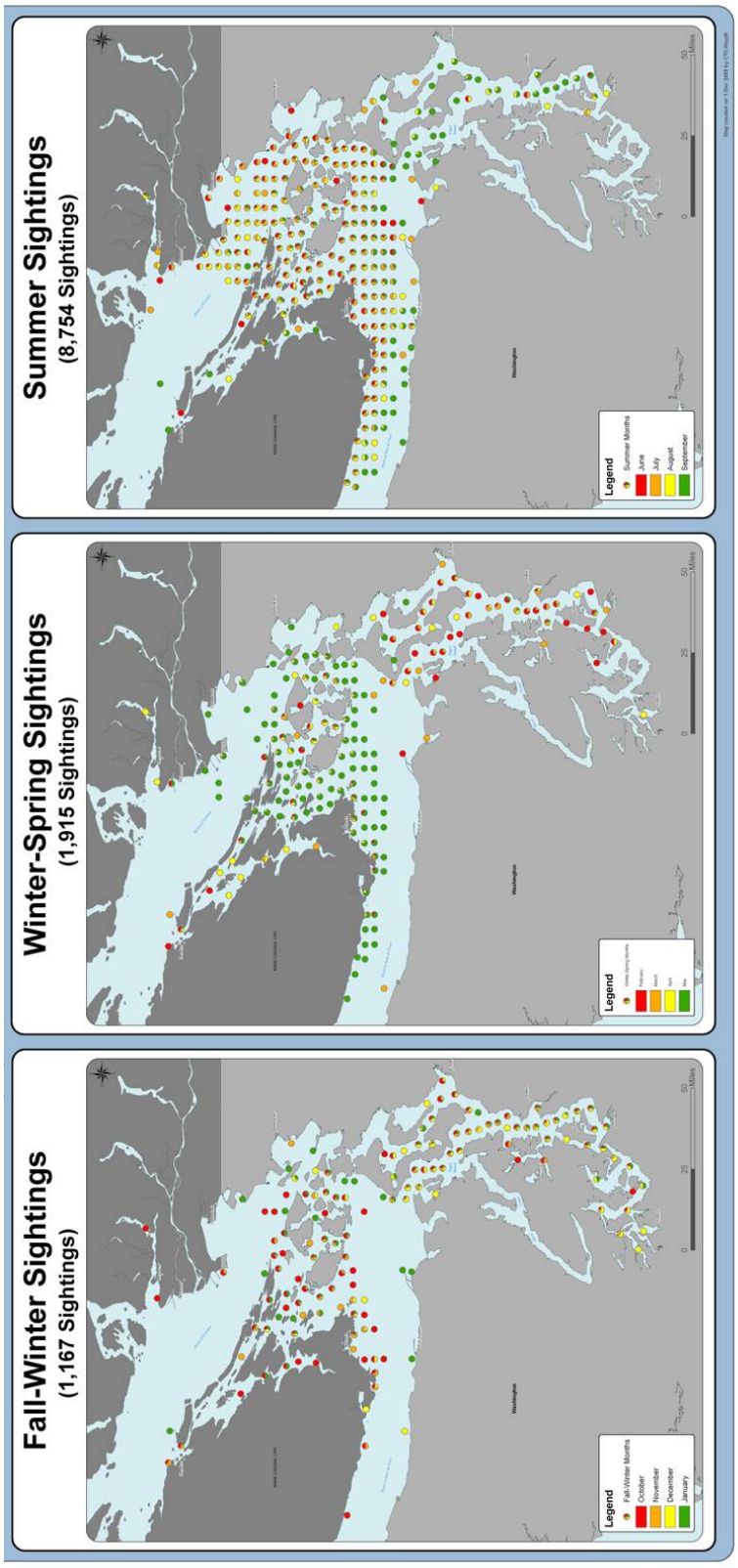

Figure 3. Seasonal distribution of Southern Resident killer whale sightings.

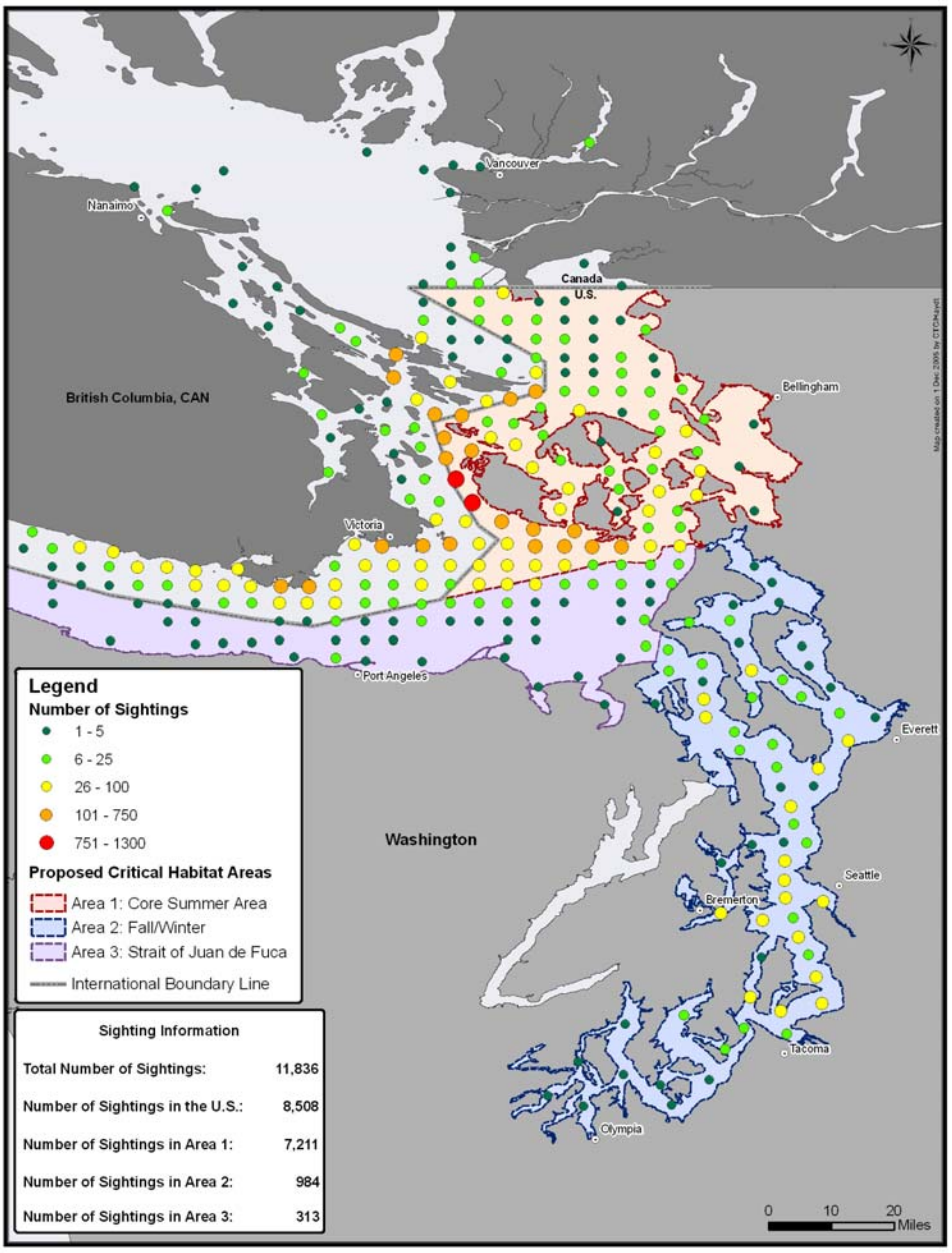

Figure 4. Number of sightings in proposed critical habitat areas for Southern Resident killer whales.

Much of the behavioral research on Southern Residents has taken place within Area 1. Southern Residents have been observed exhibiting a variety of behaviors in this area, including travel, forage, social, and play. Opportunities to forage are presumed to

be a major factor attracting the whales to Area 1, particularly in the summer months. Behavior budgets have reported that resident whales spend 50%-67% of their time foraging (Heimlich Boran 1988, Ford 1989, Morton 1990, Felleman et al. 1991).

Area 2. Puget Sound- south from Deception Pass Bridge, entrance to Admiralty Inlet, Hood Canal Bridge (Figure 2). Southern Resident killer whales have been seen in parts of Area 2 in all seasons (Figure 3). The presence of Southern Residents in Area 2 is intermittent, with the smallest number of sightings in May-July. There are different sighting patterns in Area 2 for the three pods. During September, Southern Residents, especially J pod, expand their movements into Puget Sound to likely take advantage of chum and Chinook salmon runs (Osborne 1999). In the most southern portion of Area 2, south of Tacoma Narrows Bridge, Southern Residents have been observed in October-January, with one additional sighting in April.

Research in Area 2 has focused on photo-identification efforts and while few behavioral studies have been conducted, feeding has been observed in Area 2 (Mark Sears pers. comm., NWFSC unpubl. data). Southern Resident killer whale occurrence in Area 2 has been correlated with fall salmon runs. A fall chum run has been suggested as the reason for an extended presence of members of L pod in Dyes Inlet during October and November of 1997.

Area 3. Strait of Juan de Fuca –Deception Pass Bridge, San Juan and Skagit County lines to the northeast, entrance to Admiralty Inlet to the southeast, U.S. Canadian Border to the north, Bonilla Point/Tatoosh line to the West. All pods regularly use the Strait of Juan de Fuca to transit from Areas 1 and 2 to outside waters in the Pacific Ocean. Area 3 is predominantly a passage used to access oceanic waters, including

Swiftsure and La Perouse Banks, off Tofino, British Columbia and Westport, as well as other areas with unknown usage, such as the coast of northern California. Recent observations (including feeding) at Westport coincided with the presence of a spring Chinook run, although other species were also likely present (NWFSC unpub. data). The presence of migrating salmonids in the Strait of Juan de Fuca suggests that feeding might occur during transit times, however the whales are not known to spend long periods in localized areas in the Strait. Sightings of the Southern Residents in Area 3 are limited, particularly on the U.S. side of the international border as there is little observation effort in the area, particularly near the Point Bonilla/Tatoosh boundary. The Strait of Juan de Fuca is not the only transit corridor between inland waters and coastal British Columbia, and the whales occasionally use the Strait of Georgia and Johnstone Strait in Canadian waters as an alternate route.

Special Management Considerations

The specific areas within the geographical area occupied by a species meet the definition of critical habitat only if they contain physical or biological features that "may require special management considerations or protection." Agency regulations at 50 CFR 424.02(j) define "special management considerations or protection" to mean "any methods or procedures useful in protecting physical and biological features of the environment for the conservation of listed species." Several forms of human activity have the potential to affect the habitat of killer whales and, specifically, the PCEs that are essential to their conservation.

Most salmon stocks throughout the Northwest are at a fraction of their historic levels. Historically, overfishing was a major cause of decline. More recently the major

cause is loss of freshwater habitat. Poor ocean conditions over the past two decades reduced populations already weakened by the degradation and loss of freshwater and estuary habitat, fishing pressures, hydropower system management, and hatchery practices.

Continued regulation of contaminants and pollution in Puget Sound is also necessary to protect the prey PCE for Southern Residents through management schemes, such as the National Pollutant Discharge Elimination System (NPDES). Contaminants enter marine waters and sediments from numerous sources, but are typically concentrated near areas of high human population and industrialization. Once in the environment these substances proceed up the food chain, accumulating in long-lived top predators like Southern Resident killer whales. Chemical contamination through the food chain continues to be a potential threat to Southern Resident killer whales, despite the enactment of modern pollution controls in recent decades, which were successful in reducing, but not eliminating, the presence of many contaminants in the environment.

Oil spills are another source of contamination that can have long-lasting impacts on habitat. The Environmental Protection Agency and U.S. Coast Guard oversee the Oil Pollution Prevention regulations promulgated under the authority of the Federal Water Pollution Control Act. There is a Northwest Area Contingency Plan, developed by the Northwest Area Committee, which serves as the primary guidance document for oil spill response in Washington and Oregon.

Southern Residents are highly mobile and use a variety of areas for foraging and other activities, as well as for traveling between these areas. Human activities can interfere with movements of the whales and impact the passage PCE. Vessel strikes are

rare, but do occur and can result in serious injury or mortality. Additionally, vessels may present obstacles to free passage by the whales. For example, vessel presence can cause the whales to swim further and change direction more often, which potentially increases energy expenditure for whales and impacts foraging behavior. Vessels also have the potential to affect whales through the physical presence and activity of the vessel, through engine sounds or a combination of these factors.

Major categories of habitat-related activities- which may require special management considerations or protections- include fishery management, vessel activities, and water quality management. All of these activities have the potential to affect the PCEs by altering prey abundance, prey contamination levels, and free passage between areas.

Features Which May Require Special Management in each Specific Area

Area 1. Area 1 likely has areas of low to moderate levels of contaminated sediments (Figure 5). Levels of contaminants in marine mammals such as harbor seals show a trend of decreasing levels of contamination moving north from South Puget Sound to the San Juans and up into Canadian waters (Jeffries et al., 2003; Ross et al., 2004). Exposure to contaminants for species of salmon depends on feeding patterns and may also be linked to salmon spending different amounts of time in Puget Sound (O'Neill et al., 2005). Three of the four major oil refineries in Puget Sound are located in Area 1. There is commercial and recreational fishing for salmon and other species in Area 1, and effort is seasonally dependent on fish abundance.

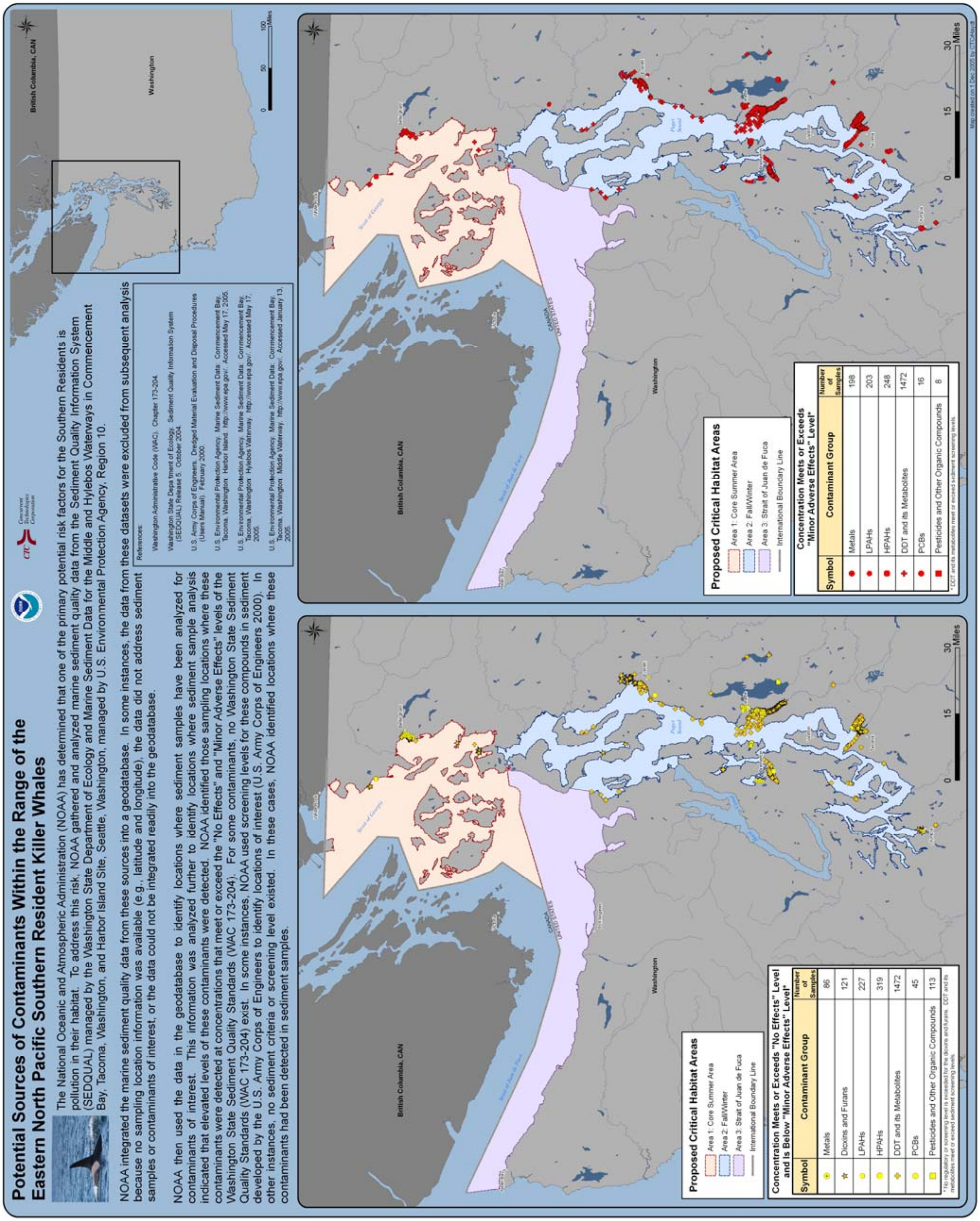

Figure 5. Contaminated sediments in Proposed Critical Habitat Areas

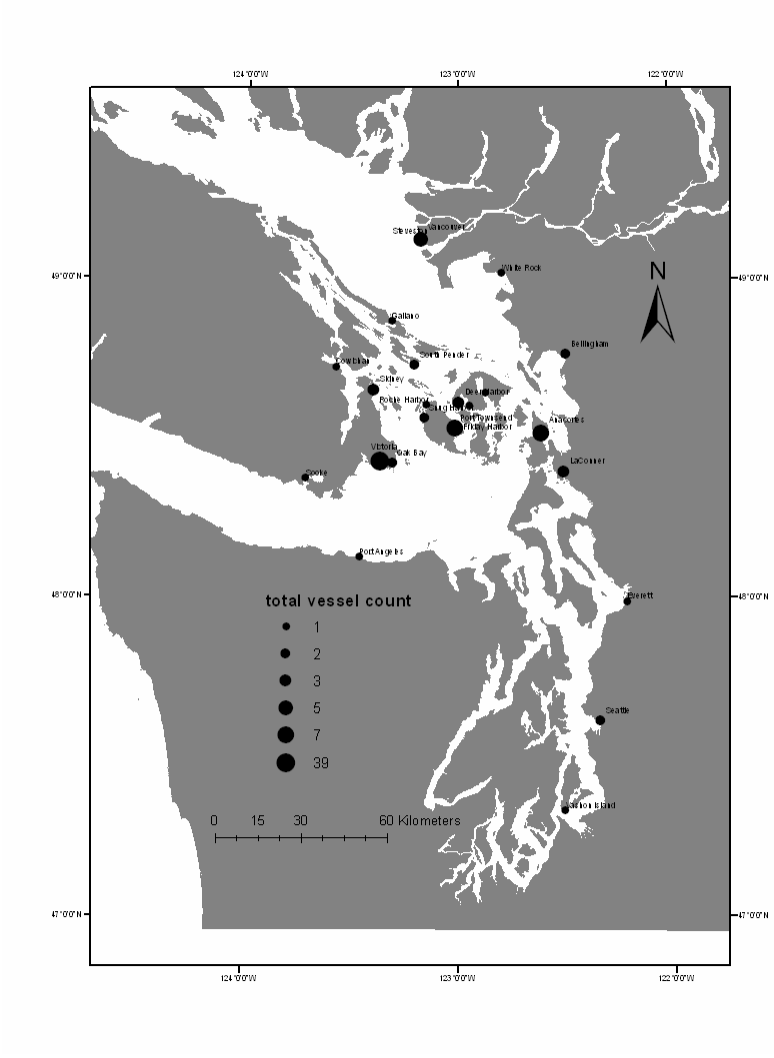

Figure 6. Total number of commercial whale watching vessels origination from ports in Washington and British Columbia.

Area 1 and nearby adjoining Canadian waters contain the highest level of commercial and recreational whale watching activity in the region. The majority of both Canadian- and U.S.-based whale watching vessels originate from ports and marinas in Area 1, although there are a small number of vessels originating from ports in Areas 2 and 3 (Hauser et al. 2006)(Figure 6). Fishing vessels, ferries, oil tankers, and commercial

shipping vessels are also present in Area 1, which contains a major shipping channel along the U.S.-Canada border.

Area 2. Contaminated sediment levels in Area 2 likely range from low/moderate (northern portions) to very high (e.g. near Tacoma). A higher number of National Pollutant Discharge Elimination System (NPDES) permits are issued in Area 2 than in Areas 1 or 3. One of the four major oil refineries in Puget Sound is located in Area 2.

Considerable vessel traffic (including shipping, oil tanker and ferry traffic) occurs in Area 2 and the ports of Seattle and Tacoma are located in Area 2. Whale watching may be expanding in Area 2 to include "shoulder seasons" (i.e., fall months following the primary summer whale watch season.) There is commercial and recreational fishing for salmon and other species in Area 2, and effort is seasonally dependent on fish abundance.

Area 3. Contaminated sediment levels in Area 3 likely range from low to moderate with isolated spots of moderate/high levels (e.g., Port Angeles) (Figure 5). Area 3 contains a major shipping lane for commercial shipping vessels entering and departing major U.S. ports of Seattle and Tacoma, and Vancouver in British Columbia, Canada. Oil tankers also utilize the shipping lane to transport crude oil to the four major refineries in Puget Sound. There is little whale watching activity in Area 3. There is commercial and recreational fishing for salmon and other species in Area 3, and effort is seasonally dependent on fish abundance.

Coastal and Offshore Areas

We have few data on Southern Resident distribution and habitat use of coastal and offshore areas in the Pacific Ocean. While we know that the whales occupy these waters for a portion of the year and they are considered part of the geographical area occupied

by the species, we do not have detailed information about distribution, behavior, and habitat. While we can infer that some of the physical or biological features essential for conservation (PCEs) must be present to support the whales, such as prey and passage, we do not have sufficient data to describe them adequately and identify “specific areas” with those features. Based on the difficulties of determining PCEs, we cannot assess the human activities affecting them or the special management considerations for protection of the physical and biological features. At this time we are not designating coastal or offshore areas, although we do recognize that they are important for the Southern Resident killer whales. There is an active research program to fill in the data gaps regarding coastal and offshore distribution and habitat features and we anticipate obtaining additional data in the coming years. We will consider new information as it becomes available to inform future considerations of critical habitat for Southern Residents.

Unoccupied Areas

ESA section 3(5)(A)(ii) further defines critical habitat to include "specific areas outside the geographical area occupied" if the areas are determined by the Secretary to be "essential for the conservation of the species." Regulations at 50 CFR 424.12(e) specify that NMFS "shall designate as critical habitat areas outside the geographical area presently occupied by a species only when a designation limited to its present range would be inadequate to ensure the conservation of the species." At the present time we have not identified any areas outside the geographical area occupied by the species that are essential for its conservation, and, therefore, we are not designating any unoccupied areas.

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