Before the Secretary of the Interior

Petition to List the Contiguous U.S. Distinct Population Segment of Tufted Puffin (*Fratercula cirrhata*) Under the Endangered Species Act

Photo credit: Getty Images

February 12, 2014

Executive Summary

The Tufted Puffin (*Fratercula cirrhata*) is a medium-sized pelagic seabird in the auk family, and is the largest of three species of puffin that comprise the genus *Fratercula*. The Tufted Puffin is also the most strikingly marked puffin, with long white or yellow tufts of feathers that droop behind the eye, a white facemask, and a thick bright red or orange bill during the summer breeding season. Tufted puffins breed in the United States (in California, Oregon, Washington, and Alaska), in Canada (British Columbia), in Russia, and in Japan. The vast majority of birds now breed in the northern portion of that range, with drastic declines seen throughout the southern portion of their range.

The contiguous United States ("U.S.") population of tufted puffins, which inhabits the states of Washington, Oregon, and California and forages in the waters of the eastern Pacific Ocean, constitutes a distinct population segment ("DPS") of Tufted Puffin because it is both discrete and significant. This population is discrete because it is markedly separated from other populations as a consequence of (1) the significant physical separation between the breeding colonies of the contiguous U.S. population and those of other tufted puffin populations; (2) behavioral/physiological factors, including the species' limited dispersal capacity and colony philopatry, and differences in breeding timing, reproductive success, and diet between the contiguous U.S. population and other tufted puffin populations; and (3) ecological factors resulting from differences between the California Current System ("CCS") inhabited by this population and the ecological settings inhabited by other tufted puffin populations, including specifically the adjacent Alaska Current System. The population is also markedly separated from populations to the north by way of the international border dividing the contiguous U.S. from Canada. The contiguous U.S. tufted puffin population is significant because it persists in a unique ecological setting for the birds: the CCS ecosystem. In addition, loss of this southernmost population would result in a significant gap in the species' range. While certain other populations of tufted puffins to the north, most notably in Alaska, have been largely stable, the contiguous U.S. population has continued to show steady and significant declines, and there is no evidence that immigration from northern populations is occurring.

The contiguous U.S. DPS of the Tufted Puffin is severely depleted and faces significant and continuing threats. According to the best available scientific evidence, the current breeding population in the contiguous U.S. is no more than 4,000 individuals, a level estimated to be ~10-15% of the level just three decades ago. Most of these birds breed in Washington, while less than 300 individuals breed in either Oregon or California. Threats to the DPS include declines in prey base, as well as climate change, fisheries bycatch, and oil pollution. In light of its very low and declining population level, the ongoing threats, and the insufficiency of current management and conservation measures, the United States Fish and Wildlife Service ("FWS") should designate the contiguous U.S. DPS of tufted puffins as endangered or, alternatively, as threatened under the U.S. Endangered Species Act ("ESA"). Alternatively, FWS should designate the Tufted Puffin as a unitary species as endangered or threatened because the Pacific coast and waters of the contiguous U.S., Japan, and other historically-occupied habitat constitute a significant portion of the species' range in which it is in danger of extinction, or is likely to become in danger of extinction within the foreseeable future.

Notice of Petition

Pursuant to Section 4(b) of the ESA, 16 U.S.C. § 1533(b), section 553(3) of the Administrative Procedure Act, 5 U.S.C. § 533(e), and 50 C.F.R. § 424.14(a), the Natural Resources Defense Council ("NRDC") hereby petitions the Secretary of the Interior, through the FWS, to list the contiguous U.S. DPS of the Tufted Puffin (*Fratercula cirrhata*) as endangered or, alternatively, as threatened under the ESA. In the alternative, NRDC requests that the FWS list the species as a whole as endangered or threatened under the ESA. NRDC also requests that critical habitat be designated concurrently with the listing.

NRDC is a national not-for-profit conservation organization with approximately 1.3 million members and activists. One of NRDC's organizational goals is to further the ESA's purpose by preserving our national biodiversity. NRDC's members have a direct interest in ensuring the survival and recovery of the contiguous U.S. population of the Tufted Puffin and in conserving the unique marine communities on which it relies and which it benefits.

The FWS has jurisdiction over this Petition. This Petition requires the FWS to make an initial finding as to whether the Petition "presents substantial scientific or commercial information indicating that the petitioned action may be warranted." 16 U.S.C. § 1533 (b)(3)(A). The FWS must make this initial finding "(t)o the maximum extent practicable, within 90 days after receiving the petition." *Id*. A petitioner need not demonstrate that listing is warranted, but rather shall present information demonstrating that such a listing *may* be warranted. While NRDC believes that the best available science demonstrates that listing the contiguous U.S. DPS of tufted puffins or the species as a whole as endangered or threatened is in fact warranted, the available information clearly indicates that listing the DPS or the species may be warranted. Accordingly, the FWS should promptly make a positive finding on the Petition and commence a status review as required by 16 U.S.C. § 1533 (b)(3)(B).

Respectfully submitted this 12th day of February, 2014.

Bradford H. Sewell, Senior Attorney
Natural Resources Defense Council
40 West 20th Street
New York, NY 10011
Tel: (212) 727-2700
bsewell@nrdc.org

Table of Contents

I. Species Account

A. Species information

1. Taxonomy and description

The Tufted Puffin, *Fratercula cirrhata*, is a medium-sized pelagic seabird in the auk family (Alcidae) (Harris and Wanless 2011: 16). The Tufted Puffin is the largest of three species of puffin that comprise the genus *Fratercula*. Tufted puffins can reach a height of approximately 30 centimeters and a weight of 750-850 grams (Harris and Wanless 2011: 18). Tufted puffins are also the most strikingly marked puffin, at least during the summer months (Harris and Wanless 2011: 18). While tufted puffins are completely dark for most of the year, in the summer, the bird takes on highly distinctive markings, including a white forehead and cheeks, long white or yellow tufts of feathers that droop behind the eye down to the shoulders, and a thick bright red or orange bill (as well as red or orange legs, feet, and eye-rings) (Harris and Wanless 2011: 18).

2. Diet

Tufted puffins feed on a variety of forage fish and invertebrate species, such as squid, octopus, crab, jellyfish, and zooplankton. The species' diet is based on both availability and quality of prey and can be used as an indicator of the marine forage base in a local area (Wehle 1980; North Pacific Research Board (NPRB) 2010: 132; Williams and Buck 2010; Schoen *et al*. 2013). Adults and chicks, while feeding at the same trophic level, typically target different prey species. The diet of tufted puffin chicks is predominately small fish (and some invertebrates) that adults capture while foraging at sea (**Table 1**; Piatt and Kitaysky 2002; Gladics *et al*. 2012: 136-53). Adult tufted puffins eat mostly invertebrates before laying eggs, and then gradually transition to fish prey while rearing their chicks (NPRB 2010: 132).

Figure 1: Tufted puffin bringing back fish to its chicks. Photo credit: Getty Images.

Tufted puffins are diurnal, feeding and provisioning their chicks during the day (Wehle 1980; Piatt and Kitaysky 2002; Harris and Wanless 2011). Adults catch prey by pursuit diving, making dives from the surface to pursue and capture their prey in their beaks while swimming, and swallowing their prey while still underwater (Wehle 1980: 98). While rearing a chick, a tufted puffin will make up to approximately 350 dives per day (Kotzerka *et al.* 2008). A tufted puffin can capture and hold multiple small fish crosswise in its bill, routinely 5 to 20 fish at a time, for delivery to chicks at the nest (**Figure 1)**. While an adult may dive as deep as 60 meters (m), the average dive depth is much shallower (mean 17.3 m ± 14.8 m; Kotzerka *et al.* 2008). The maximum recorded dive duration is 3.2 minutes (min) (mean 1.2 min ± 0.6 min; Kotzerka *et al.* 2008).

Table 1: Diet of tufted puffin chicks at selected colonies. Data shown as the percentage of the total number of prey items observed in meals that were collected from adults as they delivered food to their young. (Appendix 1 from Piatt and Kitaysky 2002).

Region	Aleutian Is.			Alaska Peninsula				British Columbia	Oregon	California
Island(s)	Buldir	Bogoslof	Aiktak	Midun	Ugaiushak	Semidi	Barren	Triangle	Goat	Farallon
Sources[1]	A	B	B	B	C	B	D	E	F	G
Years of collections	1988–1999	1991–1994	1990–1998	1991–1994	1976–1993	1991–1994	1976–1999	1977–2000	1981–1982	1973–1982
Meal loads (*n*)	263	238	2,553	1,015	?	1,834	?	445	?	?
Prey items (*n*)	1,141	1,319	16,645	4,777	1,019	13,648	1,863	2,047	52	728
Fish										
Pacific herring	0.0	0.0	0.0	0.0	0.0	tr	0.0	1.1	14.1	0.0
Anchovy	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.9	38.9
Capelin	0.0	1.7	1.0	17.1	5.8	2.3	37.6	0.0	0.0	0.0
Myctophid spp.	1.8	15.7	0.0	0.0	0.0	tr	0.0	0.0	0.0	0.0
Pacific cod	0.0	0.0	9.0	5.8	1.1	1.5	1.8	0.0	0.0	0.0
Walleye pollock	18.1	24.2	66.1	46.8	11.8	28.6	17.7	0.0	0.0	0.0
Rockfish spp.	0.0	0.0	1.3	tr	0.0	0.2	0.0	33.6	1.3	46.8
Greenling spp.	19.6	0.5	4.5	tr	0.0	2.2	0.2	0.0	0.0	0.0
Sandlance	12.8	13.6	8.1	23.5	77.9	30.1	29.4	43.5	15.4	0.0
Other fish	7.1	4.8	7.9	5.3	3.4	6.8	4.5	18.8	17.1	2.6
Total fish	59.4	60.5	97.9	98.5	100.0	71.7	91.2	97.0	94.8	88.3
Invertebrates										
Squid	38.2	35.7	1.0	0.1	0.0	5.0	3.3	2.4	5.2	10.8
Other invertebrates	2.4	3.8	1.1	1.4	0.0	23.3	5.5	0.6	0.0	0.9
Total invertebrates	40.6	39.5	2.1	1.5	0.0	28.3	8.8	3.0	5.2	11.7

[1]Sources: A = Williams and Daniels 2001; B = JFP, ASK, and S. Hatch unpubl.; C = 1976–1977 from Wehle 1980, 1983; 1992–1993 from JFP; D = 1976–1977 from Manuwal and Boersma 1977, 1978, 1979; 1991–1993 from P. D. Boersma unpubl.; 1995–1999 from Roseneau et al. 2000; E = Vermeer 1970, Gjerdrum 2001, K. Vermeer unpubl., A. Vallée unpubl., C. Cassidy St. Clair unpubl.; D. Bertram unpubl.; F = Boone 1986; G = Ainley and Boekelheide 1990.

3. Life history, longevity, and growth

Tufted puffins are long-lived seabirds that can live more than 20 years. The species exhibits delayed maturity and high adult survival (Morrison *et al.* 2009). Tufted puffins form long-term pair bonds, and they share in the care of their young. When not breeding (during the winter), they are mostly pelagic, living well offshore (100 to more than 190 kilometers (km)) in the Central North Pacific (Wehle 1980; Piatt and Kitaysky 2002). Like most long-lived seabirds, tufted puffins spend their juvenile period entirely at sea and may not return to coastal breeding areas for several years (Piatt and Kitaysky 2002). As subadult birds, tufted puffins will attend breeding colonies for a period of one or more years before recruiting (Morrison *et al.* 2009: 435).

Tufted puffins breed in colonies on coastal islands and on mainland coastlines of the north Pacific Ocean. Tufted puffins at a given breeding colony tend to arrive in the spring (March-June, depending on latitude (earlier at lower latitudes)) within the same one- to two-week period each year (Wehle 1980: 24; Piatt and Kitaysky 2002). A study in Alaska found that subadult birds arrived at the breeding colony about 2.5 months after the adults (in July) and engaged in burrow excavation and reconstruction, presumably in preparation for their initial breeding attempt the following year (Wehle 1980: 44). For up to several weeks after arriving at the colony, adult birds exhibit a quasi-cyclic attendance (alternating and roughly equivalent periods of attendance at colonies and absence while at sea) before establishing continuous occupancy at a burrow (Wehle 1980: 24-25, 150). Courtship begins soon after the birds arrive at the colony (Wehle 1980: 27). Copulation generally occurs in nearshore waters close to the breeding colony "amidst a flock of rafting birds" (Wehle 1980: 27).

After approximately one week of continuous occupancy at a nest (Wehle 1980: 25), the female lays one egg. If the first egg is lost, tufted puffins may lay a replacement egg within approximately 21 days (Wehle 1980: 153). Though data are rare due to measurement difficulty, average laying success has been measured at approximately 50-60% (range: 47-76%; Wehle 1980: 155). Timing of egg-laying appears to vary with latitude; peak egg-laying is earlier at southern than at northern breeding sites (Wehle 1980: 53). Both parents will incubate the egg for six and a half to seven and a half weeks (average 45.4 days, range 43-53 days; Wehle 1980: 71; Boone 1986; Gladics 2103 *et al.*: Table 86). Hatching success, measured in the field, averages 64% (range: 49-77%; Piatt and Kitaysky 2002: 17; *see also* Gladics *et al.* 2013: Table 88), although the "natural" (undisturbed by humans) hatching success rate is likely higher (Wehle 1980: 155; Kettle 2013: 2, 11).

After the egg hatches, both parents care for the chick for another six to seven weeks, depending on the growth rate of the chick (range 41-59 days; Wehle 1980: 78; Boone 1986), until it is ready to leave the nest, a milestone associated with a threshold size (approximately 496 g, or ~64% of adult body weight; Wehle 1980: 81). Fledging success tends to be highly variable, and is strongly linked to food supply (Vermeer *et al.* 1979; Wehle 1980; Piatt and Kitaysky 2002; Gladics *et al.* 2013: Table 88). Preliminary analyses in a recent study of the eastern Aleutian Islands in Alaska suggest that sites there "with cool, low salinity waters supported higher forage biomass and puffin densities at sea, larger prey loads for delivery to chicks, and better body condition of puffin chicks" (Schoen *et al*. 2013: 2). In that study, "the larger the size of prey delivered, the better the tufted puffin chick's condition, irrespective of the size (age) of the chick" (Schoen *et al*. 2013: 10). On average, measured fledging success is 64% (range: 41-82%; Piatt and Kitaysky 2002: 17; *see also* Gladics *et al.* 2013: Table 88), with most of the mortality occurring in the first two weeks after hatching (Wehle 1980: 155-156). While the adults are active (foraging) during the day, the fledgling leaves its burrow at night and moves to the sea by walking and/or jumping and fluttering its wings (Wehle 1980: 78). Once the fledgling reaches the water, it immediately swims to sea and is assumed to be self-sufficient (Wehle 1980: 80; Piatt and Kitaysky 2002: 13). Overall, the average measured breeding success (chicks fledged/nests with eggs) for tufted puffins is 43% (range: 30-55%; Piatt and Kitaysky 2002: 17; *see also* Gladics *et al.* 2013: Table 88).

Although study of the species is difficult, available information indicates that tufted puffins, like other alcids, demonstrate natal philopatry, returning to their natal colonies to prospect and eventually breed, although it may be several years after fledging before they return. In one study of tufted puffins fledged in 1999 and 2000 in California, 35 of 133 puffins that were banded, (26%) were resighted at their natal subcolony from 2002 to 2008 (at three to seven years of age). These resighting patterns – with some birds seen multiple times and others seen only once – suggest that some of the individuals were transient prospectors at first resighting and that others went on to recruit to their natal colony (Morrison *et al.* 2009: 436). Wehle (1980: 47) found that at least 29% of tufted puffin breeding pairs exhibited "nest-site tenacity" (returned to breed at the same nesting site in subsequent years), "however, the true value in the absence of human disturbance was probably much higher" (Wehle 1980: 152). Tufted puffins are extremely sensitive to disturbance and over half of the breeding birds (and their partners) deserted the nests after being handled, whereas none of the neighboring control nests experienced desertion (Wehle 1980: 47). Nest-site tenacity has also been observed in Atlantic puffins (Wehle 1980: 206; Harris and Wanless 2011) and rhinoceros auklets, a close relative of the puffins (Wehle 1980: 206), and is strongly suspected in horned puffins (Wehle 1980: 264).

4. Habitat

When not breeding (during winter) and during their juvenile period (year-round), tufted puffins are mostly pelagic, living well offshore (100 to more than 190 km) in the Central North Pacific (Piatt and Kitaysky 2002). For foraging, tufted puffins predominately use offshore (> 80 km, continental shelf and shelf break) and oceanic waters (shelf break to deep open ocean waters), but will also use inshore (< 64-80 km, near land) habitats, particularly during the nesting season (Wehle 1980: 98; Piatt and Kitaysky 2002). Foraging habitat varies considerably with season and geographical area, as well as within and between colonies (Wehle 1980: 98, 113).

Breeding colonies are located on steep, rocky coastal islands and similar coastal habitat on the mainland bordering the north Pacific Ocean. Tufted puffins are burrow nesters, choosing burrows on the edge of cliffs or on steep grassy slopes – steep enough for the birds to quickly take flight and land – or, more rarely, in deep rock crevices (Wehle 1980: 21; Byrd 1993: 181). Burrow density has been found to be positively correlated with the angle of slopes, and colonies "on cliff-edges usually have a higher burrow density than those on seaslopes" (Wehle 1980: 21). Their protected earthen burrows are two to seven feet long with nest chambers at the end. Because the burrows are vulnerable to destructive natural forces, tufted puffins will spend some time each year preparing these sites (*e.g.*, re-excavating and constructing nests) before egg deposition (Wehle 1980: 151). However, tufted puffins will not excavate a new burrow to use for breeding within the same season (Wehle 1980: 44). Subadult birds are believed to excavate their burrows at least one year prior to their first breeding season (Wehle 1980: 44). Breeding birds will also take over abandoned burrows or even occasionally evict the present owners (Wehle 1980: 44).

5. Geographic range

Tufted puffins breed in the United States (in California, Oregon, Washington, and Alaska), in Canada (British Columbia), in Russia, and in Japan, with the vast majority of birds now breeding in the northern portion of that range. In the eastern Pacific, tufted puffins have nested as far south as the Channel Islands in California off the coast of Los Angeles (McChesney and Carter 2008: 214; **Figure 2**). Ten birds were found on Prince Island off Santa Barbara in 1991 after an extended observed absence of up to several decades; the last confirmed siting of tufted puffins on Prince Island was in 1997 (McChesney and Carter 2008: 214). In the western Pacific, northern Japan forms the southern limit of the breeding range; the local population (once several hundred breeding pairs) decreased drastically in the 1970s and currently consists of only about ten pairs at two sites in eastern Hokkaido (Ono 2012; **Figure 3**).

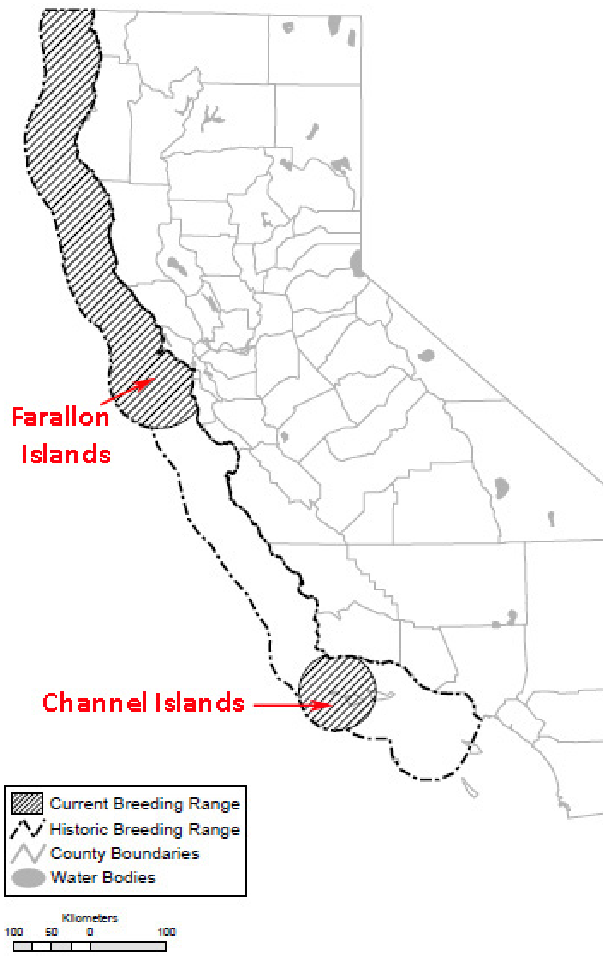

Figure 2: Current and historic breeding-season range of tufted puffins in California, the southern extent of the Tufted Puffin's range in the eastern Pacific Ocean. In the Channel Islands, tufted puffins have been present recently only at Prince Island (with the last confirmed sighting in 1997). (Modified from McChesney and Carter 2008: 213.)

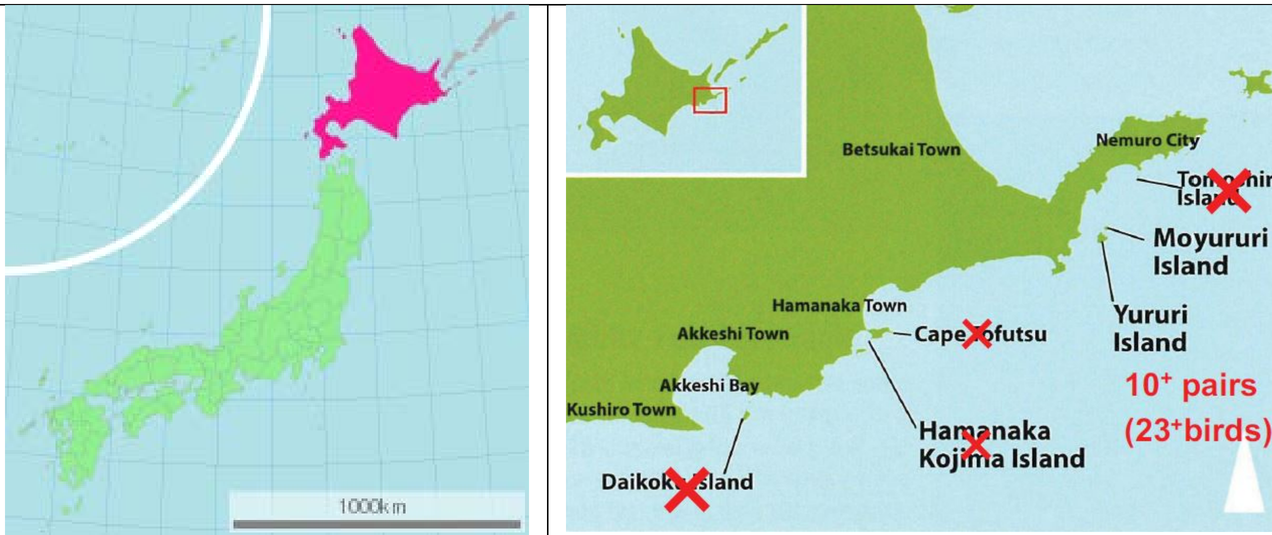

Figure 3: Current breeding sites and historic breeding sites (marked with red X's) of the Tufted Puffin (figure on the right; Sato and Ono 2012) on Hokkaido Island (the pink island in the figure on left), the northernmost island in Japan and southern extent of the Tufted Puffin's range in the western Pacific Ocean.

II. The Contiguous U.S. Population of the Tufted Puffin Qualifies as a DPS under the ESA

The ESA broadly defines the term "species" to include "any subspecies of fish or wildlife or plants and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." 16 U.S.C. § 1532(16). The FWS and the National Marine Fisheries Service ("NMFS") have published a policy to define a DPS for the purposes of listing, delisting, and reclassifying species under the ESA. 61 Fed. Reg. 4722. Under this policy, a population segment found to be both "discrete" and "significant" is considered a DPS and considered for listing under the ESA. The contiguous U.S. Tufted Puffin population meets both of these criteria and thus qualifies as a DPS under the ESA. For the purposes of this petition, the contiguous U.S. population encompasses tufted puffins inhabiting waters and nesting sites along the Pacific coast of California, Oregon, and Washington.

A. Discreteness

Under the joint NMFS/FWS policy, a population segment of a vertebrate species is considered discrete if it is (1) markedly separated from other populations of the same taxon as a consequence of physical, physiological, behavioral, or ecological factors or (2) it is delimited by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of section 4(a)(1)(D) of the Act (inadequacy of existing regulatory mechanisms). *See* DPS Policy at 4725; *Northwest Ecosystem Alliance v. United States Fish and Wildlife Serv.*, 475 F.3d 1136, 1148 (9th Cir. 2007). As explained below, the contiguous U.S. population of tufted puffins satisfies this test. It is markedly separated from other populations as a consequence of (1) the significant physical separation between the breeding colonies of the contiguous U.S.

population and those of other tufted puffin populations, (2) behavioral/physiological factors, including the species' limited dispersal capacity and colony philopatry, and differences in breeding timing, reproductive success, and diet between the contiguous U.S. population and other tufted puffin populations; and (3) ecological factors resulting from differences between the California Current System inhabited by this population and the ecological settings inhabited by other tufted puffin populations, including specifically the adjacent Alaska Current System (Hodum 2013). The contiguous U.S. DPS is also delimited by international boundaries, and the species' conservation status, management of habitat, and regulatory mechanisms differ in significant ways across the international border.

1. **Markedly separated as a consequence of physical, physiological, behavioral, or ecological factors.**

First, tufted puffins in the contiguous U.S. are **physically separated** from populations in the remainder of the species' range. The significant physical distance separating the breeding colonies of the contiguous U.S. population from breeding colonies of other tufted puffin populations contributes to the discreteness of the contiguous U.S. population (Hodum 2013). The northernmost tufted puffin colony in the contiguous U.S. population is located on Tatoosh Island (48°23' N, 124°44' W), which is approximately 415 km in linear distance from the nearest colony in British Columbia, Triangle Island (50°52' N, 129°05' W). The next nearest colony, on Kerouard Island, is located at the southern tip of the Queen Charlotte Islands, 175 km north of Triangle Island (Hodum 2013). Between the Tatoosh Island and Triangle Island colonies, there is a lack of suitable breeding islands for tufted puffins (Hodum 2013; *see also* 76 Fed. Reg. 38504, 38516 (fisher populations "markedly separated" despite potential for transient individuals to travel between U.S. and Canadian populations)).

Second, **behavioral/physiological factors** differentiate the populations. Available information indicates that tufted puffins have limited dispersal capacity and demonstrate colony philopatry, as is characteristic of alcids, which works in conjunction with physical distance to separate the contiguous U.S. population and the closest neighboring population to the north. Available data suggest fidelity by breeding birds to nesting burrows between years, supporting fidelity to nesting colonies by breeding adults (Hodum 2013 (*citing* Wehle 1980); Morrison *et al.* 2009; Piatt and Kitaysky 2002). The extensive preparation and activity associated with each breeding season likely serve to discourage relocation of breeding tufted puffins. Tufted puffins expend considerable energy and time in locating and preparing a burrow. Subadult birds will dig their burrows at least one year prior to breeding (Wehle 1980: 44). Even mature birds will not excavate a new burrow to use for breeding within the same season (*e.g.*, in the case of a burrow collapse), as apparently the effort and time needed for constructing a burrow is substantial (Wehle 1980: 44).

In the closely related Atlantic Puffin (*Fratercula arctica*), breeding site fidelity and natal philopatry have been well studied and are well established (Hodum 2013 (*citing* Harris and Wanless 2011)). In Atlantic puffins, no breeding adult has been known to change its colony (Harris and Wanless 2011: 157). For breeding birds, the average annual divorce rate is low (~7%), and burrow movements are extremely rare (~2%), typically occurring only in response to a burrow becoming unusable (Harris and Wanless 2011: 77). Furthermore, when breeding colonies of Atlantic puffins in the Gulf of Maine were extirpated due to hunting, populations failed to recover until birds were re-established through restoration programs, suggesting that re-population by neighboring colonies was either non-existent or ineffective (Harris and Wanless 2011). Specifically, it was "the tendency of Puffins to return to their natal colony to breed and to learn its location from experience gained around fledging" that has made re-introduction programs successful (Harris and Wanless 2011: 175).

Studies of natal dispersal of the Atlantic Puffin in the United Kingdom showed that although immature birds moved between colonies, the distances the birds traveled were typically 100 km or less (Hodum 2013 (*citing* Harris and Wanless 2011)). In a study of Atlantic puffin natal dispersal in the Gulf of Maine, the maximum dispersal rate between islands 80 km apart was only 8% (Hodum 2013 (*citing* Breton, *et al.* 2006)). In a study in Norway, Atlantic puffin natal dispersal was considered to be virtually non-existent (Hodum 2013 (*citing* Sandvik *et al.* 2008)). The minimum distance that young tufted puffins dispersing from their natal colonies would need to cover between the northernmost colony in Washington, Tatoosh Island, and Triangle Island in British Columbia is 415 km. Assuming that dispersal capability is similar between the Atlantic and the Tufted Puffin, this suggests that the dispersal rate from natal colonies between Tatoosh and Triangle Island approaches zero (Hodum 2013).

Other **behavioral factors** that show separation between the contiguous U.S. DPS of tufted puffins and other populations include timing of breeding, diet, and reproductive success. Timing of breeding in tufted puffins varies as a function of latitude, with the season occurring later at higher latitudes (Hodum 2013 (*citing* Piatt and Kitaysky 2002)). Between the contiguous U.S. and the Gulf of Alaska populations, a temporal offset in breeding phenology of two months has been documented (Hodum 2013 (*citing* Piatt and Kitaysky 2002)). Differences in conditions between oceanographic domains are also reflected in significant dietary differences, with percentages of invertebrates and dominant fish species in the diet of tufted puffins varying between colonies in the contiguous U.S. population and other populations (Hodum 2013 (*citing* Piatt and Kitaysky 2002)). Lastly, tufted puffin reproductive success varies between the contiguous U.S. population and its neighbors to the north, with, for example, hatching success and chick survival appearing to be lower on Tatoosh than on Triangle Island (Hodum 2013 (*citing* Hipfner *et al.* 2007 and Piatt and Kitaysky 2002)).

Third, **ecological factors** separate the contiguous U.S. population of tufted puffins from other populations, including its closest neighbors to the north. Within the North American range of the Tufted Puffin, two large marine ecosystems (LMEs) exist: the California Current and Gulf of Alaska, distinguished by the two dominant boundary current systems (Hodum 2013 (*citing* Hickey and Royer 2001)). The transition zone between these two current systems typically occurs between the southern tip of the Queen Charlotte Islands and the northern tip of Vancouver Island (Hodum 2013 (*citing* Ware and McFarlane 1989)). Colonies at the northern end of the contiguous U.S. DPS are located in the California Current LME. Tufted puffin colonies in British Columbia and Alaska are located in the Gulf of Alaska LME, with the nearest large colonies in British Columbia and Alaska approximately 415 and 2,167 km (linear distance) north, respectively, of the northernmost contiguous U.S. colony.

In addition to being spatially discrete, these two LMEs are characterized by differences in productivity, physical oceanographic processes and responses to large-scale ocean-climate fluctuations. As such, the habitat utilized by tufted puffins in the California Current LME is distinct from that used by the population in the Gulf of Alaska LME, as well as that of other populations of the species. For example, although physical and biological parameters vary inter-annually in both LMEs, evidence suggests that the two systems respond differently to large-scale fluctuations, such as the El Niño Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO) (Hodum 2013 (*citing* Hickey and Royer 2001, Brodeur *et al.* 1999)). The California Current LME is one of five LMEs in the world that undergo seasonal upwellings of cold nutrient rich water which result in localized high primary productivity, although it is classified as a low productivity ecosystem as a whole (Hodum 2013 (*citing* Aquarone and Adams 2008)). These seasonal upwellings help to sustain important fisheries, and modulate weather patterns and the hydrologic cycle of much of the western U.S. (The Long Term Ecological Research Network, UD). By contrast, the Gulf of Alaska LME is influenced by the downwelling Alaska Current (Hodum 2013 (*citing* Ware and McFarlane 1989)). It is also classified as a high productivity ecosystem (Hodum 2013 (*citing* Baum *et al*. 2011)).

An important implication of this discreteness is that replenishment of the collapsed contiguous U.S. population via immigration of breeding pairs from elsewhere (specifically British Columbia and Alaska) is unlikely. While populations of tufted puffins in Alaska have been largely stable in recent decades with some localized increases and decreases, populations in British Columbia have shown signs of decline (as discussed *infra* at note 4). Particularly given that the contiguous U.S. population has continued to show steady and significant declines, there is no evidence or reason to believe that immigration from northern populations is occurring, let alone helping to sustain or bolster the contiguous U.S. population, or that this will occur in the future.

2. Delimited by international governmental boundaries within which significant differences in conservation status, management of habitat, and regulatory mechanisms exist.

The international boundary between Canada and the contiguous United States represents a division of the regulatory and conservation status of the Tufted Puffin. The status of tufted puffins in California, Oregon, and Washington is significantly worse than that of birds to the north in Canada and Alaska, allowing for potential extirpation of the species within the contiguous U.S. through loss of the small remaining population there and lack of connectivity between populations on either side of the Washington-Canadian border.[1] Existing regulatory mechanisms within the U.S. (different from those in Canada) are inadequate to ensure the continued existence of tufted puffins in the contiguous United States in the face of the threats they face, including to their habitat and prey.

The total population sizes for Canada-Alaska and the contiguous United States differ significantly. The difference in total population size coincides with the international boundary between the contiguous United States and Canada (remaining tufted puffin populations number about 75,000 in Canada and only approximately 3,000 or less in Washington (Piatt & Kitaysky 2002 (in 1990, the WA population was estimated at 76,730); **Table 2**). Population trends also

[1] The Triangle Island population, the largest Canadian population and the population closest to the contiguous U.S., is 415 km distant from its nearest contiguous U.S. neighbor, and, as discussed above, is unlikely to serve as a source of immigrant birds.

differ on either sides of the international border: as discussed in detail below, the population of tufted puffins in Washington, Oregon, and California has seen significant and continuing declines in recent years, while the tufted puffin population in British Columbia has been only slightly declining, with periodic breeding failures. The difference in total population sizes and trends is significant because critically small populations such as those in the contiguous United States face higher extinction risk than larger ones such as the Canada-Alaska populations. Therefore, the contiguous U.S. population is more vulnerable to extinction, and thus of poor conservation status, relative to the more secure Canada-Alaska populations.

Differences in regulatory regimes currently favor the relatively more stable Canadian population, despite the higher vulnerability of the contiguous U.S. population. Canada in 2011 determined the provincial status of the British Columbia breeding population of tufted puffins as Vulnerable, which qualified the bird for British Columbia's Blue List of species of special concern, indicating that it may be at risk (BC Conservation Data Centre 2012; BC Parks 2012). Although Vulnerable status does not provide legal protection, British Columbia's Blue List serves as a "priority-setting tool for establishing baseline ranks and conservation activities." (75 Fed. Reg. 78030, 78039).

In contrast, the Tufted Puffin has no federally protected status in Washington, Oregon, and California.[2] Although the Tufted Puffin is listed as Vulnerable on Oregon's Sensitive Species List, and has been a Species of Special Concern (Candidate) under State Law in Washington since 1998 and in California since 1978 (McChesney and Carter 2008), population declines have continued in all three states even with these protections in place (**Table 2, Figure 4 and 5**). Candidate species in Washington are simply those species slated for review for possible listing as State Endangered, Threatened, or Sensitive. Oregon's Sensitive Species List is not a list of species that are candidates for listing as endangered or threatened; its purpose is simply to serve as an "early warning system for biologists, land managers, policy makers, and the public" (ODFW 2008). As described on the State of California's website, "Species of Special Concern" is "an administrative designation [with] no formal legal status" and is simply aimed at animals with conservation needs, and is intended to stimulate research on poorly known species (CDFW, UD).

Where the conservation status of a species is significantly worse on one side of an international border than another, such that the regulatory protection needed to protect the species may differ across the border, the FWS has recognized that border in determinations that a population is "markedly separated" from another population across the border. *See, e.g.*, 75 Fed. Reg. 78030 (finding contiguous U.S. DPS of wolverine "markedly separated" from Canadian and Alaskan wolverines as a result of differences in conservation status across the international border); 75 Fed. Reg. 3424, 3428-29 (finding Marbled Murrelet population in contiguous U.S. "markedly separated" from those in Canada as a result of the international border and discussing relative weakness of even endangered status under state laws in Washington, Oregon, and California). Here, significant differences in the conservation status of the Tufted Puffin exist across the border between the contiguous U.S. and Canada, in addition to differences in the regulatory

[2] Although the FWS apparently considers the Tufted Puffin a species of concern, the agency considers this designation to be an informal one not defined in the ESA. The term commonly refers to species that are declining or appear to be in need of conservation.

structures available and necessary to protect tufted puffins on either side of that border. These differences demonstrate the marked separation between populations on either side of the border.

B. Significance

A population segment is considered significant based on one or more of the following:

1. Persistence of the discrete population segment in an ecological setting unusual or unique to this taxon;
2. Evidence that loss of the discrete population would result in a significant gap in the range of a taxon;
3. Evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historical range; and
4. Evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics.

See DPS Policy at 4725. The contiguous U.S. population of tufted puffins is significant because it meets at least two of these factors.

First, the Washington, Oregon, and California population of tufted puffins persists in a unique ecological setting for the birds (Hodum 2013). The California Current LME is a coastal upwelling system with strong seasonal upwellings that yield local areas of high productivity (Hodum 2013; Aquarone and Adams 2008). This LME is unique and different from both the Gulf of Alaska LME (as discussed above) and the areas outside of North America in which tufted puffins breed – primarily in Russia in two distinctive LMEs, the Chukchi Sea and West Bering Sea (Hodum 2013 (*citing* Piatt and Kitaysky 2002, Mahon *et al.* 2010)). The California Current ecosystem is characterized by different productivity, physical oceanographic processes and responses to large-scale ocean-climate fluctuations from these other LMEs. Differences between the California Current LME and the Gulf of Alaska LME are particularly pronounced, with multiple trophic levels (from zooplankton (Brodeur *et al*. 1999) to salmon (Hare *et al.* 1999)) exhibiting an "inverse production relationship" (Hare *et al.* 1999: 10) in response to large-scale climate fluctuations such as the El Niño Southern Oscillation (ENSO) and the PDO (Brodeur *et al*. 1999; Hickey and Royer 2001). Further, sea birds (*e.g.*, marbled murrelet (75 Fed. Reg. 3424, 3428-29) and forage fish (*e.g*., eulachon; 75 Fed. Reg. 13012; Ormseth 2011: 1515)) in the California Current LME, and in WA/OR/CA specifically, show divergent responses in productivity and population trends from neighboring populations to the north in the Gulf of Alaska LME.

The California Current ecosystem "sustains active fisheries for a variety of finfish and marine invertebrates, modulates weather patterns and the hydrologic cycle of much of the western United States, and plays a vital role in the economy of myriad coastal communities" (The Long Term Ecological Research Network, UD). In addition, the California Current LME features more than 400 estuaries and bays, including San Francisco Bay, the Columbia River estuary, and Puget Sound (Aquarone and Adams 2008). The shoreline extending from Washington to California is dotted with thousands of coastal rocks and islands, ideal nesting habitat for the

Tufted Puffin as well as a diverse community of seabirds (FWS 2008; California Coastal Commission UD; Sanctuaries Integrated Monitoring Network UD).

Second, the loss of the contiguous U.S. population of tufted puffins would result in a significant gap in the species' range. The contiguous U.S. portion of the Tufted Puffin's range represents a large fraction of the species' total range. Loss of the species in this portion of the range would shift the range of the species northwards by approximately fourteen degrees latitude and would eliminate the Tufted Puffin from the fauna of the contiguous United States. *See* 70 Fed. Reg. 69854, 69865) (in Yellowstone DPS grizzly bear listing decision, the FWS determines that "[t]he loss of this population would be significant because it would substantially curtail the range of the grizzly bear by moving the range approximately 4 degrees of latitude to the north"); 75 Fed Reg. 78030, 78041 (in contiguous U.S. wolverine DPS listing decision, the FWS determines that "the loss of this population would be significant because it would substantially curtail the range of the wolverine by moving the southern range terminus approximately 15 degrees of latitude to the north (or approximately 40 percent of the latitudinal extent of wolverine range) and eliminate wolverines from the fauna of the contiguous United States."). As discussed in greater detail below, this gap in the Tufted Puffin's range – the southern extent of the North American range – is especially significant in light of the fact that the southernmost population in the western Pacific Ocean in northern Japan – where only 10 breeding pairs are known to nest (down from hundreds before the 1970s) – is likely close to extirpation (Ono 2009; Ono 2012; Piatt and Kitaysky 2002).

The contiguous U.S. population of tufted puffins contains genetic diversity found nowhere else in the world, as populations at lower latitudes and range edges typically contain increased genetic diversity (Adams and Hadly 2013; Assis *et al*. 2013). The isolation of this population from more northern populations is evidenced, for example and as noted above, by the failure of these other populations to replenish the contiguous U.S. population, which is in severe decline. Loss of the Tufted Puffin in the contiguous U.S. portion of the species' range would likely result in a loss of unique ecological and adaptive characteristics (*e.g*., the timing of breeding, which varies as a function of latitude (Hodum 2013)) and compromise the evolutionary capacity of the species (Hodum 2013). For birds like the Tufted Puffin, with slow life histories (*i.e*., long-lived and producing few offspring) and correspondingly lower evolutionary potential, "phenotypic plasticity in timing of reproduction is likely to be by far the most effective mechanism to cope with constantly increasing temperatures" (Vedder *et al.* 2013: 7). A temporal offset in breeding phenology of two months has been documented between the contiguous U.S. and Gulf of Alaska populations of tufted puffins (Piatt and Kitaysky 2002), and the degree of plasticity in breeding phenology is unknown. Losing the diversity of breeding phenology represented by the southernmost populations of tufted puffins may produce mismatches between phenotypic plasticity in the remaining populations and the rapid rate of environmental change, which can lead to considerably higher vulnerability to extinction for the species as a whole (Vedder *et al.* 2013: 7).

The maintenance and recovery of the Tufted Puffin in the contiguous U.S. is critical specifically because this population is located on the periphery of the species' range. As the FWS has previously stated, peripheral populations are believed to be frequently of "high conservation significance and important to long-term survival and evolution of species." 76 Fed. Reg. 38504, 38519 (*citing* Lesica and Allendorf (1995) and Fraser (2000)) (12-month finding for U.S. Northern Rocky Mountain Range Fisher DPS); *see also* 75 Fed Reg. 78030, 78041 (contiguous U.S. DPS wolverine listing decision).[3] According to the FWS:

> [p]eripheral populations are likely to be in suboptimal habitats and subject to severe pressures that result in genetic divergence, … either from genetic drift or adaptation to local environments (Fraser 2000, p. 50). Because of their exposure to strong selective pressures, peripheral populations may contain adaptations that may be important to the taxon in the future. Lomolino and Channell (1998, p. 482) hypothesize that because peripheral populations should be adapted to a greater variety of environmental conditions, then they may be better suited to deal with anthropogenic (human-caused) disturbances than populations in the central part of a species' range.

76 Fed Reg. 38504, 38518.

Notably, the loss of the contiguous U.S. DPS of the Tufted Puffin would restrict this species to only the most northern, subarctic habitats, a range contraction that global climate warming is likely to only exacerbate (Provan and Maggs 2011; Provan 2013). Loss of southern populations has been linked to decreased resilience to global warming as these "rear edge" populations typically contain increased genetic diversity (Reusch *et al.* 2005; Ehlers *et al.* 2008; Adams and Hadly 2013; Assis *et al.* 2013) and "rear-edge range shifts are generally characterized by population extirpation rather than habitat tracking" (Provan 2013: 62). It is believed that the populations at the "rear edge" or lower latitudinal portions of a species' range could prove particularly critical in providing stores of genetic diversity to withstand climactic changes (Hampe and Petit 2005). Finally, the severe decline in the status of the tufted puffin population in Japan, the other southernmost population of tufted puffin, and the expected extirpation of that

---

[3] In its designation of the contiguous U.S. DPS of wolverine, FWS specifically explained the significance of peripheral populations:

> Populations on the periphery of species' ranges tend to be given lower conservation priority because they are thought to exist in low-quality habitats, and are also thought to be the populations that are least likely to survive a reduction in range (Wolf et al. 1996, p. 1147). However, this tendency presumes that the ultimate cause of the species' extinction will be one that operates by eroding away the species' range beginning at the periphery and progressing to the center. This presumption is based on biogeographical information that habitat and population densities of species are highest near the center of the species' range, and decline near the edge (Brown and Lomolino 1998, Figure 4.16). Data from real range collapses of species from around the world illustrate that species' ranges tend to collapse to peripheral areas rather than to the center of their historic ranges (Lomolino and Channell 1995, p. 342; Channell and Lomomolino 2000, pp. 84-86). Of 96 species whose last remnant populations were found either in the core or periphery of their historic range (rather than some in both core and periphery), 91 (95 percent) of the species were found to exist only in the periphery, and 5 (5 percent) existed solely in the center (Channell and Lomolino 2000, p. 85). Available scientific data support the importance of peripheral populations for conservation (Fraser 1999, entire; Lesica and Allendorf 1995, entire).

75 Fed. Reg. 78030, 78042.

population (Piatt and Kitaysky 2002) increases the importance of the southern "rear edge" population in the contiguous United States.

Because it is both discrete and significant, the population of tufted puffins in the contiguous U.S. should be designated a DPS pursuant to the ESA.

III. Population Status and Abundance Trend of Contiguous U.S. DPS of the Tufted Puffin

Available information shows that the population of tufted puffins in Washington, Oregon, and California is in sharp decline (**Table 2**).[4]

Whereas **Washington** has historically (early 1900s through 1980s) supported a population of over 20,000 tufted puffins (**Table 2**) at breeding colonies both along the coast and in more sheltered interior marine waters (**Figure 4**), abundances declined dramatically after 1989 (Piatt and Kitaysky 2002; WDFW 2013). Off the southwestern coast of Washington, the tufted puffin population declined substantially in the 1990s (Wahl and Tweit 2000). More recently, from 2001-2012, on-the-water density of tufted puffins off the northwestern coast of Washington declined an average of 8.9% per year (WDFW 2013; **Figure 5**). Other recent data from Washington (from boat-based surveys conducted during the 2007 and 2008 breeding seasons) indicated that, in 2007, only 12 of 25 (48%) historically occupied breeding sites in Washington were active and, in 2008, 17 of 32 (53%) were active (Hodum *et al.* 2008; **Figure 4**). These surveys also found a lack of colony attendance throughout the state (in 2007), consistent with concurrent low on-water and on-colony counts on Tatoosh Island (Hodum *et al.* 2008). Detailed

---

[4] With respect to other Tufted Puffin populations, tufted puffins in **northern Japan** once numbered several hundred breeding pairs at colonies on at least six coastal islands of Hokkaido (Ono 2009). The population decreased drastically in the 1970s and currently only about ten pairs are breeding at two sites in eastern Hokkaido (Ono 2012). A nearshore gill-net fishery has been identified as a likely cause of declines at these colonies, with rat predation a potential contributing factor (Ono 2009; Ono 2012).

In **British Columbia**, the largest breeding population of tufted puffins nests at Triangle Island (Piatt and Kitaysky 2002). Tufted puffins (and other auk populations) at Triangle Island have been experiencing sporadic breeding failures and periods of decline since the mid-1980s, linked to oceanographic processes (specifically periods of increased ocean temperature) (Gjerdrum *et al.* 2003; Gaston *et al.* 2009: 280; Rodway and Lemon 2011). According to Gjerdrum *et al.* (2003), "[f]urther and prolonged increases in ocean temperature could make Triangle Island, which contains the largest tufted puffin colony in Canada, unsuitable as a breeding site for this species." Between 1984 and 2004, burrow counts of tufted puffins within study plots at Triangle Island declined at a rate of -1.7% per year (Gaston *et al.* 2009: 271), although Rodway and Lemon (2011) considered the decline to be not statistically-significant as of 2009. Nestling growth and survival of tufted puffins has been variable from the 1980s through 2010 (Gjerdrum *et al.* 2003; Hipfner *et al.* 2007; Gaston *et al.* 2009: 271).

In **Alaska**, based on extrapolations from bird counts in nesting burrows, the FWS in 2006 estimated that there were 693 breeding colonies in the state with an estimated population of 2,280,000 individuals (FWS 2006). Trends for specific populations have generally been marginal or insignificant with occasional positive or negative trends (FWS 2006; Dragoo *et al.* 2011: Figure 53; Corcoran 2013: 29, Tables 26, 28-30; Dragoo *et al.* 2013, Figure 39; FWS *et al.* 2013: Table 2; Gladics *et al.* 2013; Kettle 2013: 11).

surveys and studies of tufted puffins on Tatoosh Island in Washington were completed during this same period (Hodum *et al.* 2008). These 2005 to 2008 surveys and studies led scientists to estimate that the number of tufted puffins nesting on Tatoosh Island has fallen from 300-400 birds to approximately 50 (13-17% of 1970s population; Pearson *et al.* 2011). While these studies found a high percentage of active nesting burrows (ranging from 72% to 90%), hatching success was variable (ranging from 47% to 82%) and fledging success was low (with only two seasons exceeding 40% (and all four seasons below the species average value of 64%) (Piatt and Kitaysky 2002: 17). Based on the apparent premature abandonment of nests, experts believe that there may have been a widespread breeding failure in Washington in 2007 (Pearson *et al.* 2011).

In 2012, the Coastal Observation and Seabird Survey Team (COASST) detected an unusual and alarming number (181) of dead tufted puffins based on annual monitoring of beached birds on Washington coastal beaches (COASST 2013: http://depts.washington.edu/coasst/patterns.html). This die-off event was also observed in Oregon (discussed below).

Table 2: Available information on breeding populations (numbers) and colonies of tufted puffins in Washington, Oregon, and California since the early 1900s. The % decline for each state breeding population was calculated between the oldest and most recent population numbers. When exact numbers were unavailable (italicized values), population numbers were estimated based on the sources.

Year	State	Colonies (#)	Breeding population	Decline (%)	Source
1909	**WA**	44	> 25,000	~88%	Jewett *et al.* 1953
1980s		30	23,342		Speich and Wahl 1989
2000s		19	*~3,000* (“no more than several thousand”)		WDFW 2013
1966-67	**OR**	n.a.	~*6,000* (< 6,632)[1]	~98%	Browning and English 1972 (*cited in* Varoujean and Pitman 1979)
1979		38	6,632		Varoujean and Pitman 1979 (*cited in* Kocourek *et al.* 2009)
1988		49	4,858		Lowe *et al.* 1988 (*cited in* Kocourek *et al.* 2009)
2008		15	142		Kocourek *et al.* 2009
2009		12	146		Suryam *et al.* 2012
1911	**CA**	n.a.	*~3,000* (“several thousand”)	~91%	McChesney and Carter 2008: 214
1975-1980		13	250		Sowls *et al.* 1980
1989-1991		13	276		Carter *et al.* 1992
2004		n.a.	250		Sanders 2005

[1] According to Varoujean and Pitman (1979), “[a] comparison of our findings with the 1966-67 survey results [of Browning and English (1972)] … only vaguely suggests an increase in abundance of nesting puffins over the last 12-13 years.”

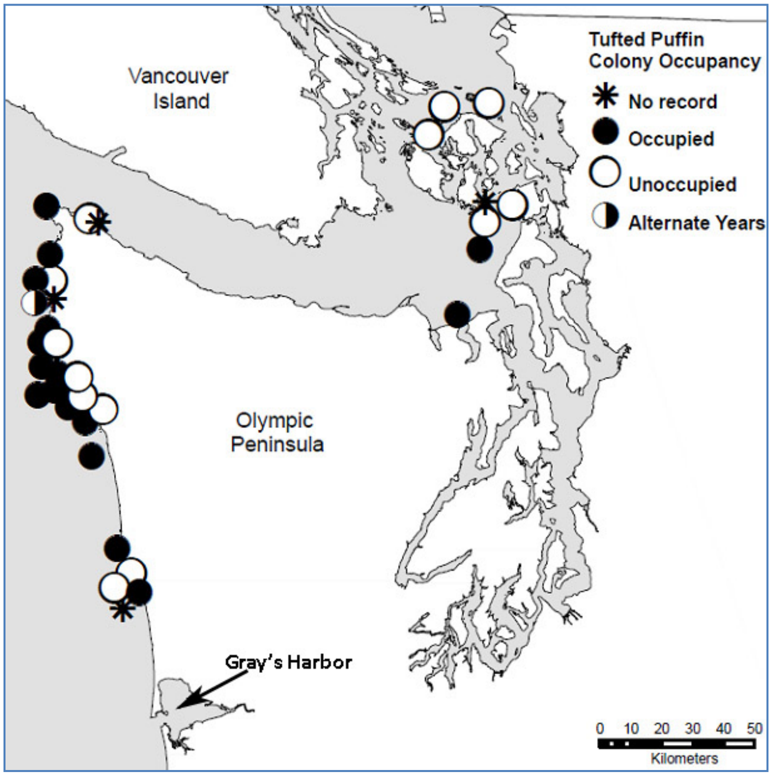

Figure 4: Tufted puffin nesting sites in Washington (Pearson *et al.* 2011).

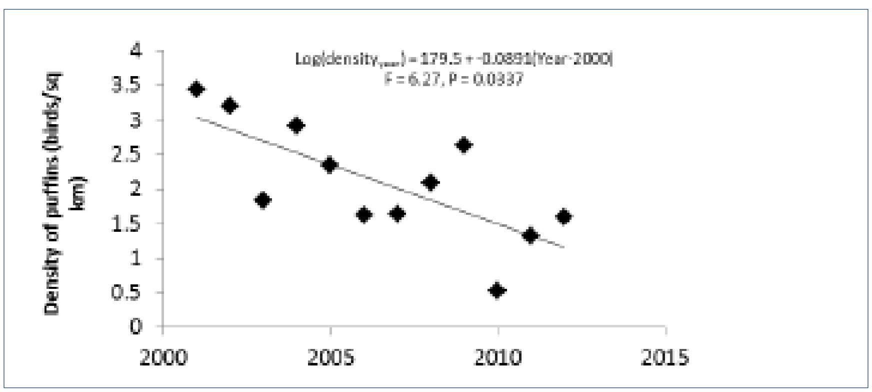

Figure 5: Trend in the on-the-water density of tufted puffins during boat-based surveys within 8 km of shore between Pt. Grenville and Cape Flattery, WA, 2001-2012 (WDFW 2013, based on S. Pearson, unpubl. data).

In **Oregon**, coast-wide population surveys of tufted puffins have been conducted by the FWS only four times since the 1960s (1966-67, 1979, 1988, and 2008; **Table 2**). Population levels were fairly stable between the 1960s and 1980s, with a modest decline from 6632 individuals in 1979 to 4,858 individuals in 1988 (**Figure 6**; Kocourek *et al.* 2009). The overwhelming majority of these birds nested along the northern coast, primarily at Three Arch Rocks, a cluster of rocky islands that is now a national wildlife refuge (Naughton *et al.* 2007: Introduction at 8; Appendix B at 447-48; **Figure 7**). A 2008 survey, however, found just 142 of the birds coast-wide (Kocourek *et al.* 2009; **Figure 6**). Most of these birds were again found along the northern coast of Oregon; however, only a handful (16) were counted at Three Arch Rocks, while the majority

(51) were counted around 80.5 km further north on Haystack Rock at Cannon Beach (Kocourek *et al.* 2009: Appendix D, part 6; **Figure 7**). Suryam *et al.* (2012) similarly found 146 tufted puffins in breeding colonies along the Oregon coast in 2009 (**Figure 6)** and 57 tufted puffins at-sea from 2003-09 in a 300 m strip transect.

The FWS has conducted intermittent monitoring of tufted puffins at Haystack Rock since 1960 (Stephensen 2014). Whereas breeding population sizes were variable over that time, the population was largest in the 1970s and 1980s (peaking at 612 birds in 1988; **Figure 6**). Since 2008, the annual breeding population (individual birds) at Haystack Rock has been stable overall (estimates ranging from 51 individuals in 2008 to 143 in 2013), but well below population sizes in the 1970s and 1980s (Stephensen 2014; **Figure 6**). Current data suggest Haystack Rock supports the largest puffin colony in Oregon due to declines at other sites along the coast (Stephensen 2014). Recently, a major die-off event of tufted puffins in Oregon (and Washington, as discussed above) occurred over the 2011-2012 winter (Shawn Stephensen, personal communication, July 12, 2012) and was likely linked to a decline in breeding population size in 2012. Because of the emaciated condition of the birds, a depleted food supply is suspected as causing or contributing to the die-off (Shawn Stephensen, personal communication, July 12, 2012).

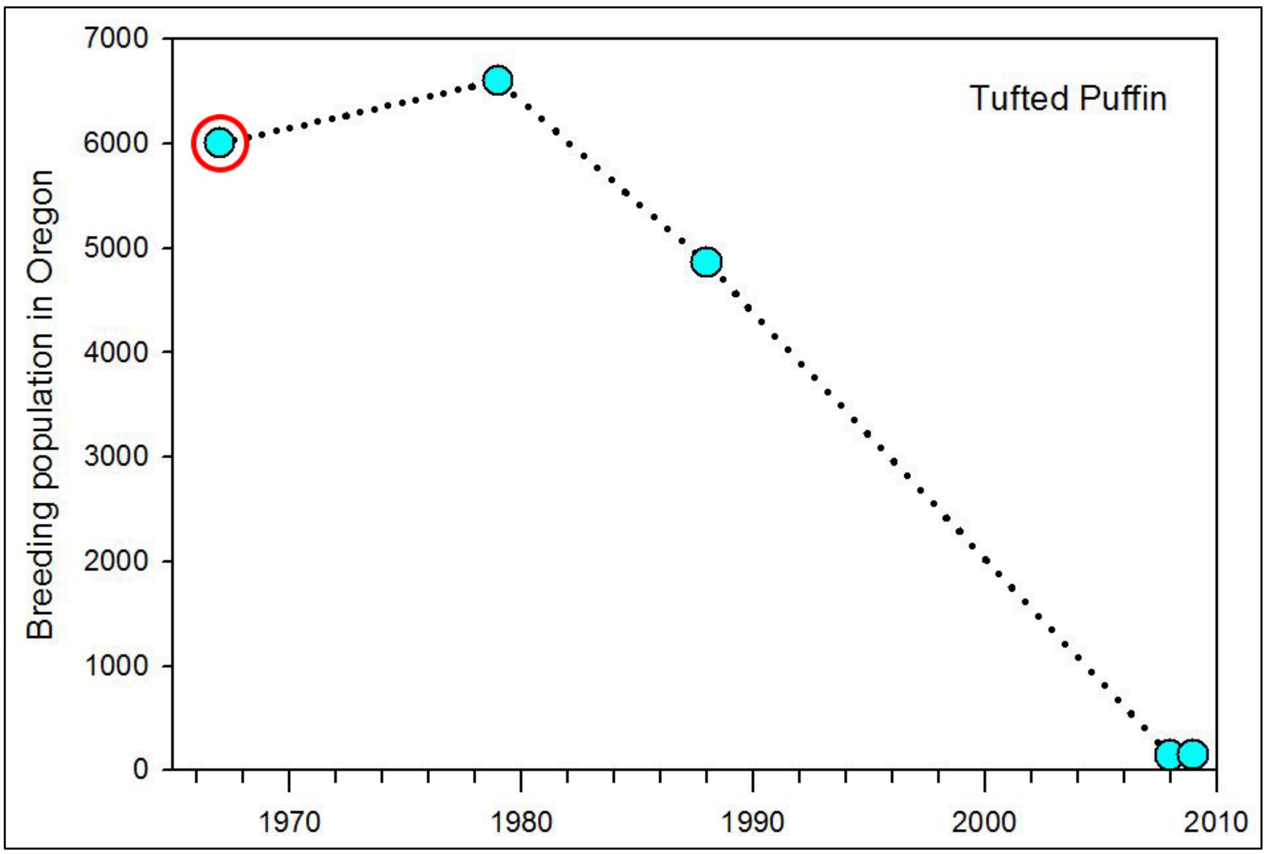

Figure 6: Decline in the estimated breeding population size of tufted puffins on the Oregon coast. Data from Kocourek *et al.* (2009) and Suryam *et al.* (2012). Population size in 1967 (circled data point) is our estimate based on Varoujean and Pitman (1979) (which stated that its analysis "only vaguely suggests an increase in abundance of nesting puffins over the last 12-13 years).

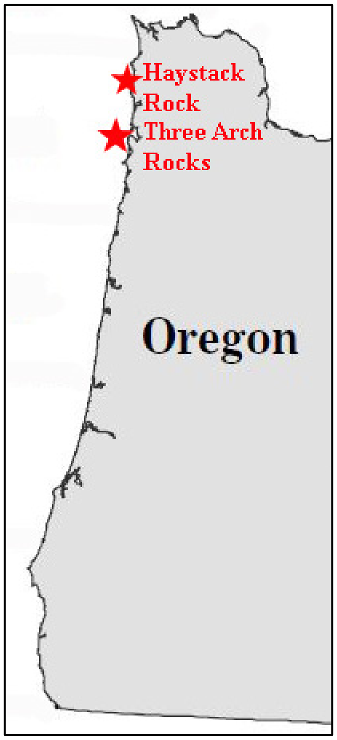

Figure 7: Locations of the historic (Three Arch Rocks) and current (Haystack Rock) largest breeding colonies of the Tufted Puffin along the Oregon coast.

In **California**, tufted puffins were most numerous in the late nineteenth and early twentieth centuries, when as many as several thousand birds were reported at different breeding islands (McChesney and Carter 2008; **Table 2**). By the mid-twentieth century, numbers had declined throughout California and the range of the breeding population was reduced (McChesney and Carter 2008: **Figure 2**). Between 1975 and 1980, statewide research surveys identified a total of only 250 breeding puffins at 13 colonies. Based on later surveys in 1989-91 (no trends were detected between these two surveys), breeding locations were as follows: on the north coast, the principal breeding sites were Prince Island (27 birds) and Castle Rock (82 birds), Del Norte County, and Green Rock, Humboldt County (29 birds); and between Cape Mendocino and the Farallon Islands, puffins were found only at Goat Island Area (8 birds) and Fish Rocks (15 birds), Mendocino County, and Point Reyes (4 birds). In 1991, small numbers of tufted puffins (about 10 birds) were rediscovered at Prince Island, Santa Barbara County, after an observed absence of up to several decades from the Channel Islands (Carter *et al.* 1992, McChesney *et al.* 1995; **Figure 2**). It is uncertain whether puffins still occur in the Channel Islands currently, with the last confirmed sighting in 1997 (McChesney and Carter 2008). There has been more recent evidence of declines at certain Northern California sites, with the population at Castle Rock Refuge, once thought to be the single largest breeding site in California and supporting more than half of all breeding birds in the state, declining from an estimated 82 birds in 1989-91 to only 9 birds in 2004 (Jaques 2007: 38; McChesney and Carter 2008). The greatest concentration of tufted puffins in California is now believed to be at several sites north of Cape Mendocino and on the Farallon Islands (**Figure 2**). The breeding population on Southeast Farallon Island (the largest nesting colony of tufted puffins in the Farallons) has fluctuated between 10 and 250 birds since 1971 (Warzybok *et al.* 2012).

A. Conservation status

The FWS has designated the Tufted Puffin as a Federal species of concern, a non-regulatory designation. In Washington, the Tufted Puffin has been designated as a Species of Conservation Concern (Candidate) since 1998. In Oregon, the Tufted Puffin is considered Vulnerable on the Sensitive Species List while the Oregon Natural Heritage Program ranks the breeding population as Critically Impaired (ORBIC 2010: 16). In California, the Tufted Puffin is currently considered a Species of Special Concern (breeding), priority 1, and has been on the special concern list since 1978 (McChesney and Carter 2008).[5]

IV. The Contiguous U.S. DPS of the Tufted Puffin Should be Listed as Endangered or Threatened.

A species is endangered if it "is in danger of extinction throughout all or a significant portion of its range." 16 U.S.C. § 1532(6). A species is threatened if it "is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." *Id.* § 1532(20). To determine whether a species is endangered or threatened, the FWS must consider five statutorily prescribed factors:

- The present or threatened destruction, modification, or curtailment of its habitat or range;
- Overutilization for commercial, recreational, scientific, or educational purposes;
- Disease or predation;
- The inadequacy of existing regulatory mechanisms; or
- Other natural or manmade factors affecting its continued existence.

Id. § 1533(1)(a).

The agency must consider each of the listing factors singularly and in combination with the other factors. *See Carlton v. Babbitt*, 900 F. Supp. 526, 530 (D.D.C. 1995); *Western Watersheds Project v. Fish and Wildlife Serv.*, 535 F. Supp. 2d 1173, 1179 (D. Id. 2007) ("It is the cumulative impacts of the disturbances, rather than any single source, [that] may be the most significant influence on the trajectory of sagebrush ecosystems."). Each factor is equally important and a finding by the Secretary that a species is negatively affected by just one of the factors warrants a non-discretionary listing as either endangered or threatened. *See Nat'l Wildlife Fed. v. Norton*, 386 F. Supp. 2d. 553, 558 (D. Vt. 2005) (*citing* 50 C.F.R. § 424.11(c)). Likewise, a species must be listed if it is endangered or threatened because of a combination of factors. *See, e.g.,* 50 C.F.R. § 424.11(c).

[5] In Japan, Tufted Puffins have been listed as a national and local endangered species since 1993 (Osa and Watanuki 2002). In British Columbia, due to the sporadic breeding failures and years of reduced food availability, the Tufted Puffin is on the Ministry of Environment's "Blue List" (http://www.env.gov.bc.ca/atrisk/red-blue.htm) as a "species of special concern" (BC Conservation Data Centre 2012; BC Parks 2012). In Alaska, the Tufted Puffin is considered Secure by the Alaska Natural Heritage Program.

The ESA provides for the listing of an endangered or threatened species if the species is threatened or endangered in an area that represents a "significant portion of [a species'] range." A "significant portion" of a species range can include both current and historical habitat. *See, e.g.*, *Northwest Ecosystem Alliance v. United States Fish and Wildlife Serv.*, 475 F.3d 1136, 1148 (9th Cir. 2007) ("major geographical areas in which it is no longer viable but once was"), *citing Defenders of Wildlife v. Norton*, 258 F.3d 1136, 1145 (9th Cir. 2001). A danger of extinction to a species within a significant portion of its range is sufficient to require listing. 16 U.S.C. § 1532(6); *Defenders*, 258 F.3d at 1141-42.

In choosing a time frame, *e.g.*, what is the "foreseeable future" in which a species is likely to become endangered for classification purposes, the FWS must choose a time frame that is reasonable, given the species' characteristics and the nature of the threats. *Cf.* Black's Law Dictionary, 8th ed. 2004 (definition of foreseeable is "reasonably anticipatable"). The time frame should also ensure protection of the petitioned species, and give the benefit of the doubt regarding any scientific uncertainty to the species.

The time frame for tufted puffins should be similar to that used for similar species. Because climate change has been implicated as a cause of the declining forage base that is a major threat to the Tufted Puffin, the FWS should also use a timeframe that is appropriate for such impacts. The minimum time period that meets these criteria is through the year 2100. The time period through the year 2100 was recently utilized as representing the foreseeable future in proposed listing determinations for 82 candidate coral species (77 Fed. Reg. 73220, 73226). This time period was based on a scientific review committee's "judgment that the threats related to global climate change... pose the greatest potential extinction risk to corals and have been assessed with sufficient certainty out to the year 2100." (77 Fed. Reg. 73220, 73226). Other species listings that relied on the 100 year time frame include various Pacific salmon and steelhead Ecologically-Distinct Units or ESUs (*e.g.*, 69 Fed. Reg. 33102, 33111 (27 salmon and steelhead ESUs); 63 Fed. Reg. 11798, 11805 (Washington and Oregon steelhead ESUs)); Queen Charlotte Goshawk (77 Fed. Reg. 45870, 45886); and the Gulf of Maine DPS of Atlantic Salmon (74 Fed. Reg. 29344, 29356). Courts have also approved the use of the 100 year timeframe. *See Western Watersheds Project v .United States Fish and Wildlife Service*, 535 F. Supp. 2d 1173, 1184 (D. Id. 2007) (to be a "threatened species under the ESA, the sage-grouse must be likely 'to be in danger of extinction' within 100 years"); *Southwest Center for Biological Diversity v. Norton*, 2002 WL 1733618, at *12 (D.D.C. July 29, 2002) (for the Queen Charlotte goshawk, FWS determined that the goshawk would be "threatened" if at any point in the next 100 years there is a 20% chance that the species would become extinct); *Western Watersheds Project v. Foss*, 2005 WL 2002473, at *15 (D. Id., Aug. 19, 2005) (court ruled that FWS's decision not to list a plant with 64 percent chance of extinction within 100 years as threatened was untenable).

The IUCN species classification system also uses a timeframe of 100 years. For example, a species must be classified as "vulnerable" under the IUCN system if there is a probability of extinction of at least 10% within 100 years. Further, a species must be listed as "endangered" if the probability of extinction is at least 20% within 20 years or five generations, whichever is the longer (up to a maximum of 100 years).

Moreover, in planning for species recovery, agencies routinely consider a 75-200 year foreseeable future threshold (Suckling 2006). For example, the FWS used 100 years in connection with recovery of the Steller's Eider (*e.g.*, the Alaska-breeding population of the species will be considered for delisting from threatened status when it has <1% probability of extinction in the next 100 years, and certain populations have <10% probability of extinction in 100 years and are stable or increasing) and 200 years in connection with recovery of the Utah prairie dog, and NMFS used 150 years in connection with the recovery of the Northern right whale (Suckling 2006).

Finally, the time period that the FWS uses in its listing decision must be long enough so that actions can be taken to ameliorate the threats to the petitioned species and prevent extinction. For all these reasons, Petitioner recommends a minimum of 100 years, or at least until 2100, as the time frame for analyzing the threats to the continued survival of the Tufted Puffin.

As discussed below and for the reasons discussed in this petition, the contiguous U.S. population of tufted puffins is endangered or, in the alternative, threatened as a result of the statutorily-prescribed factors.

A. The present or threatened destruction, modification, or curtailment of its habitat or range

Nearly all tufted puffin nesting sites in Washington, Oregon, and California (historic and currently occupied) are located within national wildlife refuges and therefore have some level of protection from human disturbance (McChesney and Carter 2008; Kocourek *et al.* 2009; Scott Pearson, personal communication, February 21, 2012). However, not all breeding sites are protected and there is evidence that human disturbance of colonies remains a current threat to breeding success of tufted puffins, at least in Washington (Hodum *et al.* 2008). This is especially true for colonies in Puget Sound, as there is more human disturbance to historically occupied sites there than on the coast, and although both areas have experienced loss of colonies, there have been more colonies lost in Puget Sound. In addition, habitat damage from natural forces (*e.g.*, erosion and disturbance from animals) and competition for space with other birds and marine mammals have been identified as threats to tufted puffins in all three states (McChesney and Carter 2008).

Climate also influences the suitability of breeding habitat. Heavy rainfall may limit the use of some islands as nesting habitat, as it can cause flooding of burrows, harming chicks and/or causing burrow collapse (Wehle 1980; Piatt and Kitaysky 2002). There is evidence that tufted puffins will delay egg laying until wet burrows dry out (Wehle 1980: 55). Predicted effects of climate change in the Pacific Northwest (Washington and Oregon) include increased precipitation, especially extreme precipitation events (Hixon *et al.* 2009; Littell *et al.* 2009), which may reduce the suitability of much of the species' current breeding habitat.

B. Overutilization for commercial, recreational, scientific, or educational purposes

Breeding tufted puffins regularly dive between 15 and 20 m (and can dive as deep as almost 60 m) to catch their fish prey (Kotzerka *et al.* 2008) and are thus vulnerable to being caught as bycatch (and subsequently drowning) in commercial fishing gear (Žydelis *et al.* 2009). Auks, the family that includes the tufted puffin, are particularly vulnerable to gillnets and are the most frequently caught seabird taxonomic group by this gear (Žydelis *et al.* 2013). Until the 1980s, bycatch in driftnets (floating gillnets) killed tens of thousands of tufted puffins each year (Manville 2005). Prohibitions of driftnets on the high seas (in effect since the early 1990s) has reduced mortality, although bycatch in fishing nets (gillnets and driftnets) still kills large numbers of tufted puffins in coastal waters (Piatt and Kitaysky 2002; FWS 2006).

Between 1996 and 2005, 5,364 tufted puffins were recorded caught as bycatch in the salmon gillnet fishery by Russian research vessels in the Russian exclusive economic zone (EEZ); tufted puffins were the second most common seabird species recorded (behind shearwaters), representing 29% of the bycatch (Artukhin 2009; Artukhin and Sato 2012). For the period 1996-2008, a higher level of bycatch, 13,200 tufted puffins, was recorded in the Russian driftnet fishery (Artukhin *et al.* 2010). Between 1992 and 2001, Japanese driftnet fishermen, who were allowed by Russia to fish for salmon in the Russian EEZ, were responsible for recorded bycatch of an additional 35,444 tufted puffins, 19% of a total of 183,646 seabirds caught during this time. During the period of intensive Japanese driftnet fishing for salmon in the Russian EEZ in 1992-2008, bycatch of tufted puffins averaged 15,300 birds per year (Artukhin *et al.* 2010). In Japan, bycatch of tufted puffins in nearshore gillnet fisheries has been identified as a likely principal cause of drastic population declines seen in the 1970s (Ono 2009; Ono 2012).

In Alaska, extensive gillnet fisheries exist and although bycatch data are sparse, auks are reported as the most frequently caught species (Žydelis *et al.* 2013: 82). The Tufted Puffin is among the most common species caught in the Kodiak Island salmon set gillnet fishery (Žydelis *et al.* 2013: 82). An estimated 110 tufted puffins (out of 528 birds caught) were caught as bycatch in 2002 (Kuletz *et al.* 2004; Manly 2007) and 96 (out of 1,097 birds caught) in 2005 (Manly 2007).

In the contiguous U.S., bycatch data for the gillnet fisheries that pose a threat to tufted puffins are unavailable (*e.g.*, there is no observer coverage in the Puget Sound gillnet fishery in Washington). Given the documented bycatch of tufted puffins in gillnet and driftnet fisheries in other areas (discussed above), it is likely that bycatch is a source of mortality for the contiguous U.S. DPS of tufted puffins; in addition to the Puget Sound gillnet fishery, drift gillnet fisheries for swordfish and coastal gillnet fisheries for salmon are of particular concern. In light of the highly depleted status of the DPS, such bycatch mortality is a likely threat.

C. Predation and Invasive Species

The Tufted Puffin is a diurnal species, actively feeding and guarding the nest during the day. As a result, tufted puffins are particularly vulnerable to daytime visual predators, such as peregrine falcons and bald eagles. Avian predation is especially problematic on some nesting islands in

Washington (Pearson *et al.* 2011), where the presence of bald eagles can keep the skittish birds from entering their burrows and feeding their young (Welch 2012). In California, western gulls have also been identified as potential predators on tufted puffin chicks and as kleptoparasites (*i.e.*, stealing the food captured by adults for their chicks) on adults (McChesney and Carter 2008). Increasing levels of avian predation on an already vulnerable population of tufted puffins may exacerbate ongoing declines and impair the likelihood of recovery for this DPS.

Nesting tufted puffins are also vulnerable to red and arctic foxes, river otters, brown bears, rats, and other mammals (Piatt and Kitaysky 2002; Ono 2009; Kettle 2013; FWS *et al.* 2013 (minks)). Such predators were once absent from most islands in the northeast Pacific, but were introduced in the 1800s and early 1900s. Where present, mammalian predators have reduced or eliminated numbers of tufted puffins on many islands. Programs to eradicate the introduced species have led to some recovery of tufted puffin population levels in certain areas. However, new introductions of mammalian predators pose an ongoing threat (Piatt and Kitaysky 2002).

For example and most recently, European rabbits have been identified as adversely affecting nesting of tufted puffins on Destruction Island, Washington (Welch 2012). The presence of a large population of rabbits is likely deterring birds from nesting in many of their historical burrows on the island. In rare cases, rabbits may even enter burrows and drive birds out directly. In addition, the large rabbit population has attracted avian predators like bald eagles. While the bald eagles may be directly impacting the puffins by preying on small adults, chicks, and/or eggs, their biggest impact is likely that they scare away adult puffins, which leads to insufficient nourishment and less successful fledging of their chicks. In the worst case, bald eagles could cause total abandonment of nesting colonies. Finally, the rabbits' ravenous consumption of the island's native grasses is destroying or adversely affecting nesting habitat. The rabbits' ongoing grazing has driven a change in the local flora to invasive annual grasses. These grasses are kept so short by the grazing rabbits that they no longer help stabilize the steep hillsides, resulting in increased erosion and the collapse of bird burrows. Increased erosion also reduces the available habitat for replacement burrows. While a rabbit eradication program for the island is in the planning stages, it will likely be years before anything is done to address this threat (Welch 2012).

D. The inadequacy of existing regulatory mechanisms

As discussed below, tufted puffins are subject to the activities of multiple governmental entities in the U.S. and internationally. These regulatory activities have failed to stop the ongoing decline of the contiguous U.S. population of tufted puffins.

1. U.S. federal regulatory mechanisms

Tufted puffins are subject to a number of federal regulatory programs, including: (1) the federal Migratory Bird Treaty Act of 1918 ("MBTA"); (2) a January 2001 executive order calling for agencies whose actions negatively impact populations of migratory birds to develop and implement memoranda of understanding to promote conservation of migratory bird populations ("Responsibilities of Federal Agencies to Protect Migratory Birds," Executive Order 13186, 10 January 2001, Federal Register 66(11): 3853-3856); (3) the National Oceanic and Atmospheric Administration ("NOAA")'s "National Plan of Action" ("NPOA") to address seabird bycatch in longline fisheries, as called for by the International Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries (adopted by the United Nations Food and Agriculture Organization in 1999); and (4) section 316 of the Magnuson-Stevens Fisheries Conservation and Management Act ("MSA").

MBTA. The MBTA makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, any migratory bird, or the parts, nests, or eggs of such a bird, except under the terms of a valid permit issued pursuant to Federal regulations. 16 U.S.C. § 703. However, the MBTA defines "take" to mean "pursue, hunt, shoot, capture, collect, kill, or attempt to pursue, hunt, shoot, capture, collect, or kill" (16 U.S.C. § 715n), and most courts have held that the MBTA, unlike the ESA, does not protect migratory birds from habitat destruction through its take prohibition (Adkins Giese 2010: 1164-69). The migratory bird species protected by the MBTA are listed in 50 CFR 10.13 and include the Tufted Puffin. The regulations governing migratory bird permits can be found in 50 CFR Part 13 (General Permit Procedures) and 50 CFR Part 21 (Migratory Bird Permits). In 2012, NMFS issued a "special purpose" permit pursuant to 50 C.F.R. § 21.27 to allow the incidental take of seabirds in the Hawaii longline fishery. No permit actions have been taken under the MBTA related to the Tufted Puffin, and we are not aware of any use of the MBTA to reduce bycatch of tufted puffins specifically or to otherwise specifically benefit tufted puffins.

Executive Order 13186. The 2001 Executive Order directs each Federal agency taking actions that have, or are likely to have, measurable negative effects on migratory bird populations to develop and implement a Memorandum of Understanding ("MOU") with the FWS to promote conservation of migratory bird populations. Pursuant to the 2001 Executive Order, an April 2010 MOU between the National Park Service and FWS (available at: http://www.fws.gov/migratorybirds/Partnerships/NPSEO13186Signed%204.12.10.pdf) describes plans to identify and implement strategies intended to complement and support existing efforts as well as to facilitate new partnerships and planning strategies for migratory birds. We are not aware of any use of the 2001 Executive Order to benefit tufted puffins specifically.

The NPOA. In 2001, the NPOA set in place a schedule for seabird bycatch assessments and a process for developing measures to reduce seabird bycatch through amendments to fishery management plants implemented pursuant to the MSA (NOAA 2001: 4-5). A June 14, 2012 MOU between NMFS and FWS (available at: http://www.fakr.noaa.gov/protectedresources/seabirds/mou/eo13186_nmfs_fws_mou2012.pdf) states the agencies' plans to continue to promote and implement the NPOA to improve information and technology to reduce seabird bycatch. We are not aware of any use of the NPOA to reduce bycatch of tufted puffins or to otherwise benefit tufted puffins specifically.

The MSA. Because bycatch minimization activities required under the MSA only apply to "fish" bycatch[6] and the MSA specifically excludes seabirds from the definition of "fish,"[7] such activities are not intended specifically to benefit tufted puffins (although there may be incidental

[6] "The term 'bycatch' means fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards and regulatory discards." 16 U.S.C. § 1802(2).
[7] "The term 'fish' means finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds." 16 U.S.C. § 1802(12).

benefits) . This has also meant that the collection of seabird bycatch data through logbooks and scientific observations historically has not been given the same priority as data collection related to other protected species and experimental designs for certain bycatch research projects were developed for non-bird species, which may complicate extrapolation to bird species (NOAA 2001: 11). In 2006, section 316 of the MSA established a program to develop technological devices and other conservation engineering changes designed to minimize bycatch, seabird interactions, bycatch mortality, and post-release mortality in federally managed fisheries. However, we are not aware of any use of the MSA to reduce bycatch of tufted puffins specifically, protect tufted puffin habitat or food supply, or address other threats to the species.

2. State regulatory mechanisms

In Washington, the Tufted Puffin is considered a Species of Conservation Concern (Candidate); in Oregon, the Tufted Puffin is considered Vulnerable on Oregon's Sensitive Species List; and in California, the Tufted Puffin is considered a Species of Special Concern (breeding), priority 1. None of these designations, however, confer meaningful protections. In November 2012, the California Fish and Game Commission approved a "Policy of Forage Species" designed to prevent new or expanded fishing pressure on forage fish species in state waters until further study of ecosystem needs is completed (Sea Stewards 2012); the new policy, however, does not apply to existing forage fisheries.

3. International regulatory mechanisms

International efforts related to seabird conservation have focused on minimizing bycatch in fisheries. *See, e.g.*, International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries (available at: http://www.fao.org/fishery/ipoa-seabirds/en). However, a 2008 report found that studies of bycatch in gillnet fisheries – of significant concern to tufted puffins – are "very scarce" and determined that "development of seabird mitigation measures for this gear type is in its infancy" (Løkkeborg 2008: iv).

E. Other natural or manmade factors affecting tufted puffins' continued existence

1. Climate change

Climate change poses a serious and increasing threat to tufted puffins. For more than two and a half centuries (since the industrial revolution), humans have discharged vast quantities of carbon dioxide (CO_2) into the earth's atmosphere through the burning of fossil fuels and land use changes (Feely *et al*. 2012: xi). Since the pre-industrial era (early 1700s), global atmospheric CO_2 levels have risen from approximately 280 parts per million (ppm) to 391 ppm, higher than they have been at any time over the past 800,000 years (Intergovernmental Panel on Climate Change (IPCC) 2007; IPCC 2013; Scripps Institution of Oceanography 2013). The substantial increase in atmospheric CO_2 levels (as well as other greenhouse gases) to date has led to climate warming, sea level rise, and related impacts as evidenced by increases in global average air and ocean temperatures, widespread melting of snow and ice cover, and rising global average sea level (IPCC 2007; IPCC 2013). Climate warming has also led to changes in precipitation patterns, river discharges, wind patterns, and other effects (Greene *et al.* 2008). Such changes are occurring faster than scientists had previously predicted (Boesch *et al.* 2007) and are impacting species and their habitats worldwide (IPCC 2007). Even under "stabilization scenarios," atmospheric levels of CO_2, NH_4 and N_2O could reach the combined CO_2-equivalent concentrations of 800 ppm by the end of the century, with temperatures likely rising more than 2 degrees C (IPCC 2013). With such increases, impacts to species and habitats are expected to increase in rate and magnitude (IPCC 2007; 77 Fed. Reg. 73220).

Predicted impacts of climate change on the CCS marine ecosystem specifically include warmer surface waters, a deepening thermocline, increased coastal stratification that may counteract upwelling, reduced nutrient enrichment and lower primary productivity (King *et al.* 2011). These impacts will likely drive changes in the distributions of marine species, as well as having variable effects on species-specific survival including a predicted decline in abundance for seabirds due to poor hatchling survival (King *et al.* 2011). There is already evidence that a warming trend over the last 50 years has impacted the CCS, forcing an ecosystem shift from a sub-arctic regime towards a subtropical environment (Ainley and Hyrenbach 2010). As a result, warm-water subtropical seabirds are occurring with increasing frequency, while certain species more characteristic of colder sub-arctic waters are decreasing (Ainley and Hyrenbach 2010).

Impacts of global climate warming on the contiguous U.S. DPS of tufted puffins will be largely indirect, such as the result of food web disruptions that will potentially reduce foraging and reproductive success (discussed below), modification of nesting habitat (discussed above in IV.A.), and seasonal and/or distributional shifts that will potentially impact vulnerability to capture in fisheries (discussed above in IV.B) and by predators (discussed above in IV.C.). While seabirds like the Tufted Puffin have life history strategies that help them withstand changing environments, the rapidity and scope of environmental changes occurring as a result of climate change may exceed the Tufted Puffin's adaptive capabilities. Moreover, the Tufted Puffin will be further constrained in responding to changes because foraging occurs near nesting sites, nesting sites are limited, and the species demonstrates colony philopatry. *See, e.g.*, 75 Fed. Reg. 3424, 3432.

2. Availability and condition of forage

Successful breeding of tufted puffins relies on an abundant food supply to sustain both the rapid growth rates that chicks require to survive as well as to nourish the breeding pair. The diet of tufted puffins, whether as chicks (**Table 1)** or adults, consists primarily of "forage species" (Koepcke 2009: 22). Forage species (also known as "forage fish," "bait fish," "coastal pelagic species," and "wetfish") include small schooling pelagic fish, juvenile stages of larger fish, and invertebrates, and their "abundance highly influences [the] productivity of predators" (Koepcke 2009: 22). In a global analysis of the contribution of marine forage fish, Pikitch *et al.* (2012) estimated that forage fish in the northern CCS supported the largest amount, by far, of total predator production (52 tons km^{-2} $year^{-1}$). This represents a major ecological contribution to important predators including fish, squid, marine mammals, and seabirds. Seabirds were the most forage-fish dependent group of predators included in this study (which included tufted puffins). Seabirds require a threshold prey abundance of approximately one-third of the maximum prey biomass observed in long-term studies, or else they will experience consistently reduced and more variable productivity (Cury *et al*. 2011). This threshold provides an indicator of the minimal forage fish biomass needed to sustain seabird productivity over the long term, a concept known as "one-third for the birds" (Cury *et al*. 2011).

Successful breeding also appears to depend on the quality of available prey. In an Alaskan study, Schoen *et al*. (2013) found a positive correlation between tufted puffin chick condition (as reflected in mass/wing length) and the size of the primary prey (walleye pollock), with condition improving as the size of prey delivered increased, irrespective of the size (age) of the chick (Schoen *et al.* 2013: 10). Preliminary analyses in that study suggest that sites with cool, low salinity waters supported higher forage biomass and puffin densities at sea, larger prey loads for delivery to chicks, and better body condition of puffin chicks (Schoen *et al.* 2013: 2).

According to the FWS, "[c]onsidering the large-scale changes in marine food chains and climate… over the last decade, changes in prey availability are the most likely source of population regulation" of tufted puffins (FWS 2006: 2). Reduced prey availability has been identified as a likely cause of declines in numbers of tufted puffins in California (McChesney and Carter 2008), Oregon (Shawn Stephensen, personal communication, July 12, 2012), Washington (Hodum *et al.* 2008, Pearson *et al.* 2011; WDFW 2013), and Triangle Island, British Columbia (Vermeer and Cullen 1979; Vermeer *et al.* 1979; Gjerdrum *et al.* 2003). Dramatic breeding failures (1% fledging success, compared to a historical average of 64% (Piatt and Kitaysky 2002: 17)) of tufted puffins at Triangle Island, British Columbia, were associated with a scarcity of sand lance (a preferred prey), reduced frequency of feeding and weight of food loads delivered to chicks, and drastically decreased chick growth rates (Vermeer and Cullen 1979). Differences in parental foraging success, and subsequent chick provisioning and growth rates, have been shown to strongly affect overall breeding success, even in nearby colonies (Hipfner *et al.* 2007).

Changes in climate has been implicated as the main culprit in forage base shifts. Higher ocean water temperatures are likely affecting the food supply and breeding productivity of tufted puffins. Declines of tufted puffin population levels in Washington in the 1990s have been linked to a climate-induced food web shift (to a warm period of lower ocean productivity) (Wahl and Tweit 2000). Dramatic breeding failures of tufted puffins (and other seabirds) in Oregon were associated with a 1992-93 El Niño, which was accompanied by warm sea surface temperature (SST) and weak marine primary production (Lowe 1993). Especially warm SSTs corresponded with drastically decreased growth rates and fledging success of tufted puffin nestlings at Triangle Island in British Columbia (Gjerdrum *et al.* 2003). The optimal temperature range for breeding and fledging success of tufted puffins in British Columbia is 8.5-9.5 °C, as this appears to be the temperature range in which feeding and growth of the nestlings is optimized (**Figure 8**, Gjerdrum *et al.* 2003). Puffins may partially compensate for within-season changes associated with SST by adjusting the timing of their breeding; in British Columbia, the mean hatching date advanced from July 15 during 1975-1981 to June 22-July 10 after 1994, related to changes in SST (Gaston *et al.* 2009: 271, *citing* Gjerdrum *et al.* 2003). These data suggest that tufted puffins are highly vulnerable to the effects of climate change in the more southern portions of their range (Gjerdrum *et al.* 2003).

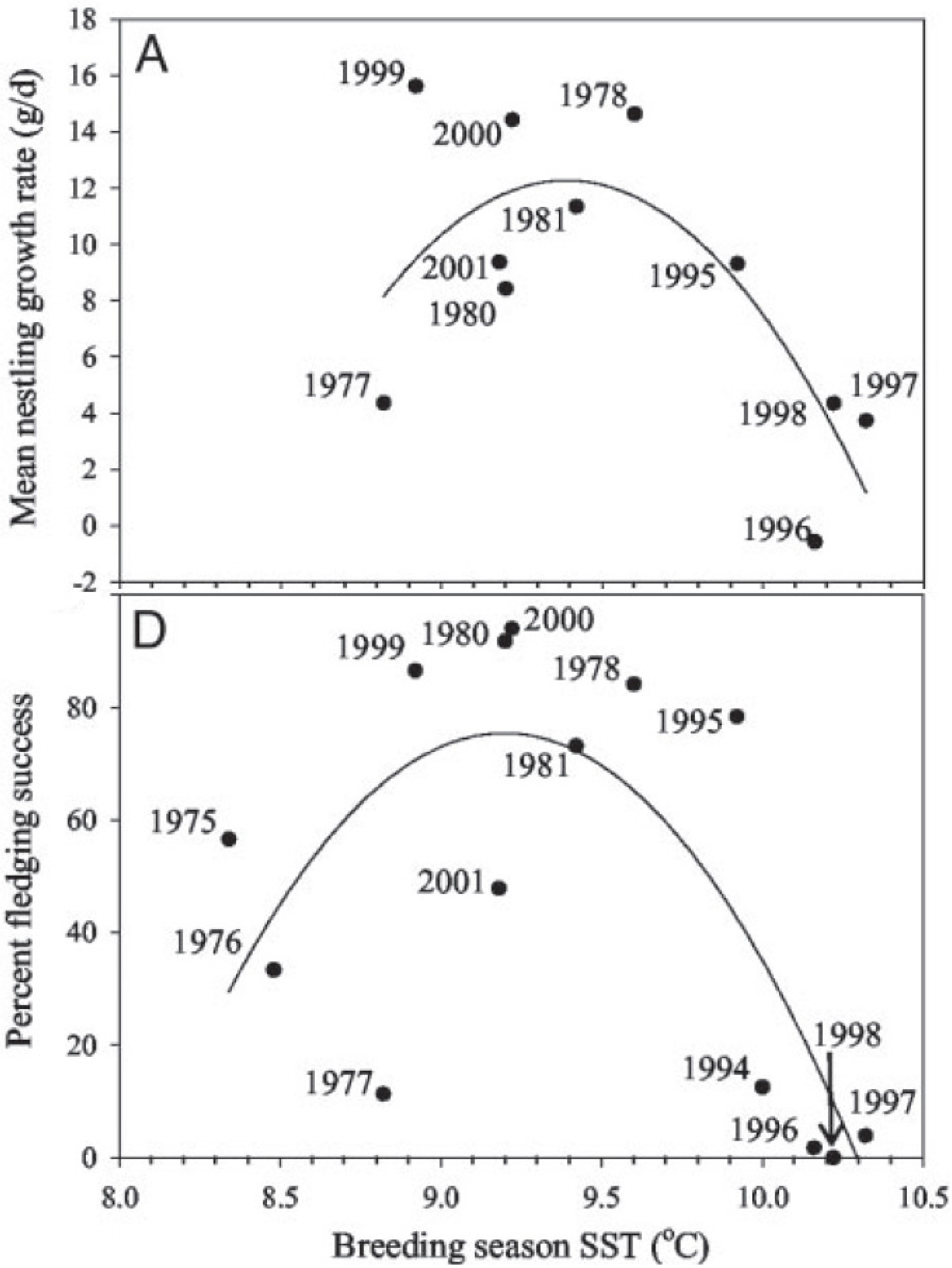

Figure 8: (A) Interannual changes in tufted puffins' nestling mass growth rate as a function of breeding season sea surface temperature (SST). (D) Interannual changes in tufted puffins' fledging success as a function of breeding season SST (modified from Gjerdrum *et al.* 2003).

Fisheries further exacerbate poor feeding conditions by competing with upper trophic level predators like tufted puffins for available prey species. Significant fisheries exist for forage species in the CCS, with forage species serving as key targets of recreational and commercial fisheries in Mexico, the U.S., and Canada (Koepcke 2009: 7). Forage species targeted by commercial and/or recreational fisheries include anchovy, sardine, euphausiids, mackerel, market squid, shortbelly rockfish, Pacific whiting (also known as hake), sand lance, eulachon, and Pacific herring (Koepcke 2009: 22),[8] many of which are key prey for tufted puffins. Competition with these fisheries can negatively impact the foraging success of birds while rearing a chick, further reducing the reproductive success and recovery potential of tufted puffin populations (McChesney and Carter 2008).

In California, Ainley and Lewis (1974) hypothesized that the collapse of Pacific sardines in the 1940s hindered the recovery of depleted tufted puffin populations. After experiencing a moderate recovery in the intervening decades, fisheries reopened and Pacific sardines are currently harvested for use as feed (for tuna farms in Australia), bait (for Asian longline tuna fisheries), and in small amounts for human consumption (Enticknap *et al.* 2011). However, sardine stock biomass levels have been steadily declining since 2006 (Hill 2013), and based on recent climate, biological, and population indicators, some experts believe that the Pacific sardine population today is again on the verge of collapse (Žwolinski and Demer 2012; Demer and Žwolinski 2012). In 2013, catch levels were low to non-existent along the coast from Canada to California. As of January 2014, stock (age 1+) biomass levels were projected to be 378,120 metric tons (mt), the lowest levels since before 1993 (Hill 2013: 4). The downward trend for the Pacific sardine population is projected to continue due to recent low recruitments (Hill 2013: 6).

There is widespread agreement that Pacific sardine populations have declined from peak levels around 10 years ago and that "maintenance of the northern portion of the [sardine] stock (shared by the United States and Canada) may be important to resource health" (MacCall *et al.* 2012). However, according to Žwolinski and Demer (2012) and Demer and Žwolinski (2012), 2013 quotas for the sardine fishery were set too high and reflected neither the poorer productivity of the recent cohorts nor the unfavorable environmental conditions. Other forage fish have also been experiencing declines. Population estimates for anchovy populations in the CCS indicate depressed populations (Pew 2013). Many Pacific herring populations are also depleted (Pew 2013), including the severely depressed Cherry Point stock in Puget Sound, formerly considered the largest herring stock in Washington State (Stick 2011; Stick and Lindquist 2009; Gustafson *et al*. 2006). Further, eulachon populations in Washington, Oregon, California, and British Columbia were listed as threatened under the Endangered Species Act in 2010 (75 Fed. Reg. 13012). As discussed above, Cury, *et al.* (2011) determined a threshold of roughly one-third of

[8] Forage fish fisheries are used most often in high volume/low value products (Enticknap *et al.* 2011). Forage finfish species, such as anchovy, sardine, herring, sandlance and mackerel, are used to make fishmeal and fish oil, canned or frozen for human consumption, and used as live and dead bait (Koepcke 2009: 7). Pacific whiting is harvested as a forage species in its juvenile stages and made into edible products like surimi (imitation crab meat) (Koepcke 2009: 7). Market squid are consumed by people and used as bait (Koepcke 2009: 8). However, while the global catch value of forage fisheries was recently estimated as $5.6 billion, fisheries supported by forage fish have been estimated to be worth more than twice as much ($11.3 billion) (Pikitch *et al.* 2012).

maximum long-term forage fish biomass below which seabirds experience consistently reduced and more variable productivity. The Pacific sardine and other west coast forage fisheries, in combination with climate-induced reductions in productivity, threaten to reduce prey abundance levels below this one-third threshold.

Fishing also makes forage fish populations more variable in abundance than would occur naturally and more susceptible to climate perturbations (Pew 2013). Such susceptibility might increase because of lower overall abundance, truncated age structure, and localized depletions (Pew 2013).

3. Oil pollution

Oil pollution, such as resulting from spills and other releases into the marine environment, poses a significant threat to tufted puffins. Alcids such as the tufted puffin have been found to be highly vulnerable to oiling, due in part to their pursuit-diving feeding technique (Wehle 1980: 98), and habit of forming groups and "roosting" on the water (King and Sanger 1979; Seip *et al.* 1991; Wiese and Ryan 2003, *cited in* Arnold *et al.* 2002: 7). Out of 176 bird species using the marine habitats of Washington, British Columbia, and Alaska, tufted puffins have been ranked among the highest in vulnerability to oil pollution (King and Sanger 1979, *cited in* Wehle 1980: 16).

Mortality from frequent oil spills has negatively impacted population abundances in the past in California (McChesney and Carter 2008), Washington (WDFW 2013) and Alaska (Piatt and Kitaysky 2002). The 1991 Tenyo Maru oil spill off the coast of Washington killed about 10 percent of the state's population of tufted puffins (Tenyo Maru Oil Spill Natural Resources Trustees 2000). As many as 13,000 tufted puffins may have been killed in the 1989 Exxon Valdez spill, with many apparently dying of starvation long after the spill (Piatt and Kitaysky 2002: 21). The contiguous U.S. DPS of tufted puffins is especially vulnerable to oil pollution due to its small population size (Piatt and Kitaysky 2002), as a single oil spill can wipe out entire breeding colonies. With most of the tufted puffins in the contiguous U.S. DPS concentrated at several breeding sites (*e.g.,* the Farallon Islands in California), a large spill offshore one of these colonies would be catastrophic.

V. In the Alternative, the Tufted Puffin as a Unitary Species Should be Listed as Endangered or Threatened

In the alternative, the FWS should designate the Tufted Puffin as a unitary species as endangered or threatened because it is in danger of extinction, or likely to become in danger of extinction in the foreseeable future, within a significant portion of its range. A portion of a species' range is significant if it contributes meaningfully to the representation, resiliency, or redundancy of the species. *See, e.g.,* 77 Fed. Reg. 54294, 54328 (listing determination for four subspecies of Great Basin butterflies); 73 Fed. Reg. 12929, 12940 (listing determination for American Wolverine). The contiguous U.S. portion of the Tufted Puffin's range specifically contributes meaningfully to the representation, resiliency, and redundancy of the species because, as discussed *supra* at Section II.B.: (1) it constitutes a unique ecological setting for the birds (the CCS LME); (2) it represents a large fraction of the species' total range and all of the range within the contiguous

U.S.; (3) it contains genetic and phenological diversity found nowhere else in the world; and (4) it is located on the periphery of the species' range, and is thus of high conservation significance and importance. Moreover, as discussed *supra* at note 4, the Tufted Puffin is in extirpation in Japan, the southernmost population in the western part of the species' range. Finally, the Tufted Puffin is in danger of extinction, or is likely to become in danger of extinction within the foreseeable future, in a significant portion of its range because in much of the species' historic range, including most of its historic range in the contiguous U.S., the Tufted Puffin is extinct. *See Defenders of Wildlife v. Norton (Lizard),* 258 F.3d 1136, 1145-46 (9th Cir. 2001).

VI. Recovery Plan Elements

The FWS must establish a recovery plan for the contiguous U.S. DPS of tufted puffins (or for the species as a whole, in the event that the FWS chooses to list the unitary species) that addresses reduction in the marine forage base, inadequacy of existing regulatory mechanisms, climate change, and other key threats, and should include the following components: (1) measures to address the current and future effects of global warming on tufted puffins, including measures to protect coastal habitats used as breeding and foraging areas; and (2) fishery restrictions with respect to populations of forage fish species relied on as the primary food supply by tufted puffins (Koepcke 2009: 22).

VII. Critical Habitat Designation

Petitioner requests the designation of critical habitat for tufted puffins breeding off the coast of the contiguous U.S. concurrent with the requested listings, as required by 16 U.S.C. § 1533(b)(6)(C); *see also* 16 U.S.C. § 1533(a)(3)(A). Critical habitat should encompass all coastal land and marine habitats in which such tufted puffins are known to reproduce and forage, respectively.

Critical habitat is defined by Section 3 of the ESA as:

> the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 1533 of this title, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 1533 of this title, upon a determination by the Secretary that such areas are essential for the conservation of the species.

See 16 U.S.C. § 1532(5).

The designation and protection of critical habitat is one of the primary ways to achieve the fundamental purpose of the ESA, "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved." *See* 16 U.S.C. § 1531(b). In adding the critical habitat provision to the ESA, Congress clearly saw that species-based conservation efforts must be augmented with habitat-based measures:

> It is the Committee's view that classifying a species as endangered or threatened is only the first step in insuring its survival. Of equal or more importance is the determination of the habitat necessary for that species' continued existence . . . If the protection of endangered and threatened species depends in large measure on the preservation of the species' habitat, then the ultimate effectiveness of the Endangered Species Act will depend on the designation of critical habitat."

See House Committee on Merchant Marine and Fisheries, H.R. Rep. No. 887, 94th Cong. 2nd Sess. at 3 (1976).

The Tufted Puffin will benefit from the designation of critical habitat in all of the ways described above. Designated critical habitat will allow the FWS to designate reasonable and prudent alternatives to activities that would adversely modify habitat essential to the species' survival or recovery. For these reasons and as already stated, we request critical habitat designation concurrent with species listing.

VIII. Conclusion

For all of the reasons discussed in this petition, the FWS should list the contiguous U.S. DPS of the Tufted Puffin as an endangered or as a threatened species under the ESA. In the alternative, the FWS should designate the Tufted Puffin as a unitary species as endangered or threatened under the ESA.

IX. Literature Cited

Adams, R.I., and E.A. Hadly. 2013. Genetic diversity within vertebrate species is greater at lower latitudes. Evolutionary Ecology 27: 133-143.

Adkins-Giese, C.L. 2010. Spreading its Wings: Using the Migratory Bird Treaty Act to Protect Habitat. William Mitchell Law Review 36: 1157-78. Available at: http://www.wmitchell.edu/lawreview/documents/9.AdkinsGiese.pdf.

Ainley, D.G., and R.J. Boekelheide. 1990. Seabirds of the Farallon Islands: Ecology, dynamics, and structure of an upwelling-system community. Stanford University Press. 455 p.

Ainley, D.G. and K.D. Hyrenbach. 2010. Top-down and bottom-up factors affecting seabird population trends in the California current system (1985–2006). Progress in Oceanography 84: 242-254.

Ainley, D.G., and T.J. Lewis. 1974. The history of Farallon Island marine bird populations, 1854-1972. Condor 76: 432-446. Available at: http://elibrary.unm.edu/sora/Condor/files/issues/v076n04/p0432-p0446.pdf

Aquarone, M.C., and S. Adams. 2008. XIV-44 California Current: MLE #3. *In*: Sherman, K. and G. Hempel (editors), The UNEP Large Marine Ecosystem Report: A perspective on changing conditions in LMEs of the world's Regional Seas. UNEP Regional Seas Report and Studies No. 182. United Nations Environment Programme. Nairobi, Kenya. Available at: http://www.lme.noaa.gov/lmeweb/LME_Report/lme_3.pdf

Arnold, J.M., Boyce, J.A., and R.J. Bellmer. 2002. Damage Assessment and Restoration Planning For Marine Birds. National Ocean and Atmospheric Administration, National Marine Fisheries Service, NOAA Technical Memorandum NMFS-F/SPO-55. Available at: http://www.habitat.noaa.gov/pdf/darrp_birds.pdf

Artukhin, Y.B. 2009. Seabird bycatch in salmon gillnet fishery by Russian research vessels in the Russian exclusive economic zone. Pacific Seabird Group 2009 Annual Meeting, Hakadote, Japan. Abstract available at: http://www.pacificseabirdgroup.org/downloads/PSG2009_Abstracts.pdf

Artukhin, Y.B., Burkanov, V.N., and V.S. Nikulin. 2010. Accidental By-catch of Marine Birds and Mammals in the Salmon Gillnet Fishery in the Northwestern Pacific Ocean. Summary. Available at: http://www.wwf.ru/resources/publ/book/eng/446

Artukhin, Y.B., and M. Sato. 2012. Accidental By-catch of Seabirds in the Salmon Gillnet Fishery in the Russian EEZ. Presentation abstract, p. 27 *in* Birdlife International Workshop Report on Seabird Bycatch in Gillnet Fisheries, 3-4 May 2012 in Berlin, Germany. Available at: http://www.birdlife.org/eu/pdfs/20120703_GillnetSeabirdBycatchWorkshopREPORT.pdf

Assis, J., Coelho, N., Alberto, F., Valero, M., Raimondi, P., Reed, D., and E.A. Serrão. 2013. High and distinct range-edge genetic diversity despite local bottlenecks. PLoS ONE 8 (7): e68646.

Barboza, T. 2014. West Coast sardine crash could radiate throughout ecosystem. L.A. Times. January 5, 2014. Available at: http://www.latimes.com/science/la-me-sardine-crash-20140106,0,7084864,full.story#axzz2qGDndcN2

BirdLife International. 2012. Species factsheet: *Fratercula cirrhata*. Available at: http://www.birdlife.org/datazone/speciesfactsheet.php?id=3323 (accessed on 04/04/2012).

Boesch, D. F., Coles, V.J., Kimmel, D.G. and W.D. Miller. 2007. Coastal Dead Zones and Global Climate Change: Ramifications of Climate Change for Chesapeake Bay Hypoxia. Excerpted from the full report, Regional Impacts of Climate Change: Four Case Studies in the United States. Prepared by University of Maryland Center for Environmental Science for the Pew Center on Global Climate Change.

Boone, D.L. 1986. Breeding biology and early life history of the Tufted Puffin (*Fratercula cirrhata*). Master's thesis. Oregon State University, Corvallis, OR. 46 p.

Breton, A.R., A.W. Diamond and S.W. Kress. 2006. Encounter, survival, and movement probabilities from an Atlantic Puffin (*Fratercula arctica*) metapopulation. Ecological Monographs 76: 133-149.

British Columbia (BC) Conservation Data Centre. 2012. Species Summary: *Fratercula cirrhata*. Ministry of Environment, British Columbia, Canada. Downloaded December 8, 2012. Available at: http://a100.gov.bc.ca/pub/eswp/

BC Parks. 2012. Anne Vallee detailed ecological reserve description. Ministry of Environment, British Columbia, Canada. Downloaded July 30, 2012. Available at: http://www.env.gov.bc.ca/bcparks/eco_reserve/anne_er/anne_vallee.pdf

Brodeur, R.D., Frost, B.W., Hare, S., Francis, R., and W.J. Ingraham, 1999. Interannual variations in zooplankton biomass in the Gulf of Alaska, and covariation with California Current zooplankton biomass. *In*: Large Marine Ecosystems of the Pacific Rim: Assessment, Sustainability and Management, *edited by* Q. Tang and K. Sherman. Blackwell Science, pp. 106-138.

Browning, M.R., and W.W. English. 1972. Breeding birds of selected Oregon coastal islands. Murrelet 53: l-7.

Byrd, G.V., Murphy, E.C., Kaiser, G.W., Kondratiev, A.Y., and Y.V. Shibaev. 1993. Status and ecology of offshore fish-eating alcids (murres and puffins) in the North Pacific. Pp. 176–186 *in* The status, ecology, and conservation of marine birds of the North Pacific, *edited by* K. Vermeer, K.T. Briggs, K.H. Morgan, and D. Siegel-Causey. Canadian Wildlife Service Special

Publication, Ottawa, ON. Available at: http://www.pacificseabirdgroup.org/publications/MB_of_NOPAC/SP1993_CWS_EC_18.pdf

California Coastal Commission. UD. California's Islands and Offshore Rocks (excerpted from California Coastal Resource Guide). Available at: http://ceres.ca.gov/ceres/calweb/coastal/islands.html.

California Department of Fish and Wildlife. UD. Species of Special Concern. Available at: http://www.dfg.ca.gov/wildlife/nongame/ssc/.

Carter, H.R., McChesney, G.J., Jaques, D.L., Strong, C.S., Parker, M.W., Takekawa, J.E., Jory, D.L., and D.L. Whitworth. 1992. Breeding populations of seabirds in California, 1989–1991. Unpublished draft report, U.S. Fish & Wildlife Service, Dixon, CA. Available from Carter Biological Consulting, 1015 Hampshire Road, Victoria, BC V8S 4S8, Canada.

Coastal Observation and Seabird Survey Team (COASST). 2013. Beached bird patterns. Accessed April 5, 2013. Available at: http://depts.washington.edu/coasst/patterns.html.

Corcoran, R.M. 2013. Seabird Colony Report, Kodiak Archipelago, Alaska 1975-2011. Unpubl. Refuge Report 02-13. U.S. Fish and Wildlife Service, Kodiak National Wildlife Refuge, Kodiak, Alaska. Available at: http://www.fws.gov/uploadedFiles/Region_7/NWRS/Zone_2/Kodiak/PDF/Kodiak%20Seabird%20Colony%20Report%202013.pdf

Cury, P.M., Boyd, I.L., Bonhommeau, S., Anker-Nilssen, T., Crawford, R.J.M., Furness, R.W., Mills, J.A., Murphy, E.J., Österblom, H., Paleczny, M., Piatt, J.F., Roux, J-P., Shannon, L., and W.J. Sydeman. 2011. Global Seabird Response to Forage Fish Depletion—One-Third for the Birds. Science 334: 1703-1706. Available at: http://www.faralloninstitute.org/Publications/CuryEtal2011Science.pdf

Demer, D.A., and J.P. Zwolinski, J.P. 2012. Reply to MacCall *et al.*: Acoustic trawl survey results provide unique insight to sardine stock decline. Proceedings of the National Academy of Sciences of the United States of America 109: E1132–E1133. Available at: http://www.pnas.org/content/109/19/E1132.full.pdf

Dragoo, D.E., Byrd, G.V., and D.B. Irons. 2011. Breeding status, population trends and diets of seabirds in Alaska, 2008. U.S. Fish and Wildlife Service Report AMNWR 2011/07. Homer, Alaska. Available at: http://alaskamaritime.fws.gov/whatwedo/bioprojects/pdf/summ_2008.pdf

Dragoo, D.E., Renner, H.M., and D.B. Irons. 2013. Breeding status and population trends of seabirds in Alaska, 2012. U.S. Fish and Wildlife Service Report AMNWR 2013/05. Homer, Alaska. Available at: http://www.fws.gov/alaska/nwr/akmar/whatwedo/bioprojects/pdf/summ_2012.pdf

Ehlers, A., Worm, G., and T.B.H. Reusch. 2008. Importance of genetic diversity in eelgrass *Zostera marina* for its resilience to global warming. Marine Ecology Progress Series 335: 1-7.

Enticknap, B., Blacow, A., Shester, G., Sheard, W., Warrenchuk, J., LeVine, M., and S. Murray. 2011. Forage Fish: Feeding the California Current Large Marine Ecosystem. Report for Oceana, Washington, D.C. 43 p. Available at: http://oceana.org/sites/default/files/reports/Forage_Fish_OCEANA_2011_final.pdf

Federal Register (77 FR 73220). 2012. Endangered and Threatened Wildlife and Plants: Proposed Listing Determinations for 82 Reef-Building Coral Species; Proposed Reclassification of *Acropora palmata* and *Acropora cervicornis* From Threatened to Endangered; Proposed Rule. FR Vol. 77, No. 236 (7 December 2012), p. 73220-73262. Available at: http://www.gpo.gov/fdsys/pkg/FR-2012-12-07/pdf/2012-29350.pdf

Federal Register (75 FR 3424). 2010. Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition To Remove the Marbled Murrelet (*Brachyramphus marmoratus*) From the List of Endangered and Threatened Wildlife. FR Vol. 75, No. 13 (21 January 2010), p. 3424-3434. Available at: http://www.gpo.gov/fdsys/pkg/FR-2010-01-21/pdf/2010-951.pdf#page=1

Federal Register (75 FR 13012). 2010. Endangered and threatened wildlife and plants: threatened status for southern distinct population segment of Eulachon. FR Vol. 75, No. 52 (18 March 2010), p. 13012-13024. Available at: http://www.gpo.gov/fdsys/pkg/FR-2010-03-18/pdf/2010-5996.pdf

Feely, R.A., Klinger, T., Newton, J.A., and M. Chadsey. 2012. Scientific Summary of Ocean Acidification in Washington State Marine Waters. NOAA OAR Special Report. Available at: https://fortress.wa.gov/ecy/publications/publications/1201016.pdf

Fish and Wildlife Service (FWS). 2006. Alaska Seabird Information Series: Tufted Puffin. Available at: http://alaska.fws.gov/mbsp/mbm/seabirds/pdf/tupu.pdf

FWS. 2008. Pacific Northwest Seabirds. Oregon Coast National Wildlife Refuge Complex, Newport, OR, Washington Maritime National Wildlife Refuge Complex, Port Angeles, WA, and U.S. FWS. Available at: http://www.fws.gov/oregoncoast/PDF/seabird%20brochure-final_sm.pdf

FWS, U.S. Forest Service, U.S. Animal and Plant Health Inspection Service, GAP Solutions, Inc. Naked Island Group. Prince William Sound. Chugach National Forest, Alaska. 2013. Potential Recovery of Pigeon Guillemot Populations.

Gaston, A.J., Bertram, D.F., Boyne, A.W., Chardine, J.W., Davoren, G., Diamond, A.W., Hedd, A., Montevecchi, W.A., Hipfner, J.M., Lemon, M.J.F., Mallory, M.L., Rail, J.-F., and G.J. Robertson. 2009. Changes in Canadian seabird populations and ecology since 1970 in relation to changes in oceanography and food webs. Environmental Reviews 17: 267-286. Available at: http://www.sfu.ca/biology/wildberg/papers/GastonetalEnvironRev09.pdf

Gjerdrum, C.A., M.J. Vallée, C. Cassady St. Clair, D.F. Bertram, J.L. Ryder, and G.S. Blackburn. 2003. Tufted Puffin reproduction reveals ocean climate variability. Proceedings of the National Academy of Sciences 100: 9377–9382. Available at: http://www.pnas.org/content/100/16/9377

Gladics, A.J., Anholt, A.R., and B.A. Drummond. 2013. Biological monitoring at Aiktak Island, Alaska in 2012. U.S. Fish and Wildlife Service Report, AMNWR 2013/01. Homer, Alaska. Available at: https://absilcc.org/science/amnwr/Shared%20Documents/Aiktak%202012.pdf

Greene, C.H., Pershing, A.J., Cronin, T.M., and N. Ceci. 2008. Arctic climate change and its impacts on the ecology of the North Atlantic. Ecology 89: S24-S38.

Gustafson, R G., Drake, J., Ford, M.J., Myers, J.M., Holmes, E.E., and R.S. Waples. 2006. Status review of Cherry Point Pacific Herring (*Clupea pallasii*) and updated status review of the Georgia Basin Pacific Herring distinct population segment under the Endangered Species Act. NOAA Technical Memorandum NMFS-NWFSC-76. U.S. Department of Commerce, Seattle Washington. 182 pp.

Hampe, A., and R.J. Petit. 2005. Conserving biodiversity under climate change: the rear edge matters. Ecology Letters 8: 461-467.

Hare, S.R., Mantua, N.J., and R.C. Francis. 1999. Inverse Production Regimes: Alaska and West Coast Pacific Salmon. Fisheries 24: 6-14.

Harris, M.P., and S. Wanless. 2011. The Puffin. T & AD Poyser, London, U.K. 256 p.

Hickey, B.M and T.C. Royer. 2001. California and Alaska currents. Encyclopedia of Ocean Sciences. J.H. Steele, S. Thorpe, K. Turekian (eds.). Elsevier Science Ltd., pp. 368-379.

Hill, K.T. 2013. Draft Pacific Sardine biomass projection in 2013 for U.S. Management during the first half of 2014 (Executive Summary). Agenda Item E.5.b, Supplemental Attachment 2. Submitted to Pacific Fishery Management Council, Portland, Oregon. Available at: http://www.pcouncil.org/wp-content/uploads/E5b_SUP_ATT2_Sardine_Projection_NOV2013BB.pdf

Hipfner, J. M., Charette, M.R., and G. S. Blackburn. 2007. Subcolony variation in breeding success in the Tufted Puffin (*Fratercula cirrhata*): Association with foraging ecology and implications. Auk 124: 1149-1157.

Hixon, M.A., Gregory, S.V., Robinson, W.D., Baker, C.S., Batchelder, H.P., Epps, C., Garcia, T.S., Haig, S.M., Letelier, R.M., Lytle, D.A., Menge, B.A., Miller, J.C., Noakes, D.L.G., Peterson, W.T., Rice, J.M., Rumrill, S.S., Schreck, C.B., Suryan, R.M., Sytsma, M., and A.E. White. 2010. Oregon's Fish and Wildlife in a Changing Climate. Chapter 7 in: Oregon Climate Change Research Institute, Oregon Climate Assessment Report, K.D. Dello and P.W. Mote (eds). College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, OR. Available at: http://occri.net/wp-content/uploads/2011/04/chapter7ocar.pdf.

Hodum, P.J., S.F. Pearson, J.K. Parrish, and T.P. Good. 2008. More than Just a Cute PSG Logo: Tufted Puffin Population Status in Washington. Pacific Seabird Group 2008 Annual Meeting, Blaine, Washington. Abstract available at: http://www.pacificseabirdgroup.org/downloads/PSG2008_Abstracts.pdf

Hodum, P.J. 2013. Consideration of the California/Oregon/Washington population of the Tufted Puffin (*Fratercula cirrhata*) as a Distinct Population Segment under the U.S. Endangered Species Act. Attached as Appendix A.

Hovis, A. T., and L. Slater. 2013. Biological monitoring at St. Lazaria Island, Alaska, in 2012. U.S. Fish and Wildlife Service Report, AMNWR 2013/06. Homer, Alaska. Available at: https://absilcc.org/science/amnwr/Shared%20Documents/St%20Lazaria%202012.pdf

International Panel on Climate Change (IPCC). 2007. Fourth Assessment Report: Climate Change 2007. Available at: http://www.ipcc.ch/publications_and_data/ar4/syr/en/contents.html

IPCC. 2013. Working Group I Contribution to the IPCC Fifth Assessment Report Climate Change 2013: The Physical Science Basis Summary for Policymakers. Available at: http://www.climatechange2013.org/images/uploads/WGIAR5-SPM_Approved27Sep2013.pdf.

Jaques, D. 2007. Final Report to the FWS: Castle Rock National Wildlife Refuge Information Synthesis. Available at: http://www.fws.gov/humboldtbay/pdfs/castlerockreport.pdf

Jewett, S.G., Taylor, W.P., Shaw, W.T., and J. W. Aldrich. 1953. Birds of Washington State. University of Washington Press, Seattle.

Kettle, A.B. 2013. Biological monitoring at East Amatuli Island, Alaska in 2011. U.S. Fish and Wildlife Service Report, AMNWR 2013/03. Homer, Alaska. Available at: https://absilcc.org/science/amnwr/Shared%20Documents/E%20Amatuli%202011.pdf

King, J.G., and G.A. Sanger. 1979. Oil vulnerability index for marine oriented birds. *In* J.C. Bartonek and D.N. Nettleship [eds.], *Conservation of Marine Birds of Northern North America*, p. 227-239, Wildlife Research Report No. 11. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C.

King, J.R., Agostini, V.N., Harvey, C.J., McFarlane, G.A., Foreman, M.G.G., Overland, J.E., Di Lorenzo, E., Bond, N.A., and K.Y. Aydin. 2011. Climate forcing and the California Current ecosystem. ICES Journal of Marine Science 68: 1199–1216. Available at: http://icesjms.oxfordjournals.org/content/68/6/1199.full.pdf

Kocourek, A.L., Stephensen, S.W., So, K.J., Gladics, A.J., and J. Ziegler. 2009. Burrow-nesting seabird census of the Oregon Coast National Wildlife Refuge Complex, June – August 2008. U.S. Fish and Wildlife Service Report. Oregon Coast National Wildlife Refuge Complex, Newport, Oregon. 63 pp.

Koepcke, J.M. 2009. Ecosystem-based Management of West Coast Forage Species: Recommendations on how to improve the management and conservation of forage species in the California Current ecosystem. Point Reyes Bird Observatory (PRBO) Conservation Science in collaboration with the Forage Fish Steering Committee. Petaluma, CA. Available at: http://www.prbo.org/cms/docs/marine/FFPlan_Final6-09.pdf

Kotzerka, J., Hatch, S. A., Garthel, S. 2008. Time-Depth-Temperature Recorder Reveals First Insights into Diving Behaviour of Tufted Puffins. Abstract available at: http://www.pacificseabirdgroup.org/downloads/PSG2008_Abstracts.pdf

Kuletz, K.J., Van Atten, A.S., Stephensen, S.W., Manly, B.F., and E.A. Labunski. 2004. Incidental catch of seabirds in the set-gillnet fishery of Kodiak, Alaska, relative to seabird abundance. Poster presentation. Available at: http://www.acjv.org/Marine_Bird_page/Working_Group_Materials/Bycatch/OTHER_RESOURCES/KodiakGillnetPoster_Feb%202004.pdf

Littell, J.S., Elsner, M.M., Whitely Binder, L.C., and A.K. Snover (editors). 2009. The Washington Climate Change Impacts Assessment: Evaluating Washington's Future in a Changing Climate. Climate Impacts Group, University of Washington, Seattle, Washington. Available at: http://www.cses.washington.edu/db/pdf/wacciaexecsummary638.pdf

The Long Term Ecological Research Network. UD. California Current Ecosystem LTER. Available at: http://www.lternet.edu/sites/cce.

Løkkeborg, S. 2008. Review and assessment of mitigation measures to reduce incidental catch of seabirds in longline, trawl and gillnet fisheries. *FAO Fisheries and Aquaculture Circular*. No. 1040. Rome, FAO. 24pp. Available at: ftp://ftp.fao.org/docrep/fao/011/i0447e/i0447e00.pdf

Lowe, R.W, J. Anderson, and D. Matthews. 1988. Oregon seabird colony surveys, 1988-1989. Unpublished field notes. U.S. Fish and Wildlife Service, Newport, Oregon.

Lowe, R. 1993. El Niño hard on Oregon seabirds. Pacific Seabird Group Bulletin 20 (2): 62. Available at: http://www.pacificseabirdgroup.org/publications/PacificSeabirds/VOL_20_2.PDF

MacCall, A.D., Hill, K.T., Cronea, P., and R. Emmett. 2012. Weak evidence for the collapse of sardines. Proceedings of the National Academy of Sciences of the United States of America 109: E1131. Available at: http://www.pnas.org/content/109/19/E1131.full.pdf

Manly, B.F.J., 2007. Incidental take and interactions of marine mammals and birds in the Kodiak Island salmon set gillnet fishery, 2002 and 2005. Final Report to NMFS Alaska Region. Available at: http://www.fakr.noaa.gov/protectedresources/observers/bycatch/kodiakreport02_05.pdf

Manville, A.M. II. 2005. Seabird and Waterbird Bycatch in Fishing Gear: Next Steps in Dealing with a Problem. Pages 1071-1082 *in* Bird Conservation Implementation and Integration in the Americas. Proceedings of the 3rd International Partners in Flight Conference, 2002 March

20-24, Asilomar, CA, Volume 1, *edited by* C.J. Ralph and T.D. Rich. USDA Forest Service, General Technical Report, PSW-GTR-191, Albany, CA.

McChesney, G.J., Carter, H.R., and D.L. Whitworth. 1995. Reoccupation and extension of southern breeding limits of Tufted Puffins and Rhinoceros Auklets in California. Colonial Waterbirds 18: 79–90.

McChesney, G.J., and H.R. Carter. 2008. Tufted Puffin (*Fratercula cirrhata*), *In* California Bird Species of Special Concern: A ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of Western Birds No. 1. *Edited by* Shuford, W. D., and T. Gardali. Western Field Ornithologists, Camarillo, California, and California Department of Fish and Game, Sacramento. p. 213-217. Available at: http://www.dfg.ca.gov/wildlife/nongame/ssc/birds.html

Morrison, K.W., Hipfner, J.M., Gjerdrum, C., and Green, D.J. 2009. Wing Length and Mass at Fledging Predict Local Juvenile Survival and Age at First Return in Tufted Puffins. *The Condor* 111(3):433–441. Available at: http://www.sfu.ca/biology/wildberg/papers/MorrisonetalCondor09.pdf

National Oceanographic and Atmospheric Administration (NOAA). 2001. The United States National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries. Available at: https://alaskafisheries.noaa.gov/protectedresources/seabirds/npoa/npoa.pdf.

Naughton, M. B., D. S. Pitkin, R. W. Lowe, K. J. So, and C. S. Strong. 2007. Catalog of Oregon seabird colonies. U.S. Department of Interior, Fish and Wildlife Service, Biological Technical Publication FWS/BTP-R1009-2007, Washington, D.C. Available at: http://www.fws.gov/oregoncoast/seabird_colony_catalog.htm

North Pacific Research Board (NPRB). 2010. North Pacific Research Board: The Foundational Years: 2001-2008. North Pacific Research Board, Anchorage, AK. 288p. Available at: http://www.nprb.org/about/foundation.html

Ono, K. 2009. Conservation efforts for the Tufted Puffin in Japan. Pacific Seabird Group 2009 Annual Meeting, Hakadote, Japan. Abstract available at: http://www.pacificseabirdgroup.org/downloads/PSG2009_Abstracts.pdf

Ono, K. 2012. Tufted Puffin Conservation in Japan: Trials on Gillnet Mitigation Measures. Presentation abstract, p. 28 *in* Birdlife International Workshop Report on Seabird Bycatch in Gillnet Fisheries, 3-4 May 2012 in Berlin, Germany. Available at: http://www.birdlife.org/eu/pdfs/20120703_GillnetSeabirdBycatchWorkshopREPORT.pdf

Oregon Biodiversity Information Center (ORBIC). 2010. Rare, threatened and endangered species of Oregon. Institute for Natural Resources, Portland State University, Portland, Oregon. 105 pp. Available at: http://orbic.pdx.edu/documents/2010-rte-book.pdf

Oregon Department of Fish and Wildlife. 2008. Sensitive Species: Frequently Asked Questions and Sensitive Species List. Available at: http://www.dfw.state.or.us/wildlife/diversity/species/docs/SSL_by_category.pdf

Ormseth, O.A. 2011. Forage fishes in the Gulf of Alaska. NPFMC Gulf of Alaska SAFE, pp. 1513-1522. NMFS Alaska Fisheries Science Center Available at: http://www.afsc.noaa.gov/REFM/docs/2011/GOAforage.pdf

Osa, Y. and Y. Watanuki. 2002. Status of seabirds breeding in Hokkaido. Journal of the Yamashina Institute for Ornithology 33: 107-141.

Pacific Fisheries Management Council (PFMC). 2012. Decision Summary Document: November 3-7, 2012. PFMC, Portland, Oregon. Available at: http://www.pcouncil.org/wp-content/uploads/1112decisions.pdf

Pearson, S., P. Hodum, and J. Parrish. 2011. Tufted Puffin Status and Trends. Available at: http://wdfw.wa.gov/conservation/research/projects/seabird/Tufted_Puffin_status/index.html

Pew Environment Group, Ocean Science. 2013. The State of the Science: Forage Fish in the California Current.

Piatt, J. F., and A. S. Kitaysky. 2002. Tufted Puffin (*Fratercula cirrhata*). *In* The Birds of North America, no. 611 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA. Available at: http://alaska.usgs.gov/science/biology/seabirds_foragefish/products/publications/Piatt_2002_Tufted_Puffin_Birds_of_N_America.pdf

Provan, J., and C.A. Maggs. 2012. Unique genetic variation at a species' rear edge is under threat from global climate change. Proceedings of the Royal Society of London B 279: 39-47.

Provan, J. 2013. The effects of past, present and future climate change on rangewide genetic diversity in northern North Atlantic marine species. Frontiers of Biogeography 5: 60-66.

Reusch, T.B.H., Ehlers, A., Hämmerli, A., and B. Worm. 2005. Ecosystem recovery after climatic extremes enhanced by genotypic diversity. PNAS 102: 2826-2831.

Rodway, M.S. & M.J.F. Lemon. 2011. Use of permanent plots to monitor trends in burrow-nesting seabird populations in British Columbia. Marine Ornithology 39: 243–253. Available at: http://marineornithology.org/PDF/39_2/39_2_243-253.pdf

Sanctuaries Integrated Monitoring Network. UD. Rocks and Islands. Available at: http://sanctuarysimon.org/regional_sections/rocksIslands/overview.php.

Sanders, S. 2005. California Wildlife Habitat Relationships (CWHR) System Life History Account for the Tufted Puffin (*Fratercula cirrhata*). Update by CWHR program staff to original report *in*:

Zeiner, D.C., Laudenslayer, W.F., Jr., Mayer, K.E., and M. White, eds. 1988-1990. California's Wildlife. Vol. I-III. California Department of Fish and Game, Sacramento, California. Available at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=1837&inline=1

Sato, M., and K. Ono. 2012. 1. Seabirds and Gillnet Bycatch in Japan and 2. Tufted Puffin Conservation in Japan: Trials on Gillnet Mitigation Measures. Oral presentation *at* Birdlife International Workshop on Seabird Bycatch in Gillnet Fisheries, 3-4 May 2012 in Berlin, Germany. Available at: http://www.birdlife.org/eu/pdfs/Russiagillnetbycatch_MayumiSato.pdf

Schoen, S., Piatt, J., Arimitsu, M., Drew, G., Madison, E., and M. Renner. 2013. Seabirds as indicators of forage fish stocks and marine ecosystems in the eastern Aleutian Islands. USGS Alaska Science Center, Anchorage Annual Progress Report. Available at: https://absilcc.org/science/Project%20Reports/Schoen%20etal%202013%20Seabirds%20%20as%20Indicators.pdf

Scripps Institution of Oceanography. 2013. The Keeling curve-a daily record of atmospheric carbon dioxide from the Scripps Institution of Oceanography at UC San Diego. Available at: http://keelingcurve.ucsd.edu/.

Sea Stewards. 2012. CA Fish and Game Commission passes the Forage Fish bill. Published online, November 8, 2012. Sea Stewards, Sausalito, California. Available at: http://seastewards.org/ca-fish-and-game-commission-passes-the-forage-fish-bill/

Sowls, A.L., DeGange, A.R., Nelson, J.W., and G.S. Lester. 1980. Catalog of California seabird colonies. U.S. Fish & Wildlife Service, Biological Service Program. FWS/OBS-80/37.

Speich, S.M., and T.R. Wahl. 1989. Catalog of Washington Seabird Colonies. United States Fish and Wildlife Service, Mineral Management Service, Department of the Interior. Biological Report 88 (6); OCS Study MMS 89-0054.

Stephensen, S.W. 2014. Tufted Puffin monitoring study at Haystack Rock, Cannon Beach, Oregon 2010-2013. U.S. Fish and Wildlife Service Unpublished Report, Oregon Coast National Wildlife Refuge Complex, Newport, Oregon 97365. 16 pp.

Stick, K. 2011. Report to Washington Department of Natural Resources – Results of 2011 Cherry Point Herring Acoustic/Trawl Survey. Interagency Agreement No. IAA 11-276. Washington Department of Fish & Wildlife, Olympia, WA.

Stick, K.C., and A.P. Lindquist. 2009. 2008 Washington State herring stock status report. Washington Department of Fish and Wildlife, Stock Status Report Number FPA 09-05. 111 p. Available at: http://wdfw.wa.gov/publications/pub.php?id=00928

Suryan, R.M., Phillips, E.M., So, K.J., Zamon, J.E., Lowe, R.W., and S.W. Stephensen. 2012. Marine bird colony and at-sea distributions along the Oregon coast: Implications for marine spatial planning and information gap analysis. Northwest National Marine Renewable Energy

Center Report no. 2. Corvallis: NNMREC. 26 pp. Available at: http://mhk.pnnl.gov/wiki/images/e/ea/Suryan_et_al_2012_NNMREC_OR_seabirds.pdf

Tenyo Maru Oil Spill Natural Resources Trustees. 2000. Final Restoration Plan and Environmental Assessment for the Tenyo Maru Oil Spill. U.S. Fish and Wildlife Service, Western Washington Office, Lacey, Washington. Available at: http://www.fws.gov/contaminants/restorationplans/tenyomaru/rpTenyo_final4-00_summary.pdf

Varoujean, D.H., and R.L. Pitman. 1979. Oregon seabird colony survey, 1979. Unpublished report. U.S. Fish and Wildlife Service, Portland, Oregon. 145 pp. Available at: http://farallones.noaa.gov/eco/seabird/pdf/articles/monitoringandstatus/varoujeanpitman1979.pdf

Vedder, O., Bouwhuis, S., and B.C. Sheldon. 2013. Quantitative assessment of the importance of phenotypic plasticity in adaptation to climate change in wild bird populations. PLoS Biology 11(7): e1001605.

Vermeer, K., and L. Cullen 1979. Growth of Rhinoceros Auklets and Tufted Puffins, Triangle Island, British Columbia. Ardea 67: 22-27. Available at: http://ardeajournal.natuurinfo.nl/ardeapdf/a67-022-027.pdf

Vermeer, K., Cullen, L., and M. Porter. 1979. A provisional explanation of the reproductive failure of Tufted Puffins (*Lunda cirrhata*) on Triangle Island. Ibis 121: 348-354. Available at: http://www.env.gov.bc.ca/bcparks/eco_reserve/anne_er/Tufted_Puffin_reproductive_failure.pdf

Wahl, T.R. and B. Tweit. 2000. Seabird abundances off Washington, 1972-1998. Western Birds 31: 69-88. Available at: http://elibrary.unm.edu/sora/wb/v31n02/p0069-p0088.pdf

Ware, D.M. and G.A. McFarlane. 1989. Fisheries production domains in the northeast Pacific Ocean. *In* Effects of Ocean Variability on Recruitment and an Evaluation of Parameters used in Stock Assessment Models, *edited by* R.J. Beamish and G.A. McFarlane. Canadian Special Publication of Fisheries and Aquatic Sciences 108: 359-379.

Warzybok, P.M, Berger, R.W., and R.W. Bradley. 2012. Status of Seabirds on Southeast Farallon Island During the 2012 Breeding Season. Unpublished report to the US Fish and Wildlife Service. PRBO Conservation Science, Petaluma, California. PRBO Contribution Number 1906. Available at: http://www.prbo.org/cms/docs/farallones/StatusofSeabirdsonSEFI_Report%202012_Final.pdf

Washington Department of Fish and Wildlife (WDFW). 2013. Candidate Species: Tufted Puffin (*Fratercula cirrhata*). Pages 197-199 *in* Threatened and Endangered Wildlife in Washington: 2012 Annual Report. Listing and Recovery Section, Wildlife Program. Washington Department of Fish and Wildlife, Olympia. 251 pp. Available at: http://wdfw.wa.gov/conservation/endangered/species/tufted_puffin.pdf

Wehle, D.H.S. 1980. The breeding biology of the Puffins: Tufted Puffin (*Lunda cirrhata*), Horned Puffin (*Fratercula corniculata*), Common Puffin (*F. arctica*), and Rhinoceros Auklet (*Cerorhinca monocerata*). Ph.D. dissertation, University of Alaska, Fairbanks.

Welch, C. 2012. Rabbits ravage seabird populations on Destruction Island. Published August 4, 2012. The Seattle Times, Seattle, WA. Available at: http://seattletimes.com/html/localnews/2018850249_destruction05m.html

Williams, C.T., and C.L. Buck. 2010. Spatial and temporal variation in Tufted Puffin *Fratercula cirrhata* nestling diet quality and growth rates. Marine Ornithology 38: 41–48.

Zwolinski, J.P., and D.A. Demer. 2012. A cold oceanographic regime with high exploitation rates in the Northeast Pacific forecasts a collapse of the sardine stock. Proceedings of the National Academy of Sciences of the United States of America 109: 4175–4180. Available at: http://www.pnas.org/content/109/11/4175.full.pdf

Žydelis, R., Bellebaum, J., Österblom, H., Vetemaa, M., Schirmeister, B., Stipniece, A., Dagys, M., van Eerden, M., and S. Garthe. 2009. Bycatch in gillnet fisheries: An overlooked threat to waterbird populations. Biological Conservation 142: 1269-1281. Available at: http://bycatch.nicholas.duke.edu/publicationsandreports/Zydelis2009.pdf

Žydelis, R., Small, C., and G. French. 2013. The incidental catch of seabirds in gillnet fisheries: A global review. Biological Conservation 162: 76-88.

Appendix A

Consideration of the California/Oregon/Washington population of the Tufted Puffin (*Fratercula cirrhata*) as a Distinct Population Segment under the U.S. Endangered Species Act

Prepared for the Natural Resources Defense Council (NRDC) by:
Peter J. Hodum, Ph.D.
Assistant Professor
Biology Department and Environmental Policy and Decision Making Program
University of Puget Sound

May 13, 2013

Introduction

The U.S. National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) have published a policy to define a Distinct Population Segment (DPS) for the purposes of listing, delisting, and reclassifying species under the Endangered Species Act (ESA). (61 Fed. Reg. 4722, February 7, 1996). Under this policy, a DPS is defined as a vertebrate population or group of populations of the species that is both *discrete* from other populations and *significant* relative to the entire species. Thus, in order to meet the criteria for a DPS designation, the California/Oregon/Washington population of Tufted Puffins must be both discrete from other populations as well as significant for the species as a whole.

The population of Tufted Puffins (*Fratercula cirrhata*) in the contiguous United States has declined significantly in all three states in which it breeds (California, Oregon and Washington (CA/OR/WA)) within the last three decades (summarized in Piatt and Kitaysky 2002). As discussed below, this population, which breeds on islands in the California Current System (or CCS), is both discrete from other populations of the species and significant relative to the species as whole.

Discussion

The CA/OR/WA Population is Discrete

The FWS Policy for the Recognition of Distinct Vertebrate Population Segments provides that a population segment of a vertebrate species is to be considered discrete if it satisfies either one of the following conditions:

1. It is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors. Quantitative measures of genetic or morphological discontinuity may provide evidence of this separation.
2. It is delimited by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of section 4(a)(1)(D) of the Act.

In the case of the CA/OR/WA population of Tufted Puffins, the first condition clearly applies. The CA/OR/WA population is markedly separated from other populations as a consequence of (1) ecological factors resulting from differences between the California Current System inhabited by this population and the ecological settings inhabited by other Tufted Puffin populations, including specifically the adjacent Alaska Current System, (2) the significant physical separation between the breeding colonies of the CA/OR/WA population and those of other Tufted Puffin populations, (3) the species' limited dispersal capacity and colony philopatry, and (4) behavioral/physiological factors, including differences in breeding timing, reproductive success, and diet between the CA/OR/WA population and other Tufted Puffin populations.

Separation resulting from different ecological settings
To address the criterion of discreteness, the oceanography of the northeastern Pacific Ocean must be considered. Within the North American range of the Tufted Puffin, two dominant boundary current systems exist, the California Current and Alaska Current, both of which arise from the eastward-flowing Subarctic (or Aleutian) Current (Hickey and Royer 2001). These currents contribute to the formation of the California Current and Gulf of Alaska large marine ecosystems (LMEs). The transition zone between these two current systems typically occurs between the southern tip of the Queen Charlotte Islands and the northern tip of Vancouver Island (Ware and McFarlane 1989).

Productivity in both LMEs is affected by large-scale atmospheric and oceanographic conditions. Physical and biological parameters vary inter-annually in both systems. Evidence, however, suggests that such variability may be out of phase, with the two systems responding differently to large-scale fluctuations, such as the El Niño Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO) (Hickey and Royer 2001). Changes in zooplankton biomass have been documented in both the Gulf of Alaska and California Current LMEs, with the changes apparently inversely related to each other (Brodeur et al. 1999).

The California Current LME is influenced by events that occur at both basin-wide and local scales, thereby resulting in an ecosystem that is considered to be highly variable (Brodeur et al. 1996, McGowan et al. 1998, Chavez et al. 2003, Lluch Belda et al. 2003, Field et al. 2006). The effects of coastal upwelling, the ENSO and the PDO result in strong interannual variability in the productivity of the ecosystem (Hickey and Royer 2001). It is one of five LMEs in the world that undergo seasonal upwellings of cold nutrient rich water which result in localized high primary productivity, although it is classified as a low productivity ecosystem as a whole (Aquarone and Adams 2008).

In contrast, the Gulf of Alaska LME is influenced by the downwelling Alaska Current (Ware and McFarlane 1989) and is classified as a high productivity ecosystem (Baum et al. 2011). Thus, in addition to being spatially discrete, these two LMEs are characterized by differences in productivity, physical oceanographic processes and responses to large-scale ocean-climate fluctuations. As such, the habitat utilized by Tufted Puffins in the California Current LME is distinct from that used by the population in the Gulf of Alaska LME, as well as that of other populations of the species.

As noted above, there is a transition zone between the California Current LME and the Gulf of Alaska LME, the precise location of which varies between years but is broadly situated between the Queen Charlotte Islands to the north and Vancouver Island to the south. Importantly, however, there is a lack of suitable breeding islands for Tufted Puffins in this transition zone.

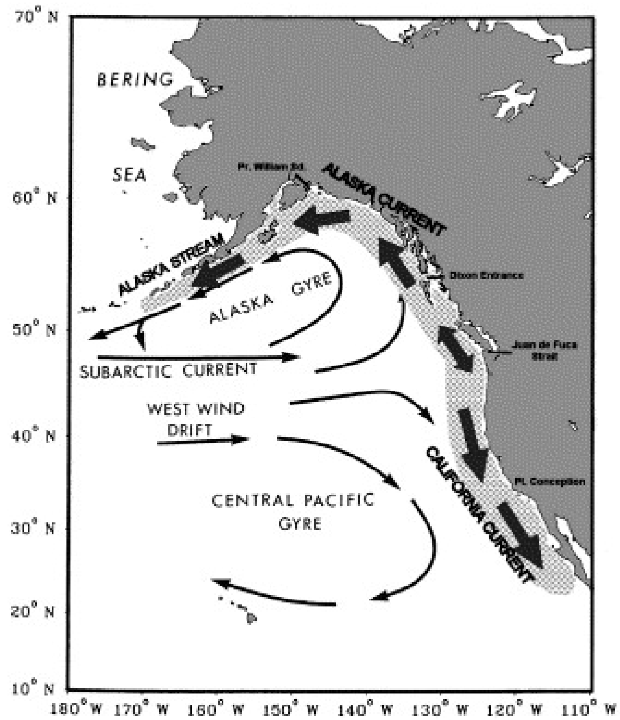

Figure 1. Map of the NE Pacific (adapted from Ware and McFarlane 1989) showing California and Alaska Current systems as annual-averaged large-scale current patterns. The location of the transition zone between the two systems varies between years.

Separation caused by physical distance between breeding colonies, limited dispersal capacity and colony philopatry

The significant physical distance separating the breeding colonies of the CA/OR/WA population from breeding colonies of other Tufted Puffin populations, in conjunction with the limited dispersal capacity and colony philopatry that is characteristic of alcids, contributes to the discreteness of the CA/OR/WA population. The northernmost Tufted Puffin colony in the contiguous U.S. population is located on Tatoosh Island (48°23' N, 124°44' W), which is approximately 415 km in linear distance from the nearest colony in British Columbia, Triangle Island (50°52' N, 129°05' W). The next nearest colony, on Kerouard Island, is located at the southern tip of the Queen Charlotte Islands, 175 km north of Triangle Island.

At present, no published data on dispersal capabilities and breeding colony fidelity exist for Tufted Puffins. There are limited data that suggest fidelity by breeding birds to nesting burrows between years (Wehle 1980), findings that support the idea of fidelity to nesting colonies by breeding adults. In the closely related Atlantic Puffin (*Fratercula arctica*), breeding site fidelity and natal philopatry have been well studied and are well established (Harris and Wanless 2011). There are no documented occurrences of breeding adult Atlantic Puffins changing breeding colonies, which suggests extremely high adult fidelity to nesting sites (Harris and Wanless 2011).

Natal dispersal is a second possible mechanism by which puffins can move between breeding colonies. In studies of Atlantic Puffins in the United Kingdom, movement between colonies was common (up to 62% of surviving individuals) but was restricted to immature birds (Harris and Wanless 2011). Typical distances of these dispersal events were 100 km or less, although there were isolated movements of individuals to colonies up to 600 km (Harris and Wanless 2011). It is important to note that these extraordinary movements comprised less than 1% of dispersal events and that there were breeding colonies on intermediate islands between the natal colony and the destination island (Harris and Wanless 2011). A study of Atlantic Puffins from northern Norway found that virtually all individuals that survived from fledging to maturity returned to their natal colony, and emigration of immature puffins at any scale was considered to be virtually non-existent (Sandvik et al. 2008). In the Gulf of Maine, Breton et al. (2006) estimated the rate of natal dispersal for Atlantic Puffins away from breeding colonies on four islands as ranging from 8-57%. The maximum linear distance between the four breeding islands, from southernmost to northernmost, was 180 km, 43% of the distance between Tatoosh Island and Triangle Island. In addition, the maximum distance between any two islands in the study was approximately 80 km, and dispersal rates correlated negatively with distance to nearest island. Thus, the dispersal rate between islands 80 km apart was only 8%. Assuming that dispersal capability is similar in Tufted Puffins, the minimum distance that young birds dispersing from their natal colonies would need to cover between the northernmost colony in Washington, Tatoosh Island, and the nearest breeding colony outside of the California Current LME (Triangle Island) is 415 km. This suggests that the dispersal rate from natal colonies between Tatoosh and Triangle Island approaches zero. Under this assumption of comparable dispersal capabilities, movement of individuals between colonies is unlikely, especially at the large spatial scales that would be involved for birds to move between the California and Alaska current systems.

Phenological discreteness

Timing of breeding in Tufted Puffins varies as a function of latitude, with the season occurring later at higher latitudes (summarized in Piatt and Kitaysky 2002). There is even breeding asynchrony within LME populations. For example, in the CCS, there is a three week difference in mean arrival dates between the Farallon Islands in California and Goat Island in Oregon, colonies approximately 490 km apart (Ainley and Boekelheide 1990 and Boone 1986, respectively). Between the CA/OR/WA and the Gulf of Alaska populations, a temporal offset in breeding phenology of two months has been documented (Piatt and Kitaysky 2002). Ultimately, the magnitude of these differences between colonies in these two LMEs likely acts as an isolating mechanism and decreases the probability of successful establishment of birds moving between the two systems, if they are even capable of dispersing at that scale.

Dietary discreteness

Differences in conditions between oceanographic domains are also reflected in significant dietary differences (summarized in Piatt and Kitaysky 2002). Percentages of invertebrates and dominant fish species in the diet of Tufted Puffins vary between colonies in the California Current and Gulf of Alaska LMEs (Piatt and Kitaysky 2002). These differences derive, in part, from distinctive assemblages of prey species that are shaped by the previously discussed differences in oceanographic conditions between the two LMEs. As such, Tufted Puffins in the California Current LME respond to a suite of environmental conditions unique to the LME, including both physical (e.g., strength of upwelling) and biological (e.g., prey availability and abundance). Although there are no published studies on comparative foraging strategies, such dietary differences may require different foraging techniques.

Reproductive success discreteness
Populations breeding in different oceanographic domains are subjected, and respond, to conditions unique to their domain. Tufted Puffin reproductive success is decoupled between the populations, meaning that reproductive success values in the Alaska Current LME do not correlate with those in the California Current (Hipfner et al. 2007 for Triangle Island, Hodum et al. unpubl. data for Tatoosh Island, summarized in Piatt and Kitaysky 2002). For example, hatching success and chick survival appear to be lower on Tatoosh than on Triangle Island (Hipfner et al. 2007, Hodum et al. unpubl. data).

The CA/OR/WA Population is Significant
According to the FWS DPS policy, a population needs to meet at least one of the following criteria to be considered significant:
1. Persistence of the discrete population segment in an ecological setting unusual or unique to this taxon;
2. Evidence that loss of the discrete population would result in a significant gap in the range of a taxon;
3. Evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historical range; and
4. Evidence that the DPS differs markedly from other populations of the species in its genetic characteristics.

Although the CA/OR/WA population of Tufted Puffins currently represents a small percentage of the global breeding population (approximately 4%), the population is significant at the level of the species because it satisfies the first two of the above criteria. In addition, the CA/OR/WA population was probably larger historically.

As discussed above, the California Current System inhabited by the CA/OR/WA population is a unique marine ecosystem and, as such, presents an ecological setting distinct from that of the Gulf of Alaska LME. Outside of North America, Tufted Puffins breed primarily in Russia in two distinctive LMEs, the Chukchi Sea and West Bering Sea (summarized in Piatt and Kitaysky 2002, Mahon et al. 2010). Both of these ecosystems are located within oceanographic domains distinct from both the Gulf of Alaska and California Current LMEs. Loss of the CA/OR/WA population would mean that the species has disappeared from a unique ecosystem that it historically inhabited.

In addition, the extirpation of the discrete CA/OR/WA population would represent a significant gap in the range of the taxon. Loss of this population, given that it has evolved in an ecological setting distinct and different from the other populations, would likely result in a corresponding loss of unique ecological and adaptive characteristics and compromise the evolutionary capacity of the species. A distinct population segment for Marbled Murrelets (*Brachyramphus marmoratus*) within the California Current LME was established, in part, on such a basis (McShane et al. 2004). Given that murrelet populations are less discontinuous in their distribution and do not have such significant distances between breeding colonies in the CCS LME, transitional zone and Gulf of Alaska LME compared to Tufted Puffins, the argument is even more compelling for puffins.

Conclusion

The population of Tufted Puffins in CA/OR/WA (California Current System) is both discrete from other populations of Tufted Puffins, including specifically the Gulf of Alaska LME population, and significant. As such, the CA/OR/WA population fulfills the criteria for designation as a Distinct Population Segment pursuant to the NMFS/FWS DPS policy.

Literature cited

Ainley, D.G. and R.J. Boekelheide, eds. 1990. Seabirds of the Farallon Islands. Stanford Univ. Press, Stanford, CA.

Aquarone, M.C. and S. Adams. 2008. XIV-44 California Current: MLE #3. *In*: Sherman, K. and G. Hempel (editors), The UNEP Large Marine Ecosystem Report: A perspective on changing conditions in LMEs of the world's Regional Seas. UNEP Regional Seas Report and Studies No. 182. United Nations Environment Programme. Nairobi, Kenya.

Baum, S., P. Saundry and C.M. Hogan. 2011. "Alaska Current". In: Encyclopedia of Earth. Eds. Cutler J. Cleveland (Washington, D.C.: Environmental Information Coalition, National Council for Science and the Environment). [First published in the Encyclopedia of Earth March 29, 2010; Last revised Date August 29, 2011; Retrieved March 24, 2013 <http://www.eoearth.org/article/Alaska_Current>].

Boone, D.L. 1986. Breeding biology and early life history of the Tufted Puffin *Fratercula cirrhata*, M.Sc. thesis. Oregon State University, Corvallis, OR.

Breton, A.R., A.W. Diamond and S.W. Kress. 2006. Encounter, survival, and movement probabilities from an Atlantic Puffin (*Fratercula arctica*) metapopulation. Ecological Monographs 76: 133-149.

Brodeur, R.D., B.W. Frost, S. Hare, R. Francis and W.J. Ingraham, 1999. Interannual variations in zooplankton biomass in the Gulf of Alaska, and covariation with California Current zooplankton biomass, In: Large Marine Ecosystems of the Pacific Rim: Assessment, Sustainability and Management, Q. Tang and K. Sherman (eds.), Blackwell Science, pp. 106-138.

Harris, M.P., and S. Wanless. 2011. The Puffin. T & AD Poyser, London, U.K., 256 p.

Hickey, B.M and T.C. Royer. 2001. California and Alaska currents. Encyclopedia of Ocean Sciences. J.H. Steele, S. Thorpe, K. Turekian (eds.). Elsevier Science Ltd., pp. 368-379.

Hipfner, M.J., M.R. Charette and G.S. Blackburn. 2007. Subcolony variation in breeding success in the Tufted Puffin (*Fratercula cirrhata*): Association with foraging ecology and implications. The Auk 124: 1149-1157.

Lluch Belda, D., D.B. Lluch Cota and S. Lluch Cota. 2003. Interannual variability impacts on the California Current Large Marine Ecosystem, In: Large Ecosystems of the World: Trends in Exploitation, Protection and Research, G. Hempel and K. Sherman (eds.), Elsevier, Amsterdam, pp. 195-226.

Mahon, R., L. Fanning, P. McConney and R. Pollnac. 2010. Governance characteristics of large marine ecosystems. Marine Policy 34: 919-927.

McShane, C., T. Hamer, H. Carter, G. Swartzman, V. Friesen, D. Ainley, R. Tressler, K. Nelson, A. Burger, L. Spear, T. Mohagen, R. Martin, L. Henkel, K. Prindle, C. Strong, and J. Keany. 2004. Evaluation report for the 5-year status review of the marbled murrelet in Washington, Oregon and California. Unpublished report. EDAW, Inc. Seattle, WA. Prepared for the U.S. Fish and Wildlife Service, Region 1. Portland, OR.

Piatt, J.F. and A.S. Kitaysky. 2002. Tufted Puffin (*Fratercula cirrhata*). In The Birds of North America, No. 708 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Sandvik, H., J.E. Erikstad, P. Fauchald, and T. Tveraa. 2008. High survival of immatures in a long-lived seabird: Insights from a long-term study of the Atlantic Puffin (*Fratercula arctica*). Auk 125: 723-730.

Ware, D.M. and G.A. McFarlane. 1989. Fisheries production domains in the northeast Pacific Ocean. *In* Effects of Ocean Variability on Recruitment and an Evaluation of Parameters used in Stock Assessment Models, R.J. Beamish and G.A. McFarlane (eds.). Canadian Special Publication of Fisheries and Aquatic Sciences 108: 359-379.

Wehle, D.H.S. 1980. The breeding biology of the Puffins: Tufted Puffin (*Lunda cirrhata*), Horned Puffin (*Fratercula corniculata*), Common Puffin (*F. arctica*), and Rhinoceros Auklet (*Cerorhinca monocerata*). Ph.D. dissertation, University of Alaska, Fairbanks.

Appendix B

CURRICULUM VITAE: PETER J. HODUM

Biology Department
University of Puget Sound
1500 N. Warner St.
Tacoma, WA 98416 USA
phodum@pugetsound.edu / peter@oikonos.org

EDUCATION

Ph.D., Ecology, University of California, Davis. 1999.
Dissertation: Foraging ecology and reproductive energetics of Antarctic fulmarine petrels
B.A., Biology/Environmental Studies, Bowdoin College. 1988.
Sea Semester, Sea Education Association, Boston University. 1986.

CURRENT POSITIONS

Assistant Professor, Biology Department and Environmental Policy and Decision Making program, University of Puget Sound
Director, Chile Program and Juan Fernández Islands Conservancy, programs of Oikonos Ecosystem Knowledge
Board of Directors, Oikonos Ecosystem Knowledge
Visiting Faculty, Universidad de Concepción, Chile

PREVIOUS POSITION

Assistant Professor, Departments of Biological Sciences and Science Education, California State University, Long Beach. Fall 2001-Spring 2005.

HONORS AND AWARDS

Fulbright Visiting Scholar Fellowship, Fulbright Chile, 2011
Outstanding Graduate Student Teaching Award, UC Davis, 1998
National Science Foundation Graduate Research Fellowship, 1991-1994
Graduate Group in Ecology Fellowship, UC Davis, 1992
Thomas J. Watson Fellowship, 1988
Phi Beta Kappa, Bowdoin College, 1988

CURRENT RESEARCH

Ecology and conservation of the threatened bird communities of the Juan Fernández Islands, Chile
Collaborators: Dr. Erin Hagen, Island Conservation; Dr. Cristián Estades, Universidad de Chile; Dr. Billy Ernst, Universidad de Concepción; Jorge Tomasevic, Univ. of Washington; Parque Nacional Archipiélago Juan Fernández, CONAF, Chile
Community-based conservation initiatives for Chilean island communities
Collaborators: Dr. Erin Hagen, Island Conservation; Verónica López and Valentina Colodro, Oikonos
Conservation of the pink-footed shearwater on Isla Mocha, Chile
Collaborator: David Muñoz, Corporación Nacional Forestal, Chile

Foraging ecology and breeding biology of rhinoceros auklets *Cerorhinca monocerata* in Washington
Collaborators: Dr. Scott Pearson, Washington Department of Fish and Wildlife; Dr. Thomas Good, NOAA
Population status of tufted puffins *Fratercula cirrhata* in Washington
Collaborators: Dr. Scott Pearson, Washington Department of Fish and Wildlife; Dr. Thomas Good, NOAA
Impacts of mammals on Washington seabird islands
Collaborators: Dr. Scott Pearson, Washington Department of Fish and Wildlife
Marine plastic debris: impacts of ingestion on marine birds and fish
Collaborators: Michelle Hester and Hannah Nevins, Oikonos; Dr. David Hyrenbach, Hawaii Pacific University; Dr. Gary Shugart, Slater Museum of Natural History, University of Puget Sound
Conservation of the critically endangered Townsend's shearwater in the Revillagigedo Archipelago, México
Collaborator: Dr. Juan Martínez Gómez, Endémicos Insulares

UNIVERSITY TEACHING EXPERIENCE

Visiting/Assistant Professor, Biology Dept., University of Puget Sound, Fall 2005-present (Assistant Professor from Fall 2012-present).
Courses taught:
- Conservation Biology. Upper-division majors course with laboratory.
- Thinking about Biodiversity. Interdisciplinary upper-division undergraduate course.
- Principles of Biology. Non-majors biology course with laboratory.
- Diversity of Life. Lower-division majors course with laboratory.
- Introduction to Biological Research. Research and grant-writing course for majors.
- Ecology. Lower-division majors course with laboratory.
- Ornithology. Upper-division majors course with laboratory.

Visiting Professor, Zoology Department, Universidad de Concepción, Chile, Spring 2011-present.
Course taught:
- Conservación Biológica de Sistemas Terrestres y Marinos. Upper-level undergraduate majors and graduate course.

Assistant Professor, Depts. of Biological Sciences and Science Education, CSU Long Beach, Fall 2001-Spring 2005.
Courses taught:
- Conservation Biology. Upper-level undergraduate majors and graduate course.
- Current Topics in Conservation Biology. Graduate seminar course.
- Marine Ornithology. Upper-level undergraduate and graduate course.
- General Biology and General Biology Laboratory. General Education course and laboratory for non-majors.
- Life Science Applications. Graduate course in Science Education.
- A Process Approach to Science. Upper-level undergraduate course in Science Education.
- Teaching Assistant Professional Development Course. Graduate course for the College of Natural Sciences and Mathematics.

Lecturer, Bamfield Marine Station, Vancouver Island, Canada, Summer 2003.
Biology of Marine Birds. Upper-level undergraduate and graduate course.

Lecturer, Dept. of Nature and Culture, UC Davis, Spring 2000 and 2001.
Nature and Culture Field Methods Course: Natural and Cultural History of the Isla Tiburón Region, Mexico.

Adjunct Faculty, Wildlands Studies, San Francisco State University, Summer 2000 and 2001.
Field Course: Critical Canadian Environments: The Vancouver Island Project.

Co-Lecturer, Dept. of Animal Science, UC Davis, Fall 1997.
Introduction to Avian Biology.

Teaching Assistant, Dept. of Animal Science, UC Davis, Fall 1996.
Introduction to Avian Biology.

STUDENT ADVISING

University of Puget Sound

11 undergraduate thesis advisees.
14 undergraduate independent study advisees.
24 student academic advisees.

California State University, Long Beach

1 Master's student advisee.

Chilean universities

4 undergraduate thesis advisees (co-advised with Chilean university faculty).

PUBLICATIONS

Peer-reviewed articles

Pearson, S.F., P.J. Hodum, T.P. Good, M. Schrimpf and S.M. Knapp. 2013. A model approach for estimating colony size, trends, and habitat associations of burrow-nesting seabirds. The Condor 115: 356-365.

Reyes, R., P. J. Hodum and R. P. Schlatter. 2012. Nest site use in sympatric petrels of the Juan Fernández Archipelago, Chile: Juan Fernández Petrel (*Pterodroma externa*) and Stejneger's Petrel (*Pterodroma longirostris*). Ornitología Neotropical 23: 73-82.

Tomasevic, J.A., P.J. Hodum, and C.F. Estades. 2010. On the ecology and conservation of the critically endangered Másafuera Rayadito (*Aphrastura masafuerae*). Ornitología Neotropical 21: 535-543.

Creuwels, J.C.S., S. Poncet, P.J. Hodum and J.A. van Franeker. 2007. Distribution and abundance of the Southern Fulmar *Fulmarus glacialoides*. Polar Biology 30: 1083-1097.

Snellen, C.L., P.J. Hodum and E. Fernández-Juricic. 2007. Assessing western gull predation on purple sea urchins in the rocky intertidal using optimal foraging theory. Canadian Journal of Zoology 85: 221-231.

Hodum, P. J. and W. W. Weathers. 2003. Energetics of nestling growth and parental effort in Antarctic fulmarine petrels. Journal of Experimental Biology 206: 2125-2133.

Hodum, P. J. 2002. Breeding biology of high-latitude Antarctic fulmarine petrels. Journal of Zoology 256: 139-149.

Townsend, H. M., K. P. Huyvaert, P. J. Hodum, and D. J. Anderson. 2002. Nesting distributions of Galápagos boobies (Aves: Sulidae): an apparent case of amensalism. Oecologia 132: 419-427.

Weathers, W. W., P. J. Hodum, and J. A. Blakesley. 2001. Thermal ecology and ecological energetics of California spotted owls. Condor 103: 678-690.

Hodum, P. J. and K. A. Hobson. 2000. Trophic relationships among Antarctic fulmarine petrels: insights into dietary overlap and chick provisioning strategies inferred from stable isotope (δ^{15}N and δ^{13}C) analyses. Marine Ecology Progress Series 198: 273-281.

Weathers, W. W., K. L. Gerhart, and P. J. Hodum. 2000. Thermoregulation in Antarctic fulmarine petrels. Journal of Comparative Physiology B 170: 561-572.

Hodum, P. J., W. J. Sydeman, G. H. Visser, and W. W. Weathers. 1998. Field metabolic rates of Cassin's Auklets provisioning young. Condor 100: 546-550.

Foin, T. C., S. P. Riley, A. L. Pawley, D. R. Ayres, T. M. Carlsen, P. J. Hodum, and P. V. Switzer. 1998. Improving recovery planning for the conservation of threatened and endangered taxa. Bioscience 48: 177-184.

Weathers, W. W., P. J. Hodum, and D. J. Anderson. 1997. Is the energy cost of begging by nestling passerines surprisingly low? Auk 114: 133.

Hodum, P. J., K. L. Gerhart, and W. W. Weathers. 1996. Growth and development in Antarctic fulmarine petrels. Antarctic Journal of the United States 31: 112-113.

Hodum, P. J. and W. W. Weathers. 1995. Ecological energetics of Antarctic fulmarine petrels. Antarctic Journal of the United States 30: 182-183.

Hodum, P. J. 1994. Foraging ecology and reproductive energetics of Antarctic petrels. Antarctic Journal of the United States 29: 167-168.

Anderson, D. J. and P. J. Hodum. 1993. Predator behavior favors clumped nesting in an oceanic seabird. Ecology 74: 2462-2464.

Wheelwright, N. T., C. B. Schultz, and P. J. Hodum. 1992. Polygyny and male parental care in Savannah sparrows: effects on female fitness. Behavioral Ecology and Sociobiology 31: 279-289.

In review:

Smith, J. and P. J. Hodum. In review. The consequences of a provisioning study on early and late stage Juan Fernández petrel chicks, *Pterodroma externa*. Journal of Avian Biology.

BOOK CHAPTERS

Towns, D.R., A. Aguirre Muñoz, S.W. Kress, P.J. Hodum, A.A. Burbidge and A. Saunders. 2011. The social dimension- public involvement in seabird island restoration. *In* Seabird Islands: Ecology, Invasion and Restoration. Mulder, C.P.H., W.B. Anderson, D.R. Towns and P.J. Bellingham (eds). Oxford University Press.

NATIONAL CONSERVATION PLANS/RECOVERY STRATEGIES

Hinojosa Saez, A. and P.J. Hodum. 2008. Plan nacional para la conservación de la fardela de vientre blanco *Puffinus creatopus* Coues, 1864 en Chile. Corporación Nacional Forestal (CONAF) and Comisión Nacional del Medio Ambiente (CONAMA), Chile.

Environment Canada (Smith, J.L., N.R. Parker, K.H. Morgan, L.K. Blight, P.J. Hodum, M.J. Chutter. T. Mawani, and D. Cunnington). 2008. Recovery strategy for the Short-tailed Albatross (*Phoebastria albatrus*) and the Pink-footed shearwater (*Puffinus creatopus*) in Canada. Environment Canada.

SELECTED TECHNICAL REPORTS

Hodum, P.J. 2013. Seabirds. In: Miller, I.M., Shishido, C., Antrim, L, and Bowlby, C.E. Climate Change and the Olympic Coast National Marine Sanctuary: Interpreting Potential Futures. Marine Sanctuaries Conservation Series ONMS-13-01. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. 238 pp.

Hodum, P.J. 2013. Programas de restauración de hábitat crítico para aves amenazadas en el Archipiélago Juan Fernández. Technical report prepared for CONAF (Chilean Forest Service).

Hodum, P.J. 2013. Programa de conservación del Rayadito de Másafuera (*Aphrastura masafuerae*). Technical report prepared for CONAF.

Hodum, P.J. 2013. Estado poblacional de la Fardela Blanca de Masatierra (*Pterodroma defilippiana*) en el Archipiélago Juan Fernández. Technical report prepared for CONAF.

Hodum, P.J. 2011. Monitoreo de la población reproductora de la Fardela Blanca (*Puffinus creatopus*) en Isla Santa Clara. Technical report prepared for CONAF.

Hodum, P.J. 2011. Monitoreo de la población reproductora de la Fardela Negra (*Pterodroma neglecta*) en Morro Juanango, Archipiélago Juan Fernández. Technical report prepared for CONAF.

Hodum, P.J. 2011. Monitoreo de la población reproductora de la Fardela Blanca (*Puffinus creatopus*) en Isla Santa Clara. Technical report prepared for CONAF.

Hodum, P.J. 2011. Proyecto piloto: Control de plantas invasivas en Isla Alejandro Selkirk, Archipiélago Juan Fernández. Technical report prepared for CONAF.

Hodum, P.J. 2010. Estimación poblacional y evaluación de la clasificación de la Fardela Blanca de Masatierra (*Pterodroma defilippiana*). Technical report prepared for CONAF.

Gladics, A. and P.J. Hodum. 2010. Impactos a madrigueras de la fardela blanca (*Puffinus creatopus*) en colonias con y sin ganado, Isla Robinson Crusoe, Archipiélago Juan Fernández. Technical report prepared for CONAF.

Hodum, P.J. 2007. Population response of pink-footed shearwaters (*Puffinus creatopus*) to the eradication of European rabbits (*Oryctolagus cuniculus*) on Isla Santa Clara. Technical report prepared for CONAF.

Tomasevic, J., A. Suardo, P. Hodum, C. Estades. 2007. Conservación del Rayadito de Másafuera (*Aphrastura masafuerae*)- Informe preliminar – temporada 2006. Technical report prepared for CONAF.

Hodum, P.J. 2006. Biology and conservation of the Juan Fernández Archipelago seabird community. Annual Report prepared for CONAF.

Tomé, A. and P.J. Hodum. 2005. Quantitative assessment of invasive plants on Isla Robinson Crusoe, Juan Fernández Archipelago National Park, V Region, Chile. Technical report prepared for Conservation International.

Hodum, P.J. 2005. Conservation status of the Juan Fernández Archipelago, Chile. Technical assessment report prepared for the Jeniam Foundation.

Mills, K. L., W. J. Sydeman and P. J. Hodum (eds.). 2005. The California Current Marine Bird Conservation Plan, v. 1, PRBO Conservation Science, Stinson Beach, CA.

Hodum, P. J. and M. D. Wainstein. 2004. Biology and conservation of the Juan Fernández Archipelago seabird community. Annual Report prepared for CONAF.
Hodum, P. J. and M. D. Wainstein. 2003. Biology and conservation of the Juan Fernández Archipelago seabird community. Annual Report prepared for CONAF.
Hodum, P. J. and M. D. Wainstein. 2002. Biology and conservation of the Juan Fernández Archipelago seabird community. Annual Report prepared for CONAF.
Hodum, P., A. Miller, D. Page, G. Barlee, and A. O'Carroll. 2002. Logging to extinction: The last stand of the spotted owl in Canada. Technical report prepared for Western Canada Wilderness Committee, Sierra Legal Defense Fund and Forest Watch of British Columbia.
Hodum, P. J. 1999. Assessment of the Herger-Feinstein Quincy Library Group Forest Recovery Act Draft Environmental Impact Statement. Technical Report prepared for Sierra Nevada Forest Protection Campaign.
Hodum, P. J. and S. P. Harrison. 1997. Ecological assessment of the British Columbia Spotted Owl management plan. Technical Report prepared for BC Wild.

EXPERT OPINION

Hodum, P.J. 2013. Consideration of the California/Oregon/Washington population of the Tufted Puffin (*Fratercula cirrhata*) as a Distinct Population Segment under the U.S. Endangered Species Act. Submitted as part of a petition by the Natural Resources Defense Council (NRDC) to the U.S. Fish and Wildlife Service.

SELECTED FUNDED RESEARCH

Mohamed bin Zayed Species Conservation Fund. 2012. Conservation of the critically endangered Másafuera Rayadito. $5,000.
American Bird Conservancy, 2011 and 2012. Breeding population estimate and evaluation of the conservation status of De Filippi's Petrel (*Pterodroma defilippiana*). $5,000.
American Bird Conservancy, 2010-2011. Conservation of the pink-footed shearwater on its breeding grounds. $84,000.
Beneficia Foundation, 2010-2011. Invasive plant control to restore habitat in the Juan Fernández Islands, Chile. $20,000.
Beneficia Foundation, 2009-2010. Capacity building and invasive plant control in the Juan Fernández Islands, Chile. $31,000 (Co-P.I. Erin Hagen).
American Bird Conservancy, 2007-2008. Conservation of the Juan Fernández Firecrown. $40,000 (Co-P.I. Erin Hagen).
American Bird Conservancy, 2007-2008. Conservation of Townsend's Shearwater in the Revillagigedo Archipelago. $5,000 (Lead P.I. Juan Martínez Gómez).
SeaDoc Society, 2007. Testing the limits of diet: Short-term climate effects on seabird-forage fish linkages in Puget Sound. $31,322 (Co-PI with Scott Pearson, Julia Parrish and Tom Good).
Commission for Environmental Cooperation, 2006-2007. Satellite tracking Pink-footed Shearwaters. $25,900 (Co-P.I. David Hyrenbach).
National Atmospheric and Oceanic Administration (NOAA), 2006-2007. Satellite tracking Pink-footed Shearwaters. $10,000 (Co-P.I. David Hyrenbach).
SeaDoc Society, 2006. Linking marine birds to forage fish: Is diet a limiting factor in Puget Sound? $34,417 (Co-PI with Scott Pearson, Julia Parrish and Monique Lance).

Conservation International, 2005-2006. Conservation of the Juan Fernández Firecrown and Másafuera Rayadito. $5000 (Co-P.I.s Cristián Estades and Maria-Victoria López-Calleja).
American Bird Conservancy, 2005-2006. Conservation of the Juan Fernández Firecrown and Másafuera Rayadito. $5000 (Co-P.I.s Cristián Estades and Maria-Victoria López-Calleja).
Commission for Environmental Cooperation, 2005-2006. Satellite tracking Pink-footed Shearwaters. $23,000 (Co-P.I. David Hyrenbach).
Conservation International, 2004-2005. Conservation of the Juan Fernández Firecrown, *Sephanoides fernandensis*, on Isla Robinson Crusoe, Juan Fernández Islands, Chile $5,000 (Co-P.I. Michelle Wainstein).
American Bird Conservancy, 2003-2004. Conservation of the endangered Juan Fernández firecrown (*Sephanoides fernandensis*). $12,500 (Co-P.I.s Federico Johow and Michelle Wainstein).
Wallis Foundation, 2003-04. Conservation of the threatened seabird community of the Juan Fernández Islands, Chile. $50,000. (Co-P.I. Michelle Wainstein).
National Geographic Society, 2002-03. Satellite tracking of pink-footed shearwaters (*Puffinus creatopus*). $16,935. (Co-P.I. Michelle Wainstein).
Wallis Foundation, 2002-03. Conservation of the threatened seabird community of the Juan Fernández Islands, Chile. $50,000. (Co-P.I. Michelle Wainstein).
Wallis Foundation, 2001-02. Conservation of the threatened seabird community of the Juan Fernández Islands, Chile. $40,000. (Co-P.I. Michelle Wainstein).
US Forest Service Research Grant, Redwood Sciences Lab, 1992-94. Thermal ecology and energetics of California spotted owls. $20,000.

SELECTED PRESENTATIONS

Hodum, P.J., E. Hagen, V. Colodro, V. López, C. López and P. González. 2013. Engaging local communities to advance conservation of endemic species: A case study from Chilean islands. International Congress for Conservation Biology.
Adams, J., J.C. Mangel, J. Alfaro-Shigueto, P. Hodum, K.D. Hyrenbach, V. Colodro, P. Palavecino, M. Donoso, and J. Hardesty Norris. 2013. Conservation implications of pink-footed shearwater (*Puffinus creatopus*) movements and fishery interactions off South America assessed using multiple methods. Annual Meeting of the Pacific Seabird Group.
Hodum, P.J., P. González and C. López. 2013. Reevaluating the conservation status of De Filippi's Petrel, a poorly known Chilean endemic. Annual Meeting of the Pacific Seabird Group.
Hodum, P.J. and E. Hagen. 2012. Conservation threats to, and status of, the threatened seabird community of the Juan Fernández Islands, Chile. Fifth North American Ornithological Conference.
Hodum, P.J. and E. Hagen. 2011. Estado y conservación de las aves marinas del Archipiélago Juan Fernández. X Congreso Chileno de Ornitología.
Hodum, P.J. 2011. Estado poblacional de la fardela blanca de Masatierra (*Pterodroma defilippiana*) en el Archipiélago Juan Fernández. X Congreso Chileno de Ornitología.
Tomasevic, J.A., P.J. Hodum and C.F. Estades. 2011. Propuesta para la recuperación del rayadito de Másafuera (*Aphrastura masafuerae*). X Congreso Chileno de Ornitología.

Hodum, P.J., M. Wainstein and E. Hagen. 2010. Conservation threats to, and status of, the threatened seabird community of the Juan Fernández Islands, Chile. 1st World Seabird Conference.

Hodum, P.J., K.D. Hyrenbach and J. Adams. 2010. Wintering habitat use patterns of threatened pink-footed shearwaters. Annual Meeting of the Pacific Seabird Group.

Hodum, P. J., S. F. Pearson, J. K. Parrish and T. P. Good. 2008. More than just a cute logo: population status of Tufted Puffins in Washington. Annual Meeting of the Pacific Seabird Group.

Hodum, P. J., K. D. Hyrenbach and M. D. Wainstein. 2007. Use of distinct marine habitats by threatened pink-footed shearwaters: implications for conservation. Annual Meeting of the Pacific Seabird Group.

Schreiner, M. K., P. J. Hodum and M. D. Wainstein. 2007. The impact of non-native European rabbits on breeding activity, hatching success and chick survival of pink-footed shearwaters. Annual Meeting of the Pacific Seabird Group.

Hodum, P. J., K. D. Hyrenbach and M. D. Wainstein. 2006. Use of distinct foraging habitats by threatened pink-footed shearwaters: implications for interactions with fisheries. Annual Meeting of the Society for Conservation Biology.

Hodum, P. J., M. D. Wainstein and K. D. Hyrenbach. 2005. Pink-footed shearwaters: Population status and use of satellite tracking to determine breeding habitat use patterns. Second International Manx Shearwater Workshop.

Hodum, P. J., M. D. Wainstein and E. Hagen. 2004. Conservation threats to, and status of, the seabird community of the Juan Fernández Islands, Chile. Third International Albatross and Petrel Conference.

Wainstein, M., P. J. Hodum and E. Hagen. 2003. Competition vs. predation: relative impacts of introduced mammals on shearwaters of the Juan Fernández Islands, Chile. Annual Meeting of the Society for Conservation Biology.

Hodum, P. J., M. D. Wainstein and E. Hagen. 2002. Conservation of the threatened seabird community of the Juan Fernández Islands, Chile. 2nd North American Ornithological Conference.

Hodum, P. J. and W. W. Weathers. 2000. Ecological energetics of California spotted owls. Annual Meeting of the Society for Conservation Biology.

Hodum, P. J. and W. W. Weathers. 2000. Reproductive energetics of Antarctic fulmarine petrels. Second International Albatross and Petrel Conference.

Hodum, P. J. 1998. Invited speaker in symposium on “Conservation and ecology of Southern Ocean seabirds.” Annual Meeting of the Society for Conservation Biology.

Hodum, P. J. 1998. Are seabirds indicators of the marine environment? Perspectives from an Antarctic seabird community. North American Ornithological Conference.

Hodum, P. J. and K. A. Hobson. 1998. Trophic relationships of Antarctic fulmarine petrels: a stable isotope perspective. Annual Meeting of the Pacific Seabird Group.

Hodum, P. J. 1997. Interannual variation in foraging of Antarctic fulmarine petrels. Annual Meeting of the Cooper Ornithological Society.

Hodum, P. J. 1996. Comparative nestling growth in Antarctic fulmarine petrels. Annual Meeting of the American Ornithologists’ Union.

PROFESSIONAL SERVICE

Regional Representative, Executive Committee, Pacific Seabird Group, 2013-present.
Member, Puget Sound Environmental Monitoring Program Birds and Mammals Working Group, 2012-present.
Member, Chilean Másafuera Rayadito and Juan Fernández Firecrown National Recovery Team, 2011-present.
Member, Chilean Pink-footed Shearwater National Recovery Team, 2007-present.
Member, Canadian Short-Tailed Albatross and Pink-footed Shearwater National Recovery Team, 2006-present.
Member, Local Organizing Committee, 1st World Seabird Conference, 2009.
Member, Local Organizing Committee, Annual Meeting of the Pacific Seabird Group, 2008.
Member, Curriculum Committee, CSU Long Beach, 2003-2004.
Member, graduate student thesis committees, CSU Long Beach, 2001-2005.
Chairperson, Ecology Graduate Student Association, UC Davis, 1996-1998.
Member, Graduate Group in Ecology Executive Committee, UC Davis, 1996-1998.

COMMUNITY SERVICE AND OUTREACH (since 2005)

Member, Technical Committee, Puget Sound Seabird Survey, Seattle Audubon, 2008-present.
Science Advisor, Tahoma Audubon Conservation Committee, 2012-present.
Six invited presentations to public schools in Washington and Chile, 2006-present.
Twenty-six invited public outreach presentations to local conservation groups in Washington, 2007-present (Audubon chapters, REI lecture series, Outdoor Research lecture series, local birding groups, COASST annual meeting).

REFERENCES

Available upon request.