

**PETITION TO ESTABLISH A WHALE PROTECTION ZONE FOR THE SOUTHERN
RESIDENT KILLER WHALE (*ORCINUS ORCA*) DISTINCT POPULATION
SEGMENT UNDER THE ENDANGERED SPECIES ACT
AND MARINE MAMMAL PROTECTION ACT**



**ORCA RELIEF CITIZENS' ALLIANCE
CENTER FOR BIOLOGICAL DIVERSITY
PROJECT SEAWOLF**

November 2016

NOTICE OF PETITION

Penny Pritzker
Secretary of Commerce
U.S. Department of Commerce
1401 Constitution Avenue N.W.
Washington, DC 20230
Email: TheSec@doc.gov

Dr. Kathryn Sullivan
Under Secretary of Commerce for
Oceans & Atmosphere and
NOAA Administrator
1315 East-West Highway
Silver Spring, MD 20910
Email: kathryn.sullivan@noaa.gov

Eileen Sobeck
Assistant Administrator for Fisheries
National Marine Fisheries Service
1315 East-West Highway
Silver Spring, MD 20910
Email: eileen.sobeck@noaa.gov

William Stelle
Regional Administrator
National Marine Fisheries Service
7600 Sand Point Way NE
Seattle, WA 98115
Email: Will.Stelle@noaa.gov

Lynne Barre
Seattle Branch Chief
Protected Resources Division
National Marine Fisheries Service
7600 Sand Point Way NE
Seattle, WA 98115
Email: Lynne.Barre@noaa.gov

PETITIONERS

Orca Relief Citizens' Alliance
Post Office Box 1969
Friday Harbor, WA 98250
Email: bstedman@orcarelief.org

Center for Biological Diversity
1212 Broadway #800
San Francisco, CA 94612
Phone: 510-844-7100

Project Seawolf
Post Office Box 929
Marysville, WA 98270
Email: michael@seawolfmedia.com

Orca Relief Citizens' Alliance ("Orca Relief") is a non-profit organization committed to conservation of killer whales (*Orcinus orca*), with a primary focus on the southern resident killer whale (SRKW) population stock in the Pacific Northwest.

Center for Biological Diversity is a national, nonprofit conservation organization with more than 1.1 million members and online activists dedicated to the protection of endangered species and wild places.

SeaWolf is an all-volunteer, NW marine wildlife advocacy and education organization, focusing mainly on the Southern Resident Killer Whale population and other coastal NW species.

ACTION REQUESTED

Pursuant to the Endangered Species Act (ESA), 16 U.S.C. § 1540(f); the Marine Mammal Protection Act (MMPA), 16 U.S.C. § 1382(a); and Section 553(e) of the Administrative Procedure Act (APA), 5 U.S.C. § 553(e)¹, Orca Relief Citizens' Alliance and others hereby petition the Secretary of Commerce, through the National Marine Fisheries Service (NMFS), to establish a whale protection zone (WPZ) with supporting regulations to facilitate recovery of the endangered southern resident killer whale (*Orcinus orca*; SRKW). The SRKW is listed as an endangered distinct population segment (DPS) under the ESA and a depleted population stock under the MMPA. In the course of such rulemaking, NMFS should determine the most appropriate geographic location, boundaries, and other supporting regulations to ensure recovery of the endangered SRKW DPS.²

Section 9 (a)(1) of the ESA makes it “unlawful for any person subject to the jurisdiction of the United States to take any such [endangered] species within the United States or the territorial sea of the United States” and Section 3(19) defines the term “take” to mean “to harass, harm, pursue . . . or to attempt to engage in any such conduct,” any or all of which may occur as commercial and private motorized vessels follow the SRKWs.

Section 7(a) (1) of the ESA directs the Secretary to “carry out programs for the conservation of endangered species and threatened species listed pursuant to section 4 of this Act.” Section 3(3) defines “conserve,” “conserving,” and “conservation” to mean “to use and the use of *all methods and procedures* which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary.”³

The MMPA (section 2(2)) states: “In particular, efforts should be made to protect *essential habitats*, including the rookeries, mating grounds, and areas of similar significance for each species of marine mammal from the adverse effect of [human] actions.”⁴ The MMPA (section 112(e)) further states: “If the Secretary determines, based on a stock assessment under section 117 or other significant new information obtained under this Act, that impacts on rookeries, mating grounds, or other areas of similar ecological significance to marine mammals may be causing the decline or impeding the recovery of a strategic stock, the Secretary may develop and *implement conservation or management measures to alleviate those impacts*. Such measures shall be developed and implemented after consultation with the Marine Mammal Commission and the appropriate Federal agencies and after notice and opportunity for public

¹ Providing that federal agencies must “give . . . interested person[s] the right to petition for the issuance, amendment, or repeal of a rule.” The APA requires agencies to respond to petitions for rulemaking “within a reasonable time.” 5 U.S.C. § 555(b). If the agency denies the petition, it must include “a brief statement of the grounds for denial.” 5 U.S.C. § 555(e).

² ESA 16 U.S.C. 1540 (f) authorizes NMFS “to promulgate such regulations as may be appropriate to enforce this chapter,” and section 1382(a) of the MMPA provides that “[t]he Secretary, in consultation with any other Federal agency to the extent that such agency may be affected, shall prescribe such regulations as are necessary and appropriate to carry out the purposes of this subchapter.” These are the two provisions that NMFS cited for its 2011 vessel regulations.

³ Emphasis added.

⁴ Emphasis added.

comment.”⁵ The SRKW DPS is a strategic stock by virtue of the fact that it is listed as endangered under the ESA.

The APA allows for an interested person to participate in the updating of regulations through the submission of a petition for the “issuance, amendment, or repeal of a rule” (5 U.S.C. § 553(e)). Failure to respond to such a petition within a reasonable timeframe constitutes a violation of an agency’s duty under the APA (5 U.S.C. § 555(e)). The petitioners consider 12 months to be such a reasonable timeframe and request that the agency respond to the petition within that period.

In this petition, Orca Relief and co-signers (hereafter referred to as the petitioners) demonstrate that the SRKW DPS is not recovering, that SRKWs are being “taken” regularly by noise and disturbance from commercial and non-commercial vessels ranging from tanker and cargo ships to commercial whale watch and recreational boaters, which collectively impact the SRKW communication and degrade their habitat with noise. Thus, both the whales and their habitat warrant further protection. NMFS has the authority to establish and implement protective measures that it is not using. To fulfill its responsibilities, the agency should rapidly implement any methods and procedures that would aid full recovery of the SRKW DPS, including a whale protection zone (WPZ). Although SRKW suffer from multiple threats, including lack of adequate food, pollution, and the risk of a catastrophic oil spill, a WPZ is a commonsense approach to noise impacts that can be implemented immediately.

The best available science, evident in NMFS’ own documents, clearly demonstrates that a WPZ is necessary. NMFS included the SRKW DPS in its 2016 report to the US Congress, “Species in the Spotlight: Survive to Thrive” – a five-year action plan for recovery of eight species most at-risk of extinction from population decline and habitat destruction.⁶ The agency writes that it will take action where it has “the discretion to make critical investments to safeguard these most endangered species” and that its evaluation of existing regulations “will inform any potential revisions to existing guidelines and regulations or consideration of additional protections, *such as a protected area.*”⁷

⁵ Emphasis added.

⁶ NMFS 2016, p. 1 (see also NMFS Endangered and Threatened Listing Recovery Guidelines (55 FR 24296, June 15, 1990).

⁷ NMFS 2016, p. 4 emphasis added.

Confident that such a WPZ is necessary, the petitioners urge NMFS to act on this petition with all due haste. Recent trends indicate that recovery will be increasingly difficult in the absence of stronger habitat protection. Killer whales are an iconic species, particularly in the Pacific Northwest; and their presence in the Salish Sea is strongly reflected in Native culture and the staunch environmental ethic that is characteristic of the region. These iconic whales deserve protection from noise and disturbance and, given recent trends, their very existence appears to depend upon it.

Dated this 4th day of November, 2016



Bruce Stedman, Executive Director
Orca Relief Citizens' Alliance

Miyoko Sakashita
Center for Biological Diversity

Michael Kundu
Project Seawolf

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I. Introduction

The southern resident killer whale (*Orcinus orca*; SRKW) distinct population segment (DPS) is in trouble, declining from 98 individuals in 1995 to only 83 as of July 2016, a 15% decrease.⁸ As described in detail below, the numbers of breeding-age females and juvenile females (representing current and future reproductive potential) also have declined significantly since 1995. These trends indicate that measures taken to date by the National Marine Fisheries Service (NMFS) have not recovered the DPS or even maintained it at a stable level. Furthermore, future recovery efforts will be confounded by the SRKW's distorted age-sex composition and declining reproductive potential.

All the major risk factors for the SRKW DPS are forms of habitat degradation.⁹ They include insufficient prey (primarily Chinook salmon: *Oncorhynchus tshawytscha*), contaminants, risk of oil spill, and noise and disturbance (particularly from motorized vessels).¹⁰ NMFS has very recently indicated that there are a number of steps that it intends to take to improve the quality of SRKW habitat.¹¹ Central among those are measures to reduce the noise and disturbance that SRKWs experience.

To protect SRKW habitat and recover the DPS, the petitioners (Orca Relief and co-signers) propose that NMFS establish a whale protection zone (WPZ) with supporting regulations. The petition is focused on the critical need to reduce noise and disturbance of SRKWs in the center of their critical habitat core Area 1. Among other reasons, protecting this area is necessary to ensure that SRKWs have unimpeded access to their primary foraging and resting habitat during spring, summer, and autumn months.

The best available scientific information documents the need to reduce SRKW exposure to noise and disturbance, particularly that resulting from whale watching vessels. Nonetheless, responding to this request will require a comprehensive evaluation by NMFS of all sources of noise and disturbance in the proposed WPZ as well as the essential features of the WPZ.

II. Description and Features of a Whale Protection Zone

The petitioners propose that NMFS promulgate a regulation to establish a WPZ that extends three-quarters of a mile offshore of San Juan Island from Mitchell Point in the north to Cattle Pass in the south (Map 1). This area is similar to, but wider and longer than the protected area proposed by NMFS in 2010. Petitioners also propose that NMFS include a one quarter-mile wide buffer adjacent to the WPZ.¹² Petitioners regard the added size (with a buffer) necessary to give the SRKWs more quiet and rest even

⁸ July 1 is the official census date each year. (Orca Relief analysis of publicly available data from the Center for Whale Research and National Marine Fisheries Service [breeding-age females assumed to be ages 16-35]; <http://www.Orcarelief.org/status/>). Three additional deaths are known to have occurred after July 1, 2016.

⁹ NMFS 2008.

¹⁰ "Researchers have documented behavioral disturbance and estimated the considerable potential for auditory masking from vessels . . . as far away as 400 yards." ". . . [A]t 200 yards the models show auditory masking of 75-95 percent." (NMFS 2010, p. P-2).

¹¹ NMFS 2016.

¹² NMFS 2010, p. 2-3. NMFS chose a protected area that was the same as the then (and now) existing voluntary no-go-zone.

when vessels are near the boundary of the zone. NMFS should also consider the proposal by Ashe *et al.* to establish a protected area extending from south of Lime Kiln Point State Park to Cattle Point, at a distance of one mile offshore.¹³ Those authors found that “[k]iller whales are predicted to be 2.7 times as likely to be engaged in feeding activity in this site [the proposed WPZ] than they were in adjacent waters.”¹⁴ The protected area would encompass approximately 10-12 square miles (about 0.5% of the currently designated critical habitat of 2,560 square miles).^{15 16}

This area is based on the essential biological and habitat needs of the SRKW. NMFS has acknowledged “the basis for setting and designating [protected areas] should rest on an evaluation of the needs of the population at risk [i.e., the SRKW population], its distribution, sensitive activities (i.e., breeding, feeding), and threats.”¹⁷ “Even if [the SRKWs] only [use] the protected area for part of the time, protected areas reduce the frequency of exposure to certain threats and diminish the overall cumulative impact of other threats.”¹⁸ The petitioners concur with NMFS’ assessment and propose that, at the least, efforts to establish a WPZ account for the following essential features.

¹³ Ashe, *et al.* 2009, p. 1.

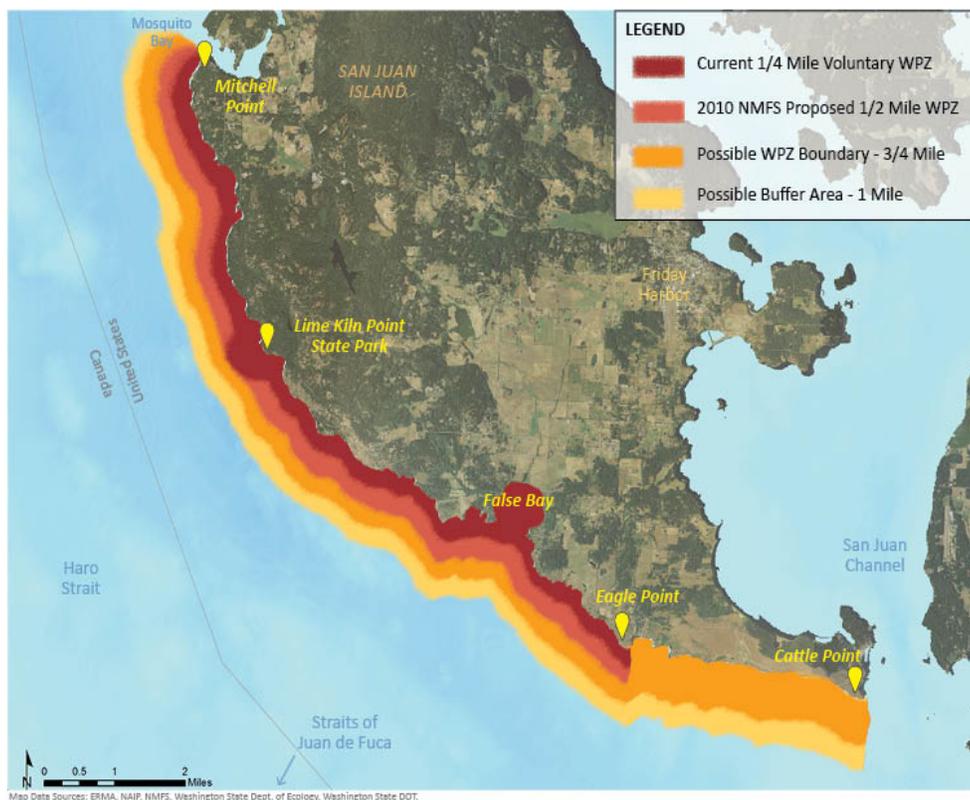
¹⁴ Ashe, *et al.* 2009, p. 1.

¹⁵ “No matter where [a] line is drawn to delineate a specific area, there will be activities occurring outside of the delineated area that may affect the features within the area. When prey items are a biological feature that moves freely in and out of the geographical area occupied by the species [as would be the case with the WPZ], it creates a situation in which there is a “biological feature” outside the occupied specific areas. This fact does not make line-drawing arbitrary because the statute requires [NMFS] to designate as critical habitat specific areas occupied by the species that contain those physical and biological features essential to conservation and may require special management considerations or protection.” *Federal Register* 71(229):69055.

¹⁶ Currently, the SKRW critical habitat does not extend closer to shore than 20 feet in water depth. Many commenters to the process establishing the critical habitat requested that the boundary of the critical habitat be much closer to shore due to the importance of shallow water depths for salmon and forage fish. This limit would also prevent vessels from travelling at high speed close to shore to avoid speed limits within the protected area. *Federal Register* 71(229):69055.

¹⁷ NMFS 2010, p.4-5.

¹⁸ Hooker and Gerber 2004.



Map 1. Proposed $\frac{3}{4}$ mile wide Whale Protection Zone (orange) with $\frac{1}{4}$ mile wide protection buffer (yellow)

Key behaviors

No population can persist if it fails to achieve adequate vital rates, those rates being reproduction and survival. To achieve those rates, SRKWs must be able to find and secure sufficient prey (e.g., energy and nutrients), maintain sufficient health and condition, communicate, socialize, reproduce, move among critical habitats, and rest. SRKWs are social in their behaviors and the use of sound is a critical component of those behaviors. The behaviors are considered “significant” because, if disrupted, they may compromise reproduction, survival or both. To be effective, a WPZ must protect the whales and their habitat to the extent that these behaviors are not substantially disrupted.

Key habitat

The extensive data on SRKWs in Puget Sound clearly indicate that the area in question off the western and southern shores of San Juan Island is key habitat for these whales, and protection of that habitat is essential for SRKW recovery. NMFS has acknowledged that “[p]rohibiting vessels from portions of the whales’ habitat along the west side of San Juan Island would protect the whales: 1) from multiple threats; 2) in an area the local [human] community already recognizes; and 3) [by providing] opportunities to evaluate the effectiveness of the area.”¹⁹ This area is used for many of

¹⁹ NMFS 2010, p. 4-17; 4-19.

the essential behaviors described above, including feeding, socializing (which may include reproductive activities), resting, and transiting. Such areas are often referred to as biological “hot spots” as a way of indicating their importance to populations, species, and ecosystems. In that regard, the availability of Chinook salmon, and SRKW access to these salmon, are particularly important; as part of the development of the WPZ, NMFS must address the potential for interactive and exploitative competition between SRKWs and fisheries.

The existing data not only identify key habitat for the SRKWs, but also are informative regarding the times when that habitat is essential. The three SRKW pods use Puget Sound habitat somewhat differently, their habitat-patterns vary from year to year, and they may now be adjusting their habitat-use patterns to adapt to the effects of climate change. Although more whales are likely to be present during the April-to-October period, whale watching appears to be an increasingly year-round activity. Furthermore, the extent to which human activities discourage the whales’ presence in the remainder of the year is not evident. Other types of information (e.g., tides, currents) could also provide important insights into the whales’ use of this habitat and therefore may be useful in designing the WPZ. To be duly precautionary, the petitioners propose that the WPZ should be in effect year-round. At a minimum, it should be in effect from April 1 to September 30, with the requirement that NMFS continue to monitor the WPZ and extend that period if the data indicate the whales’ use of the area is increasing during other months.

WPZ acoustics

The acoustical properties of the WPZ are particularly important because of the whales’ dependence on sound for foraging, communicating, socializing, and likely other activities such as reproduction and traveling. Human-generated sounds, especially low-frequency sounds, can travel long-distances underwater. Especially loud sounds pose a risk of injury and behavioral disruption to the whales and such disruptions have at times resulted in the deaths of some animals in other species. Such risks are not insignificant for SRKWs because a whale disoriented by sound could move into the path of a vessel.²⁰ Masking is a more common risk and occurs when human-generated sounds are sufficiently loud and close that the whales cannot hear the sounds that they depend on for communications, hunting, and other purposes. Finally, sounds may cause subtle changes in behaviors that, when combined with other human-related effects, may cumulatively compromise the whales’ ability to survive and reproduce. The National Research Council has published a number of reports on the effects of sound, which are highly relevant to conservation efforts for the SRKW. Those reports indicate that scientists still cannot describe with full confidence the extent of acoustic effects on marine mammals.²¹ That observation holds true for the SRKW.

²⁰ In 2003 killer whales exhibited considerable disorientation as a result of sonar activities by the Navy’s USS Shoup. NMFS 2005.

²¹ NRC 2003; NRC 2005.

WPZ management

The purpose of the WPZ is to manage human activities with the intent of preventing undue disturbance of SRKWs and disruption of their significant behaviors. The petitioners propose that, within the WPZ, NMFS prohibit all motorized vessels, with specific exceptions such as government enforcement vessels and vessels responding to safety and environmental emergencies, and vessels transiting to and from areas of San Juan Island accessible only through the Whale Protection Zone. The petitioners propose that these exempt vessels be required to adhere to a “no-wake” speed limit, both to significantly reduce the amount of noise and disturbance that these vessels could introduce, and to minimize the likelihood of striking a whale in the WPZ.

NMFS should consider whether there should be an exception for fishing vessels. The Soundwatch 2015 report indicates that private recreational vessels and US and Canadian commercial whale watching vessels commit the greatest number of incidents inconsistent with current best practices or vessel regulations.²² Accordingly, NMFS should review whether an exception for fishing vessels or other vessels that do not pursue the SRKWs is appropriate in this rulemaking. Specifically, petitioners respect tribal sovereignty and tribal rights to traditional fishing and cultural practices. NMFS should consider approaches to tailor the rulemaking to avoid conflicts with lawful fishing activities.

The petitioners also request that NMFS evaluate the need to manage human activities that may not involve the use of motorized vessels, but that also may cause unnecessary disturbance. Examples include the use of non-motorized vessels, aircraft, and coastal development. Notably, the Soundwatch 2015 report finds that, “[d]espite the low occurrences of aircraft as a vessel type, planes and helicopters committed roughly 5% of vessel incidents annually from 2007-15, with 2% in 2015.”²³

The petitioners propose that NMFS include in its management measures adequate *monitoring* to ensure that human activities within the WPZ comply with the associated regulations, *enforcement* to ensure that violators are identified and held accountable for their violations, and *education* to ensure that the public — and especially those concerned about SRKWs or who are affected by the WPZ — understand the need for the zone and associated regulations.

These proposals are reasonable and achievable, particularly in light of the small size of the proposed WPZ. Despite its small size, the proposed WPZ should promote recovery of the SRKW. Hoyt has described the value of even small protected areas and, as noted by NMFS, “small protected areas [can] help conserve [marine mammal] species. Several models for fishery reserves have included migration and movement of animals and show benefits of small protected areas even to highly mobile species.”²⁴

Buffers and Edge Effects

Finally, the petitioners propose that NMFS include in the WPZ a one-quarter-mile-wide buffer. A “no wake” speed restriction should be in effect within this buffer area

²² Seely 2015, p. 31 (figure 36).

²³ Seely 2015, p. 43.

²⁴ NMFS 2010, p. 4-5; Hoyt 2011.

and throughout the WPZ.²⁵ Recent research has demonstrated that “reduc[ing] vessel speed in the vicinity of killer whales would reduce noise exposure in [the SRKW DPS].”²⁶ As NMFS has pointed out, “there could continue to be some disturbance along the edge of [a WPZ], as vessels engaged in whale watching currently park or travel along the edge of the zone to view whales.”²⁷ A speed restriction would help boaters in the buffer area identify the WPZ boundary as they approach it, not unlike notices on a highway indicating that the speed limit reduces ahead. From an enforcement point of view, it would also be easier to demonstrate violations with the WPZ if there is a buffer zone.

III. SRKW Status

A. Distribution

SRKWs range from the Queen Charlotte Islands in British Columbia to at least as far south as Monterey Bay in California. Each year they spend considerable time in the Salish Sea, including Puget Sound, Haro Strait, and the Strait of Juan de Fuca.²⁸ Historically, SRKWs “have been sighted in [the critical habitat core] Area 1 during every month of the year [Map 2], but sightings are more consistent and more concentrated in spring, summer, and autumn months.”²⁹ (Map 3)

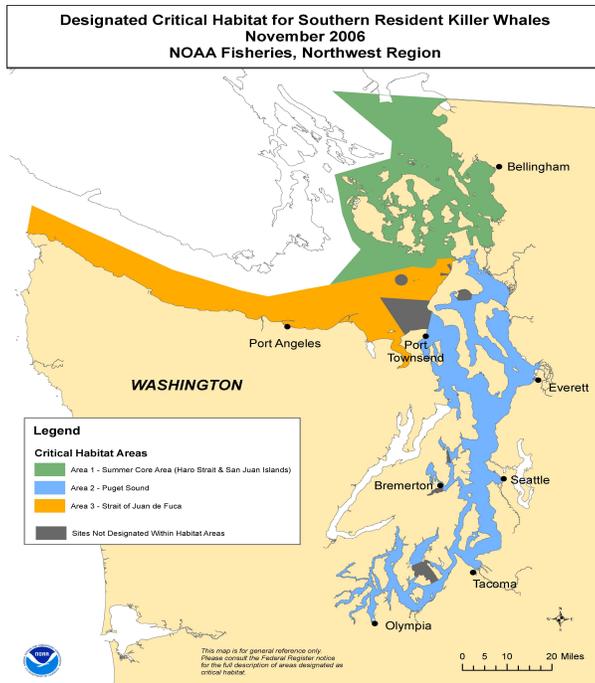
²⁵ Houghton, *et al.* 2015.

²⁶ *Ibid.*

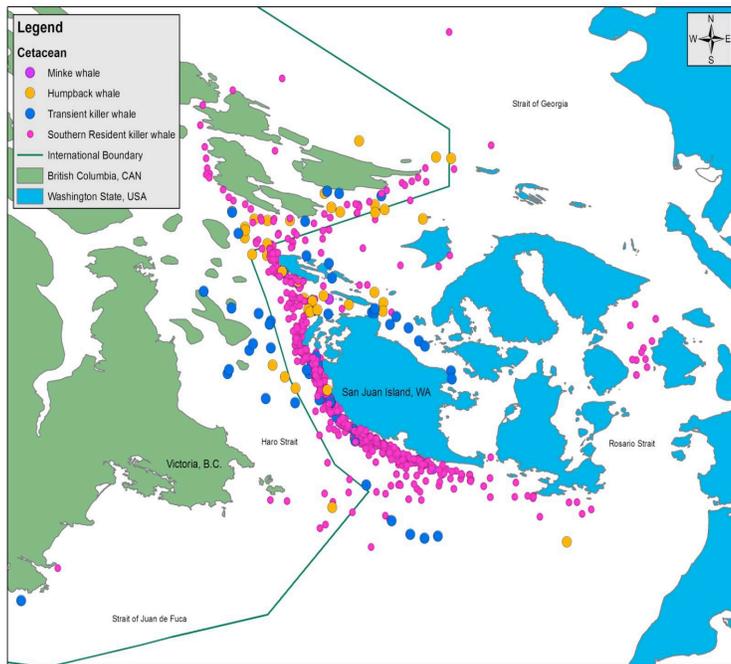
²⁷ NMFS 2010, p. 4-16. This would be especially true at the north or south ends of the long narrow protected area, where whale watchers and other boaters would be able to rush to within 200 yards of the whales after having been required to stay as much as 600-800 yards away; the “no wake” speed restriction would help reduce the effects of this problem.

²⁸ NMFS 2008, p. II-6.

²⁹ *Federal Register* 71(229):69062; Hauser, *et al.* 2007.

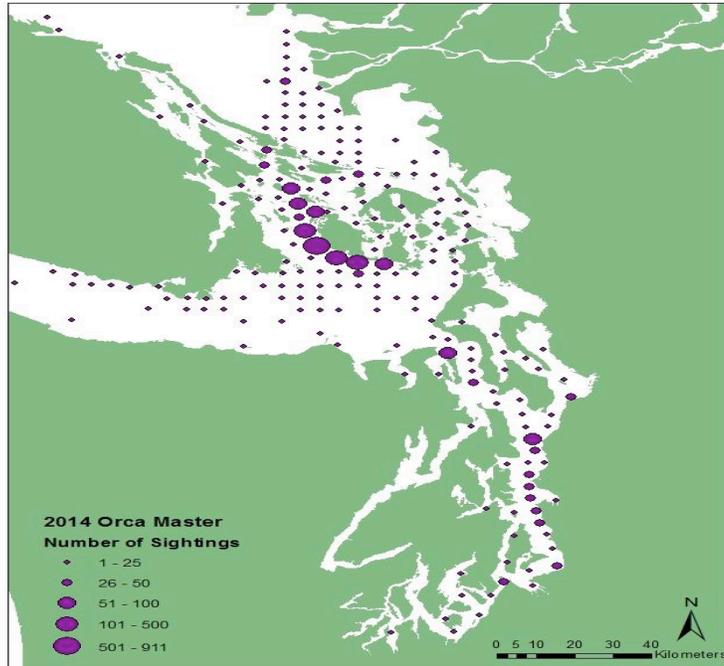


Map 2. Designated Critical Habitat of Southern Resident Killer Whales



Map 3. Locations of whale sightings by Soundwatch program, 2015³⁰

³⁰ Seely, 2015, p. 7.



Map 4. SRKW plotted sightings, 2014.³¹

The requested rulemaking should include a detailed analysis of the geographic boundaries of a protected area that would be the most beneficial for the SRKW. The most likely candidate is in Area 1 of the designated critical habitat on the west side of San Juan Island.³² As is evident in Maps 3 and 4, killer whale observations are concentrated in this area.

B. Abundance and Trends

NMFS' 2008 *Recovery Plan* for the SRKWs describes the population's long-term status and trends.³³ The historic SRKW population (mid- to late-1800s) has been estimated to be about 140 to 200 individuals.^{34 35} The *Recovery Plan* describes a variety of factors that contributed to the SRKW's subsequent decline (e.g., unregulated shooting, fishery interactions, loss of prey, vessel interactions). By the early 1960s, the stock had been reduced substantially, likely the result of these and other risk factors, at which point the SRKWs then experienced further, unprecedented decline from removals (live capture and some deaths) associated with efforts to capture whales for display in oceanaria and aquaria.³⁶ According to the *Recovery Plan*, about 70% of the captured

³¹ Seely 2015. Appendix M. Plotting by The Whale Museum Oca Master.

³² *Federal Register* 71(229):69054.

³³ NMFS 2008, p. II-54-6.

³⁴ *Ibid.*

³⁵ Bain, D.E., unpublished: the population may have been as high as 2,000 in the mid- to late 1700s.

³⁶ The *Recovery Plan* (NMFS 2008, p. II-54-6) states that "[f]rom 1962-1977, 275-307 whales were captured in Washington and British Columbia . . . [of which] 208-240 were released or escaped back into the wild." The fate of

whales were from what is now recognized as the SRKW DPS. Because of public opposition, these captures were curtailed and finally discontinued by the late 1970s.

By 1974 – the year when precise census counts began – the SRKW DPS had been reduced to 71 individuals. The DPS appeared to be recovering after passage of the Marine Mammal Protection Act (MMPA) in 1972 (Figure 1), growing to a peak of 98 individuals in 1995 (with the exception of the period from 1980 to 1984).³⁷ However, the 2016 official SRKW census is 83 individuals, and the population has declined by 15% since its high point in 1995. As part of the 2008 *Recovery Plan*, NMFS established recovery goals of 155 SRKWs by 2029 and a “down-listing” interim target of 113 by 2015.³⁸ Although well-intentioned, NMFS recovery actions have not been sufficient to recover the SRKW DPS, or even maintain it at a stable level.

The SRKW population is divided into three “pods” that are often geographically and socially separate – they are designated as pods J, K, and L. The trends for the individual pods also are of significant concern. For example, L-Pod is now at its lowest count (35) since 1974, when the SRKW census began, and down 40% since its peak of 58 in 1995; K-Pod has not experienced a birth since 2011.

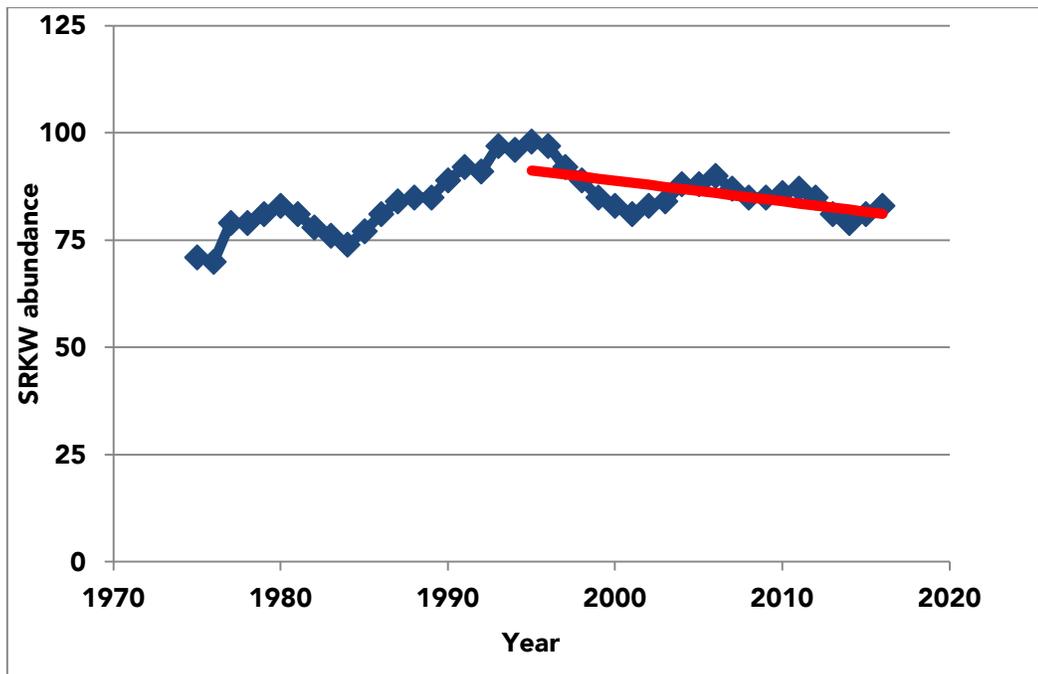


Figure 1. Population abundance of the SRKW stock since 1974 (70 individuals), when precise counting began (blue points and line) and linear regression fitted to the points from 1995 (98 individuals) to 2016 (red line; 83 individuals). The regression shows a statistically significant decline ($p=0.001$).³⁹

all those whales that were released or escaped is not clear, and it is possible that some of them later died from injuries sustained during capture.

³⁷ NMFS 2008, p. II-55.

³⁸ NMFS 2008, p. IV-4,9; based on a starting point of 81 animals in 2001.

³⁹ NMFS 2008, p. II-55.

C. Age-Sex Composition

In addition to the overall population decline, the numbers of reproductive females and males, juvenile females, and newborns also have exhibited variable trends inconsistent with a recovering population. Since 2005 juvenile females have declined by 21%, 1- to 2-year-olds by 9% and most significantly, reproductive females are down by 25%.⁴⁰ As is the case for all marine mammals, females are the more important component of this stock because of their reproductive capacity. The SRKW's composition indicates that the numbers of adult and, especially, juvenile females are declining steadily (Figure 2).

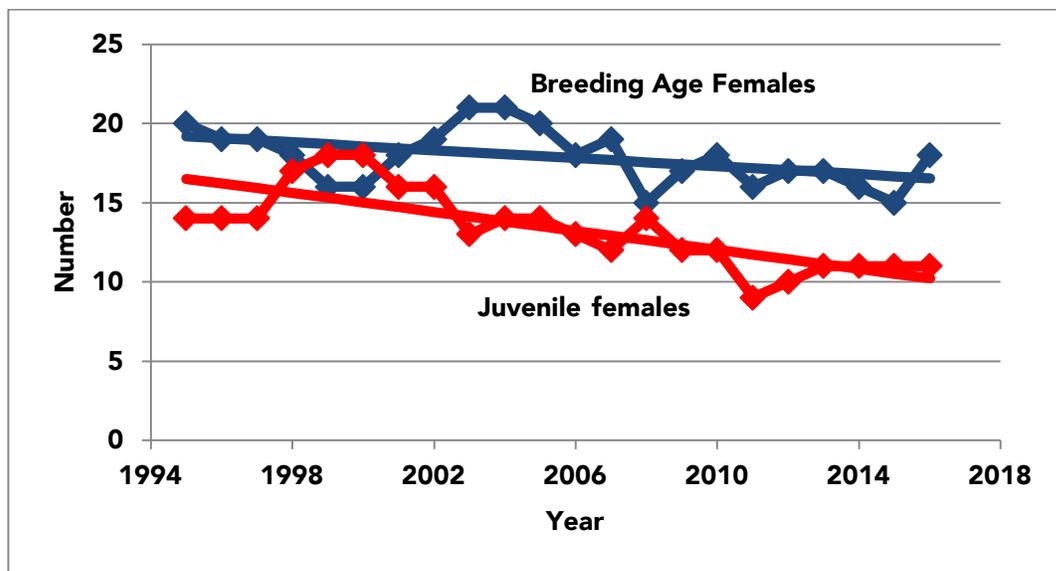


Figure 2. Statistically significant declines in the number of SRKW breeding age females ($p=0.032$; 20 in 1995, 15 in 2016) and juvenile females ($p=0.000$; 14 in 1995, 11 in 2016). Blue line represents current reproductive capacity; red line represents future reproductive capacity.

These changes likely reflect increasing variability in demographic parameters (survival, reproduction, and sex ratio at birth) – a phenomenon known as “demographic stochasticity,” which becomes increasingly important for declining, small populations. Extreme stochastic fluctuations – such as the 2015 births of eight calves (seven have survived to date) after only four births in the three prior years (three surviving) – may indicate a troubling pattern that will work against the SRKWs in the coming years, particularly if most of the surviving calves are males.⁴¹ New-born mortality has been calculated at approximately 43%.⁴²

IV. Four Main Impediments to Recovery

NMFS regards prey availability, vessel effects (especially noise and disturbance), and contaminants as the three most severe causes of the SRKW decline and failure to recover.⁴³

⁴⁰ Orca Relief analysis of publicly available data from the Center for Whale Research and National Marine Fisheries Service (breeding age females assumed to be ages 16-35); <http://www.Orcarelief.org/status/>.

⁴¹ Gender of new-borns is often not known for 1-2 years.

⁴² Olesiuk et al. 1990.

⁴³ NMFS 2008, p. II-74.

NMFS must commence work immediately to ensure that killer whales in Puget Sound and the Salish Sea have greater access to salmon and reduced exposure to contaminants. While NMFS works on those longer-term outcomes, we urge you to take the relatively quick and inexpensive step of establishing a WPZ.

A. Prey Availability

SRKWs are almost exclusively fish-eaters, with Chinook salmon (*Oncorhynchus tshawytscha*) constituting their preferred and primary prey (although they also consume other species of salmon and fish). Especially during the period of high vessel disturbance (May through September) 80-90% of the SRKW diet is composed of Chinook salmon.⁴⁴ However, several of the key runs of this species are themselves listed as threatened or endangered under the ESA.⁴⁵ There is “a strong positive correlation between changes in overall coast wide Chinook [salmon] abundance and combined mortalities of [the Southern and Northern] resident communities.”⁴⁶ The SRKWs’ ability to find adequate prey is also limited by vessel-caused disturbance and masking that interferes with hunting in their primary feeding areas or their efficiency in capturing sufficient amounts of prey to meet their nutritional and energetic needs.⁴⁷

B. Noise and Disturbance⁴⁸

Killer whales use clicks, calls, and whistles to forage, navigate, and communicate with one another within and across different groups and sub-groups. Echolocation is the primary means by which SRKWs seek their large salmonid prey. As discussed below, noise and disturbance can harm SRKWs by increasing their levels of stress, interfering with their foraging and communication, and masking other sounds. Specifically, masking occurs when the level and frequency of an introduced noise prevent the whales from hearing the natural sounds that they depend on for foraging, communicating, navigating, and, in a more general sense, for reproduction and survival.

C. Contaminants^{49, 50}

SRKWs are known to carry high levels of contaminants (e.g., dioxins, polychlorinated biphenyls) because they are long-lived apex predators. High toxic loads contribute to impaired reproduction, immunotoxicity, hormonal dysfunction, suppression of the immune system, and other health problems. Each generation begins with a high toxic load, and in other dolphins “females pass as much as 70-100 percent of their organochlorine load to their offspring during lactation,” especially to their first-born;⁵¹ this is highly likely to be true for the SRKWs as well.

D. Cumulative Effects

In its SRKW *Recovery Plan*, NMFS wrote that “[i]t is not clear, and may be impossible to quantify or model, which of the threats or combination of threats [to

⁴⁴ Ford & Ellis 2006; Ford, et al. 2010; Hanson *et al.* 2010.

⁴⁵ Gustafson, *et al.* 2007; http://www.rco.wa.gov/salmon_recovery/listed_species.shtml.

⁴⁶ NMFS 2008, p. II-76.

⁴⁷ NMFS 2010, p. P-2.

⁴⁸ Clark, *et al.* 2009; Erbe 2002; Holt 2008; Houghton *et al.* 2015.

⁴⁹ NMFS 2008, p. II-100.

⁵⁰ Ross *et al.* 2000 ; Krahn, *et al.* 2007.

⁵¹ NMFS 2008, p. II-92.

which] the Southern Resident killer whale population is subject is the most important to address relative to recovery. It is likely that there is a cumulative effect, which could be more pronounced due to the small size of the Southern Resident population.”⁵² In addition, the cumulative effects of contaminant levels, increased noise, and reduced prey could “increase the vulnerability of Southern Residents to a catastrophic disease event (J.P. Schroder pers. com.).”⁵³

Cumulative effects occur when multiple risk factors affect SRKWs concurrently. Those effects may be additive if the risk factors are independent of one another or, if the effects interact, they may be synergistic (i.e., combined effects are more than additive) or countervailing (i.e., combined effects are less than additive). For SRKW, cumulative effects are almost certainly synergistic:

- Reduced access to prey is likely to mean that the whales are in poorer condition and less able to tolerate the effects of contaminants.
- Increased exposure to noise and disturbance may cause the whales to avoid or spend less time in key foraging areas, thereby compromising their health and their ability to reproduce and survive.
- Increased exposure to contaminants may compromise the whales’ immune and reproductive systems, increasing their sensitivity to noise and disturbance and making them more vulnerable to disease.⁵⁴

V. Noise and Disturbance Are Major Risk Factors

NMFS has summarized the effects of noise and disturbance: “Disturbance from vessels and sound can . . . impact the behavior and feeding of the whales, increasing their energy expenditure, possibly reducing the effectiveness of their hunting techniques, and reducing the time they spend foraging.”⁵⁵ In turn, these affects undermine SRKW population dynamics.⁵⁶

Other researchers⁵⁷ have documented behavioral disturbance and estimated the considerable potential for auditory masking from vessels . . . as far away as 400 yards. “[A]t 200 yards the models show auditory masking of 75-95 percent.”⁵⁸ It is likely that any noise above ambient levels will result in some “masking.”^{59, 60} In response, killer whales are known to change their behavior. For example, in one study, whale watching boats caused male northern resident killer whales to travel about 13% farther when a boat approached than when left alone.⁶¹

⁵² NMFS 2008, p. II-122.

⁵³ NMFS 2008, p. II-121.

⁵⁴ *Ibid.*

⁵⁵ NMFS 2016, p.2.

⁵⁶ Bain, *et al.* 2014.

⁵⁷ Erbe 2002; Foote, *et al.* 2004; Holt, *et al.* 2009; Jensen, *et al.* 2009; Lusseau 2004; Lusseau, *et al.* 2009; NMFS 2008, II-106-7; Noren, *et al.* 2009; Van Parijs & Corkeron 2001; Wieland, *et al.* 2010; Williams, *et al.* 2009a; Williams, *et al.* 2008; 2013.

⁵⁸ NMFS 2010, p. P-2.

⁵⁹ Bain, *et al.* 2014.

⁶⁰ “There has been no detailed study of SRKW behavior since the new regulations went into effect in 2011; so we have insufficient data to determine safe vessel distance.” David Bain, personal communication, 2014.

⁶¹ Williams, *et al.* 2002a.

To avoid vessels, SRKWs use various tactics, such as increasing their swimming speed, altering their normal travel patterns, taking unpredictable travel paths, making shorter or longer dives, moving toward open water, modifying surface behaviors, altering vocalizations, and/or altering other normal patterns of behavior.⁶² Leaps, jumps, tail and fin slaps, and other surface behaviors also may be related to the presence of vessels.⁶³

Changes in behavior, especially those that reduce access to prey, may alter killer whale energy balance.⁶⁴ “Increased energy expenditure likely has a negative impact on the whales, particularly in light of the concerns regarding reduced prey for the whales . . . other studies . . . found short-term behavioral response can have long-term consequences for individuals and populations.”⁶⁵ These consequences may include such things as lower birth rates, shorter life spans, and problems with social cohesion. “Increasing the energetic requirements of individuals within the population and reducing effective prey availability are equivalent to reducing the carrying capacity in food-limited populations” such as the SRKWs.⁶⁶

VI. A Whale Protection Zone Is Necessary for the Conservation and Recovery of SRKW

The history of ESA protection, and the science underlying that history, demonstrate that protecting habitat is one of the most important steps in endangered species recovery. The purposes of the ESA are “to provide a program for the conservation of . . . endangered species and threatened species” and “a means whereby the ecosystems upon which [these] species depend may be conserved.”⁶⁷ In 2005, NMFS listed the SRKW DPS as “endangered” under the ESA. As required by that Act, NMFS established critical habitat for the SRKW in 2006⁶⁸ and drafted a *Recovery Plan* in 2008.⁶⁹

Research demonstrates that, at present, the SRKWs are at risk from three major, interrelated factors: low prey availability, noise and disturbance, and high concentrations of toxins in their blubber.⁷⁰ NMFS also has noted that it “is likely that there is a cumulative effect, which could be more pronounced due to the small size of the Southern Resident population.”⁷¹ As a small population (with three smaller, distinct pods), not widely distributed, and social in its behavior, the SRKW DPS also is highly

⁶² Bain et al. 2006; Bejder et al. 2006; Foote et al. 2004; Holt et al. 2008; Lusseau 2003, 2005; Morton & Symonds 2002; NMFS 2008; Noren et al. 2007, 2009; NRC 2003; Williams & Ashe 2006, 2007; Williams et al. 2002a, 2002b, 2006, 2009a.

⁶³ *id.*

⁶⁴ Lusseau, *et al.* 2009; Romano, *et al.* 2004; Wasser, *et al.* 2010; Williams & Noren, 2009; Williams, *et al.* 2002a, 2002b, 2006, 2009a, 2010.

⁶⁵ Lusseau and Bejder 2007.

⁶⁶ Bain, *et al.* 2014, p. 209

⁶⁷ *Ibid.* § 1531 (b).

⁶⁸ *Federal Register* 71(229):69054. Critical Habitat is “the specific areas within the geographic area occupied by the species . . . on which are found those physical or biological features . . . essential to the conservation of the species and . . . which may require special management considerations or protection.” 16 U.S.C. §1532(5)(A)(i),(ii).

⁶⁹ NMFS 2008.

⁷⁰ NMFS 2008, p. II-71-116.

⁷¹ NMFS 2008, p. II-122.

vulnerable to catastrophic events, such as oil spills or exposure to communicable disease (e.g., morbillivirus), and (possibly) even whale research.⁷² Recovery of the population would greatly increase its resilience to its various risk factors, including catastrophic events.

In 2010, based on the ESA and MMPA, NMFS established regulations aimed at protecting the SRKW from human-generated noise and disturbance. The regulations prohibit vessel approaches less than 200 yards from killer whales and forbid parking in the whales' path while they are traveling. NMFS also considered, but did not include in the 2011 regulations, an SRKW protected area.⁷³

A. The Threats to SRKWs Continue and Justify Protective Regulations.

Eleven years after NMFS listed the SRKW as endangered, risks to the population remain unchanged or have grown worse. In the *Recovery Plan*, NMFS specifically include five factors with criteria that must be met to consider delisting the SRKWs as endangered.⁷⁴ Importantly, implementation of a WPZ would help address the following threats:

First, habitat degradation continues to threaten SRKW. NMFS has noted that “habitat areas for these [southern resident] killer whales are unique and irreplaceable.”⁷⁵ This habitat continues to be degraded by the noise and disturbance that these whales experience from whale watching vessels (both commercial and recreational) and other commercial and private vessels, including large ships.⁷⁶ Significantly, vessel noise can cause stress and can “mask” the sounds that SRKWs depend on to communicate and forage, even as far away as 400 yards; even “at 200 yards the models show auditory masking of 75-95 percent.”⁷⁷ A whale protection zone would allow the SRKWs to spend more of their time in critical foraging and resting habitat that is quieter and less likely to be disturbed by vessels.

Second, motorized vessels disturb SRKWs, and the noise from these activities inhibits their foraging abilities. The Soundwatch 2015 report recommends an effort to “manage both commercial and recreational whale watching as well as other vessel traffic near whales...to reduce potential threats to the whales from vessel presence, behavior and underwater noise.”⁷⁸ The increase in commercial and recreational whale watching has “increased noise where [SRKWs are] trying to find prey.”⁷⁹ In effect, increased noise reduces SRKW ability to find to prey, by masking their hunting sonar. NMFS has placed no limits on the number of vessels that may follow the whales at any one time, nor on the length of time any single vessel can follow the whales.⁸⁰

⁷² NMFS 2008, p. II-116-122.

⁷³ *Federal Register* 76(72):20870.

⁷⁴ NMFS 2008, p. IV-6-8.

⁷⁵ *Federal Register* 71(229):69065.

⁷⁶ Holt 2009.

⁷⁷ NMFS 2010, p. P-2.

⁷⁸ Seely 2015, p. 44.

⁷⁹ Bain, *et al.* 2014; Bain n.d., p. 3.

⁸⁰ When the commercial motorized whale watching fleet is near the SRKWs, that fleet attracts those in private boats, who might not (or likely would not) otherwise have come close to the whales.

Third, SRKWs are at heightened risk from disease. “The Southern Resident community is perhaps the most vulnerable of the four [orca] populations in Washington and British Columbia to a serious disease outbreak due to its gregarious social nature, smaller population, seasonal concentration near the San Juan Islands, and high levels of PCB contamination.”⁸¹ To the extent that excessive noise and harassment forces SRKWs to expend extra energy communicating and feeding (due to longer dive times and swimming distances) and interferes with the whales’ opportunities for rest, their ability to respond effectively to disease is diminished. A WPZ would provide a respite from such disturbance (see also #5 below).

Fourth, existing regulatory mechanisms are inadequate. To date, the listing, determination of critical habitat, development of a recovery plan, and distance regulations have not been sufficient to bring about the recovery of the SRKW and, indeed, do not appear to have been sufficient to maintain the DPS at a stable level. The approach regulations promulgated in 2011 have not to date been sufficient to address adequately the impacts on the SRKWs from noise and disturbance. In accordance with the SRKW *Recovery Plan*, recovery would be considered sufficient to delist based on the following two measures, neither of which is close to being achieved (see Section B, below):

- *An average population growth rate of 2.3% per year for 28 years.* (NMFS gives the example of “beginning in 2001, with 81 animals and estimated annual growth of 2.3 percent over the succeeding 28 years, would result in a population of about 155 animals in 2029” [and 113 in 2015]).⁸² The 2016 official census was 83 individuals; the population has declined 15% from a peak of 98 individuals in 1995.⁸³
- *An adequate number of individuals in all sex and age categories.*⁸⁴ Since its listing as endangered in 2005, the SRKW DPS has had losses in significant population categories: reproductive females are down 25%, juvenile females are down 21%, and 1- to 2-year-olds are down 9%.⁸⁵

Finally, the ongoing threat of an oil spill (along with the increasing effects of climate change) may increase the risk of extinction for the SRKW DPS by compounding the adverse effects of vessel noise and disturbance, declining food sources, and high contaminant loads. Ocean acidification in particular may contribute to further ecosystem, habitat, and food web changes, as well as to ill health (possibly through range expansion of disease vectors). Although there is little direct evidence about how climate change would directly harm the SRKWs, its cumulative effects are a major concern.

⁸¹ NMFS 2008, p. II-121.

⁸² NMFS 2008, p. IV-4,9; given two 14-year cycles of high and low mortality.

⁸³ With the recent loss of three additional individuals since July 1, 2016, the population is now down to 80 individuals.

⁸⁴ NMFS 2008, p. IV-4. In particular a ratio of sex and age numbers that are similar to the Northern Resident Killer Whale model. NMFS notes that “specific measure of these parameters have not been quantified for any stable non-threatened killer whale population against which the Southern Residents can be compared.”

⁸⁵ Orca Relief analysis of publicly available data from the Center for Whale Research and National Marine Fisheries Service (breeding age females assumed to be ages 16-35); <http://www.Orcarelief.org/status/>.

NMFS makes clear that “because the Southern Residents are such a small population, improvement to the fitness of even a small number of individual whales could lead to population level effects, improving their status.”⁸⁶ A WPZ would increase protection of the whales and their critical foraging and resting habitat with positive effects for individuals and the population as a whole.

B. SRKW Recovery Plan Supports the Whale Protection Zone

The recovery plan for the SRKW supports the development of a WPZ. It includes management measures to minimize vessel disturbance and evaluate the need for restricting vessels. Furthermore, the recovery goals have not yet been met, which clearly indicates that stronger conservation and recovery measures are necessary to protect SRKW.

Recovery actions

The 2008 *Recovery Plan* recommends actions to minimize disturbance of SRKW from vessels, including areas that restrict vessel traffic.⁸⁷ Specifically, the *Recovery Plan* actions include management measures to:

- 1.3 Minimize disturbance of Southern Resident killer whales from vessels.
 - 1.3.1 Monitor vessel activity around whales.
 - 1.3.1.1 Expand efforts to monitor commercial and recreational whale-watching vessels.
 - 1.3.1.2 Evaluate the relative importance of shipping, ferry, fishing, research, military, and other vessel traffic to disturbance of killer whales.
 - 1.3.2 Continue to evaluate and improve voluntary whale-watching guidelines.
 - 1.3.3 Evaluate the need to establish regulations regarding vessel activity in the vicinity of killer whales.
 - 1.3.4 Evaluate the need to establish areas with restrictions on vessel traffic.

Biological Criteria

For the SRKW DPS to be regarded as fully recovered, and thereby eligible to be removed “from the Federal List of Endangered and Threatened Wildlife and Plants under the ESA, NMFS must determine that the species is neither in danger of extinction nor likely to become so ‘in the foreseeable future throughout all or a significant portion of its range.’”⁸⁸ To be eligible for delisting, the SRKW *Recovery Plan* specifies the SRKWs achieve the following:

1. *An increasing population trend of 2.3% per year for 28 years (two full cycles).*

⁸⁶ NMFS 2010, p. 4-17; 4-19.

⁸⁷ NMFS 2008, p. V-2.

⁸⁸ NMFS 2008, p. IV-4.

2. *Social structure, calf recruitment, survival, age structure, and gender ratios are “indicative of an increasing or stable population.”*⁸⁹

These biological criteria for the recovery of the SRKW have not yet been met.⁹⁰ The “continued persistence of the Southern Residents depends not just on a demonstrated positive growth rate or an absolute number of animals, but also on the presence of an adequate number of individuals in all sex and age categories, distributed among the three pods.”⁹¹ There are very worrisome trends in many of these categories, especially evident in the decline in reproductive females.

Threats Criteria

Recovery criteria must consider not only the status of the population, but also management of the threats to it. In that regard, the Southern Resident DPS *Recovery Plan* states that, among other things, this population should not be delisted until:

- Management actions [are] in place to reduce vessel disturbance, auditory masking, and risk of ship strikes.
- Regulations and/or protected areas have been considered and put in place if it is determined that they will provide additional reduction in vessel effects.
- Impacts from commercial and recreational whale watching have been reduced, or NMFS has evidence that this activity does not cause population level effects. Among other things, reductions may be measured through establishment of *regulations or protected areas if needed*.
- Adequate habitat to support a recovering population of southern resident killer whales has been ensured, including sufficient quantity, quality, and accessibility of prey species.⁹²

The 2008 recovery plan for the SRKW indicates that reducing vessel disturbance of SRKW is of utmost priority for the conservation and recovery of the species. The plan supports the action requested here.

VII. The Identification of Critical Habitat Alone Does Not Provide Sufficient Protection

Protective regulations beyond critical habitat designation are necessary. Critical habitat is essential for the conservation of the SRKW, as is expansion of critical habitat to include winter foraging areas. Critical habitat, while important, is nonetheless insufficient to conserve and recover the SRKW.

NMFS designated critical habitat for the SRKW DPS in 2006,⁹³ including those portions of the SRKWs’ range that extend into Haro Strait, Puget Sound, and the Strait of Juan de Fuca (approximately 2,560 square miles).⁹⁴ The ESA defines critical habitat

⁸⁹ NMFS 2008, p. IV-4.

⁹⁰ With a base year of 2001 (81 animals), NMFS estimated there would need to have been 115 SRKWs by 2015.

⁹¹ NMFS 2008, p. IV-4.

⁹² NMFS 2008, pp. IV-6,7 [emphasis added].

⁹³ *Federal Register* 71(229):69054-66

⁹⁴ SRKW also spend significant amounts of time in Canadian waters.

to include “the specific areas within the geographical area occupied by the species, at the time it is listed... on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection....”⁹⁵

In its critical habitat designation, NMFS indicated that essential features (often referred to as “primary constituent elements,” or PCEs) could include such elements as:

- “(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.”⁹⁶

All five of those elements are clearly aspects of SRKW habitat. NMFS specifically noted that “[t]he PCEs identified for [the critical habitat] may require special management considerations or protection. Fishery management, *vessel activities*, and water quality management are all activities that have the potential to affect the PCEs by altering prey abundance, prey contamination levels, and passage between areas.”⁹⁷ Prey availability is determined, in part, by the whales’ capacity to hunt key fish species, and that access is disrupted by vessel noise and disturbance. Similarly, conditions must be such that the whales perceive migration, resting, and foraging areas to be sufficiently safe from vessel noise and disturbance.

Petitioners support NMFS’ determination that expansion of SRKW critical habitat is warranted. In 2014, the Center for Biological Diversity petitioned NMFS to “adopt a fourth primary constituent element for the [SRKW] for both its summer and winter range Critical Habitat area providing for in-water sound levels that: (1) do not exceed thresholds that inhibit communication or foraging activities . . . , (2) do not result in temporary or permanent hearing loss to whales, and (3) do not result in abandonment of Critical Habitat areas.”⁹⁸ In 2015, NMFS responded to the petition by stating that it intends to proceed with the petitioned action, and that the agency will take a number of steps to improve its understanding of killer whale habitat needs prior to making final decisions concerning the CBD petition, including CBD’s request for an additional PCE.⁹⁹ NMFS committed to proposing expanded critical habitat protections for SRKW in 2017, which would require it to be implemented in 2018 at the latest. We urge NMFS to act promptly and immediately propose an expanded critical habitat designation.

⁹⁵ 16 U.S.C. § 1532(5)(A)(i),(ii)

⁹⁶ 50 C.F.R. § 424.12(b)

⁹⁷ *Federal Register* 71(229):69063 [emphasis added]

⁹⁸ Center for Biological Diversity 2014, p. 20.

⁹⁹ <https://www.federalregister.gov/articles/2015/02/24/2015-03378/listing-endangered-or-threatened-species-12-month-finding-on-a-petition-to-revise-the-critical-h-17>.

Under present conditions, the SRKWs' distribution and behavior are the two best indicators of their habitat needs. As indicated by Map 2 (above), the habitat most used by SRKWs in the Salish Sea occurs just off the western and southern coasts of San Juan Island. The whales are most commonly sighted in those areas, and behavioral observations confirm that the areas are important for foraging, resting, and migration.¹⁰⁰

ESA regulations describe critical habitat as an area that is intended to help protect habitats from disturbance (among other impacts).¹⁰¹ ESA regulations also identify special management considerations or protection as “any method or procedure useful in protecting physical and biological features of the environment for the conservation of the species.”¹⁰²

In identifying the essential features of SRKW critical habitat, NMFS recognized the need to include “passage conditions to allow for migration, resting, and foraging.”¹⁰³ There is strong evidence that quiet and lack of disturbance are necessary for the foraging condition to be met (and some evidence that quiet and lack of disturbance will help migration and resting). In its 2014 petition, the Center for Biological Diversity noted that “in contrast to the U.S., Canada recognizes ‘acoustic degradation’ of Critical Habitat . . . as a threat to killer whale recovery, and it is illegal [in Canada] to introduce sufficient noise in Critical Habitats to ‘destroy’ it.”¹⁰⁴

NMFS must add special management protection to the critical habitat designation, because critical habitat designation and Section 7 consultations have not adequately reduced noise and disturbance for the SRKW. A WPZ along the western and southern coasts of San Juan Island could add substantial protection of SRKW habitat; to strengthen the protections provided by the WPZ, NMFS should add a federal permit system for commercial and private motorized whale watching vessels operating in U.S. waters that would ensure meaningful Section 7 consultations.

VIII. A Whale Protection Zone Is Necessary and Overdue

NMFS has long been considering actions to reduce noise and disturbance. NMFS has been considering the need for a protected area off the west coast of San Juan Island since at least 2007. In its recovery planning, NMFS identified “vessel effects as a risk factor in the decision to list the Southern Residents,”¹⁰⁵ and one of its goals was to “minimize disturbance of Southern Residents from vessels.”¹⁰⁶ In 2007, NMFS published an Advance Notice of Proposed Rulemaking to gather related information.¹⁰⁷ In 2009, NMFS published proposed regulations that included a prohibition on

¹⁰⁰ Seely 2015. Appendix M.

¹⁰¹ 50 CFR 424.02. <https://www.federalregister.gov/articles/2015/02/24/2015-03378/listing-endangered-or-threatened-species-12-month-finding-on-a-petition-to-revise-the-critical>.

¹⁰² *Id.*

¹⁰³ *Federal Register* 71(229):69061.

¹⁰⁴ Center for Biological Diversity 2014, p. 15, note 123.

¹⁰⁵ NMFS 2010, E-1.

¹⁰⁶ NMFS 2010, E-1.

¹⁰⁷ <https://www.regulations.gov/#!documentDetail;D=NOAA-NMFS-2008-0327-0003>

“motorized, non-motorized, self-propelled, and human-powered vessels” from “entering a restricted zone along the west coast of San Juan Island during a defined season.”¹⁰⁸

The final rule, published in 2011, did not include such a protected zone, despite the agency’s concern that “some whale watching activities may harm individual killer whales, potentially reducing their fitness and increasing the population’s risk of extinction.”¹⁰⁹ In the environmental assessment for the rule, NMFS indicated that it would “develop additional information and seek public input to further evaluate the costs and benefits of a [WPZ] and [might] propose a rule revision in the future.”¹¹⁰ The agency also indicated that it would “pursue this additional work *expeditiously* because the best available information [then indicated that] there would be a significant conservation benefit to the whales if they were free of all vessel disturbances in their core foraging area.”¹¹¹

In its 2014 review of 10 years of research and conservation on SRKW, NMFS expressed concern about the failure of the SRKW DPS to recover, and declared that the agency expected to “explore additional management actions outlined in the recovery plan.” Furthermore, NMFS said, “seasonal health assessments, habitat use, and potential times and places with prey limitations or vessel impacts that affect health or feeding will be taken into consideration when determining the need for additional conservation actions, *such as a protected area.*”¹¹²

In 2016, NMFS reiterated that its “evaluation of the [2011] vessel regulations . . . will inform any potential revisions to existing guidelines and regulations or consideration of additional protections, *such as a protected area.*”¹¹³

Thus, the agency has been studying and considering a protected area for the southern residents for at least a decade. Since 2005, the SRKW population has shown no signs of recovery; instead, the population has declined by 8%.

Noise and disturbance increase as the number of vessels increases. Noise and disturbance have undoubtedly increased over time, with more people inhabiting the Salish Sea region (especially Puget Sound) and more commercial and private vessels and watercraft on the water.

In 2015, 96 commercial vessels from 57 whale watch companies provided whale watching trips in U.S. and Canadian waters of Haro Strait, the highest number since the beginning of the industry in 1976. The numbers of total vessels, active vessels, and active commercial companies all have increased recently.¹¹⁴ Bain, *et al.* noted “the correlation between fleet size and [SRKW] population trends merits careful evaluation.”¹¹⁵ In 2015, the most vessels seen near whales at any one time was 81, with the monthly average fluctuating between 12 and 23 during the period from May through September.

¹⁰⁸ *Federal Register* 74(144):37674.

¹⁰⁹ *Federal Register* 76(72):20870.

¹¹⁰ NMFS 2010, P-4-5 [emphasis added].

¹¹¹ *id.*

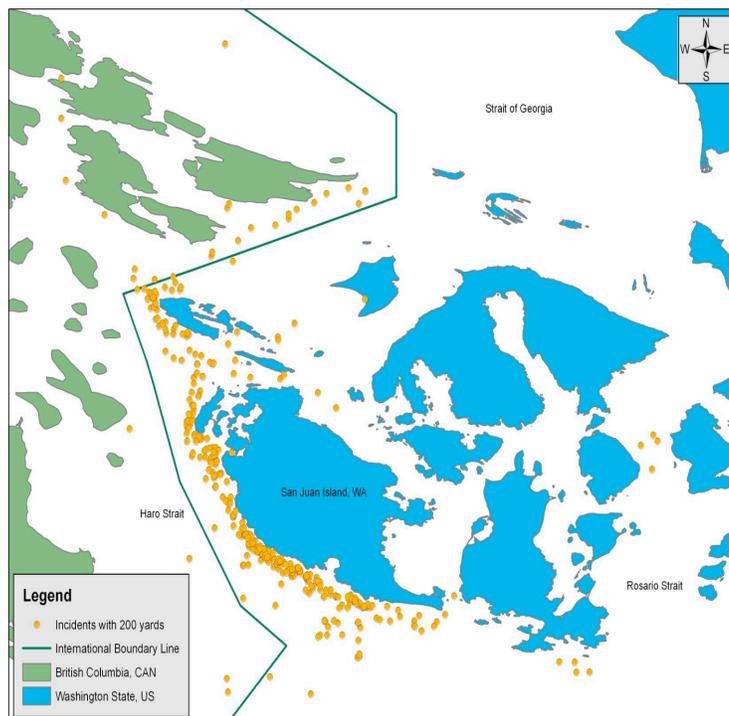
¹¹² NMFS 2014, p. 20 [emphasis added].

¹¹³ NMFS 2016, p. 4 [emphasis added].

¹¹⁴ Seely, 2015, p. 6-8.

¹¹⁵ Bain *et al.* 2015.

Vessels have been observed following the SRKWs as much as 90% of the time during daylight hours between May and October.¹¹⁶ Furthermore, commercial whale watching has now expanded to include nearly all months of the year.



Map 5. Vessels seen within 200 yards of SRKWs, thus closer than that allowed by current regulations (U.S. waters only)¹¹⁷

Many motorized vessels approach SRKWs closer than the current legal limit of 200 yards (Map 5). Most of these sightings are within the area of the requested whale protection zone.

Voluntary efforts are not sufficient. When the SRKW DPS was designated as endangered in 2005, NMFS cited, among other reasons, “sound and disturbance from vessel traffic . . . and their overutilization for commercial and recreational purposes.”¹¹⁸ In its 2008 *Recovery Plan*, NMFS determined that minimizing SRKW disturbance by vessels is necessary to achieve recovery.¹¹⁹ In 2011, NMFS took an essential step for minimizing vessel noise and disturbance by establishing protective regulations for the SRKW under the ESA and MMPA.¹²⁰ Although voluntary distance guidelines, speed limits, and “no-go zone” were in place, NMFS determined that

existing prohibitions, regulation, and guidelines [do] not provide sufficient protection of killer whales from vessel impacts. . . Vessel effects may limit the ability of the endangered SRKWs to recover and may impact other killer

¹¹⁶ Lusseau, *et al.* 2009; Seely 2015.

¹¹⁷ Seely, 2015, p. 34.

¹¹⁸ *Federal Register* 70:69910.

¹¹⁹ NMFS 2008. V-2.

¹²⁰ *Federal Register* 76(72):20870-90.

whales in inland waters of Washington. [NMFS therefore deems] it necessary and advisable to adopt regulations to protect killer whales from vessel impacts, which will support recovery of the Southern Resident killer whales.”¹²¹

The regulations established in 2011 limit the approach of all vessels to a boundary of 200 yards from an orca and forbid parking in their path while the whales are traveling. NMFS concluded that, “. . . in general, vessel operators are more likely to adhere to mandatory specific regulations [e.g., a regulatory WPZ] than to the current [San Juan County] voluntary [protection zone]. This likelihood . . . would be affected by the clarity of the rules, motivations to comply, and the level of monitoring and enforcement.”¹²²

NMFS based its decision to propose mandatory rules (rather than maintain the voluntary guidelines and protection zone) on its assessment that “Citizens may be willing to comply with [the new regulations] out of a sense of civic duty or obligation, social influences, fear of sanctions, or economic consequences associated with non-compliance. These factors may affect compliance differently for commercial and recreational vessel operators. . . .”¹²³ Ultimately, “vessel operators are more likely to adhere to mandatory specific regulations than to the current voluntary guidelines.”¹²⁴

The current 200-yard approach limit does not provide sufficient protection. Scientists have estimated that at 200 yards, boat noise still masks 75% to 90% of the natural sounds important to SRKWs.¹²⁵ As noted above, these whales depend on natural sounds for foraging, communicating, and navigating; clearly, their ability to hear their world is vital, given the limits of light transmission and vision in the marine environment. A WPZ could reduce such masking substantially.

Supporting Regulations

The effectiveness of the WPZ will be determined, in large part, by the regulations associated with it. The petitioners propose that, at a minimum, NMFS consider regulations based on the following:

Permit Systems (Licenses)

A system of permits or licenses for motorized commercial and private whale watching combined with education programs would go a long way toward ensuring that the whale watching fleet (and the private whale watchers the fleet attracts and for which the fleet sets the example) does indeed adhere to the WPZ and other regulations designed to protect the SRKW DPS. Therefore, a permit system should be included as part of the regulatory system for managing whale watching in U.S. waters, particularly inside the core critical habitat. NMFS should carefully consider licenses based on meeting noise level standards (expressed in terms of distance and speed) that meet strict acoustic thresholds.

¹²¹ *Federal Register* 72:20875.

¹²² NMFS 2010, p. 4-4.

¹²³ NMFS 2010, p. 4-2.

¹²⁴ NMFS 2010, p. P-13.

¹²⁵ NMFS 2010, p. P-2.

Equipment Options

NMFS should consider requiring Automated Identification Systems (AIS) for all commercial and non-commercial vessels actively watching whales; these devices would enable enforcement boats to know the location of the whale watching and fishing fleets. They are easily available and increasingly less expensive, and it is likely that all vessels will eventually be required to use them.

Compliance, Monitoring, and Enforcement

NMFS should implement effective monitoring and enforcement measures of the whale protection zone and other protective regulations for SRKW. NMFS has noted that “fear of sanctions is a stronger motivation for compliance with mandatory rules rather than voluntary guidelines. . . .”¹²⁶ “Inspections and enforcement actions, as well as publicizing or ‘showcasing’ enforcement actions, which may cause embarrassment, can contribute to effective deterrence.”¹²⁷ “Commercial operators would also be motivated to avoid monetary impact on their economic status from penalties charged for violations of regulations. However, there may also be economic incentives for commercial whale watch operators not to comply with mandatory regulations. They may believe they will attract more customers or that customers would be willing to pay more if their tours result in close contact with the whales, closer than is allowed by guidelines or rules.”¹²⁸ Therefore, sufficient funding for strict enforcement is necessary for the WPZ to aid Southern Resident recovery. As part of the rulemaking, NMFS should also study shore-based video and/or listening stations, and systems with observers on-board larger vessels.¹²⁹

Education

The WPZ provides an excellent platform for education directed toward SRKWs – their endangered status, the need for both private and commercial vessels to be cautious and respectful when near them, and the necessity for regulatory restrictions in our use of orca as objects of recreation. “Regardless of the regulatory impact of a protected area, they all have some value in education and outreach. Protected areas for marine mammals have been effective in raising awareness of important areas for species, encouraging coordination and funding of research, and other non-regulatory activities.”¹³⁰

Enhanced education programs should be discussed during a WPZ rulemaking; the best possible education approaches must be implemented to ensure that a whale protection zone is given every chance of assisting SRKW DPS recovery. Information about the WPZ should be included on nautical charts, in notices to mariners, in the Washington State fishing regulations, and in Coast Guard and Washington state boater education programs. NMFS should also establish a system of educational signs and

¹²⁶ NMFS 2010, p. 4-2.

¹²⁷ *Ibid.*

¹²⁸ NMFS 2010, p. 4-4.

¹²⁹ See <http://www.st.nmfs.noaa.gov/observer-home/>.

¹³⁰ Hoyt 2011; NMFS 2010, p. 4-5.

materials for ports near the protected area and a program for education through social media.

IX. Proposed Regulatory Language

Protective regulations for killer whales in Washington—(1) Applicability. The following restrictions apply to all motorized vessels in inland waters of the United States west of San Juan Island from three-quarters of a mile offshore of San Juan Island from Mitchell Point in the north to Cattle Pass in the south.

(2) *Prohibitions.* Except as provided in paragraph (e)(3) of this section, it is unlawful for any person subject to the jurisdiction of the United States to cause a vessel to operate within the area during the period April 1 – September 30.

(3) *Exceptions.* The following exceptions apply to this section:

(i) The prohibitions of paragraph (2) of this section do not apply to

(A) Federal Government vessels operating in the course of their official duty or state and local government vessels when engaged in official duties involving law enforcement, search and rescue, or public safety.

(B) Vessels transiting to and from areas of San Juan Island accessible only through the Whale Protection Zone, so long as vessels adhere to a no-wake speed limit.

(C) Vessel operations necessary to avoid an imminent and serious threat to a person, vessel, or the environment, including when necessary for overall safety of navigation and to comply with the Navigation Rules.

X. Conclusion

Orca Relief Citizens' Alliance submits this petition based on its strong concerns regarding the Southern Resident DPS's declining status and the clear need to strengthen recovery efforts. Given its low abundance, poor population trends, distorted age-sex composition, and dependence on degraded habitat, this DPS is subject to a high risk of extinction because of human activities. It has virtually no tolerance for further decline. An extremely precautionary management approach is essential to lower the southern resident DPS's risk of extinction and the long-term costs of its conservation.

NMFS has been entrusted with and is responsible for recovering the southern resident killer whale DPS. That trust obligates the Service to take the actions necessary to achieve recovery. Although measures taken to date have been helpful, they have not been sufficient to help the southern resident killer whales recover, and, based on the recent trends, will not be sufficient to enable the population to do so. Future recovery efforts will be confounded by the SRKW's distorted age-sex composition and declining reproductive capacity.

Scientific research over the past 15 years demonstrates that the endangered southern resident killer whales are harmed by the noise and disturbance they experience from motorized vessels in their critical habitat. More quiet and less disturbance are both necessary objectives for this distinct population segment to recover. Current regulations

of vessels in the SRKW's critical habitat are not achieving these objectives; therefore, special management steps are required.

This petition requests that NMFS further address noise and disturbance as a significant factor in the failure of the SRKWs to recover. A specific management step that NMFS can implement relatively quickly and inexpensively is the designation of a whale protection zone in Haro Strait, Salish Sea, along the western and southern coasts of San Juan Island – an area in the center of its critical habitat that includes the whales' prime foraging and resting areas.

Orca Relief Citizens' Alliance and the other petitioners look forward to National Marine Fisheries' response. We will be pleased to assist the agency to design and implement a whale protection zone and other means of facilitating the recovery of the southern resident killer whales. Given the southern residents' poor population status, we urge NMFS to take the above actions with all due haste.

REFERENCES

- Ashe, E., D.P. Noren, and R. Williams. 2009. Animal behavior and marine protected areas: incorporating behavioral data in to the selection of marine protected areas for an endangered killer whale population. *Animal Conservation* 13:196-203.
- Ayers, K.L., R.K. Booth, J.A. Hempelmann, K.L. Koski, C.K. Emmons, R.W. Baird, K. Balcomb-Bartok, M.B. Hanson, M.J. Ford, and S.K. Wasser. 2012. Distinguishing the impacts of inadequate prey and vessel traffic on an endangered killer whale (*Orcinus orca*) population. *PLoS ONE* 7(6):e36842. doi: 10.1371/journal.pone.0036842.
- Bain, D.E., J.C. Smith, R. Williams, and D. Lusseau. 2006. *Effects of vessels on behavior of southern resident killer whales (Orcinus spp.)*. NMFS Contract Report Nos. AB133F03SE0959 and AB133F04CN0040.
- Bain, D.E., R. Williams, and A.W. Trites. 2014. Energetic linkages between short-term and long-term effects of whale-watching disturbance on cetaceans: an example drawn from northeast Pacific resident killer whales. In (J. Hingham, L. Bejder and R. Williams, eds.), *Whale-watching, Sustainable Tourism and Ecological management*. Cambridge University Press. 206-228.
- Bain, D.E. n.d. "Comments on the petition to revise critical habitat for the southern resident killer whale distinct population segment under the Endangered Species Act."
- Bain, D.E., in press. A model linking energetic effects of whale watching to killer whale population dynamics. Orca Relief Citizens' Alliance website.
- Bejder, L., A. Samuels, H. Whitehead, N. Gales, J. Mann, R. Conner, M. Heithaus, J. Watson-Capps, C. Flaherty, and M. Krutzen. 2006. Decline in relative abundance of bottlenose dolphins exposed to long-term disturbance. *Conservation Biology* 20(6):1791-1798.
- Center for Biological Diversity. 2014 (16 January). "Petition to Revise the Critical Habitat Designation for the Southern Resident Killer Whales (*Orcinus Orca*) under the Endangered Species Act."
- Clark, C.W., W.T. Ellison, B.L. Southall, L. Hatch, S.M. Van Parijs, A. Frankel, and D. Ponirakis. 2009. Acoustic masking in marine ecosystems: intuitions, analysis, and implication. *Marine Ecology Progress Series* 39:201-222.
- Erbe, C. 2002. Underwater noise of whale-watching boats and potential effects on killer whales (*Orcinus Orca*) based on an acoustic model. *Marine Mammal Science* 128:394-418.
- Foote, A.D., R.W. Osborne, and A.R. Hoelzel. 2004. Whale-call response to masking boat noise. *Nature* 428 (April 29):910.
- Ford, J.K.B. and G.M. Ellis. 2006. Selective foraging by fish-eating killer whales, *Orcinus orca* in British Columbia. *Marine Ecology Progress Series* 316:185-199.

- Ford, J.K.B., G.M. Ellis, and K.C. Balcomb. 2010. Linking killer whale survival and prey abundance: Food limitation in the ocean's apex predator? *Biology Letters* 6:139-142.
- Gustafson, R.G., Richard G. Gustafson, Robin W. Waples, James M. Myers, Laurie A. Witkamp, Gregory J. Bryant, Orlay W. Johnson, and Jeffrey J. Hard. 2007. Pacific salmon extinctions: Quantifying lost and remaining diversity. *Conservation Biology* 21:1009-1020.
- Hanson, M. B., R. W. Baird, J. K. B. Ford, J. Hempelmann-Halos, D. M. Van Doornik, J. R. Candy, C. K. Emmons, G. S. Schorr, B. Gisborne, K. L. Ayres, S. K. Wasser, Kenneth C. Balcomb, Kelley Balcomb-Bartok, John G. Sneva, and Michael J. Ford. 2010. Species and stock identification of prey consumed by endangered southern resident killer whales in their summer range. *Endangered Species Research* 11:69-82.
- Hauser, D.D.W., M.G. Logsdon, E.E. Holmes, G.R. VanBlaricom, and R.W. Osborne. 2007. Summer distribution patterns of southern resident killer whales *Orcinus orca*: core areas and spatial segregation of social groups. *Marine Ecology-Progress Series* 351:301-310.
- Holt, M.M. 2008. *Sound Exposure and Southern Resident Killer Whales (Orcinus orca): A Review of Current Knowledge and Data Gaps*. NMFS, Technical Memorandum, NMFS-NWFSC-89, Feb.
- Holt, M.M., D.P. Noren, V. Veirs, C.K. Emmons, and S. Veirs. 2009. Speaking up: killer whales increase their call amplitude in response to vessel noise. *Journal of the Acoustical Society of America (Express Letters)* 125:EL27-EL32.
- Holt, M.M., Noren, and C.K. Emmons. 2011. Effects of noise levels and call types on the source levels of killer whale calls. *Journal of the Acoustical Society of America* 130:3100-3106.
- Hooker, S.K., and L.R. Gerber. 2004. Marine reserves as a tool for ecosystem-based management: the potential importance of megafauna. *BioScience* 54 (1):27-39.
- Houghton, J., M.M. Holt, D.A. Giles, M.B. Hanson, C.K. Emmons, J.T. Hogan, T.A. Branch, and G.R. VanBlaricom. 2015. The relationship between vessel traffic and noise levels received by killer whales (*Orcinus orca*). *PLOS ONE* DOI:10.1371.
- Hoyt, E. 2011 (2nd Edition). *Marine Protected Areas for Whales, Dolphins and Porpoises. A World Handbook for Cetacean Habitat Conservation and Planning*. Earthscan. London, New York.
- Krahn, M.M., M.B. Hanson, R.W. Baird, R.H. Boyer, D.G. Burrows, C.K. Emmons, J.K.B. Ford, L.L. Jones, D.P. Noren, P.S. Ross, G.S. Shorr, and T.K. Collier. 2007. Persistent organic pollutants and stable isotopes in biopsy samples (2004/2006) from southern resident killer whales. *Marine Pollution Bulletin* 54:1903-1911.
- Lusseau, D. 2003. The effects of tour boats on the behavior of bottlenose dolphin. *Conservation Biology* 17:1785-1793.

- Lusseau, D. 2004. The hidden cost of tourism: detecting long-term effects of tourism using behavioral information. *Ecology and Society* 9(1): 2.
- Lusseau, D., D.E. Bain, R. Williams, and J.C. Smith. 2009. Vessel traffic disrupts the foraging behavior of southern resident killer whales, *Orcinus orca*. *Endangered Species Research* 6:211-221.
- Morton, A.B. and H.K. Symonds. 2002. Displacement of *Orcinus orca* (L.) by high amplitude sound in British Columbia, Canada. *ICES J. Mar. Res.* 59:71-80.
- Noren D.P., A. H. Johnson, D. Rehder, and A. Larson. 2007. Close approaches by vessels elicit surface active displays by Southern Resident killer whales. Abstract at the 17th Biennial Conference on the Biology of Marine Mammals, Cape Town, South Africa.
- Noren, D.P., A.H. Johnson, D. Rehder, and A. Larson. 2009. Close approaches by vessels elicit surface active behaviors by southern resident killer whales. *Endangered Species Research* 8:179-192.
- NRC (National Research Council of the National Academies). 2003. *Ocean Noise and Marine Mammals*. Washington, DC. National Academy Press.
- NRC. 2005. *Marine Mammal Populations and Ocean Noise: Determining When Noise Causes Biologically Significant Effects*. Washington, DC. National Academy Press. 126 pp
- NMFS (National Marine Fisheries Service). 2005. *Assessment of Acoustic Exposures on Marine Mammals in Conjunction with USS Shoup Active Sonar Transmissions in the Eastern Strait of Juan de Fuca and Haro Strait, Washington, 5 May 2003*). National Marine Fisheries Service, Office of Protected Resources.
- NMFS (National Marine Fisheries Service). 2008. *Recovery Plan for Southern Resident Killer Whales (Orcinus Orca)*. National Marine Fisheries Service, Northwest Region, Seattle, Washington.
- NMFS 2010. *Final Environmental Assessment for New Regulations to Protect Killer Whales from Vessel Effects in Inland Waters of Washington*. RIN 0648-AV15.
- NMFS 2014. *Southern Resident Killer Whales. 10 Years of Research & Conservation*. National Marine Fisheries Service, Northwest Region, Seattle, Washington. http://www.nwfsc.noaa.gov/news/features/killer_whale_report/
- NMFS 2016. *Priority Actions: 2016-2020 Southern Resident Killer Whale DPS*. National Marine Fisheries Service, Silver Spring, MD.
- Olesiuk, P.M., M.A. Bigg, and G.M. Ellis. 1990. Life History and Population Dynamics of Resident Killer Whales (*Orcinus orca*) in the Coastal Waters of British Columbia and Washington State. Report of the International Whaling Commission, Special Issue 12, pp. 209-43.
- Romano, T.A., M.J. Keogh, C. Kelly, P. Feng, L. Berk, C.E. Schlundt, D.A. Carder, and J.J. Finneran. 2004. Anthropogenic sound and marine mammal health: measures of the nervous and immune systems before and after intense sound exposure. *Canadian Journal of Fisheries and Aquatic Science*. 61:1124-1134.

- Ross, P.S., G.M. Ellis, M.G. Ikonomou, L.G Barrett-Lennard, and R.F. Addison. 2000. High PCB concentrations in free-ranging Pacific killer whales, *Orcinus orca*: Effects of age, sex and dietary preference. *Marine Pollution Bulletin* 40:504-515.
- Seely, E. 2015. *Final 2015 Soundwatch Program Annual Contract Report*. The Whale Museum Contract # CQ-0057, Friday Harbor, WA.
- Van Dorp, J., and J. Merrick. *Final Report: Vessel Traffic Risk Assessment 2010*. Puget Sound Partnership.
- Van Parijs, S.M., and P. Corkeron. 2001. Boat traffic affects the acoustic behavior of Pacific humpback dolphins. *Journal of the Marine Biology Association of the United Kingdom* 81:533-538.
- Wasser, S.K. *et al.* 2010. Non-invasive measurement of thyroid hormone in feces of a diverse array of avian and mammalian species. *General and Comparative Endocrinology* 168:1-7.
- Wieland, Monika, Albyn Jones and Susan C. P. Renn. 2010. Changing durations of southern resident killer whale (*Orcinus orca*) discrete calls between two periods spanning 28 years. *Marine Mammal Science* 26:195-201.
- Williams R., and E. Ashe. 2006. *Northern Resident Killer Whale Responses to Vessels Varied with Number of Boats*. Final report to NOAA Fisheries for Contract AB133F04SE0736.
- Williams R., and E. Ashe. 2007. Killer whale evasive tactics vary with boat number. *Journal of Zoology* 272: 390–397.
- Williams, R., E. Ashe, and D. Lusseau. 2010. Killer whale activity budgets under no-boat, kayak-only and power-boat conditions. Contract via Herrera Consulting, Seattle, Washington. 29 pages.
- Williams, R., D. Lusseau, and P.S. Hammond. 2006. Estimating relative energetic costs of human disturbance to killer whales (*Orcinus Orca*). *Biological Conservation* 133:301-311.
- Williams, R., and D.P. Noren. 2009. Swimming speed, respiration rate, and estimated cost of transport in adult killer whales. *Marine Mammal Science* 25: 327-350.
- Williams, R., D.E. Bain, D.E. Ford, J.K.B. Ford, and A.W. Trites. 2002a. Behavioural responses of killer whales to a “leapfrogging” vessel. *Journal of Cetacean Research and Management* 4:305-310.
- Williams, R., A.W. Trites, and D.E. Bain. 2002b. Behavioural responses of killer whales (*Orcinus orca*) to whale-watching boats: opportunistic observations and experimental approaches. *Journal of Zoology* (London) 256:255-270.
- Williams, R., D. Lusseau, and P. Hammond. 2006. Estimating relative energetic costs of human disturbance to killer whales (*Orcinus orca*). *Biological Conservation* 133:301-311.

- Williams, R., D.E. Bain, J.C. Smith, and D. Lusseau. 2009a. Effects of vessels on behavior patterns of individual southern resident killer whales *Orcinus orca*. *Endangered Species Research* 6: 199–209.
- Williams, Rob, Christine Erbe, Erin Ashe, Amber Beerman, and Jodi Smith. 2013. Severity of killer whale behavioral response to ship noise: A dose response study. *Marine Pollution Bulletin* 1.
- Williams, R., C. Erbe, E. Ashe, and C.W. Clark. 2015. Quiet(er) marine protected areas. *Marine Pollution Bulletin*.