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Risks and Recovery: A Multifaceted Outlook Towards Conservation of the Southern Resident Orca Population

Matthew Pritchett

RISKS AND RECOVERY: A MULTIFACETED OUTLOOK TOWARDS CONSERVATION OF THE SOUTHERN RESIDENT ORCA POPULATION

MATTHEW PRITCHETT†

ABSTRACT

An unequivocal icon of the Pacific Northwest, the Southern Resident orca (Southern Resident) spends its summer and fall months in the Salish Sea, an estuarine network of British Columbia and Washington State waterways. During these months, visitors and residents alike enjoy the opportunity to witness Southern Residents gathering in the inland waters surrounding the San Juan Islands, the Strait Juan de Fuca, and, most notably, Puget Sound. However, the chance to see these extraordinary marine predators in their Northwest Pacific habitat may be disappearing by the year, with the already-endangered Southern Resident population in steady decline and dropping to a thirty-year low in August 2018.

Pursuant to the Endangered Species Act, the National Marine Fisheries Service (NMFS) created a Recovery Plan in 2008 for the Southern Resident. In this Recovery Plan, NMFS identified the three critical risk factors threatening the population: prey reduction, contaminant levels, and vessel traffic. However, subsequent conservation efforts have failed to reverse the Southern Resident's continuing decline. This Note will examine the existing federal conservation policies for the Southern Resident orca, including those within the 2008 Recovery Plan, and offer ways to improve current conservation and management techniques to ultimately restore this population to pre-endangered numbers.

The plight of the Southern Resident illustrates a common conflict faced in natural resource policy. Population growth within British Columbia and Washington State has transformed the Salish Sea to an ecosystem increasingly imperiled by pollution, water use, and vessel activity; in turn, these impacts have collectively contributed to the Southern Resident's recent population decline. In hoping to address not only the dwindling numbers of the Southern Resident but the deterioration of the Salish Sea ecosystem in its entirety, this Note proposes a multifaceted approach that relies on

† J.D., Florida State University College of Law, 2019; B.S., Environmental Science, University of Florida, 2012.

the combined use of research, litigation, and policy implementation. As coastal populations in the Pacific Northwest continue to grow, it will become increasingly critical to mitigate the harmful ecological effects of this growth in order to prevent further degradation of the Salish Sea ecosystem and the possible extinction of the Southern Resident.

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I. INTRODUCTION

Best known for its striking black-and-white color pattern and extraordinary social abilities, the killer whale, or orca (Orcinus orca), is an undisputed icon of the Pacific Northwest.[1] A distinct

1. *See Nat'l. Oceanic & Atmospheric Admin., Nat'l. Marine Fisheries Serv.*, Recovery Plan for Southern Resident Killer Whales (Orcinus orca), NAT'L MARINE FISHERIES SERV. NORTHWEST REGIONAL OFFICE (2008) [hereinafter 2008 Recovery Plan] http://www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_

population of this species, the Southern Resident orca (Southern Resident), makes its home within the Salish Sea during the summer and early fall months, primarily in anticipation of seasonal salmon runs.[2] Named for a group of American Indian peoples inhabiting the Pacific Northwest region, the Salish Sea consists of inland waterways shared by Washington State and British Columbia.[3] The Salish Sea itself is an exceptional place, a complex estuarine system that provides habitat for thousands of plant and animal species.[4] The Salish Sea is also home to Puget Sound, a bay and waterway system that houses some of Washington State's major port cities, including Olympia, Tacoma, and Seattle.[5]

Studies of Orcinus orca reveal an apex predator species with incredible social capabilities and the largest global range of any marine mammal.[6] Despite these studies, the Southern Resident population is visibly suffering.[7] The Southern Resident was listed as

mammals/killer_whales/esa_status/srkw-recov-plan.pdf (describing recognizable color pattern of orca species and its iconic status in Pacific Northwest). The orca has been designated as the "official marine mammal" of Washington State. *Id.* at II-70 (noting designation in 2005). For an additional overview of the biology, distribution, and behavior of Orcinus orca, *see also* Marilyn E. Dahlheim & John E. Heyning, *Killer whale Orcinus orca*, HANDBOOK OF MARINE MAMMALS 281-322 (S. Ridgway & R. Harrison, eds., 1999).

2. *See* 2008 Recovery Plan, *infra* note 42 for a description of the Southern Resident's seasonal habitat variations as related to diet. For further explanation about the "distinct population segment" classification under the Endangered Species Act, see *infra* notes 56-59 and accompanying text.

3. *See* Theodore Pietsch & James Orr, *Fishes of the Salish Sea: a compilation and distributional analysis*, NOAA PROFESSIONAL PAPER NMFS (2015) https://spo.nmfs.noaa.gov/sites/default/files/pp18.pdf (describing geographical boundaries of Salish Sea). *See also National board adopts Salish Sea name,* SEATTLE TIMES (Nov. 15, 2009) https://www.seattletimes.com/seattle-news/national-board-adopts-salish-sea-name/ (explaining Sea's name originating from indigenous peoples within region).

4. *See* Pietsch & Orr, *supra* note 3, at 4 (explaining that thousands of species of flora and fauna inhabit Sea).

5. *See id.* at 3, Figure 2 (providing map of southern part of Salish Sea). The Salish Sea also adjoins coastline containing major port cities within British Columbia, including Victoria and Vancouver. *See id.* at 2, Figure 1. Canada has made similarly significant efforts to assist in the conservation and recovery of the Southern Resident. *See Government of Canada taking further action to protect Southern Resident Killer Whales,* CISION: NEWS (Oct. 21, 2018) https://www.newswire.ca/news-releases/government-of-canada-taking-further-action-to-protect-southern-resident-killer-whales-699169241.html (announcing governmental measures to strengthen protections for Southern Resident). For reasons of simplicity, however, this article primarily focuses on conservation efforts and policy with respect to the Southern Resident in the United States.

6. *See* 2008 Recovery Plan, *supra* note 1, at II-4 (noting orcas inhabit all oceans across world). For description of the orca's behavioral characteristics, *see* DAHLHEIM & HEYNING, *supra* note 1.

7. For an explanation of the Southern Resident's ongoing population decline, see *infra* notes 10-12 and accompanying text.

endangered under the Endangered Species Act (ESA) in 2005, and critical habitat for the population was designated shortly afterwards in 2006.[8] In 2008, the National Marine Fisheries Service (NMFS) created a Recovery Plan for the population, identifying prey reduction, contaminant levels, and vessel traffic as three important risk factors threatening the Southern Resident population.[9]

Despite conservation efforts, the Southern Resident's numbers have continued to decline.[10] In March 2018, the Governor of Washington State issued an executive order establishing a Southern Resident Killer Whale Task Force to address the ongoing downtrend in Southern Resident population numbers.[11] As of August 2018, the population was down to seventy-five orcas, its lowest number in over thirty years.[12]

The Southern Resident may fit within the category of "charismatic megafauna" which people criticize has overtaken control of the ESA, but realistically the decrease in Southern Resident numbers represents a greater problem, an entire ecosystem in peril.[13]

8. Endangered Status for Southern Resident Killer Whales, 70 Fed. Reg. 69,903 (Nov. 18, 2005) [hereinafter 2005 Endangered Listing] https://www.federalregister.gov/documents/2005/11/18/05-22859/endangered-and-threatened-wildlife-and-plants-endangered-status-for-southern-resident-killer-whales (issuing final determination to list Southern Resident as endangered); Designation of Critical Habitat for Southern Resident Killer Whale, 71 Fed. Reg. 69,054 (Nov. 29, 2006) [hereinafter 2006 Critical Habitat] https://www.gpo.gov/fdsys/pkg/FR-2006-11-29/pdf/06-9453.pdf (issuing final rule designating critical habitat for Southern Resident).

9. 2008 Recovery Plan, *supra* note 1, at II-71 (listing factors that pose greatest risk to Southern Resident population).

10. *See* L.A. Vélez-Espino et al., *Relative importance of chinook salmon abundance on resident killer whale population growth and viability,* 25 AQUATIC CONSERVATION: MARINE & FRESHWATER ECOSYSTEMS 756, 756-80 (2014) (noting Southern Resident population has declined at rate of 0.91% per year from 1987 to 2011).

11. Wash. State Exec. Order No. 18-02 (Mar. 14, 2018) https://www.governor.wa.gov/sites/default/files/exe_order/eo_18-02_1.pdf (creating task force to identify and implement long-term actions supporting recovery of Southern Resident).

12. *See Trump Administration Sued for Failing to Protect Orcas' West Coast Habitat*, CTR. FOR BIOLOGICAL DIVERSITY (Aug. 16, 2018) https://www.biologicaldiversity.org/news/press_releases/2018/southern-resident-killer-whale-08-16-2018.php (noting lack of federal action as Southern Resident's population falls to seventy-five individuals). For an estimate of what a healthy Southern Resident population would be, see *infra* notes 76-77.

13. *See, e.g.*, Jim Robbins, *Orcas of the Pacific Northwest Are Starving and Disappearing,* N.Y. TIMES (Jul. 9, 2018) https://www.nytimes.com/2018/07/09/science/orcas-whales-endangered.html (noting concern of some scientists that recent population decline of Southern Resident signifies overall deterioration of Puget Sound ecosystem). For a history of Congress' focus on protecting "charismatic megafauna," *see* Shannon Petersen, *Congress and Charismatic Megafauna: A Legislative History of the Endangered Species Act,* 29 ENVTL. L. 463, 479 (1999) (noting focus at time of ESA's passage).

Dwindling salmon populations, high levels of contaminants, and the increasing presence of waterborne vessels within the Salish Sea all continue to hinder the Southern Resident's recovery.[14] These risk factors, when examined alongside the Salish Sea's growing coastal population, draw parallels to what Richard Strahan described as an "urban sea," a marine environment so impacted by pollution and vessel activity that native whale species struggle to survive.[15] As coastal populations in the Pacific Northwest continue to grow, it will become increasingly critical to mitigate the harmful ecological effects of this growth in order to prevent further degradation of the Salish Sea ecosystem and the possible extinction of the Southern Resident.[16]

This article will examine the existing federal conservation policies for the Southern Resident, including those within the 2008 Recovery Plan, and offer ways to improve current conservation and management techniques to ultimately restore this population to pre-endangered numbers.[17] Part I of this article gives a brief overview of the Southern Resident's biological characteristics, while Part II discusses the history of conservation efforts for this population.[18] Part III examines the three primary risk factors associated with Southern Resident population decline within the 2008 Recovery Plan, discusses recent developments, and offers new suggestions to address these risks.[19] In addition, Part IV describes recent litigation efforts to improve conservation of the Southern Resident, including a petition to expand its critical habitat, and provides policy-related

14. For an examination of these risk factors and suggestions on how to address them, see *infra* notes 78-235.

15. Richard M. Strahan, *A New Paradigm for Conservation of Great Whales in the Urban Sea of the United States –Species in Need of a "Green Knight"*, 36 B.C. ENVTL. AFF. L. REV. 431, 433 (2009) (summarizing deleterious effects of northeastern coastal development for great whale population). For an account of ongoing population growth in the coastal Pacific Northwest, *see* RICHARD M. HUTCHINGS, MARITIME HERITAGE IN CRISIS: INDIGENOUS LANDSCAPES AND GLOBAL ECOLOGICAL BREAKDOWN 34 (2017) (noting steady population growth rate within Salish Sea basin—from seven million people in 2001 to 9.4 million people in 2025).

16. For additional discussion of the effects of coastal development as specifically related to salmon habitat, see *infra* notes 95-99.

17. For further explanation of the current management techniques of the Southern Resident and suggested methods of improvement, see *infra* notes 78-282.

18. For further discussion of the behavior, habitat, and diet of the Southern Resident, see *infra* notes 26-47. For an overview of the Southern Resident's conservation history, including its listing under the Endangered Species Act, see *infra* notes 48-77.

19. For further examination of the identified risk factors of prey availability, contaminant levels, and vessel traffic, see *infra* notes 78-235.

arguments for why the Southern Resident's critical habitat should be expanded.[20]

II. DESCRIPTION OF SOUTHERN RESIDENT ORCA

The orca has the largest habitat range of any marine mammal in the world.[21] Highly social and intelligent, orcas live primarily in groups, or "pods," of up to forty to fifty animals.[22] The orca relies on its intelligence and communication skills to employ cooperative hunting and feeding techniques, which help establish the species as an "apex" or top-level predator in marine environments.[23] The Southern Resident is a distinct subpopulation of Orcinus orca that resides in the Northeastern Pacific Ocean, within a range that stretches generally from Alaska to California.[24] The Southern Resident also feeds almost exclusively on Pacific salmon, distinguishing it from other orca subpopulations in the Northeastern Pacific.[25]

A. Behavior & Social Structure

The title "killer whale" is a misnomer.[26] Orcas are actually the largest species within *Delphinidae*, the taxonomic family for oceanic dolphins.[27] Like most members of the marine dolphin family, orcas are incredibly social and travel in groups of up to forty to fifty animals, known as pods.[28] The orca's advanced social behavior is reinforced by vocal communication, and the species relies on vocal-

20. For further analysis of litigation efforts to improve Southern Resident conservation and related policy arguments, see *infra* notes 236-282.

21. *See* 2005 Endangered Listing, *supra* note 8, at 69,904 (characterizing orca as most widely distributed marine mammal in world).

22. 2008 Recovery Plan, *supra* note 1, at II-10 (citing, *inter alia*, DAHLHEIM & HEYNING, *supra* note 1) (noting high social ability of orcas).

23. *See* 2005 Endangered Listing, *supra* note 8, at 69,904 (classifying orcas as top-level predators in food chain).

24. *See id.* at 69,905 (documenting Southern Resident's occurrence in coastal waters off Oregon, Washington, and central California, but noting scant knowledge about Southern Resident's winter habitat).

25. *See id.* (noting fish as primary prey of resident orcas in Eastern North Pacific).

26. Orcas are not "whales" in the taxonomic sense, but rather a member of the dolphin family. *See* 2005 Endangered Listing, *infra* note 27 and accompanying text.

27. 2005 Endangered Listing, *supra* note 8, at 69,904 (noting orca as largest species within *Delphinidae* family).

28. 2008 Recovery Plan, *supra* note 1, at II-10 (citing, *inter alia*, DAHLHEIM & HEYNING, *supra* note 1) (describing pod sizes of orca subspecies). For more information about the *Delphinidae* family, *see* ALAN RAUCH, DOLPHIN 104-33 (2014) (describing intelligence, social behavior, and echolocation abilities of dolphins).

ization techniques "that are useful in navigation, communication, and foraging."[29]

To hunt their food, orcas have developed sophisticated methods such as "cooperative hunting, food sharing, and innovative learning."[30] Cooperative hunting techniques can increase both the frequency and success of orca-prey encounters.[31] A well-known cooperative hunting technique of the orca is the carousel method, where an orca group will continuously circle its prey, essentially herding the prey into a tight space.[32] While keeping the fish contained by swimming in a circular and "highly coordinated" fashion, the orcas will take turns feeding on the herded school of fish.[33]

In addition to relying on cooperative hunting, orcas have also been documented sharing their prey. One study observed orcas transporting captured salmon to the water's surface, where it could be "broken up for sharing or provisioning" during feeding events.[34] Orcas have also shown innovative techniques which hint that the orca may be capable of adapting to its prey in order to hunt more efficiently.[35] Worldwide, studies have noted the orca's ability to de-

29. 2008 Recovery Plan, *supra* note 1, at II-13 (citing, *inter alia*, Marilyn E. Dahlheim & Frank Awbrey, *A classification and comparison of vocalizations of captive killer whales*, 72 J. ACOUSTICAL SOC. AM. 661 (1982)) (noting advanced level of vocal communication in orcas).

30. 2008 Recovery Plan, *supra* note 1, at II-16 (citing, *inter alia*, Thomas G. Smith et al., *Coordinated behavior of killer whales, Orcinus orca, hunting a crabeater seal, Lobodon carcinophagus*, 59 CANADIAN J. ZOOLOGY 1185 (1981)) (detailing specific foraging traits of orcas).

31. *See* Robin W. Baird, *The killer whale: foraging specializations and group hunting*, CETACEAN SOCIETIES: FIELD STUDIES OF DOLPHINS AND WHALES 127, 140 (Janet Mann et al. eds., 2000) (detailing benefits of group hunting).

32. Tiu Similä & Fernando Ugarte, *Surface and underwater observations of cooperatively feeding killer whales in northern Norway*, 71 CANADIAN. J. ZOOLOGY 1494, 1494 (1993) (summarizing 'carousel method' as feeding technique). The observations of this study were based on orcas feeding on schools of herring. *Id.*

33. *See id.* at 1495-96 (describing observations of orca hunting and feeding behaviors). The study notes that

> [w]hile feeding, whales still swam very closely around and under the encircled fish, yet with less synchronized movements than during initial herding . . . One to nine individuals at a time could be seen circling around the fish, and there were always more whales encircling the fish than eating.

Id.

34. John K.B. Ford & Graeme M. Ellis, *Selective foraging by fish-eating killer whales Orcinus orca in British Columbia*, 316 MARINE ECOLOGY PROGRESS SERIES 185, 194 (2006) (detailing observations of food-sharing). The study noted that these types of feeding events were "strong evidence that sharing was taking place" among the orca groups. *Id.* at 190.

35. The study documenting an orca's use of the 'carousel method,' *supra* notes 32-33, also noted that the hunting orca group would use "a combination of visual and acoustic stimuli," such as vocalization and emitting large bubbles, to herd the school of herring more effectively. Similä & Ugarte, *supra* note 32, at

velop distinct hunting or feeding methods based on its preferred prey and habitat range.[36]

Orcas in the Northeastern Pacific are divided into three distinct ecotypes: resident, transient, and offshore orcas.[37] Key differences in genetics, diet, and behavior exist among these three ecotypes, although there is "considerable overlap" in their habitat ranges.[38] Southern Residents themselves are further classified into three distinct pods—J pod, K pod, and L pod.[39]

B. Habitat

While orcas as a species are found in "all oceans and seas of the world," the Southern Resident resides in the eastern region of the north Pacific Ocean, more specifically in a range from northern British Columbia to as far south as central California.[40] Within this range, the Southern Resident migrates seasonally, spending summer and fall months in waterways within Washington State and British Columbia and moving to offshore "coastal waters" during the winter.[41] Southern Residents exhibit a well-recorded focus on Puget Sound in the early fall months "to likely take advantage of chum and Chinook salmon runs."[42] In the 2008 Recovery Plan, NMFS noted that the "ranges and movements of the Southern Resident

1494-96 (summarizing cooperative hunting methods of orcas in northern Norway). The orcas in this study likely developed these practices to counteract the herrings' keen eyesight and hearing; by emitting "visual and acoustic stimuli," the orcas could use distraction to make escape even more difficult for the school of herring. *Id.* at 1496.

36. *See* Baird, *supra* note 31, at 142 (noting orca foraging techniques can vary among populations, due to distinctions in habitat, prey type, and prey abundance); Similä & Ugarte, *supra* note 32, at 1498 (explaining orca's well-known ability to adapt to wide range of marine habitats through development of specialized hunting and feeding techniques).

37. 2005 Endangered Listing, *supra* note 8, at 69,905 (listing and discussing distinct orca types in Northeastern Pacific region); *see also* 2008 Recovery Plan, *supra* note 1, at II-5 (listing forms of orcas in eastern North Pacific Ocean).

38. 2008 Recovery Plan, *supra* note 1, at II-5 (noting genetic, behavioral, and ecologic differences among three ecotypes of Northeastern Pacific orcas).

39. 2005 Endangered Listing, *supra* note 8, at 69,905 (classifying distinct pods within Southern Resident population).

40. 2008 Recovery Plan, *supra* note 1, at II-26 (noting "distance of about 2,200 km" for Southern Resident habitat range). For more information about the global range of the orca, *see* John E. Heyning & Marilyn E. Dahlheim, *Orcinus orca*, 304 MAMMALIAN SPECIES 1, 2 (1988) https://www.jstor.org/stable/3504225 (noting worldwide occurrence of orca species)

41. 2008 Recovery Plan, *supra* note 1, at iv (describing Southern Resident's primary habitat range); *see also infra* notes 243-246 for more recent research detailing the Southern Resident's offshore movements.

42. 2008 Recovery Plan, *supra* note 1, at II-29 (citing Richard W. Osborne, *A historical ecology of Salish Sea "resident" killer whales (Orcinus orca): with implications for*

are less well known" during late autumn, winter, and early spring months.[43]

C. Diet

While other orca populations feed on a wider variety of marine wildlife, the Southern Resident preys almost exclusively on fish.[44] Specifically, Southern Residents exhibit a "strong preference" for Chinook salmon, especially the months during late spring to fall.[45] The 2008 Recovery Plan estimated that a population of ninety Southern Residents could potentially eat as many as 820,000 adult salmon annually.[46] Nevertheless, NMFS' 2008 Recovery Plan also noted a need for more information about the diet of the Southern Resident during the winter and early spring months.[47]

III. HISTORY OF CONSERVATION EFFORTS FOR THE SOUTHERN RESIDENT ORCA

Prior to 1974, information about the Southern Resident was scarce, making it difficult to gauge changes in the subspecies' population.[48] A 1972 study gave a tentative but "admittedly unsure" estimate of 225 to 300 whales in Puget Sound and surrounding waterways during that time.[49] The onset of photo-identification studies in the early 1970s allowed for more definite population

management (1999) Ph.D. thesis, University of Victoria, British Columbia) (describing Southern Resident's seasonal movements as reflective of prey preference).

43. *Id.* at II-30 (conceding lack of knowledge about Southern Resident's winter habitat range).

44. 2005 Endangered Listing, *supra* note 8, at 69,905 (noting fish as main prey source of resident orcas). For a description of diets for other orca subspecies, *see* 2008 Recovery Plan, *supra* note 1, at II-28 (noting that unlike their resident counterparts, transient orcas in Northeastern Pacific "feed almost entirely on marine mammals.").

45. *See* 2008 Recovery Plan, *supra* note 1, at II-18 (citing, *inter alia*, B. Hanson et al., *Focal behavioral observations and fish-eating killer whales: improving our understanding of foraging behavior and prey selection*, 16TH BIENNIAL CONFERENCE ON THE BIOLOGY OF MARINE MAMMALS (Dec. 2005)) (noting Chinook salmon constitute "78 percent of identified prey during late spring to fall").

46. *Id.* at II-21 (noting this estimate would "not . . . account for any other prey species and is therefore likely an overestimate of potential salmon consumption.").

47. *Id.* at II-18 (describing lack of recorded data about Southern Resident's dietary preferences during winter and early spring months). The 2008 Recovery Plan states that "[l]ittle is known about the winter and early spring foods of Southern and Northern Residents or whether individual pods have specific dietary preferences or have shifted preference for different prey species over time." *Id.*

48. *See id.* at II-54 (admitting overall lack of empirical data to estimate orca populations in Northeastern Pacific Ocean before 1974).

49. *Id.* (noting this report "made no distinctions among resident, transient, and offshore populations" of Northeastern Pacific orcas).

counts of the Southern Resident, and annual censuses of the population began in 1974.[50]

In general, the Southern Resident's population since 1960 can be characterized as experiencing "several . . . declines . . . , punctuated by periods of limited growth."[51] After reaching ninety-eight individuals in 1995, the Southern Resident's population began to steadily decrease, including a twenty percent decline from 1996 to 2001.[52] In 2005, the Southern Resident was listed as "endangered" under the ESA, and a designation of critical habitat and creation of a recovery plan for the population shortly followed.[53] The recovery plan identified the three key risk factors threatening Southern Resident health and set a goal of a 155-orca population to warrant delisting from the ESA.[54] Despite increased federal efforts to conserve and manage the Southern Resident, the population has recently experienced another decline and is currently listed at seventy-five individuals, a thirty-year low for the population.[55]

A. Petition for Listing under the ESA

In May 2001, the Center for Biological Diversity petitioned to list the Southern Resident under the ESA, but the NMFS published a final determination that such listing for the Southern Resident was "not warranted," primarily because the population did not properly qualify as a "distinct population segment" of the global orca species.[56] The Center for Biological Diversity, however, subse-

50. *Id.* at II-56 (acknowledging photo-identification studies as "the foundation of all Southern Resident research since the early 1970s.").

51. *Petition to Revise the Critical Habitat Designation for the Southern Resident Killer Whale (Orcinus orca) under the Endangered Species Act*, CTR. FOR BIOLOGICAL DIVERSITY (Jan. 16, 2014) [hereinafter 2014 Petition to Expand Critical Habitat], https://www.biologicaldiversity.org/species/mammals/pdfs/Petition_to_Revise_the_Critical_Habitat_Designation_for_the_Southern_Resident_Killer_Whale.pdf (summarizing population trends of Southern Resident since 1960).

52. *Id.* (detailing Southern Resident population trends); *see also* 2008 Recovery Plan, *supra* note 1, at iv (noting precipitous decline in Southern Resident population from 1996 to 2001).

53. For further discussion of the Southern Resident's listing, critical habitat designation, and recovery plan creation under the ESA, see *infra* notes 58-74. At the time of its critical habitat designation in 2006, the Southern Resident had recovered to 90 individuals. *See* 2008 Recovery Plan, *supra* note 1, at II-55 (detailing recorded population size of Southern Resident by year).

54. For further discussion of the Southern Resident's recovery plan, see *infra* notes 71-77.

55. For an affirmation of the Southern Resident's population as of August 2018, see *supra* note 12.

56. *12-Month Finding for a Petition To List Southern Resident Killer Whales as Threatened or Endangered Under the Endangered Species Act (ESA)*, 67 Fed. Reg. 44,133, 44,136–38 (Jul. 1, 2002) (denying listing Southern Resident as threatened or en-

quently challenged this determination in United States district court.[57] The district court concluded that NMFS failed to rely on the "best scientific and commercial data available" in its determination that the Southern Resident did not meet the qualifications to be a distinct population segment, and remanded the decision back to the agency.[58] After review, the NMFS issued a final determination that designated the Southern Resident as an endangered distinct population segment under ESA.[59] In its designation, the NMFS review team first identified the three environmental risk factors that will become the most well-known dangers to the Southern Resident population, noting "in particular, *disturbance from vessels*, the *persistence of legacy toxins and the addition of new ones* into the whales' environment, and the *potential limits on prey availability (primarily salmon)* given uncertain future ocean conditions."[60]

B. Critical Habitat Designation

Following listing of the Southern Resident as endangered under the ESA, the NMFS designated critical habitat for this distinct population in 2006.[61] The NMFS is required under the Secretary of Commerce to designate a critical habitat for all species listed as endangered or threatened under the ESA.[62] A species' critical habitat includes several requisite areas.[63] First, critical habitat must

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dangered under ESA). An organism group is considered to be a "distinct population segment" when it is both "discrete" from other populations and "significant" to the species or subspecies to which it belongs. 2005 Endangered Listing, *supra* note 8, at 69,907 (discussing requirements for classification as "distinct population segment").

57. Ctr. for Biological Diversity v. Lohn, 296 F. Supp. 2d 1223, 1227 (W.D. Wash. 2003) (noting Center's challenge of NMFS' determination that Southern Resident population does not warrant listing under ESA).

58. *Id.* at 1236-43 (citing 16 U.S.C. § 1533(b)(1)(A)) (finding NMFS' conclusions did not constitute best available scientific information).

59. 2005 Endangered Listing, *supra* note 8, at 69,903 (issuing final rule listing Southern Resident DPS as endangered).

60. *Id.* at 69,906 (emphasis added) (warning of potential threats facing Southern Resident). For further discussion of these risk factors, see *infra* notes 78-235.

61. 2006 Critical Habitat, *supra* note 8, at 69,054 (issuing final rule designating critical habitat for Southern Resident).

62. 16 U.S.C. § 1533(b)(2) (2018) ("The Secretary shall designate critical habitat, and make revisions thereto, under subsection (a)(3) on the basis of the best scientific data available and after taking into consideration the economic impact, the impact on national security, and any other relevant impact, of specifying any particular area as critical habitat."); *see also* 2008 Recovery Plan, *supra* note 1, at II-36 (explaining NOAA and FWS are required to designate critical habitat for ESA-listed species).

63. *See infra* notes 64-66 (outlining specific requirements for designating critical habitat under Endangered Species Act).

include specific areas *within* a species' occupied geographical area (i) that contain "physical or biological features . . . essential to the conservation of the species" and (ii) that "which may require special management considerations or protection."[64] Additionally, critical habitat must include specific areas *outside* a species' occupied geographical area if the NMFS has determined "such areas are essential for the conservation of the species."[65] The NMFS must designate critical habitat "on the basis of the best scientific data available," but must also account for "economic impact, the impact on national security, and any other relevant impacts" for specifying a particular area as critical habitat.[66]

NMFS designated the following three areas, overall encompassing approximately 2,560 square miles, as Southern Resident critical marine habitat: (i) the Summer Core Area in Haro Strait and waters around the San Juan Islands; (ii) Puget Sound; and (iii) the Strait Juan de Fuca.[67] These three areas, all inland waterways within Washington State, largely overlapped with the Southern Resident's summer and early autumn habitat range.[68] As an indication of what would later be stated in the 2008 Recovery Plan, NMFS discussed a lack of information "on Southern Resident distribution and habitat use of coastal and offshore areas in the Pacific Ocean," or the areas inhabited by Southern Residents during the late fall, winter, and early spring months.[69] Because of a lack of data about the Southern Resident's "distribution, behavior, and habitat" with respect to its winter habitat range, NMFS decided not to designate any coastal or offshore areas within the Southern Resident's critical habitat.[70]

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64. 16 U.S.C. § 1532(5)(A) (2018) (defining "critical habitat" under ESA).

65. *Id.* (defining "critical habitat" under ESA); *see also* Holly Doremus, *The Endangered Species Act: Static Law Meets Dynamic World,* 32 WASH. U. J. L. & POL'Y 175, 208 (2010) (summarizing critical habitat designation).

66. 16 U.S.C. § 1533(b)(2) (2018) (detailing required basis for determination of critical habitat).

67. 2006 Critical Habitat, *supra* note 8, at 69,054 (detailing specific areas classified as critical habitat for Southern Resident).

68. *Id.* at 69,062-63 (explaining basis for choosing specific areas as Southern Resident critical habitat); For additional discussion of the Southern Resident's seasonal habitat and movements, see *supra* notes 41-42 and accompanying text.

69. 2006 Critical Habitat, *supra* note 8, at 69,063-64 (noting dearth of information on Southern Resident's offshore habitat range and distribution).

70. *Id.* at 69,063 (withholding designation of coastal or offshore areas within Southern Resident's critical habitat but acknowledging importance of these areas).

C. Recovery Plan

As required by the ESA, NMFS began working on a recovery plan for the Southern Resident following its federal listing as an endangered species.[71] The ESA mandates the development and implementation of recovery plans for the conservation and survival of endangered and threatened species.[72] The Southern Resident recovery plan originated as a conservation plan under the Marine Mammal Protection Act (MMPA), but was updated to conform with the arguably more stringent requirements of the ESA.[73] In its listing of key threats to the Southern Resident, the 2008 Recovery Plan echoed the findings of the NMFS review team from the Southern Resident's ESA listing that reductions in prey availability, high levels of organochlorine and "emerging" contaminants, and sound and disturbance from vessel traffic were the three factors of greatest concern for the population.[74]

The 2008 Recovery Plan's long-term objective is to restore the Southern Resident to a healthy population, warranting its removal from the ESA.[75] To be delisted under the ESA, the Southern Resident population must be "neither in danger of extinction nor likely to become so 'in the foreseeable future throughout all or a significant portion of its range.'"[76] Calculating an average yearly growth rate of 2.3 percent per year for the Southern Resident, NMFS concluded that a population of approximately 155 orcas would be sufficient to prevent an imminent or foreseeable likelihood of extinction, and would thus warrant de-listing from the ESA.[77]

71. For further discussion of the ESA's recovery plan provision, see *infra* note 72.

72. 16 U.S.C. § 1533(f)(1) (2018) (mandating development of recovery plan for endangered and threatened species pursuant to ESA); *see also* 2008 Recovery Plan, *supra* note 1, at iv (noting ESA requires development and implementation of recovery plan for listed species).

73. 2008 Recovery Plan, *supra* note 1, at I-2 (detailing creation of MMPA conservation plan for Southern Resident in 2003).

74. *Id.* at II-71 (summarizing important risk factors threatening Southern Resident population).

75. *See* 16 U.S.C. § 1533(f)(1)(B)(ii) (2018) (discussing criteria required for incorporation into each recovery plan).

76. 2008 Recovery Plan, *supra* note 1, at IV-4 (citing 16 U.S.C. § 1533(b)(1)(B)(ii)) (stating requirements for de-listing species from ESA).

77. *Id.* at IV-4 to IV-5 (estimating Southern Resident population that would warrant removal from Federal Endangered and Threatened Wildlife and Plants List under ESA).

IV. EXAMINATION OF SOUTHERN RESIDENT RISK FACTORS AND SUGGESTIONS FOR FUTURE ACTION

The primary causes of the Southern Resident's population decline continue to be the risk factors identified by NMFS in the 2008 Recovery Plan, namely reductions in prey quality and availability, increasing levels of "legacy" organochlorine and emerging contaminants, and disturbance from vessel traffic.[78] Efforts have been made in recent years to address these risk factors, with varying success.[79] This section describes the three primary threats to the Southern Resident population, discusses subsequent efforts to reduce these threats, and offers suggestions for future action through varying scopes of management, regulation, and litigation.[80]

A. Reduction in Salmon Populations

The Southern Resident's 2008 Recovery Plan discusses "reductions in quantity or quality of prey" as a key factor contributing to the decline of the Southern Resident population.[81] The Southern Resident preys heavily on salmon, specifically Chinook salmon.[82] Unfortunately, the Chinook and many other Pacific salmon subspecies are also facing significant population declines.[83] In 1999, the NMFS listed four subspecies, or Evolutionary Specific Units (ESUs), of Chinook Salmon as threatened or endangered.[84] Among these was the Puget Sound Chinook, an important prey source for the Southern Resident.[85] In 2005, the NMFS maintained a threatened status for the Puget Sound Chinook, while issuing a final determi-

78. *Id.* at iv-v (listing key risk factors contributing to Southern Resident's population decline); 2005 Endangered Listing, *supra* note 8, at 69,906 (highlighting these three risk factors as greatest threats to Southern Resident).

79. For further discussion of the identified Southern Resident risk factors of prey availability, contaminant levels, and vessel traffic and how they have been addressed, see *infra* notes 81-235.

80. For further examination of the identified risk factors and suggestions for improved management, see *infra* notes 81-235.

81. 2008 Recovery Plan, *supra* note 1, at II-71 (noting 2004 Biological Review Team's identification of primary risk factors for Southern Resident).

82. For explanation of the Southern Resident's diet, see *supra* notes 44-47.

83. For a description of the ongoing population decline of Pacific salmon, including the Puget Sound Chinook, see *infra* notes 84-89.

84. As explained by the NMFS, ESUs are essentially Distinct Population Segments of the salmon species, *see Threatened Status for Three Chinook Salmon Evolutionarily Significant Units (ESUs) in Washington and Oregon, and Endangered Status for One Chinook Salmon ESU in Washington*, 64 Fed. Reg. 14,308-10 (Mar. 24, 1999) [hereinafter 1999 ESA listing for Four Chinook Salmon] (issuing final determination to list four ESUs of west coast Chinook salmon as threatened or endangered). For more explanation of Distinct Population Segments, see *supra* note 56.

85. *Id.* at 14,308 (listing Puget Sound Chinook as threatened under ESA).

nation that listed a total of sixteen ESUs of Pacific salmon as either threatened or endangered.[86] Studies during this time also showed that the Puget Sound Chinook was decreasing in size, with mean weights of adult-size fish decreasing by thirty percent.[87] In 2007, the NMFS made further conservation efforts by announcing the adoption of an ESA-mandated Recovery Plan for the Puget Sound Chinook Salmon.[88]

Despite these efforts, Pacific Chinook salmon numbers have yet to recover; in 2010, the Pacific Salmon Commission reported a sixty percent population decrease in Chinook Salmon within the Salish Sea since the Commission began recording data in 1984.[89] The reduced numbers of the Puget Sound Chinook and other Pacific salmon subspecies mean that Southern Residents likely have to spend additional time and energy foraging for alternative food sources.[90] This increased time and energy expenditure, due to inadequate prey levels, can subsequently lead to lower reproductive rates and higher mortality rates for the Southern Resident.[91]

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86. 70 Fed. Reg. at 37,163 (Jun. 28, 2005) (proposing continuation of 'threatened' status for Puget Sound Chinook under ESA).

87. 2008 Recovery Plan, *supra* note 1, at II-81 (citing, *inter alia*, Laurie A. Weitkamp et al., *Status review of coho salmon from Washington, Oregon, and California*, NOAA TECH. MEMORANDUM NMFS-NWFSC-24 (1995) (finding decrease in mean weight of Puget Sound Chinook reflected similar decline in size of many Pacific salmon species during previous few decades).

88. *Endangered and Threatened Species; Recovery Plans*, 72 Fed. Reg. 2,493-95 (Jan. 19, 2007) (announcing adoption of Recovery Plan for Puget Sound Chinook Salmon ESU). The designation of both the Southern Resident and its primary prey species, the Puget Sound Chinook, as endangered may require more advanced management practices that simultaneously account for both species. One study has successfully relied on simulation-based modeling to optimize management actions for two IUCN-listed species: the predatory sea otter and its prey species, the Northern Abalone. *See* Iadine Chad?s et al., *Setting Realistic Recovery Targets for Two Interacting Endangered Species, Sea Otter and Northern Abalone,* CONSERVATION BIOLOGY (2012) https://doi.org/10.1111/j.1523-1739.2012.01951.x (discussing use of simulation-based "optimization procedures" to examine effect of different management techniques on population dynamics). Simulation modeling allowed the study's authors to predict recovery rates of the sea otter and Northern Abalone based on important variables like interspecies interactions, poaching or harvesting, and environmental catastrophes such as oil spills. *Id.* With these variables in place, the authors could use modeling to determine what management actions yielded the greatest net recovery for both species simultaneously. *See id.*

89. *Salish Sea, Chinook Salmon*, U.S. ENVTL. PROT. AGENCY, https://www.epa.gov/salish-sea/chinook-salmon (last visited Nov. 1, 2018) [hereinafter *Chinook Salmon*] (noting 2010 population numbers for Chinook salmon in Salish Sea represented sixty percent decline since recording began in 1984).

90. 2008 Recovery Plan, *supra* note 1, at II-75 (explaining reductions in prey availability may force orcas to "spend more time foraging.").

91. *Id.* (warning reduced prey availability may lead to lower reproductivity and higher mortality rates); *see also* Samuel K. Wasser et al., *Population Growth is Limited by Nutritional Impacts on Pregnancy Success in Endangered Southern Resident*

Most agree that recent population declines of the Puget Sound Chinook, and other Pacific salmon subspecies, are attributed to a wide range of factors.[92] Key causes for the population loss of Chinook salmon within the Salish Sea include: changes in ocean and climate conditions, habitat loss or modification from dam construction and urbanization, and reduced water quality resulting from intensified land uses.[93] This part will focus on the two risk factors with arguably the most potential for improvement: habitat loss and modification, and reduced water quality within the Salish Sea area.[94]

Increased population growth and urbanization in coastal areas of Washington State and British Colombia has undoubtedly had a major effect both on the Salish Sea ecosystem and salmon species that inhabit it.[95] The population growth in these areas caused former estuarine and riparian habitats, which are important to Pacific salmon species, to be destroyed or altered for human-related land

Killer Whales (Orcinus orca), PLOS ONE (2017) https://doi.org/10.1371/journal.pone.0179824 (noting how "[l]ow availability of Chinook salmon appears to be a significant cause of late pregnancy failure" for Southern Residents).

92. For sources that have discussed the variety of factors causing the decline of the Puget Sound Chinook and Pacific salmon in general, see *infra* note 93 and accompanying text.

93. *Salmon: Background*, PAC. FISHERIES MGMT. COUNCIL, https://www.pcouncil.org/salmon/background/ (last updated 10/28/2014) (listing factors affecting salmon populations); *Chinook Salmon – Overview*, NAT'L OCEANIC ATMOSPHERIC ADMIN., NOAA FISHERIES, https://www.fisheries.noaa.gov/species/chinook-salmon (last visited Sept. 26, 2018) (listing factors affecting Chinook Salmon populations); *Chinook Salmon*, *supra* note 89 (attributing three key factors to causing recent decline in Chinook Salmon).

94. Some have suggested that, due to their predator-prey interaction, it may be impossible for "marine mammals [such as the Southern Resident] and Chinook salmon populations to be robust at the same time." Michelle Ma, *Largest Chinook Salmon Disappearing from West Coast*, U. WASH. NEWS (Feb. 27, 2018) https://www.washington.edu/news/2018/02/27/largest-chinook-salmon-disappearing-from-west-coast/ (noting that predator-prey relationship between orcas and salmon may make it impossible for both species to thrive simultaneously). For an illustration of the established population "cycle" that exists between predators and their prey species, see Bob Carpenter, *Predator-Prey Population Dynamics: the Lotka-Volterra Model in Stan*, MC STAN (Jan. 28, 2018) http://mc-stan.org/users/documentation/case-studies/lotka-volterra-predator-prey.html (providing example of predator-prey interaction through historical case study of Canadian lynx and snowshoe hare populations between 1900 and 1920). However, the joint causes of the Southern Resident's and Chinook salmon's steady population decline more accurately describe a different scenario: a diminishing ecosystem for these two distinct populations due to habitat loss and modification, as well as increased levels of water-borne pollutants. *See* Robbins, *supra* note 13 (detailing concern of scientists that Southern Resident's decline signifies "a marine ecosystem in collapse.").

95. *See* HUTCHINGS, *supra* note 15, at 34-35 ("Population growth in [ ] Salish Sea is considered [ ] 'major underlying force contributing to [ ] cumulative stresses on [ ] land, air, water and other ecosystem resources.'").

uses such as residential development, agriculture, logging, and hydropower generation.[96]

In addition to direct habitat loss or modification, increased population growth and land development in the Salish Sea area have increased rates of non-point pollution through stormwater runoff, subsequently impairing the water quality of the sea's waterways and tributaries.[97] Washington State's Department of Ecology named non-point pollution through stormwater runoff as the "biggest threat" to Puget Sound's ecosystem and wildlife, including salmon species.[98] Unsurprisingly, Puget Sound stormwater with the highest pollutant concentrations originates in areas that have been converted for residential, commercial, and agricultural land uses.[99]

Despite the resulting harm, trends of habitat and water quality degradation for Salish Sea salmon can still be reversed.[100] An ideal solution would likely encompass a variety of resource management actions.[101] The Puget Sound Partnership, a Washington state agency created in 1997 to implement comprehensive recovery measures within the Puget Sound ecosystem, has presented and initi-

96. 2008 Recovery Plan, *supra* note 1, at II-75 (describing decline of Pacific salmon as result from number of deleterious human practices). The construction of multi-purpose, hydroelectric dams along the Columbia and Snake Rivers in the Pacific Northwest has materially impacted salmon populations within the Salish Sea, leading to significant litigation. *See* Nat'l Wildlife Found. v. Nat'l Marine Fisheries Serv., 254 F.Supp.2d 1196 (D. Or. 2003) (finding NMFS' Biological Opinion addressing effects of proposed Federal Columbia River Power System action on threatened or endangered salmon and steelhead trout in Columbia River basin was arbitrary and capricious). The continuing decline of Pacific Northwest salmon species has led to the proposal that certain dams be removed to assist in the recovery of salmon and orca populations. Phuong Le, *Scientists Call for Breaching Dams to Save Puget Sound Orcas,* ASSOC. PRESS (Oct. 28, 2016) https://www.apnews.com/aaa8b3c8e9d94a46844dd662b19ddfbb (noting some scientists and researchers have called for "four dams on the Lower Snake River to be breached to open up habitat for salmon."). This article does not expand on the possibility of dam removal to assist in Pacific salmon and Southern Resident recovery, but ample consideration should be given to this proposal going forward.

97. For further discussion of the extent and causes of nonpoint pollution within the Salish Sea watershed, see *infra* notes 98-99.

98. WASH. STATE DEP'T OF ECOLOGY, PUGET SOUND TOXICS ASSESSMENT, PUB. NO. 11-03-060 (2011), at 2-3 (noting stormwater runoff is most "common pathway" for toxic pollutants to enter Puget Sound).

99. *Id.* at 3 (discussing sources of toxic pollutants found within stormwater). The stormwater runoff in this area is reported to contain a combination of "nutrients, bacteria, sediment, and toxic chemicals." *Id.* at 1.

100. For suggestions to address habitat and water quality deterioration in the Salish Sea, see *infra* notes 101-107.

101. *See infra* notes 102-107 for additional detail on suggested actions.

ated some helpful actions.[102] To protect and restore salmon habitat, efforts should be made to implement and maintain floodplain restoration projects for "ecologically sensitive areas."[103]

Additionally, there needs to be a greater focus on discouraging future development in and near important riparian areas and estuaries.[104] This requires coordination with local governments to incorporate this focus within their comprehensive plans and land use regulations.[105] Reducing non-point pollution through stormwater runoff can be achieved through a number of efforts including upgrading municipal and industrial wastewater facilities to reflect best practices, management of urban runoff through bioswales and similar stormwater projects, and promoting the use of safer alternatives to products containing environmentally-harmful chemicals and nutrients.[106] Furtherance of these projects can help create conditions within the Salish Sea and its tributaries that are more favorable to Chinook and other Pacific salmon growth.[107]

Other risk factors for Salish Sea salmon may include overutilization from commercial and recreational harvest rates, as well as negative side effects of hatcheries.[108] These two risk factors have, however, recently shown statistics that suggest improvement.[109] For one, harvest rates of Chinook salmon have shown a twenty-nine percent reduction since 1999, when Puget Sound Chinook were listed as a threatened species under the ESA.[110] Additionally, while Pacific salmon hatcheries have played a contributing factor in the decrease of wild fish stocks through processes such as deleterious

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102. *2016 Action Agenda for Puget Sound – Comprehensive Plan*, PUGET SOUND P'SHIP (2016) https://pspwa.box.com/shared/static/rlhdytkj5wsqb6k2lg9zbjak5tn4cva3.pdf (listing strategies to address Puget Sound ecosystem pressures).

103. *Id.* at 37 (listing strategies to assist in salmon population recovery).

104. *Id.* (listing strategies to "focus development" away from areas of ecologic importance).

105. *Id.* (encouraging support of local governments in their implementation of plans and regulations).

106. *Id.* at 38-39 (listing strategies to reduce water pollution and surface runoff).

107. *See* 2008 Recovery Plan, *supra* note 1, at II-77 (specifically linking salmon declines in Pacific Northwest to "greater human impacts on freshwater and estuarine habitats as well as ocean productivity cycles").

108. *Chinook Salmon, supra* note 89 (noting harvest rates and hatchery influence as two key factors contributing to decline in Chinook Salmon).

109. *See infra* notes 110-112 for factors that have helped offset harms from fish harvesting and hatchery practices.

110. *Chinook Salmon, supra* note 89 (noting significant reductions in harvested salmon numbers since 1999); *see also* Ma, *supra* note 94 ("fishing pressure has relaxed in [ ] last 30 years . . . while [ ] reductions in Chinook size have been most rapid over [ ] past 15 years.").

gene spreading, competition, and disease, they also have likely acted as a compensatory prey source for the Southern Resident in recent years.[111] With harvest rates notably decreasing, and with Pacific salmon hatcheries providing a replacement food source for the Southern Resident, there must be greater implementation of solutions like riparian and wetland habitat restoration, better education and management regarding water quality standards, and possibly the decommissioning or removal of dams within the Columbia and Snake River systems to help address declining salmon populations within the Salish Sea.[112]

B. Increasing Contaminant Levels

The population declines of the Southern Resident and the Puget Sound Chinook likely underlie another Southern Resident risk factor described in the Recovery Plan: the persistence of harmful contaminants within the Salish Sea's sediment and waters.[113] "Legacy" organochlorine compounds such as polychlorinated biphenyls (PCBs) and dichlorodiphenyl trichloroethane (DDT) are of primary concern, but increasing attention should be given to "emerging" contaminants such as brominated flame retardants (BFRs).[114] Generally relied upon for a variety of industrial, agricultural, and household uses, these environmentally harmful chemical compounds can lead to numerous health effects in Southern Residents, including depression of the species' immune and reproductive sys-

111. 2008 Recovery Plan, *supra* note 1, at II-81 (acknowledging hatchery production "has likely benefited resident killer whales to some undetermined extent."); *see also* Doremus, *supra* note 65, at 220 ("Carefully managed hatcheries hold promise as conservation tools, although their value has yet to be determined in practice.").

112. For a further discussion of dam removal as a possible method to assist in Salish Sea salmon recovery, see *supra* note 96. If Chinook salmon and Southern Resident population numbers continue to fall, however, a complete closure of recreational and commercial fishing for Chinook salmon might be necessary. *See US Conservation Group Supports BC Groups in their Call for an Emergency Science-Based Response to Preserve Southern Resident Killer Whales*, WILD FISH CONSERVANCY NORTHWEST (Aug. 16, 2018) http://wildfishconservancy.org/wfcrelease8.16.2018/at_download/file (calling for immediate moratorium of Chinook salmon fishing in British Columbia coastal waters).

113. 2008 Recovery Plan, *supra* note 1, at II-87 (stating toxic organochlorines are "frequently considered" to pose greatest risk to orca populations). Elevated levels of contaminants have been found in both Chinook salmon and Southern Residents within the Salish Sea. *See id.* at II-87 to II-96 (detailing studies examining contaminant levels in Northeastern Pacific orca and Chinook salmon populations).

114. *Id.* at II-71 (listing high and increasing contaminant levels as primary risk factor threatening Southern Resident population).

tems.[115] Reducing levels of toxic "legacy" and "emerging" contaminants within the Salish Sea is a wide-ranging issue, and will require combined action at a statewide, national, and international level.[116]

1. "Legacy" Contaminants – DDT and PCBs

Compounds such as PCBs and DDT, labeled under the umbrella term 'organochlorines,' are "frequently considered to pose the greatest [toxicological] risk to killer whales."[117] Discovered to be environmentally toxic, these compounds were widely used for industrial and agricultural purposes in the United States during the first half of the twentieth century.[118]

Elevated levels of toxic organochlorines have been associated with a large number of health defects within marine mammals, including impaired reproduction, immunotoxicity, hormonal dysfunction, and skeletal deformities.[119] In addition to their harmful health potential for orcas, organochlorines such as PCBs and DDT have other characteristics that make them environmentally worrisome.[120] To begin with, organochlorine compounds are notorious as "legacy" (or "persistent") contaminants, meaning they remain undegraded and toxic within the natural environment for decades.[121] These compounds are also highly "lipophilic," which allows them to bioaccumulate and store within fatty tissues of

115. *Id.* at II-87 to II-103 (discussing common uses for toxic chemical compounds, providing studies examining contaminant levels in Pacific Northwest orcas, and linking health responses to contaminant exposure).

116. For further discussion of suggested actions, *see infra* notes 129-174.

117. *Id.* at II-87-88 (citing, *inter alia*, P.S. Ross et al., *High PCB Concentrations in Free-Ranging Pacific Killer Whales, Orcinus orca: Effects of Age, Sex and Dietary Preference*, 40 MARINE POLLUTION BULL. 504, 512-13 (2000)) (providing overview of organochlorines and their presence in Northeastern Pacific orcas).

118. *See* Susan Korrick & Sharon Sagiv, *Polychlorinated Biphenyls (PCBs), Organochlorine Pesticides, and Neurodevelopment*, 20 CURRENT OPINION OF PEDIATRICIANS 1, 2 (2008) doi:10.1097/MOP.0b013e3282f6a4e9 (providing historical background on uses of PCBs and DDT). Sediment analyses show both DDT and PCBs have been present in Puget Sound since the 1930s. *See* Alan J. Mearns, *Long-term contaminant trends and patterns in Puget Sound, the Straits of Juan de Fuca, and the Pacific Coast*, PUGET SOUND RES. (2001) (noting both PCBs and DDT as "substantial historical contaminant[s]" within Puget Sound basin).

119. 2008 Recovery Plan, *supra* note 1, at II-93 (listing physiological responses likely caused by organochlorine exposure).

120. For additional problematic characteristics of organochlorine contaminants, see *infra* notes 121-123 and accompanying text.

121. *Id.* at II-87 ("Some [organochlorines] are highly persistent in [ ] environment and resistant to metabolic degradation."); *see also* Korrick & Sagiv, *supra* note 118, at 7 (noting likely neurodevelopmental risks of PCBs and "persistent organochlorine pesticides").

animals, including orcas.[122] Organochlorines bioaccumulate within Southern Residents at an even greater level due to the orca's existence as an apex, or "top-level," predator.[123]

The United States banned the use of both DDT and PCBs in the 1970s and other developed nations shortly followed suit, leading to a general decline in the environmental levels of these organochlorine compounds in the past fifty years.[124] Unfortunately, residual amounts of both "legacy" contaminant compounds continue to plague orcas in the Pacific Northwest.[125] These contaminants have persisted within the Southern Resident population even following the 2008 Recovery Plan; studies leading up to 2016 have consistently measured PCBs and DDT-related compounds within the blubber and scat of Southern Residents.[126] Despite most developed nations implementing a usage ban for PCBs and DDT, NMFS' 2008 Recovery Plan noted the continued use of these compounds by developing nations within Asia and Latin America as a cause for residual organochlorine contaminant levels.[127] Specifically, the 2008 Recovery Plan attributed the presence of organochlorines like PCBs and DDT in the northern Pacific Ocean largely to "atmospheric transport from Asia."[128]

The contamination from "legacy" pollutants such as PCBs and DDT is a wide-ranging problem requiring solutions on a national

122. 2008 Recovery Plan, *supra* note 1, at II-87 (referencing lipophilic character of many organochlorines); Korrick & Sagiv, *supra* note 118, at 2 (characterizing PCBs as "lipophilic chemicals").

123. 2008 Recovery Plan, *supra* note 1, at II-87 (explaining bioaccumulation process that greatly affects "top-level marine predators").

124. Korrick & Sagiv, *supra* note 118, at 1-2 (providing historical background on use of PCBs and DDT); *see also* 2008 Recovery Plan, *supra* note 1, at II-91 (citing, *inter alia*, C. Gray & T. Tuominen, *The Fraser River is Getting Cleaner: Will it Continue to Improve?*, PUGET SOUND RES. (2001)) (noting decline in Puget Sound organochlorine levels since 1960).

125. 2008 Recovery Plan, *supra* note 1, at II-88 to II-91 (describing organochlorine levels of orca populations within Washington State and British Columbia).

126. *Nat'l Marine Fisheries Serv., Exposure to a Mixture of Toxic Chemicals: Implications for the Health of Endangered Southern Resident Killer Whales*, NOAA TECHNICAL MEMORANDUM NMFS-NWFSC-135 (2016) https://www.nwfsc.noaa.gov/assets/25/8314_11302016_111957_TechMemo135.pdf (citing unpublished research subsequent to 2015 that measured organochlorine contaminant levels in blubber and scat of Southern Resident population members).

127. *Id.* at II-87 (noting organochlorine compounds like PCBs and DDT "continue to be used widely in other parts of [ ] world," despite being banned in United States and Canada).

128. *Id.* at II-88 (citing, *inter alia*, L.A. Barrie et al., *Arctic Contaminants: Sources, Occurrence and Pathways*, 122 SCI. OF TOTAL ENV'T 1 (1992)) (noting majority of organochlorine load in Northeastern Pacific is carried from Asia via atmospheric transport).

and global scale.[129] First, the monitoring and cleanup of existing contaminated sites within the Salish Sea need to continue.[130] There are currently nine "Superfund" sites within Puget Sound or its surrounding waterways, which make up almost one-third of the total number of "Superfund" sites in Washington State.[131] Methods for cleanup should include those traditionally used for these types of pollutants, such as the dredging and capping of contaminated sediment.[132]

Additionally, increased efforts are required to control and reduce global environmental levels of toxic organochlorines like PCBs and DDT; these efforts are especially important to reduce organochlorine amounts that may be transported from developing Asian-Pacific countries to Pacific Northwest marine environments like the Salish Sea.[133] The Stockholm Convention, an international treaty aiming to restrict and eliminate persistent organic pollutants, including PCBs and DDT, became effective in 2004.[134] Nations that signed the Stockholm Convention are obligated to *eliminate* the use of PCB-containing products by 2025 and to bring these PCB-containing products under "environmentally sound waste management" by 2028.[135] Further, signatory nations are obligated to *restrict* the use of DDT, subject to exceptions for "disease vector control use."[136] By February 2013, fifty-two Asian-Pacific countries had signed the Stockholm Convention, and thirty-six of these signatory

129. For further discussion of suggested actions, *see infra* notes 130-131, 147-155.

130. For further explanation of contamination cleanup within the Salish Sea, *see infra* notes 131-132.

131. *Superfund Sites in Reuse in Washington*, U.S. ENVTL PROT. AGENCY, https://www.epa.gov/superfund-redevelopment-initiative/superfund-sites-reuse-washington (last updated June 2017) (providing map and list of Superfund sites in Washington State).

132. *Id.* (detailing cleanup plans, including removing soil, dredging contaminated sediment, and capping additional contaminated portions).

133. For a link between elevated Salish Sea contaminant levels and the atmospheric transport of organochlorines from Asia, see *supra* note 128 and accompanying text.

134. *Stockholm May 22, 2001*, STOCKHOLM CONVENTION ON PERSISTENT ORGANIC POLLUTANTS, https://treaties.un.org/doc/Publication/MTDSG/Volume%20II/Chapter%20XXVII/XXVII-15.en.pdf (showing effective date of May 17, 2004 and providing list of signatory countries).

135. *Stockholm May 22, 2001*, STOCKHOLM CONVENTION ON PERSISTENT ORGANIC POLLUTANTS, chm.pops.int/Portals/0/download.aspx?d=UNEP-POPS-COP-CONVTEXT-2009.En.pdf (assigning PCBs under 'Elimination' category in Annex A).

136. *Id.* at 41-42 (assigning DDT as pollutant under 'Restriction' category in Annex B). The more lenient controls for the use of DDT indicate its continuing use as an insecticide to control mosquito-borne diseases like malaria and typhus in some countries. *See id.*

countries had submitted an action plan for reducing and eliminating environmental levels of "legacy" organochlorine contaminants.[137]

While the inception of the Stockholm Convention and creation of action plans are important initial efforts to improve reduction and elimination of the use of persistent organochlorines in Asia, there remain opportunities for improvement.[138] Some Asian-Pacific nations still lack an action plan for initiating contaminant reduction measures, and "the majority of [Asian] countries" do not have facilities in place for the management and disposal of contaminants like PCBs.[139] Moreover, the reported inventory on levels of PCBs within each country is likely "incomplete and unreliable," and actual amounts might be higher than current estimates.[140]

Concrete steps must be taken to ensure complete and uniform implementation of the Stockholm Convention's objectives to reduce and control global levels of persistent contaminant pollutants like PCBs and DDT.[141] Facilitating the reduction and disposal of persistent organochlorides within developing nations is a multi-step process that includes: (i) institutional capacity building and policy framework development, (ii) awareness raising, (iii) national strategy and action plan development, (iv) monitoring and safeguard-

137. Li Jin-hui et al., *Achieving Target of Stockholm Convention on PCBs Elimination: Asia-Pacific Case,* BASEL CONVENTION COORDINATING CTR. FOR ASIA & THE PACIFIC 2147, 2148 (2013) (providing overview of PCBs management status in Asian-Pacific countries). As of November 2018, there are 182 parties to the Convention; ironically, the United States has signed but has not yet ratified this agreement. *See Status of Ratification: Parties and Signatories,* STOCKHOLM CONVENTION, http://chm.pops.int/Countries/StatusofRatifications/PartiesandSignatoires/tabid/4500/Default.aspx (last visited Mar. 2, 2019) (providing list of signatories and parties to convention).

138. *See* POLYCHLORINATED BIPHENYLS (PCB) INVENTORY GUIDANCE, PCB ELIMINATION NETWORK (PEN) 4 (2016) (noting "[d]eveloping countries and countries with economies in transition . . . still have many obstacles" in identifying, managing, and eliminating environmental levels of PCBs and related compounds).

139. Jin-hui et al., *supra* note 137, at 2148 (noting that China, Korea, and Vietnam have developed disposal facilities or practices for PCBs).

140. *Id.* at 2152 (finding incomplete inventory on PCBs and PCB-containing equipment poses significant obstacle to improving management techniques in some Asian-Pacific countries). The issues related to international management and reduction of chemical contaminants are compounded by the chemical industry's "global geographical shift" towards developing nations that has occurred after implementation to phase out chemicals in developed countries. Ying Wang & Yang-Zhao Sun, *The Causes of the Scientific and Regulatory Gap in the Listing of New Persistent Organic Pollutants into the Stockholm Convention,* 50 ENVTL. SCI. & TECH. 6117, 6117 (2016) (discussing likely cause for disparity in chemical management practices between developed and developing nations).

141. For further discussion of suggested action to reduce global levels of persistent organochlorines, see *infra* notes 147-154.

ing of contaminant stocks, and (v) final disposal of contaminants.[142] While improvements can be made in all stages of contaminant reduction and disposal within developing countries, this article focuses primarily on the first step: institutional capacity building and policy framework development.[143] For the majority of countries, the legal groundwork for management and reduction of harmful contaminants has been laid—a report from the United Nations Environment Programme (UNEP) reveals that "[m]ost all developing countries and countries in economic transition" have adopted legal instruments, created agency infrastructure, and more recently, enacted laws focused on chemical safety.[144] Nonetheless, UNEP's report notes that many developing nations still lack the budget and personnel required to implement nationwide policies related to management of chemical contaminants like PCBs and DDT.[145] The report adds that safe chemical and contaminant management is often given a lower priority when compared to more urgent needs like "economic development, national security and poverty eradication."[146]

A key solution to this problem would be to link funding and technical assistance to developing countries, so national policies for contaminant control and reduction can be implemented more effectively.[147] For example, the Global Environmental Facility has already funded a number of projects in several developing Asian-Pacific nations for objectives related to PCB management and dis-

142. Jin-hui et al., *supra* note 137, at 2151 (listing and describing key PCB-related projects in Asian-Pacific nations).

143. For further discussion of possibilities to improve capacity-building for chemical management in developing Asian-Pacific nations, see *infra* notes 147-154.

144. UNITED NATIONS ENV'T PROGRAMME, GLOBAL CHEMICALS OUTLOOK - TOWARDS SOUND MANAGEMENT OF CHEMICALS 199 (2013) [hereinafter UNEP, Global Chemicals Outlook], https://sustainabledevelopment.un.org/content/documents/1966Global%20Chemical.pdf (noting "[s]ome of these authorities are parts of omnibus environmental statutes; however, most are independent laws addressing chemicals separately in wastes, emissions, agriculture, industrial settings and commerce."); *see also* Ben Boer, *The Rise of Environmental Law in the Asian Region,* 32 U. RICHMOND L. REV. 1503, 1511-39 (1998) (summarizing environmental legislation for countries in Asian-Pacific region, but at "varying stages of development.").

145. UNEP, GLOBAL CHEMICALS OUTLOOK, *supra* note 144, at 184 (explaining that developing countries lack adequate budget and personnel needed for increasing capacity for chemical management programs).

146. *Id.* (noting issue of chemical management can be overlooked by international donors and aid agencies).

147. For further discussion on providing financial aid and technical assistance for chemical management in developing nations, see *infra* notes 148-151.

posal.[148] Continued efforts like this should be made to link funding from similar international donors and economic aid agencies to developing Asian-Pacific nations to help strengthen institutional frameworks for regulating "legacy" contaminants.[149] Additionally, already-developed nations within the Asian-Pacific region should provide financial and technical assistance, to the extent they are able, to help developing countries expand their institutional capacity for regulating "legacy" contaminants.[150]

In order to expand developing nations' institutional capacity for control and reduction of toxic pollutants like PCBs and DDT, UNEP also suggests integrating safe chemical management practices into national economic development strategies.[151] UNEP cites one such example in Uganda, where national agencies collaborated to weave chemical management priorities into the country's National Development Plan and Poverty Eradication Action Plan.[152] Through its explanation of Uganda's case study, UNEP illustrates that combining chemical management policies with national socioeconomic development programs not only creates additional resources for chemical management, but also "raises the profile" of chemical and contaminant issues to the level of other important needs such as poverty reduction and economic development.[153] In general, a combined effort of providing funding, technical assistance, and measures to integrate safe chemical management practices into national economic development strategies will help

148. Li Jin-hui et al., *Review of PCBs Management in the Asia-Pacific region,* PCBs ELIMINATION NETWORK (PEN) MAGAZINE 32 (2012) http://chm.pops.int/Portals/0/download.aspx?d=UNEP-POPS-PAWA-CASES-ReviewOfPCBsManagementAsiaPacificRegion.En.pdf (charting projects related to PCB control and disposal, with various funding sources).

149. Jin-hui et al., *supra* note 137, at 2152-53 (asserting that Asian-Pacific signatory nations will "need support" in developing environmentally sound PCB management practices, to ensure achieving target goals of Stockholm Convention).

150. *See Nat'l Implementation Plan of Japan under the Stockholm Convention on Persistent Organic Pollutants* (Jun. 24, 2005) https://www.env.go.jp/chemi/pops/plan/en_full.pdf (noting Articles 12 and 13 of Stockholm Convention require developed countries to "provide financial and technical assistance to [ ] parties to [ ] convention [who] are developing countries and countries with economies in transition."); *but see* Wang & Sun, *supra* note 140, at 6117 (explaining Stockholm Convention-related technical or financial assistance from developed countries often comes with conditions that developing countries must meet prior to receiving assistance).

151. UNEP, GLOBAL CHEMICALS OUTLOOK, *supra* note 144, at 200 (suggesting "strong relationship" between environmentally sound chemical management and socioeconomic development).

152. *Id.* (detailing case study where chemical management practices were integrated into nation's development plan).

153. *Id.* at 201 (summarizing benefits of assimilating chemical management practices into development programs).

developing Asian-Pacific nations to increase their institutional capacity for reduction of "legacy" contaminants and thus more quickly achieve the Stockholm Convention's objective to reduce global levels of persistent contaminant pollutants like PCBs and DDT.[154] In turn, a global reduction of "legacy" organochlorine contaminants will lessen contaminant amounts transported from the Asian-Pacific region to Pacific Northwest marine environments like the Salish Sea.[155]

2. "Emerging" Contaminants – PBDEs and other BFRs

In addition to well-known "legacy" organochlorine contaminants, there is also a need to address other "emerging" contaminants like brominated flame retardants (BFRs), which are likely causing long-term biological harm to the Southern Resident population.[156] BFRs encompass a large number of chemicals, most notably chemical groups polybrominated diphenyl ethers (PBDEs) and cyclic aliphatic bromides (HBCDs), which are generally used as flame retardants on consumer products.[157] The increased use of PBDEs and HBCDs in recent years derives from an increased production and use of goods made from petroleum-derived materials, such as plastics and foam.[158] While production of plastic and foam materials have increased, these petroleum-based products are more flammable than their traditional wood or metal counterparts, and thus BFRs are applied to prevent these new petroleum-based products from burning quickly.[159]

While BFRs help safeguard against fire-related casualties, their increased production and use has been mirrored by increasing bioaccumulation levels in both humans and wildlife during the past

154. *See supra* notes 140-152 for additional discussion on reducing institutional capacity for "legacy" contaminants.

155. For a link between elevated Salish Sea contaminant levels and the atmospheric transport of organochlorines from Asia, see *supra* note 128 and accompanying text.

156. For further discussion of actions suggested to address levels of "emerging" contaminants, see *infra* notes 171-190.

157. 2008 Recovery Plan, *supra* note 1, at II-93 (noting BFRs as contaminant of "recent concern"); *see also* Leif Magnuson, *Overview of Brominated Flame Retardants*, U.S. ENVTL. PROT. AGENCY, https://archive.epa.gov/region9/science/web/pdf/rsc-seminar-overview-bfr.pdf (last visited Oct. 18, 2018) (listing PBDEs and HBCDs as BFRs of recent concern).

158. Magnuson, *supra* note 157 (providing historical background on use of BFRs).

159. *Id.* (adding that some states, specifically California, have enacted high product standards for flame retardancy).

several decades.[160] Similar to established "legacy" contaminants like PCBs and DDT, BFRs are lipophilic and persistent contaminants, making them environmentally problematic and difficult to clean up.[161] BFRs have been associated with endocrine disruption, immunotoxicity, neurotoxicity, and early developmental problems in both wild and laboratory animals.[162] The 2008 Recovery Plan cited a study that revealed higher PBDE concentrations in male Southern Residents than Northern Residents, but still lower than male and female Transient orcas.[163]

Both state and nation-wide efforts have been made to reduce the occurrence of PBDE-related compounds in the natural environment.[164] In 2004, manufacturers initiated the voluntary withdrawal of both penta-BDE and octa-BDE from the United States' marketplace.[165] Similarly, in 2008, Washington State passed legislation prohibiting the use of penta-BDE and octa-BDE in consumer products.[166] The United States Environmental Protection Agency (EPA) also announced the phase out of deca-BDE in 2009, and production, importation, and sales of deca-BDE for all uses in the United States to end by 2014.[167] As of 2017, eleven states had banned penta-BDE and octa-BDE, and four states had either banned or

160. Ronald A. Hites, *Polybrominated diphenyl ethers in the environment and in people: a meta-analysis of concentrations,* 38 ENVTL. SCI. & TECH. 945, 945 (2004) (stating "[i]n human blood, milk, and tissues, total PBDE levels have increased exponentially by . . . approximately 100 during [ ] last 30 [years]."). For an explanation of BFRs' utility as a fire retardant, see Magnuson, *supra* note 157 (noting that "BFRs save lives," because they give "people more time to get out of [ ] building.").

161. 2008 Recovery Plan, *supra* note 1, at II-93 (noting "lipophilic, bioaccumulative, and persistent qualities" of PBDEs). For discussion of similar persistent and lipophilic qualities of PCBs and DDT, see *supra* notes 121-122.

162. *Id.* at II-93 (citing, *inter alia*, Cynthia A. de Wit, *An overview of brominated flame retardants in the environment,* 46 CHEMOSPHERE 583, 583-624 (2002)) (detailing potential health harms related to PBDEs exposure).

163. *Id.* at II-89, II-93-95 (citing Sierra Rayne et al., *PBDEs, PBBs, and PCNs in Three Communities of Free-Ranging Killer Whales (Orcinus orca) from the Northeastern Pacific Ocean,* 38 ENVTL. SCI. & TECH. 4293, 4293-4299 (2004)) (discussing results from study documenting PBDE concentrations in northeastern Pacific orcas).

164. For further discussion of these efforts, see *infra* notes 165-168.

165. ENVTL. PROT. AGENCY, AN EXPOSURE ASSESSMENT OF POLYBROMINATED DIPHENYL ETHERS, EPA/600/R-08/086F at xviii (2010) [hereinafter EPA, EXPOSURE ASSESSMENT OF PBDEs] (noting penta-BDE and octa-BDE are banned in Europe as well).

166. *See* REVISED CODE OF WASH., Ch. 70.76.020 (2018) (outlawing manufacture, sale, and distribution of PBDE-containing products after January 1, 2008).

167. EPA, EXPOSURE ASSESSMENT OF PBDEs, *supra* note 165, at xviii (declaring for "all uses" of deca-PBDE to end by December 31, 2013).

were considering prohibition of certain products containing deca-BDE.[168]

Despite these recent efforts, concerns still remain about BFRs and related compounds.[169] Because of their persistent and bioaccumulative abilities, PBDEs arguably still pose a potential health threat to human and wildlife populations, including the Southern Resident.[170] EPA has listed several emerging technologies to possibly reduce environmental levels of PBDEs, including the use of catalysts to assist in aerobic or anaerobic degradation of PBDEs.[171] Increased attention and funding should be given to these emerging technologies, as well as conventional methods of treatment such as dredge-and-cap of PBDE-contaminated sediment.[172]

In addition, since the nation-wide phase out of primary PBDE compounds, manufacturers have begun using alternative flame retardants in order to continue meeting flammability standards.[173] Some of these alternative flame-retardant chemicals are also brominated, and their potential effect on humans and the natural environment is largely unknown.[174]

To ensure that any new flame-retardant chemicals are environmentally safe, there must also be adequate implementation of the newly-reformed Toxic Substances Control Act (TSCA).[175] Initially passed in 1976, TSCA delegates EPA authority to develop "adequate

168. ENVTL. PROT. AGENCY, TECHNICAL FACT SHEET –POLYBROMINATED DIPHENYL ETHERS (PBDEs), EPA 505-F-17-015 1, 3 (2017) [hereinafter EPA, PBDEs FACT SHEET] (describing existing state guidelines for PBDEs).

169. For discussion related to the link between animal health problems and exposure to brominated flame retardants such as PBDEs, see *supra* note 162 and accompanying text.

170. EPA, PBDEs FACT SHEET, *supra* note 168 (stating "PBDEs have been detected in air, sediments, surface water, fish and other marine animals.") (citations omitted).

171. *Id.* (describing technologies used to reduce PBDE contaminant levels).

172. *See supra* note 132 for suggested cleanup methods of "legacy" contaminants. EPA noted that as of 2016, "PBDEs were not identified at any of the current or former hazardous waste sites on the EPA National Priorities List (NPL)[,]" but also added that site evaluation for PBDEs has not been 'well documented.'" EPA, PBDEs FACT SHEET, *supra* note 168, at 2 (discussing presence of PBDEs in natural environment).

173. *Brominated Flame Retardants, Alkylphenolic Compounds, and Hexabromocyclododecane in Freshwater Fish Washington State Rivers and Lakes*, WASH. DEP'T OF ECOLOGY, (2016) https://fortress.wa.gov/ecy/publications/documents/1603012.pdf (providing contextual background on use of brominated flame retardants).

174. *Id.* (noting "little is known" about toxicity of these PBDE replacement chemicals).

175. *See generally* 15 U.S.C. §§ 2601–2629 (2018) (providing guidelines for federal control of toxic chemical substances).

information" about commercially-used chemicals, and to regulate those chemicals which "present an unreasonable risk of injury to health or the environment."[176] As chemical compounds used to reduce flammability in consumer products, BFRs and flame retardants fall squarely within EPA's regulatory authority under the TSCA.[177]

Congress passed legislation reforming the TSCA in 2016, which favored stricter review and regulation processes for commercially-used chemicals.[178] The 2016 reforms not only expanded the potential number of chemicals that EPA can ban or restrict, but also set a mandate that EPA evaluate "all new chemicals or significant new uses of existing chemicals to determine whether the chemical presents an unreasonable risk of injury to potentially exposed or susceptible individuals."[179] These reforms also mandated that the EPA conduct a yearly evaluation of ten chemicals the agency believes pose the greatest risk to human and environmental health.[180]

Pursuant to the newly-reformed TSCA, EPA published its first list of the ten chemicals for environmental and human health risk assessment in October 2017.[181] Included in this list was the chemical group cyclic aliphatic bromide cluster (HBCDs).[182] EPA states that at least two chemicals within this group are used as flame

176. *Id.* at § 2601 (2018) (explaining findings, policy, and congressional intent of TSCA).

177. *See id.* (delegating EPA to "carry out this chapter in a reasonable and prudent manner").

178. *See* Megan W. Bennett et al., *The Toxic Substances Control Act of 1976—The Lautenberg amendments of 2016,* 15 N.Y.PRAC., New York Law of Torts § 16:85.70 (2018) (concluding this legislation "significantly amended" existing TSCA).

179. *Id.* (discussing consequences of 2016 TSCA amendments); *see also* Kristin Robrock, *Flame Retardants: An Overview of Environmental Regulations*, EXPONENT, https://www.aatcc.org/wpcontent/uploads/2016/09/Presentation_Robrock-1.pdf (last visited Oct. 19, 2018) (describing "New TSCA" which became effective in 2016).

180. Robrock, *supra* note 179 (discussing effects of 2016 TSCA amendments).

181. Eric Lipton, *The E.P.A.'s Top 10 Toxic Threats, and Industry's Pushback,* N.Y. Times (Oct. 21, 2017) [hereinafter Lipton, *E.P.A.'s Top 10 Toxic Threats]* (discussing and listing EPA's publication of ten toxic compounds to be evaluated under TSCA reform); *see also EPA Names First Chemicals for Review Under New TSCA Legislation*, ENVTL. PROT. AGENCY (Nov. 29, 2016), https://19january2017snapshot.epa.gov/newsreleases/epa-names-first-chemicals-review-under-new-tsca-legislation.html (announcing first ten chemicals to be evaluated under new TSCA).

182. Lipton, *E.P.A.'s Top 10 Toxic Threats*, *supra* note 181 (listing ten chemicals to be evaluated).

retardants, primarily within polystyrene foams used in the construction industry.[183]

Despite its promulgation of the top ten list of risk chemicals, EPA under the Trump Administration announced plans in May 2018 to significantly limit the scope of most chemicals' risk evaluations.[184] In assessing the environmental and human health-related risk of many of the ten listed chemicals, EPA decided to exclude from its assessments "any potential exposure caused by the substances' presence in the air, the ground or water," instead focusing only on "possible harm caused by *direct contact* with a chemical in the workplace or elsewhere."[185] For example, risk assessment of chemicals within the listed HBCD group will not include any potential human or environmental harm resulting from: (i) emissions from hazardous waste incinerators, (ii) on-site releases that go into underground injection, (iii) on-site releases to land that go to hazardous waste landfills, or (iv) on-site releases to land that go to municipal solid waste landfills.[186] In support of its decision not to consider any of these above-mentioned releases in the HBCD risk assessment, EPA asserted that "other environmental statutes," such as the Safe Drinking Water Act (SDWA), the Clean Water Act (CWA) and the Resource Conservation and Recovery Act (RCRA) already have "long-standing regulatory and analytical processes" in place to "adequately assess and effectively manage exposures."[187] To assess the environmental and human-health related risks of a chemical based only on hazards occurring from direct and workplace exposure, however, is "ridiculous," as one former EPA official notes.[188] Additionally, failing to include the long-term water and air exposure risks within an assessment of "persistent and highly

183. *Risk Evaluation for Cyclic Aliphatic Bromide Cluster (HBCD Cluster)*, ENVTL. PROT. AGENCY, https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-evaluation-cyclic-aliphatic-bromide-cluster-hbcd (last visited Oct. 19, 2018) (stating these chemicals are primarily used for materials in "building and construction industry," but are also used in plastics and textiles).

184. For further discussion of the EPA's current objectives to limit chemical risk evaluations, see *infra* notes 185-187.

185. Eric Lipton, *The Chemical Industry Scores a Big Win at the E.P.A.*, N.Y. TIMES (Jun. 7, 2018) [hereinafter Lipton, *Chemical Industry*] https://www.nytimes.com/2018/06/07/us/politics/epa-toxic-chemicals.html (detailing agency's new, limited assessment of chemical compounds under TSCA).

186. *See* ENVTL. PROT. AGENCY, PROBLEM FORMULATION FOR CYCLIC ALIPHATIC BROMIDES CLUSTER (HBCD), EPA-740-R1-7012 (2018) https://assets.documentcloud.org/documents/4495888/Problem-Forumulations.pdf (detailing exposure pathways that EPA plans not to include in HCBDs risk evaluation).

187. *Id.* (supporting its decision to limit scope of HCBDs risk assessment).

188. Lipton, *Chemical Industry*, *supra* note 185 (detailing concern of former agency officials).

toxic" compounds like HCBDs will lead to decreased TSCA regulation of these chemicals, likely leading to long-term health problems for ESA-listed aquatic species such as the Southern Resident.[189] Litigation might be necessary to ensure that EPA considers *all* risks of exposure from priority chemicals under the TSCA.[190]

C. Vessel Effects and Sounds

Vessel traffic within the Salish Sea, stemming from commercial shipping, ferry operations, commercial whale watching, and recreational boaters, presents a third risk factor for the endangered Southern Resident, primarily through its ability to impair the orca's behavioral and communication patterns.[191] Puget Sound within the Salish Sea is one of the world's busiest waterways, with several thousand commercial shipping vessels entering and exiting the sound each month.[192] Seattle's port accounts for approximately 200,000 jobs and $7 billion in wages throughout the surrounding Puget Sound region.[193] Washington State also has the largest ferry system in the United States, and the second largest in the world for number of vehicles carried.[194] In addition, Puget Sound vessel traffic has increased in recent years due to a growing industry for com-

189. *See* United Nations Envtl. Programme, Persistent Organic Pollutants Review Comm., *Risk Management Evaluation on Hexachlorobutadiene* (2013) chm.pops.int/Portals/0/download.aspx?d=UNEP-POPS-POPRC.8-3.English.pdf (concluding that HCBD is "very toxic to aquatic organisms."); *see also* Robrock, *supra* note 179, at 13 (noting "[v]ery high" level of aquatic toxicity for HBCD).

190. As of earlier this year, the limited scope of EPA's new risk evaluation for chemicals is being challenged as violating the "plain text, structure, and purpose" of the TSCA, thus amounting to agency interpretation that reflects "arbitrary and capricious reasoning." Brief for Petitioner at 18-19, Safer Chemicals, Healthy Families v. EPA (9th Cir. 2018) (No. 17-72260) https://www.edf.org/sites/default/files/Petitioners_Opening_Brief.pdf (citing 5 U.S.C. § 706(2)) (challenging EPA's approach to chemical risk assessment under TSCA).

191. 2008 Recovery Plan, *supra* note 1, at II-103 (describing increase of vessel presence and activity in Pacific Northwest).

192. *Id.* at II-112 (characterizing Georgia Basin and Puget Sound as "among the busiest waterways in the world."). Seattle ranks as the fifth-largest port in North America in number of containers handled within foreign and domestic trade. NAFTA REGION CONTAINER TRAFFIC, 2017 PORT RANKING BY TEUS, http://aapa.files.cms-plus.com/Statistics/NAFTA%20Container%20Port%20Ranking%202017.pdf (last visited Nov. 1, 2018) (ranking North American ports by container traffic).

193. PORT OF SEATTLE, 2018-2022 LONG RANGE PLAN 4 (2018) https://www.portseattle.org/sites/default/files/2018-05/POS_2017_LRP_Web_Commission_4-26-18.pdf (providing overview of Port of Seattle).

194. Margo Greenman, *Washington State Ferries: A Fleet of Its Own,* 425 MAGAZINE (Sept. 4, 2018) https://425magazine.com/washington-state-ferries-a-fleet-of-its-own/ (providing overview of Washington's ferry system).

mercial whale watching in the Pacific Northwest.[195] The whale watching industry alone boasts a fairly large economic impact within the Puget Sound region; the Southern Resident Recovery Plan determined whale watching brings as much as $82.7 million to surrounding areas.[196]

As previously discussed, orcas are highly intelligent and communicative animals, using vocal communication to navigate, hunt prey, and socialize.[197] Studies have shown that vessel sound and traffic can effect an orca's short-term behavior in numerous ways.[198] A key behavioral effect is the potential for human-caused vessel sound or traffic to impair an orca's foraging ability.[199] Simply put, the sound and presence of nearby watercraft can cause the Southern Resident to expend more energy in foraging and movement efforts, resulting in a "negative energy balance."[200] A negative energy balance caused by increased behavior disturbance and reduced foraging can result in malnutrition, which in turn can affect the orca's immune function, growth, and development.[201]

Similarly, vessel sounds can partially or completely mask vocal communication sounds, including echolocation, which orcas use for vital functions like navigation and foraging.[202] Because orcas rely on cooperative techniques when hunting their prey, 'sound masking' can significantly impair the Southern Resident's ability to feed effectively, which can lead to possible health complications re-

195. *See* Grace A. Ferrara et al., *Reducing Disturbance from Vessels to Southern Resident Killer Whales: Assessing the Effectiveness of the 2011 Federal Regulations in Advancing Recovery Goals,* NOAA TECH. MEMORANDUM NMFSOPR-58 at 46 (2017) (noting growing industry since "the early 1980s," which now has reached peak ninety-six commercial whale watching vessels operating in Haro Strait).

196. 2008 Recovery Plan, *supra* note 1, at II-105 (estimating Washington State at $13.6 million and British Columbia at $69.1 million).

197. For discussion of the orca's social and cooperative hunting capabilities, see *supra* notes 29-36.

198. Ferrara et al., *supra* note 195, at 35 ("[O]bserved behavioral changes have included faster swimming speeds, less directed swimming paths, and less time foraging. Vessels in the path of the whales can also interfere with important social behaviors such as prey sharing or nursing.") (citations omitted).

199. 2008 Recovery Plan, *supra* note 1, at II-104 (warning exposure to vessel sound can be "detrimental" to orca's survival).

200. *Id.* (citing, *inter alia*, Rob Williams et al., *Behavioural Responses of Killer Whales (Orcinus orca) to Whale-Watching Boats: Opportunistic Observations and Experimental Approaches,* 256 J. ZOOLOGY 255 (2002)) (explaining exposure to vessel sound can interfere with orca's foraging abilities and other behaviors).

201. Ferrara et al., *supra* note 195, at 35 (citing D. Lusseau & L. Bejder, *The Long-term Consequences of Short-term Responses to Disturbance Experience from Whalewatching Impact Assessment* 20 INT. J. COMP. PSYCH. 228 (2007)) (describing negative effects of energy loss related to behavioral disturbance).

202. *Id.* at 35 (detailing potential for vessel "sound masking.").

sulting from poor nutrition.[203] One study has revealed that vessel sounds indeed affect the Southern Resident's ability to communicate; the study concluded that the presence of vessels presumably forced Southern Residents to increase the time length of their primary communication call.[204] Additionally, if anthropogenic sound levels are high enough, orcas can experience temporary or even permanent hearing loss.[205] High-level sound can originate from a range of sources, including military and commercial sonar, seismic exploration, and construction activities.[206]

Overall, the 2008 Recovery Plan conceded that the threshold levels at which underwater anthropogenic sound can negatively affect an orca's hearing and behavior are "poorly understood."[207] There is, however, a general consensus that a vessel's sound becomes "louder" as its speed increases.[208] The 2008 Recovery Plan, in sum, seemed to place the greatest concern for vessel effects on both private and commercial whale watching boats, as opposed to larger vessels such as cargo ships and passenger vessels.[209] A possible explanation for this shifting of focus to smaller vessels is that these smaller watercrafts often have the ability to achieve higher speeds and approach orcas more quickly.[210] Additionally, these smaller watercrafts simply violate the guidelines more frequently; a 2006 report listed the highest number of "incidents" to be caused by private boaters (over fifty percent), followed by Canadian com-

203. Ferrara et al., *supra* note 195, at 35 (discussing possible effects of vessel "sound masking"). For discussion of the orca's cooperative hunting capabilities, see *supra* notes 30-36.

204. Andrew D. Foote et al., *Environment: Whale-Call Response to Masking Boat Noise*, 428 NATURE 910 (2004) (recording vocal behavior of Southern Resident pods in presence and absence of vessel traffic).

205. 2008 Recovery Plan, *supra* note 1, at II-113 (discussing effects of underwater anthropogenic sound).

206. *Id.* at II-113-15 (detailing sources of high-level underwater anthropogenic sound).

207. *Id.* at II-113 (giving estimated threshold levels from related observations of dolphins and baleen whales).

208. *Id.* at II-106 (citing, *inter alia*, David E. Bain, *A Model Linking Energetic Effects of Whale Watching to Killer Whale (Orcinus orca) Population Dynamics,* ORCA RELIEF CITIZENS ALLIANCE (2002)) ("Acoustic outputs vary with vessel and engine type and become 'louder' as speed increases.").

209. *See id.* at II-104-113 (providing overview of whale watching industry in Pacific Northwest, its possible effects on orca populations, and regulatory guidelines).

210. *Id.* at II-106 (acknowledging that "[w]hale-watching vessels can produce high levels of underwater sound in close proximity to [ ] animals.").

mercial whale watching operators (twenty-one percent) and United States commercial operators (nine percent).[211]

As the whale watching industry grew in Washington and southern British Columbia, the NMFS developed a set of voluntary guidelines in the early 1980s to educate commercial operators and recreational boaters on appropriate orca viewing practices.[212] These voluntary guidelines, later definitively known as the "Be Whale Wise" (BWW) guidelines, served as a "proactive alternative" to the stricter legal prohibition on "taking" orcas under the Marine Mammal Protection Act.[213] At the time of the 2008 Recovery Plan's publication, a 2006 revision of the BWW guidelines advised that vessel operators parallel orcas no closer than about 100 meters, and to avoid bringing vessels within about 400 meters in front of or behind the orcas.[214] In addition, these BWW guidelines recommended that vessels reduce their speed to about thirteen kilometers per hour when within 400 meters of the whales.[215]

Following the publication of the 2008 Recovery Plan, NMFS adopted more stringent regulations in 2011 to protect Northwest Pacific orca populations from potentially harmful vessel sound and interference.[216] The 2011 regulations prohibit vessels from ap-

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211. 2008 Recovery Plan, *supra* note 1, at II-110 (providing compliance trends for 2006 whale watch season). "Incidents" can be generally defined as "[vessel] activities that are inconsistent with the federal regulations and BWW guidelines." Ferrara et al., *supra* note 195, at 18 (discussing vessel compliance). While it provides benefits related to ecotourism and conservation education, the commercial whale watching industry has faced criticism for its potential to negatively impact the social and foraging behaviors of whale populations. *See Who, What, Why: Is whale watching harmful to whales,* BBC NEWS MAGAZINE (July 12, 2011) https://www.bbc.com/news/magazine-14107381 (weighing costs and benefits of whale watching industry).

212. 2008 Recovery Plan, *supra* note 1, at II-108 (providing historical context of whale watching guidelines in Washington and British Columbia).

213. *Id.* at II-108-09 (discussing advent of BWW guidelines); *see also Marine Wildlife Guidelines,* BE WHALE WISE, http://www.bewhalewise.org/marine-wildlife-guidelines/ (last visited Oct. 27, 2018) (providing guidelines). The Marine Mammal Protection Act, 16 U.S.C.A. § 1361, seeks to halt "taking" of all marine mammals, including whales, porpoises, and seals. JAN G. LAITOS, NATURAL RESOURCES LAW 187 (Westgroup Hornbook Series ed. 2002) (providing overview of MMPA). When the BWW Guidelines were first promulgated in the 1980s, the MMPA only protected the Southern Resident and not yet the Endangered Species Act.

214. 2008 Recovery Plan, *supra* note 1, at II-108-09 (discussing 2006 BWW guideline revisions). For a 2006 version of the guidelines, *see Marine Wildlife Guidelines for Boaters, Paddlers, and Viewers*, BE WHALE WISE (revised 2006) https://georgiastrait.org/wp-content/uploads/2015/04/Be_Whale_Wise_poster.pdf (providing guidelines).

215. For further discussion in regard to the 2008 Recovery Plan, see *supra* note 1, at II-109 (discussing 2006 BWW guideline revisions).

216. *See* Protective Regulations for Killer Whales in the Northwest Region Under the Endangered Species Act and Marine Mammal Protection Act, 76 Fed.

proaching killer whales within 200 yards (182.9 meters) and from parking in the path of the whales within 400 yards (365.8 meters).[217] In short, the revised voluntary BWW guidelines from 2006 *recommended* vessels remain 100 yards away from the whales, whereas federal regulations implemented in 2011 *mandate* that vessels must stay at least 200 yards away.[218] While the 2011 regulations required a 200-yard minimum distance that vessels must maintain from orcas, they failed to adopt a mandatory speed limit for vessels within a certain distance from orcas.[219] Even though NMFS concluded that a mandatory speed limit near the whales would reduce risks of vessel strikes and sound masking, the agency concluded that it would be "too difficult to enforce."[220]

The stricter 2011 vessel regulations are a marked improvement in terms of beneficial management of Salish Sea vessel traffic, yet the Southern Resident population has continued to decrease.[221] One possible explanation is that some vessel operators simply are not complying with the regulations.[222] A 2017 NMFS report illustrates that since the implementation of the stricter 2011 vessel regulations, respective rates of noncompliance have generally remained about the same for recreational and commercial whale-watching vessels.[223] In general, private recreational vessel users continue to commit the greatest number of violations, closely followed by commercial vessels.[224]

For recreational and commercial whale-watching vessels, these higher noncompliance rates likely stem from two needs: education

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Reg. 20,870 (Apr. 14, 2011) (issuing final rule to protect orcas from vessel noise and interference).

217. *Id.* at 20,886 (discussing restrictions on vessel approach and parking). Exceptions under these regulations were made for: (i) government vessels, (ii) cargo vessels within shipping lanes, (3) research vessels, (4) fishing vessels actively engaged in fishing, and (5) vessels limited in their ability to maneuver safely. *Id.* at 20,885.

218. *See* Ferrara et al., *supra* note 195, at 19 (comparing compliance data before and after promulgation of 2011 regulations).

219. *Id.* at 32 (noting "mandatory speed limit was considered . . . but not adopted in the final regulations.") (citations omitted).

220. *Id.* (discussing compliance with existing voluntary speed limits).

221. For an account of the Southern Resident's ongoing population decline, see *supra* notes 10-12 and accompanying text.

222. For further explanation of compliance issues related to the 2011 vessel regulations, see *infra* notes 223-224.

223. Ferrara et al., *supra* note 195, at 23, Figure 4.2 (charting annual frequency of noncompliance "incidents" by vessel type).

224. *Id.* (charting annual frequency of noncompliance "incidents" by vessel type).

and enforcement.[225] From 2012 to 2015, the number of boaters responding that they were unaware of the vessel operation guidelines surpassed those who have said they were aware of the guidelines, indicating an overall lack of familiarity with the regulations.[226] To address this, greater efforts should be made with organizations such as longtime NMFS partner Soundwatch to increase boater awareness of the current federal regulations with respect to keeping vessels at a minimum distance from orcas within the United Sates boundaries of the Salish Sea.[227]

Additionally, enforcement should play a greater role in managing vessel traffic to ensure less harm and interference to Southern Residents.[228] During the summer months of 2014 and 2015, Washington Department of Fish and Wildlife (WDFW) officers patrolled inland state waters to ensure compliance with federal orca-related vessel regulations, issuing warnings and citations to boaters found in violation of these regulations.[229] In 2017, NMFS asserted that these records indicated boater compliance with orca-related vessel regulations is "strongly influenced by the presence or absence of a marked patrol vessel."[230] It follows naturally that additional funding and efforts should be made to increase the number of marked enforcement patrols that are conducted within United States' waters of the Salish Sea.[231] In general, state, federal, and non-governmental actors have already successfully established a dual-pronged framework of education and enforcement to help carry out current orca-related vessel regulations; the only recommended change is to increase the intensity of these existing efforts to ensure that orca-

225. For further discussion of education and enforcement needs related to the 2011 regulations, see *infra* notes 226-232 and accompanying text.

226. Ferrara et al., *supra* note 195, at 9, Figure 2.1 (charting annual frequency of boaters' responses to questions about awareness of guidelines and regulations).

227. *Id.* at 7 (discussing education and outreach as means of promoting compliance). Officially known as the Soundwatch Boater Education Program, this organization enlists the help of staff and volunteer members to both educate boaters about orca-related vessel regulations and to record incidents of noncompliance.; *see also Soundwatch Boater Education Program,* THE WHALE MUSEUM, https://whalemuseum.org/pages/soundwatch-boater-education-program (last visited Oct. 27, 2018) (providing overview of program).

228. For discussion of the need for increased enforcement, see *infra* notes 229-232.

229. *See* Ferrara et al., *supra* note 195, at 14 (discussing issuance of violations, citations, and warnings pursuant to 2011 vessel regulations).

230. *Id.* at 15 (discussing impact of enforcement).

231. *See id.* at 14 (renewing federal funding to increase "on-the water patrols" and support of Soundwatch Program).

related vessel regulations are implemented within the United States' Salish Sea boundaries as effectively as possible.[232]

Increasing education and enforcement efforts is crucial, however, NMFS should also consider issuing a mandatory speed limit for vessels that approach orcas within 400 meters.[233] This would simply codify the already-recommended speed limit listed within the voluntary BWW guidelines and further reduce vessel-related disturbances experienced by the Southern Resident population.[234] Even if this mandatory speed limit proves "difficult to enforce" as asserted by NMFS, authorities could, in an attempt to limit speeding, initially rely on a form of passive enforcement by installing vessel speed limit signs throughout the United States' Salish Sea waterways.[235]

V. RECENT AND FUTURE CONSERVATION EFFORTS IN THE COURTROOM FOR SOUTHERN RESIDENT ORCA

Subsequent to the publication of the 2008 Recovery Plan, there has been notable litigation to improve conservation management for the Southern Resident.[236] In 2014, the Center for Biological Diversity ("Center") filed a petition to expand the Southern Resident's critical habitat under the ESA, citing new research that illustrated areas where the Southern Resident spent time "foraging and wintering" in offshore waters along the west coast of the United States.[237] While NMFS initially demonstrated intent to undergo a critical habitat revision to reflect the new "winter foraging" areas of the Southern Resident, the agency has not acted since 2015.[238] Consequently, the Center filed a complaint earlier this year asserting that NMFS' failure to expand critical habitat for the Southern

232. *See id.* at 13 (discussing coordination among NMFS, Washington Department of Fish and Wildlife, and other enforcement groups).

233. *See supra* notes 219-220 and accompanying text (describing NMFS' consideration of, but failure to adopt, mandatory speed limit within 2011 vessel regulations).

234. *See* Ferrara et al., *supra* note 195, at 45-46 (noting multiple studies have suggested lower vessel speeds "would likely reduce acoustic exposure to Southern Resident killer whales."). BWW guidelines recommend that vessels reduce speed to about 13 kilometers per hour when within 400 meters of the whales. *See supra* note 215.

235. *See, e.g.*, Ferrara et al., *supra* note 195, at 12 (acknowledging ability of signs "to reach a broad public audience.")

236. For further discussion of litigation efforts, see *infra* notes 241-252.

237. 2014 Petition to Expand Critical Habitat, *supra* note 51, at 3 (arguing for designation of these areas as critical habitat).

238. For NMFS' failure to timely revise the Southern Resident's critical habitat, see *infra* notes 248-250 and accompanying text (explaining procedural history).

Resident violated the ESA and Administrative Procedure Act.[239] While it is unclear whether this complaint will be successful, the proposed critical habitat expansion for the Southern Resident should still be adopted due to the likely provision of long-term benefits that it will bring to the population.[240]

A. Petition to Expand Critical Habitat

In January 2014, the Center for Biological Diversity filed an additional petition addressed to NMFS, this time petitioning to expand the Southern Resident's critical habitat.[241] In its petition, the Center noted NMFS's decision in 2005 not to designate any of the coastal or offshore waters occupied by the Southern Resident outside during late fall, winter, and early spring months as critical habitat.[242] The Center requested that the critical habitat designation for the Southern Resident be expanded to include a portion of the Southern Resident's winter range, including "Pacific Ocean waters off the coasts of Washington, Oregon and California."[243] The Center argued that expanding the orca's critical habitat to include its offshore movements was necessary, citing recent research that asserted the "early spring period when [Southern Residents] are typically in coastal waters might be a more important foraging time than was previously believed."[244] Additionally, the Center offered actual documentation of Southern Residents traveling "through

239. Complaint, Ctr. for Biological Diversity v. Natl. Marine Fisheries Serv., No. 2:18-cv-1201 (W.D. Wash. 2018) [hereinafter 2018 Claim to Expand Critical Habitat] https://jkiro.files.wordpress.com/2018/08/srkw-ch-delay-complaint-final-8-16-18-ecf.pdf (asserting that NMFS' inaction "constitutes agency action unlawfully withheld or unreasonably delayed" and "fails to ensure [required ESA] protections.").

240. For further discussion of arguments in favor of expanding the Southern Resident's critical habitat range, see *infra* notes 267-282.

241. 2014 Petition to Expand Critical Habitat, *supra* note 51, at 3 (arguing for designation of these areas as critical habitat). Similar to the ESA provision allowing citizens to petition to list a species as endangered or threatened, a citizen can petition to revise the critical habitat of a listed species, initiating a similarly-detailed response requirement for the responding agency. *See* 16 U.S.C. § 1533(b)(3)(D)(i)-(ii) (2018) (discussing specifications for petition to revise ESA critical habitat).

242. 2014 Petition to Expand Critical Habitat, *supra* note 51, at 4 (detailing critical habitat history for Southern Resident); For additional discussion of NMFS' decision not to include winter offshore ranges, *see also supra* notes 69-70.

243. 2014 Petition to Expand Critical Habitat, *supra* note 51, at 1 (requesting revision of Southern Resident critical habitat).

244. *Id.* at 23 (citing Katherine L. Ayres et al., *Distinguishing the Impacts of Inadequate Prey and Vessel Traffic on an Endangered Killer Whale (Orcinus orca) Population*, 7 PLOS ONE *1, *8-9 (2012)) (arguing for revision of Southern Resident critical habitat).

more than 23,580 square kilometers of marine habitat between Point Reyes, California, and Cape Flattery, Washington" during the winter months.[245] The Center concluded that the Southern Resident population relies on coastal areas during wintertime for "essential behaviors" including feeding, calf rearing, and seasonal movements, and that these coastal areas require "special management considerations or protection," thus making it a qualified range to consider as critical habitat under the ESA.[246]

Pursuant to ESA requirements, in April 2014, NMFS published a ninety-day finding that the Center's petition to revise critical habitat "present[ed] substantial scientific information indicating the petitioned action may be warranted."[247] Less than a year later, NMFS issued a twelve-month determination voicing the agency's intent to "proceed with the petitioned action to revise critical habitat for Southern Resident killer whales."[248] To conclude this twelve-month determination, NMFS stated that it anticipated having a proposed rule for the Southern Resident critical habitat revision completed by 2017.[249]

Despite the intent to undergo a revision of the Southern Resident's critical habitat, under the Trump Administration, NMFS has made no steps towards proposing a rule to possibly expand Southern Resident critical habitat.[250] In August 2018, the Center filed a

245. *Id.* at 5 (detailing evidence on Southern Resident's offshore habitat use). The Center also noted that passive acoustic recorders had "regularly" detected Southern Resident vocalizations in this geographic range during winter and spring months from 2006 to 2011. *Id.* at 8 n.52.

246. *Id.* at 17-19 (arguing for essential elemental features within Southern Resident's offshore winter habitat range). The Southern Resident's winter range habitat for foraging, raising young, and migration presumably designate the winter range with habitat features "essential to the conservation" of the Southern Resident, with needs for "special management" to address ongoing threats to the population. This conclusion argues that the Southern Resident's winter habitat range meets the elemental requirements to be considered "critical habitat" within the regulatory definition of the term. 50 CFR § 424.12(b) (2018) (detailing criteria for critical habitat designation); *see also supra* notes 63-66 for additional discussion of ESA requirements for designating critical habitat.

247. 90-Day Finding on a Petition To Revise the Critical Habitat Designation for the Southern Resident Killer Whale, 79 Fed. Reg. 22,933, 22,933 (Apr. 25, 2014) (announcing ninety day finding and commencing further review).

248. 12-Month Finding on a Petition To Revise the Critical Habitat Designation for the Southern Resident Killer Whale Distinct Population Segment, 80 Fed. Reg. 9,682, 9,685-86 (Feb. 24, 2015) (announcing NMFS' intent to proceed with critical habitat revision).

249. *Id.* at 9,687 (discussing intentions to develop a proposed rule).

250. 2018 Claim to Expand Critical Habitat, *supra* note 239, at 2 (noting agency's failure to finalize or even propose rule to revise Southern Resident critical habitat). In December 2016, the NMFS did publish a five-year status review of the Southern Resident, concluding that the subpopulation should remain listed as en-

complaint against NMFS asserting the agency's failure to expand critical habitat for the Southern Resident was in violation of the ESA and the Administrative Procedure Act.[251] Specifically, the Center alleged that the NMFS's ongoing decision to not expand or even revise the Southern Resident's critical habitat constituted "unlawfully withheld or unreasonably delayed" agency action subject to judicial review.[252]

B. Lawsuit to Expand Critical Habitat

It is unclear how the Southern Resident's conservation fate will play out in the courtroom.[253] The Center has played an important role in litigating for protections under the ESA, both successfully petitioning for the Southern Resident to be listed as an endangered distinct population segment and later initiating discussion for a revision of its critical habitat range.[254] Nevertheless, previous case law indicates that the Center may be unsuccessful in compelling the current administration's NMFS to take agency action with respect to expanding the Southern Resident's critical habitat range.[255]

In 2013, Sierra Club filed a similar action against the United States Fish and Wildlife Service (FWS) for failing to issue a timely expansion of the critical habitat for the leatherback sea turtle.[256] In its twelve-month determination, FWS confirmed that a critical habitat revision for the leatherback sea turtle needed to be made, but that it intended to delay critical habitat revision until the

dangered. *See Southern Resident Killer Whales (Orcinus orca) 5-Year Review: Summary and Evaluation*, NAT'L MARINE FISHERIES SERV. (2016) https://www.westcoast.fisheries.noaa.gov/publications/status_reviews/marine_mammals/kw-review-2016.pdf (summarizing updated information and status of ESA listing). This five-year status review is required for all listed species under Section 4 of the Endangered Species Act to periodically guarantee the listed species has the appropriate level of protection. 16 U.S.C. § 1533(c)(2)(A) (2018) (requiring five-year review of all ESA-listed species).

251. 2018 Claim to Expand Critical Habitat, *supra* note 239, at 3 (seeking court order to establish "prompt deadlines" for habitat revision).

252. *Id.* at 15 (alleging NMFS' inaction as violation of Administrative Procedure Act).

253. For a legal analysis of the Center's recent complaint to expand critical habitat, see *infra* notes 255-266.

254. For additional explanation of the Center's petition for the Southern Resident to be listed under the ESA, see *supra* notes 56-60. For additional explanation of the Center's petition to expand Southern Resident critical habitat, see *supra* notes 241-252.

255. For discussion of applicable case law, see *infra* notes 256-261 and accompanying text.

256. Sierra Club v. U.S. Fish & Wildlife, 930 F. Supp. 2d 198, 198 (D.D.C. 2013) (alleging that FWS' response to petition to revise critical habitat for leatherback sea turtle was arbitrary and capricious).

agency conducted the leatherback's planned status review in the future.[257] FWS explained that the agency was in an ongoing process to conduct "an analysis and review" of most of the world's listed sea turtle species, and that the leatherback sea turtle was slated as fourth for review because the "need for [a] status review[ ] for [this] species was deemed not to be as urgent as for other species."[258] In its complaint, Sierra Club alleged: (i) that the Service's decision to delay revision of the critical habitat until the future planned status review was arbitrary and capricious, and (ii) that the Service's delay in designating critical habitat for the leatherback sea turtle constituted "agency action unlawfully withheld or unreasonably delayed."[259] Ultimately, the district court agreed with FWS that the agency's decision within its twelve-month determination to delay critical habitat revision of the leatherback sea turtle was "committed to agency discretion by law," and therefore not reviewable under the Administrative Procedure Act.[260] Relying on textual, structural, and legislative history analyses, the district court found that the ESA's provision for petitioning to revise critical habitat clearly reflected that FWS as the responding agency should have "broad, unreviewable discretion in issuing twelve–month determinations regarding petitions to revise critical habitat."[261]

While *Sierra Club v. U.S. Fish & Wildlife* appears to give a responding agency nearly unbridled discretion in how to answer a petition to revise critical habitat, there are a couple of factual distinctions to make between *Sierra Club* and the Center's potential suit against NMFS.[262] One key distinction is that FWS in *Sierra Club*

257. *Id.* at 203 (discussing FWS' twelve month determination for critical habitat revision).

258. *Id.* (citing Admin. Record at 4132) (detailing FWS' stated reasons for delay).

259. *Id.* (citing 5 U.S.C. § 706(2)(A), § 706(1)) (summarizing Serra Club's claims against FWS).

260. *Id.* at 204 (citing 5 U.S.C. § 701(a)(2)) (granting FWS' cross-motion for summary judgment).

261. *Sierra Club,* 930 F. Supp. 2d at 205 (detailing analysis of twelve-month determination). For a slightly different interpretation of an agency's obligations to revise critical habitat following a 12-month finding, *see* Biodiversity Legal Found. v. Norton, 285 F. Supp. 2d 1, 14-16 (D.D.C. 2003) (finding that Fish and Wildlife Service had "duty" to revise Cape Sable seaside sparrow's critical habitat). FWS' duty to revise critical habitat followed the issuance of a multi-species recovery plan (MSRP), but the D.C. Circuit found that the Service's two-year delay in revising habitat after the issuance of the twelve-month finding (and four-year delay after issuance of MSRP) was not unreasonable due to the Service's "need to prioritize in the face of limited [monetary] resources." *Id.* at 16.

262. For a comparison of *Sierra Club* and the Center's current complaint against NMFS, see *infra* notes 263-266.

gave a reasoned explanation within its twelve-month determination for why revision of leatherback sea turtle critical habitat would be delayed—the Service had created a list of important endangered and threatened sea turtle species to analyze with regards to status and critical habitat, and the leatherback sea turtle was fourth on that list.[263] In contrast, NMFS stated in its twelve-month determination that it "intend[ed] to proceed with the petitioned action to revise critical habitat" for the Southern Resident, and that it anticipated having a proposed rule for Southern Resident critical habitat revision completed by 2017.[264] There is no possible reason given within the twelve-month determination for why NMFS could have delayed in promulgating a proposed rule for revision of Southern Resident critical habitat, and in this twelve-month determination NMFS appears not to have given any reason for delay at all.[265] Such a marked departure from the agency's standpoint in the twelve-month finding without any factual or policy-related support might constitute "agency action unlawfully withheld or unreasonably delayed," or even agency action that amounts to an arbitrary and capricious level.[266]

C. Arguments to Expand Southern Resident Orca Critical Habitat

Even if the Center is unable legally to compel NMFS to revise and expand the Southern Resident's critical habitat to include its winter range, this proposal should still be adopted due to the likely provision of long-term benefits that a critical habitat expansion would bring to the Southern Resident population.[267] For an endangered or threatened species, the mere designation of critical habitat is an important conservation tool with a number of advantages.[268] A key aspect of critical habitat is that it broadens the application potential of the ESA's Section 7 consultation requirement.[269] Section 7 requires federal agencies to consult with the Secretary of

263. *Sierra Club*, 930 F. Supp. 2d at 203 (detailing FWS' reasons for delay).

264. 80 Fed. Reg. 9,682, 9,685-86 (Feb. 24, 2015) (announcing NMFS' intent to proceed with critical habitat revision).

265. *See id.* at 9,687 (anticipating published rule by 2017).

266. *See* 5 U.S.C. § 706(2)(A), § 706(1) (2018) (delineating judicial review for agency action).

267. For further discussion of arguments in favor of expanding the Southern Resident's critical habitat range, see *infra* notes 292-304.

268. See *infra* notes 269-282 for conservation benefits related to critical habitat designation.

269. *See* 16 U.S.C. § 1536(a)(2) (2018) (detailing Section 7 consultation requirement).

Interior or Commerce to ensure that they do not authorize, fund, or carry out any action likely to "jeopardize the continued existence" of a listed species.[270] In addition, federal agency action requires consultation that the action will not "result in the destruction or adverse modification of [designated critical] habitat" of a listed species.[271] Critical habitat designations themselves thus help expand ESA's Section 7 consultation requirement to a more comprehensive set of actions, including "beyond those that result in direct mortality or injury to members of a protected species."[272]

Practically speaking, ESA's Section 7 mandates that federal agencies engage in consultations with NMFS for any construction, transportation, or natural resource management projects that may destroy or adversely modify the Southern Resident's habitat.[273] This Section 7 consultation requirement also includes privately-run development projects that either require a federal permit, license, or that receive federal funding.[274] Expanding this requirement will give greater assurance that federally-implemented or approved projects are not carried out in a way that will further degrade the Southern Resident's habitat range, including its winter foraging areas.[275] Broadening the use of the ESA's Section 7 consultation requirement also helps increase awareness of the specific conservation issues facing listed species within a given area, which in turn can increase the opportunity for public education and involvement.[276]

Additionally, expanding the Southern Resident's habitat to include winter areas is more beneficial simply because it gives a more accurate representation of the population's year-long feeding, travel, and breeding habits.[277] In the 2008 Recovery Plan, NMFS

270. *Id.* (directing federal agencies to avoid actions likely to harm any ESA-listed species).

271. *Id.* (mandating federal agencies to avoid actions likely to destroy or adversely modify any ESA-listed species' critical habitat).

272. 2014 Petition to Expand Critical Habitat, *supra* note 51, at 3 (discussing significance of ESA critical habitat designation).

273. *See* 2008 Recovery Plan, *supra* note 1, at II-67 (detailing protective measures for Southern Resident under ESA).

274. *See* KLEIN ET AL., NATURAL RESOURCE LAW 863 (2018) (explaining effects of Section 7 consultation requirement).

275. 2014 Petition to Expand Critical Habitat, *supra* note 51, at 26 (arguing Southern Resident's winter habitat range requires special management considerations and protection).

276. 2008 Recovery Plan, *supra* note 1, at II-68 (explaining benefits of critical habitat designation); *see also* 76 Fed. Reg. 20,180, 20,191 (Apr. 11, 2011) (discussing benefits of designating critical habitat for Cook Inlet beluga whales).

277. 2014 Petition to Expand Critical Habitat, *supra* note 51, at 5 (asserting that recent research illustrating Southern Resident's winter range represents "[ ]

explicitly mentioned a need for more information about both the movements and diet of the Southern Resident during wintertime months.[278] The research subsequent to the 2008 Recovery Plan directly addresses this need by documenting important offshore "foraging and wintering" areas used by the Southern Resident.[279] The Southern Resident's critical habitat, therefore, should be expanded to include these offshore areas that incorporate its recorded winter range.[280] Put in broader terms, Southern Resident critical habitat should be expanded to more accurately reflect the dynamic character of the species' movements and patterns within its yearlong habitat range.[281]

Whatever specific benefits may arise from the designation of critical habitat for ESA-listed species, critical habitat has undoubtedly proved to be an important aspect of a threatened or endangered species' recovery: one study found that species with critical habitat for two or more years were more than twice as likely to have an improving population trend in the late 1990s than species without critical habitat.[282]

VI. CONCLUSION

The troubling, continuous decline of the Southern Resident is not the result of one single problem. Rather, the species' population downtrend stems from three serious risks identified within the Salish Sea ecosystem: lack of available prey, high levels of persistent contaminants, and the ever-increasing presence of waterborne vessels.[283] Like the multitude of risk factors threatening the Southern Resident, it will likely take a multitude of conservation efforts to

best scientific data available" warranting revision of Southern Resident's critical habitat).

278. For additional explanation of the NMFS' 2008 Recovery Plan conclusions on Southern Resident habitat and diet, *see supra* notes 40-43, 44-47 and accompanying text.

279. Ayres et al., *supra* note 244, at *9 (concluding that "early spring period when the whales are typically in coastal waters might be a more important foraging time than was previously believed.").

280. *See* 2014 Petition to Expand Critical Habitat, *supra* note 51, at 23 (arguing for revision of Southern Resident critical habitat).

281. *See* Timothy H. Profeta, *Managing without a Balance: Environmental Regulation in Light of Ecological Advances*, 7 DUKE ENVTL. L. & POL'Y F. 71, 75 (1996) ("[I]f ecosystems are dynamic, shifting systems . . . resources must be regulated under considerable and everchanging uncertainty.").

282. Martin F.J. Taylor et al., *The Effectiveness of the Endangered Species Act: A Quantitative Analysis* 55 BIOSCIENCE 360, 360 (2005) (concluding critical habitat promotes species survival and recovery).

283. For examination of these three risk factors and suggestions for future action, see *supra* notes 78-235.

address these threats and reverse the species' decline. One study focused on another marine mammal, the North Atlantic Right Whale, encouraged the contemporaneous use of scientific research, negotiation, lobbying, and litigation in order to effectively manage an ESA-listed species.[284] This type of multifaceted approach to conservation and management is likely needed here to help address the three key risk factors that continue to impair the Salish Sea and threaten the Southern Resident. Considerable efforts have been made to manage the Southern Resident's risk factors since the release of the 2008 Recovery Plan, but much more can be done to help restore this iconic Northwestern species to healthy population numbers.[285] The end result of the management techniques chosen can either be a Salish Sea ecosystem that bears a closer resemblance to Richard Strahan's bleak description of an "urban sea," or a more utopian vision where the sea's human and wildlife populations can live harmoniously.[286]

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284. Regina Asmutis-Silvia, *A Multi-Faceted Approach is Necessary to Protect Endangered Species: A Case Study of the Critically Imperiled North Atlantic Right Whale*, 36 B.C. ENVTL. AFF. L. REV. 483, 494 (2009) (arguing for multi-pronged approach to improving conservation and management of critically endangered right whale).

285. *See generally supra* notes 48-266 for a review of existing conservation efforts, which include rulemaking, management, enforcement, education, and litigation.

286. *See supra* note 15 (depicting dismal marine environment impacted by pollution and vessel activity).