Conservation Action Plan for Ashy Storm-Petrels (*Oceanodroma homochroa*) in California and Baja California

Ashy storm-petrel at-sea. Photo by D. Pereksta. Used with permission.

FINAL PLAN
September 2016

Suggested Citation: Parker, M.W. 2016. Conservation action plan for ashy storm-petrels (*Oceanodroma homochroa*) in California and Baja California. Unpublished report, California Institute of Environmental Studies, Davis, California. 93 p.

Executive Summary

Current Species Status

The ashy storm-petrel (*Oceanodroma homochroa*; hereafter ASSP) is endemic to the southern California Current System. Its breeding is restricted to nest cavities on coastal rocks and offshore islands from north-central California to northern Baja California, with most of the breeding population found on the offshore islands. Although commonly observed along the continental shelf break of southern to northern California, its breeding population size is relatively small compared to many seabird species. Though only roughly known, it is thought to number about 5,000 breeding pairs. At-sea population estimates place the global population between 10,000 and 20,000 birds. However, both breeding and global population estimates for ASSP suffer from significant data gaps, not uncommon for a cavity-nesting species that visits colonies only at night.

Responding to the proposals by conservation NGOs, the U.S. Fish and Wildlife Service completed status reviews, in 2009 and 2013, to evaluate potential listing of the ASSP under the U.S. Endangered Species Act but ruled that "listing the ashy storm-petrel is not warranted at this time" (USFWS 2013). The Mexican federal government lists the species as in danger of extinction. The State of California has not considered it for listing under the California Endangered Species Act but does consider it a "Species of Special Concern." ASSP, however, is considered endangered and declining by the International Union for the Conservation of Nature (IUCN 2015).

Current Conservation Concerns and Threats

While a majority of the breeding sites of ASSP exist within federal and state public lands, owing to its restricted range there has been concern for its vulnerability to a number of factors. In addition to the need for updated population estimates and trend information, several threats have been identified. Predation by avian and mammalian (native and non-native) predators appears to play a role reducing storm-petrel numbers at several breeding colonies including at the Farallones, California Channel Islands (e.g. Santa Cruz, Santa Barbara, San Miguel, and San Clemente) and Todos Santos Islands. Most of the predation issues are site-specific, can comprise relatively complex predator-prey relationships, and involve socio-political issues to effectively manage predation issues. Thoughtful conservation actions can address identified predation concerns. Other potential threats include human presence at breeding colonies (recreationists, military activities, and researchers), oil and organocholorine pollution, artificial lighting especially on vessels and structures at sea, invasive non-native vegetation, and ingestion of plastics. Finally, wind energy farms, proposed for development off the California coast, have potential to impact ASSP populations.

Conservation Strategy and Goals

The conservation strategy to address the potential vulnerability of the geographically restricted ASSP and help ensure the long-term viability of the ashy storm-petrel focuses on four areas of concentration:

- establishment of an index monitoring program range-wide;
- reduction of predation at breeding colonies, as appropriate;
- use of artificial nest structures and habitat improvements to maintain viable populations, as appropriate;
- surveys and research to: (a) identify unknown breeding locations, (b) determine population size(s) and breeding/non-breeding bird ratios, (c) determine movements and relationships among colonies and (d) identify information gaps and additional conservation issues.

The goals for each of these four areas are:

Index Monitoring Program Goal: Create and implement a range-wide monitoring program that can detect "biologically significant" trends in populations (e.g., population size, breeding success, adult survival) and emphasizes attributes of sampling design (e.g., randomization, bias, detection probability) and a desired level of precision.

Artificial Habitat/Nest Structures Goal: Provide and maintain appropriate artificial habitat and/or nest structures at breeding colonies to aid in the long-term survival of the ASSP colonies (and other co-occurring nesting storm-petrel species, e.g., Leach's storm-petrel *O. leuchorhoa*, black storm-petrel *O. melania*) through greater availability of nesting habitat, improved nesting success, or increased adult survival by reducing the risk of predation at the nest site.

Reduction of Predation at Breeding Colonies: Reduce avian and mammalian predation to a level where predation is no longer a significant risk to the continued survival of ASSP breeding colonies.

Survey and Research Goal: Develop and conduct research to fill information gaps on known and potential threats as well as enhance other conservation actions necessary for the continued existence of ASSP.

Important Conservation Actions

This conservation action plan identifies conservation objectives and linked actions that the Ashy Storm-Petrel Working Group determined important implemented in the next 5 to 10 years in order to ensure the long-term viability of the species. Objectives were ranked when ASSP experts cast from 0 to 5 votes for each objective identified in the plan, with 30 votes allocated to each expert (Appendix 1). A total of 19 individuals voted. The highest priority objectives identified were:

1. Within the next 5 years, complete the necessary NEPA documentation and permitting and eradicate invasive, introduced house mouse from the Farallones, thereby eliminating negative impacts of mouse predation to ASSP and other native species of the Farallon National Wildlife Refuge.
2. Within 3 years of this plan, an ASSP monitoring working group will develop an ASSP monitoring plan.
3. Within 5 years of the completion of this plan, investigate the feasibility of eradicating black rat (*Rattus rattus*) on San Miguel Island. If feasible, initiate rat eradication from San Miguel Island using the selected feasible method.
4. At appropriate ASSP nesting locations, with documented predation issues, Channel Islands National Park and its cooperators will maintain avian predator proof artificial nest sites in order to increase the availability of protected nest sites and reduce the percentage of ASSP nest sites (adults, eggs, and chicks) vulnerable to avian predation.

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Acknowledgements
Funding for the development of this plan was provided by the National Fish and Wildlife Foundation (NFWF) with key assistance from Scott Hall. In-kind contributions were provided by: U.S. Fish and Wildlife Service (Gerry McChesney and Bill McIver); National Park Service (David Mazurkiewicz and Ben Becker); U.S. Geological Service (Josh Adams); Bureau of Land Management (David Ledig); Audubon California (Anna Weinstein, Katie Krieger, and Liling Lee); Carter Biological Consulting (Harry Carter); Point Blue Conservation Science (Jaime Jahncke, Pete Warzybok and Russell Bradley); and California Institute of Environmental Studies (Frank Gress and Jessica Brenner). Scott Hall (NFWF), Anna Weinstein (Audubon California), Shaye Wolf (Center for Biological Diversity), and Harry Carter (Carter Biological Consulting) provided assistance in the development of the grant proposal. Key administrative support at California Institute of Environmental Studies was provided by Frank Gress and Jessica Brenner.

Thanks to Katie Krieger and Liling Lee from Audubon California for their excellent work on the development of the ASSP colony distribution maps. In addition, special thanks go to Jaime Jahncke and Dori Dick of Point Blue Conservation Science (Point Blue) for providing the ASSP at-sea distribution map collating numerous researchers' data. Thanks to all the researchers whose data were included in the figure.

The collation of information and writing of this plan was done by Michael Parker (California Institute of Environmental Studies). However, the development of this plan was a group effort and benefitted from the advice, knowledge, assistance and review of many individuals. The following individuals graciously gave their time to inform this plan: Josh Adams (U.S. Geological Survey); David Ainley (H.T. Harvey & Associates); Sarah Allen (National Park Service); Ben Becker (National Park Service); Yuliana Bedolla-Guzmán (Grupo de Ecología y Conservación de Islas); Melissa Booker (U.S. Navy); Jennifer Boyce (NOAA Restoration Center); Russell Bradley (Point Blue Conservation Science); Harry Carter (Carter Biological Consulting); Alejandra Fabila (Grupo de Ecología y Conservación de Islas); María Félix Lizárraga (Grupo de Ecología y Conservación de Islas); Scott Hall (National Fish and Wildlife Foundation); Alfonso Hernández (Grupo de Ecología y Conservación de Islas); Jim Howard (California Institute of Environmental Studies); Jaime Jahncke (Point Blue Conservation Science); John Knapp (The Nature Conservancy); Danielle Lipski (NOAA, Cordell Bank National Marine Sanctuary); David Ledig (Bureau of Land Management); Annie Little (U.S. Fish and Wildlife Service); David Mazurkiewicz (National Park Service); Gerry McChesney (U.S. Fish and Wildlife Service); William McIver (U.S. Fish and Wildlife Service); Jess Morton (NOAA, Channel Island National Marine Sanctuary); David Pereksta (Bureau of Ocean Energy Management); John Takekawa (Audubon California); Anna Weinstein (Audubon California); Pete Warzybok (Point Blue Conservation Science); James Weigand (Bureau of Land Management) and Shaye Wolf (Center for Biological Diversity).

Section I. Introduction and Background: Need For A Conservation Plan

ASSP is endemic to the southern, Mediterranean climate region of the California Current System. Within that region, its breeding is restricted to nest cavities in xeric locations on coastal rocks and offshore islands from north-central California to northern Baja California, with most of the breeding population found on the offshore islands (Carter et al. 2016a). Although common at sea along the continental shelf break of southern to northern California (Briggs et al. 1987, Ainley 1995), its breeding population is relatively small compared to many seabird species. Indeed, though only roughly known, its breeding numbers are estimated to be about 5,000 breeding pairs; its at-sea numbers indicate a global population of twice that figure (Carter et al. 2016a). However, both breeding and global population estimates for ASSP suffer from significant data gaps, not uncommon for a cavity-nesting species that visits colonies only at night and otherwise found far at sea.

The largest known colony occurs at the South Farallon Islands (hereafter “Farallones”, composed of a group of islets) first estimated at ~1,500 - 2,000 pairs in 1959 and 1971-72 (Ainley and Lewis 1974). Most of the colony occurs on Southeast Farallon Island, since 1969 included within the Farallon National Wildlife Refuge and managed by the U.S. Fish and Wildlife Service. The next largest colonies occur at Prince Island (~300 pairs) and Santa Barbara Island (~150 pairs, including Sutil Island) which were not surveyed until 1975-1977 (Hunt et al. 1979). Santa Barbara Island was part of the Channel Islands National Monument, when formed in 1933. Prince Island had been managed by the U.S. Navy since 1934. Both islands were subsequently included in Channel Islands National Park when the Park was created in 1980. By the 1980s, all three major colonies (Farallones, Prince Island and Santa Barbara/Sutil islands) were protected in federal public ownership and introduced predators (primarily feral cats *Felis catus*) had been removed from the Farallones and Santa Barbara Island. As a result of these protections and conservation actions, ASSP populations appeared to be secure by the 1980s, though still considered globally to be a relatively rare seabird species. In response, the California Department of Fish and Wildlife (formerly California Department of Fish and Game) has designated ASSP as a Species of Special Concern (Remsen 1978).

Concerns for the conservation of ASSP were heightened in the 1990s based on studies indicating the species was in decline on the Farallones and faced major new threats related to chemical and light pollution in waters surrounding southern California locations, despite legal protection of major colonies. Sydeman et al. (1998) documented a 44% decline in the population size at the Southeast Farallon Islands in 1992 compared to 1971-72 based on a comparison of mist-net captures, estimating ~995 pairs. The cause of this decline was attributed to predation by an expanded breeding population of western gulls (*Larus occidentalis*) and increasingly prevalent, seasonally resident burrowing owls (*Athene cunicularia*). The owls are encouraged to remain longer than otherwise on the islands owing to an infestation of non-native house mouse (*Mus*

musculus; Chandler 2015; Mills 2016; Chandler et al. 2016, in press). More recently, Joyce et al. (2016; Pacific Seabird Group presentation) noted no change in the total world population of ASSP, based on analysis of at-sea survey data, 1988-2004. It is unknown whether this population estimate at sea reflects a reduced world-wide population from what is assumed to have been a larger population in the early 1970s. Furthermore, in a detailed seabird survey throughout California,1989-1991, Carter et al. (1992) reported higher estimates of ASSP at Santa Barbara Island (~730 pairs, including Sutil Island), and Prince Island (~577 pairs) than previous reports, apparently the result of increased survey effort (Carter et al. 1992). Directed surveys found additional colonies in the Channel Islands during 1994-1996, especially Santa Cruz Island (see summary in Carter et al. 2016a). Based on the best available information during the late 1990s, including the ~995 breeding pair estimate for the Farallones, ~38% of the global population of ASSP would have been known to nest on the Farallones as compared to the 85% estimate (~7,000 individuals) reported in Ainley and Boekelheide et al. (1990), the 55% estimated by Carter et al. (1992) and the 50% to 70% reported by Sydeman et al. (1998).

Despite larger population size estimates in the Channel Islands in 1991-1996 than in previous years, concern for ASSP increased greatly when high levels of organochlorine pollutants (DDTs and PCBs) detected in eggs from Santa Cruz Island in 1992-1997 were identified to have resulted in causing depressed nesting success (Fry 1994; Kiff 1994; Carter et al. 2008a, b; McIver et al. 2009). Mammals, including native and introduced, as well as bright lights from squid fishing vessels, were also identified as a problem for ASSP at the Channel Islands (McIver et al. 2016; Carter et al. 2016a). Ainley and Hyrenbach (2010) provided further evidence that the global population was declining as their at-sea estimates of ASSP declined 76% from 1985-1994 to 1997-2006. In short, by the early 21st century the best available science indicated uncertainty about changing ASSP status but that major factors may threaten the viability of the species.

As a result of major threats and a suspected decline in ASSP populations, several changes in status and management actions have occurred since 2000:

2001 – International Union for the Conservation of Nature (IUCN) designated ASSP as endangered and declining on its Red List (version 3.1).

2001-2002– Black rats were eradicated from Anacapa Island. The rat eradication is expected to aid nesting ASSP, as well as other seabirds breeding there (Harvey et al. 2016).

2002 – U.S. Fish and Wildlife Service listed ASSP as a Bird of Conservation Concern (USFWS 2002).

2005 – U.S. Fish and Wildlife Service identifies the ASSP as "highly imperiled" in its Pacific Region Seabird Conservation Plan (USFWS 2005). Restoration of ASSP was included in the Montrose Settlements Restoration Program (MSRP 2005).

2006 – The National Audubon Society includes ASSP as among the 10 most endangered birds in the United States as of 2006 (National Audubon Society 2006).

2007 – Center for Biological Diversity petitions the U.S. Fish and Wildlife Service to list the ASSP as threatened or endangered pursuant to the Endangered Species Act (Wolf 2007).

2008 – California Department of Fish and Game released their updated list of Bird Species of Special Concern, which again included ASSP but with an elevated priority 2 (Carter et al. 2008a). Restoration actions were initiated at Santa Cruz Island (McIver et al. 2016).

2009 – U.S. Fish and Wildlife Service announces a 12-month finding of "not warranted at this time" for listing the ASSP under the Endangered Species Act (USFWS 2009a).

2010 – ASSP is listed as "in danger of extinction" under Mexican Law, NOM-059-SEMARNAT-2010 (SEMARNAT 2010).

2012-2014 – Audubon California hosted meetings of ASSP experts and management agencies to discuss range-wide monitoring and conservation efforts.

2013 – U.S. Fish and Wildlife Service announces a second 12-month finding of "not warranted at this time" for listing the ASSP under the Endangered Species Act (USFWS 2013a). The U.S. Fish and Wildlife Service conducted this second examination of the status of the species was conducted as part of a settlement agreement with the Center for Biological Diversity.

2015 – A special ASSP paper session occurs at the Pacific Seabird Group annual meeting in San Jose, California. Several papers from this session are published, as a special section, in the scientific journal *Marine Ornithology* (see Carter et al. 2016a introducing this section). This special paper session aided in providing land and wildlife managers and others interested in the conservation of ASSP with some of the latest science and information about the species.

Based on the limited population size and range (compared to many other seabirds) and ongoing threats, it appears that improved conservation and monitoring efforts are still needed to ensure that ASSP current status remains or is enhanced.

Purpose

The three main purposes of this plan are to:

1) provide a framework for conservation actions that should reduce threats to the ASSP population and help to ensure long-term population viability and retention of breeding colonies throughout its current range;
2) assist management and funding decisions by government agencies within the U.S. and Mexico as well as provide useful information to conservation organizations (e.g., NFWF, California Audubon, Grupo de Ecología y Conservación de Islas, Center for Biological Diversity); and
3) foster continued coordination and cooperation of the ASSP Working Group that will work to coordinate research, monitoring and conservation activities and share information to facilitate ASSP conservation.

This conservation plan focuses on four actions, identified by management agency representatives and ASSP experts who supported the development of this plan and provided substantial input to the plan:

- establishment of a monitoring program range-wide to derive an index of population size and change comparable among colonies;
- reduction of predation at breeding colonies, as appropriate;
- conducting surveys and research to: (a) identify breeding locations, (b) determine population size(s) and breeding/non-breeding bird ratios, (c) determine movements and relationships among colonies and (d) identify information gaps and additional conservation issues; and
- use and evaluate artificial nest structures and habitat improvements to maintain viable populations, as appropriate.

Section II. Ashy Storm-Petrel Species Account

Life History

Breeding Habitats

Most of the ASSP colonies on offshore islands and nearshore rocks occur in xeric locations within the Mediterranean climate zone of the southern California Current System. ASSP do not excavate burrows; rather, they are known to nest within rock crevices, formed among the talus and rocky slopes, rock walls (natural and man-made), sea caves and driftwood that occur on various offshore islands, islets and coastal rocks (James-Veitch 1970; Ainley et al. 1990; Ainley 1995; McIver 2002; Carter et al. 2008a; Carter et al. 2015; Carter et al. 2016a; McIver et al. 2009a; McIver et al. 2016a). At the largest known colony at the Farallones, a large but unknown proportion also breeds in talus slopes and human-built rock walls developed after 1800 (Ainley et al. 1990; Carter et al. 2008a, 2016a). At Prince Island, commercial guano harvesting as well as bombing practice by the U.S. Navy have likely modified natural habitats (San Francisco Call 1895; Carter et al. 2008c). At Bat Cave, the largest sea cave colony at Santa Cruz Island (92 nesting pairs in 2014), many nests are found within piles of driftwood inside the cave (McIver 2002).

ASSP also nest on nearshore rocks and mainland cliffs, based on work conducted by Hunt et al. (1979) at Sutil Island, calls being detected from small crevices in cliffs on Santa Barbara Island (G. McChesney, pers. comm.), and mist-net captures near cliff habitats (e.g., Point Reyes Headlands, Becker et al. 2016; Santa Cruz Island, D. Mazurkiewicz, pers. comm.; Brown et al. 2003, Anacapa Island, Harvey et al. 2016). However, much of the cliff-type terrain precludes access by researchers and documentation of ASSP nesting in cliff habitats is limited. Nesting on islands and islets is considered, in general, to be an adaptation among seabirds to prevent or greatly reduce mammalian predation. However, islands and rocks are still accessible to avian predators (e.g., in the case of ASSP: common ravens (*Corvus corax*), burrowing owls, barn owls (*Tyto alba)* and western gulls) (Sydeman et al. 1998; McIver 2002; McIver et al. 2016), and, in general, use of cavities and visitation only at night, are adaptations to avoid avian predation. Nearshore islets can be accessible by some mammalian predators (e.g., river otters *Lontra canadensis*) while some offshore island and islets have native mammalian predators (e.g., Channel Islands: island spotted skunks (*Spilogale gracilis amphiaia*), island foxes (*Urocyon littoralis*), deer mice (*Peromyscus maniculatus*) and introduced non-native mammals (e.g., Farallones: house mouse; San Miguel Island and San Clemente Island: black rats). River otter populations have expanded in central California (Bouley et al. 2015) and have been observed at storm-petrel nesting sites at Point Reyes National Seashore (B. Becker, pers. comm.) and suspected of depredating ASSP adults at Franklin Smith Rock in Mendocino County (Carter et al. 2015). Both mammalian and avian predators are known to prey on adults, eggs, and chicks (Ainley et al. 1990; McIver 2002; McIver et al. 2009a, 2016).

Throughout the ASSP breeding range, natural breeding habitats are relatively stable, and with the exception of spaces among driftwood, undergo little change between years. However, erosion of coastal islands from water, wind and earthquakes does occur over time with either the creation of small sections of new habitat (e.g., through rockfall crevices), and loss of small sections of habitat, especially in sea caves and offshore rocks. For instance, during an intense deluge on the normally somewhat xeric Farallones during El Niño, in 1983, a large cascade of rocks washed down the talus slopes changing ASSP nesting habitat (D. Ainley, pers. comm.). The loss or creation of habitat from different forms of natural erosion has not been well studied but should be monitored, as global climate change appears to be increasing precipitation extremes in California (Donat et al. 2016).

Global climate change, however, is bringing rising sea levels (IPCC 2014) with noticeable increase already. High-water and large wave events have recently impacted nesting habitats in certain sea caves and offshore rocks, by changing driftwood configurations or moving smaller rocks and boulders that provide nesting habitat, resulting in loss or temporary flooding (McIver et al. 2016b). Low-lying nesting habitats, in sea caves and some nearshore rocks, are at risk of being impacted by sea-level rise and high-water and large wave events. As sea-levels increase, these low-lying nesting areas may become unsuitable for ASSP. However, wave events, likely from winter storms, have washed large amounts of driftwood and other debris into sea caves (e.g., Bat Cave), thereby creating nesting habitat utilized by ASSP (W. McIver, pers. comm.).

Ashy storm-petrel on a nest in Cave of the Birds Eggs, Santa Cruz Island.
Photo by W. McIver. Used with Permission.

Timing of Breeding

The breeding season is protracted and ASSP visit breeding colonies year-round, although visitation is most frequent from February through October based on data collected at the Farallones (James-Veitch 1970; Ainley et al. 1974, 1990). Visitations can be divided into three general periods: pre-egg, incubation and chick-rearing. ASSP begin visiting breeding colonies in late December and courtship or maintenance of sites can last up to 3 months (Ainley 1995; Ainley et al. 1990). Egg-laying is asynchronous and extends from early April through October with most egg-laying in late June or early July (James-Veitch 1970; Ainley et al. 1990; McIver 2002). Clutch size is one egg and parents alternate incubation duties every 1-8 days (average 2-3 days) during an average incubation period of about 45 days, ranging 42 to 59 days (Ainley 1995). Replacement eggs are sometimes laid after failure of a first egg (Ainley et al. 1990; McIver 2002). Once hatched, a nestling is brooded for approximately 5 days, after which it remains at the nest site alone during the day (Ainley et al. 1990). Nestlings are fed irregularly, an average of about once every 1 to 3 nights, during brief parental visits. ASSP chicks fledge at an average age of 85 days, ranging 72 to 119 days (Ainley et al. 1990). Most fledging occurs between late September and late October but some chicks fledge as early as June and as late as January in some years (Ainley et al. 1990; McIver 2002).

Diet

While the diet of ASSP has not been well-studied, it likely includes euphausiids (e.g., *Euphausia pacifica*, *Thysanoessa spinifera*) and other crustaceans (including the young of spiny lobsters *Panulirus interrtuptus*), fish eggs, larval and small fish and squid, all taken at the ocean's surface (Anthony 1898; McChesney 1988; Ainley 1995, Carter et al. 2008a). High-lipid prey items likely make the ASSP susceptible to bioaccumulation and/or biomagnification of compounds and elements contained in the prey. Fry (1994) suspected that high-lipid prey items may have been the sources of high levels of organochlorine residues found in ASSP eggs collected in the Channel Islands. In addition, plastic particles, including nurdles, have been found in storm-petrel species that forage in the California Current (Blight & Burger 1997; Schuiteman 2006). Similar plastic pellets collected from beaches around the world have been shown to contain PCBs and organochlorine pesticides. Ingestion by storm-petrels represents an additional pathway for these toxins to be absorbed by storm-petrels (Mato et al. 2001). Moreover, storm-petrels with high loads of plastic in their guts also have low body mass and condition (Spear et al. 1995), though this has not been observed in ASSP.

At-sea Distribution

ASSP forage along the continental slope in waters of central and southern portions of the California Current System between northern California and central west Baja California, based on information from at-sea surveys, telemetry studies and pelagic birding trips (Figure 1; Stallcup 1976; Briggs et al. 1987; Ainley 1995; Howell & Webb 1995; Mason et al. 2007; Spear & Ainley 2007; Adams & Takekawa 2008; Ainley & Hyrenbach 2010; Howell 2012). They

primarily occur in waters seaward of the continental shelf break, i.e., the continental slope, where depths range 200 – 2000 m, within range of offshore islands colonies, and closer to the coast within the southern parts of its range. ASSP are non-migratory and exhibit little post-breeding dispersal (Ainley 1995; Adams & Takekawa 2008). Off southern California, concentrations of ASSP have been recorded in three main areas: the continental slope SW of Point Buchon, western Santa Barbara Channel and in the Santa Cruz Basin area (Briggs et al. 1984; Mason et al. 2007; Adams & Takekawa 2008). Off northern California, ASSP concentrations occur along the continental slope from the Monterey Bay Submarine Canyon north to Cordell Bank (Stallcup 1976; Briggs et al. 1984; Ainley et al. 1990; Allen 1994; NOAA 2003, 2007; Spear & Ainley 2007). Information from pelagic birding trips indicates that some ASSP "hotspots" in this region have shifted. For example, a major late summer and fall hotspot over the Monterey Submarine Canyon (~36.5° N) known since the 1970s (Stallcup 1976) appears to have shifted to the Cordell Bank area (~38° N) sometime in the early 2000s (D. Shearwater, pers. comm.).

While sparse north of Point Arena, California, ASSP have been observed as far north as latitude 47° N (off the coast of Westport, Washington) on two occasions in 2006 and 2008 (Washington Ornithological Society, http://wos.org/documents/WBRC/wbrcacceptedec2014.pdf, accessed October 19, 2015). To date, six sightings of single or small numbers of birds (<10) have been accepted by the Oregon Bird Records Committee since 2007 with 4 of the 6 sightings occurring in 2014 (Oregon Birding Association, http://www.orbirds.org/obrcrecordsmay2015.pdf, accessed October 19, 2015) and have been documented in low density off extreme northern California and southern Oregon (D. Ainley, GLOBEC data). In the southern part of their range, ASSPs are sparse south of Los Coronados Islands. At-sea observations of ASSP south of the San Benito Islands, Mexico (latitude 28° N) appear to be unusual, based on the few at-sea surveys that have been conducted in this region (Spear & Ainley 2007; D. Ainley, pers. comm.).

Colony Distribution

ASSP have been confirmed to breed at 33 locations between Point Cabrillo, Mendocino County, California, south to the Todos Santos Islands, Baja California, Mexico (Table 1; Figures 2-6)(Everett & Anderson 1991; Carter et al. 2016a). ASSP breeding populations are concentrated at the Farallones and the northern Channel Islands. Breeding at Todos Santos Islands was first determined from a single nest found in 2005 (Carter et al. 2006a, 2008a) although additional nests have since been detected, i.e., during the 2015 breeding season using vocalizations and in-hand species identification (Bedolla-Guzmán, GECI, unpublished data). More detailed work is needed to differentiate what storm-petrel species actually nest, and in what proportion, and not necessarily just at Todos Santos but also at other Channel and Mexican islands (Adams et al. 2016; Carter et al. 2016a; Y. Bedolla-Guzmán, pers. comm.).

Twenty-seven ASSP nesting locations (n=32) are managed by U.S. federal agencies, including the National Park Service (11 nesting locations in Channel Islands National Park; 2 nesting

locations in Point Reyes National Seashore; 1 nesting location within the Golden Gate National Recreation Area), Bureau of Land Management (9 nesting locations in the California Coastal National Monument), U.S. Navy (3 nesting locations: 2 locations at San Miguel Island on Castle Rock and Prince Island, 1 nesting location at San Clemente Island) and U.S. Fish and Wildlife Service (1 location at the Farallon National Wildlife Refuge). The National Park Service also co-manages San Miguel and Santa Cruz islands with the U.S. Navy and The Nature Conservancy, respectively. The U.S. Navy is a stewardship partner for the islets adjacent to San Clemente Island owned by Bureau of Land Management as part of the California Coastal National Monument. A non-governmental organization (i.e., The Nature Conservancy) owns and manages 4 locations at western Santa Cruz Island. The federal government of Mexico owns and manages 2 nesting location at Todos Santos Islands.

Breeding Colony and Population Estimates

Obtaining direct counts of ASSP nests at breeding islands or rocks is extremely difficult, as is true with most crevice- or burrow-nesting seabird species. Moreover, confounding estimates of breeding numbers is the possible presence of a 'floating population' of adults not breeding owing to being denied access to suitable nesting cavities or for other unknown reasons. Floating populations are a characteristic of some cavity-nesting seabirds at California and Baja California locations (e.g., Cassin's Auklets *Ptychoramphus aleuticus* at the Farallones – see Manuwal 1974). For example, Ainley and Boekelheide (1990; see also Manuwal 1974) present information that suggests competition for nest sites exists among cavity-nesting species, including ASSP at the Farallones (see Manuwal 1974; Ainley and Boekelheide 1990 pages 149 and 374 for details). At the San Benitos Islands, competition for nest sites may be one explanation for the observation of several storm-petrel species utilizing Cassin's Auklet burrows once the auklets have seasonally abandoned them and the almost immediate use of artificial nests installed there (Bedolla-Guzmán, 2016). However, current data and information from the Farallones and Channel Islands, including the placement of artificial nest structures, does not appear to support a competition for nest sites or habitat limitation for ASSP (R. Bradley, pers. comm.; W. McIver, pers. comm.; D. Mazurkiewicz, pers. comm.; Point Blue, unpubl. data). At-sea data indicate far more ASSPs than have been estimated to be associated with various breeding sites (Ainley et al. 2015), the vast majority of which have been intensively surveyed (Carter et al. 2016a). Regardless, the presence of non-breeding birds, whether immature or breeding age, increases the difficulty in estimating populations accurately.

Breeding population estimates of ASSP in California have been determined through two primary methods:

(1) capture-recapture analyses; uses data collected on 2 or more nights per month of mist-netting (usually with call play-backs) of adults and subadults from April to August at the largest colony at the Farallones (1,001-5,000 pairs; Ainley & Lewis 1974; Sydeman et al. 1998; Bradley 2011, Nur et al., in review), certain medium-sized colonies (101-1,000

pairs) at Prince, Sutil and Santa Barbara islands (Hunt et al. 1979; Carter et al. 1992; Adams et al. 2016), and certain small colonies such as South Cove Seal Rock off of San Clemente Island (Carter & Henderson 2015, 2016). The main advantages of this method at these locations are that most habitat is not accessible to humans during the breeding season, methods can be standardized (though have yet to be so across the range of ASSP), a population estimate can be derived using a standardized method, other simultaneously collected data documents presence and relative abundance (e.g., capture rates), and vital population variables can be estimated with long-term effort (e.g., adult survival rates). The main drawbacks are that data collection is relatively labor intensive and limited to good weather conditions, birds may avoid recapture, adults are difficult to distinguish from subadults based on brood patch development, analyses involve assumptions that are violated or cannot be validated, and the accuracy of estimates is difficult to determine; the existence of any floating population is difficult to verify and quantify; and

(2) direct counts of nests at some small colonies (<100 pairs) and certain medium-sized colonies (101-1,001 pairs) at largely accessible rocks and sea caves (e.g., Bird Rock, Stormy Stack, Orizaba Rock and Santa Cruz Island sea caves; Becker et al. 2016, McIver et al. 2016a). The main value of using this method at these small- to medium-sized colonies is that the raw total count, if available nesting habitat is completely surveyed, can be close to the actual number of nests (if the raw total count occurs after most egg laying and before fledging), a standardized population estimate can be derived, estimates can be based on the raw count or with an adjustment for inaccessible habitats if needed to better indicate approximate colony size, and other information can be simultaneously gathered (e.g., reproductive success and predation rates). The main drawbacks of this method is that it is also labor intensive, eggs are laid asynchronously and colonies should be visited monthly (or more frequently) during the breeding season to determine total nest counts and account for failed nests, it may be difficult to determine species nesting in crevices, and the assumption has to be made that nest density is constant and can be applied to habitat that cannot be surveyed. As noted in certain crevice habitats, inaccessible nest sites make obtaining a complete count difficult.

In addition, various other methods have been used for certain small colonies to obtain rough estimates of population size, such as counting suitable crevices in accessible habitats and adjusting with a correction factor for occupancy, finding a few nests and extrapolating for areas not searched, or conducting one night of mist-netting for determining capture rate then making a rough adjustment based on habitat available to estimate colony size (Hunt et al. 1979; Carter et al. 1992).

World breeding population estimates of ASSP have been determined through summing colony estimates. Sowls et al. (1980) estimated 5,187 breeding ASSP (~2,590 pairs) in California, based on data gathered at 9 colonies in 1975-1980 and substituting past estimates for 2 colonies (including 2,000 nests at the Farallones in 1972 and 100 nests at Castle Rock, San Miguel Island, in 1968). Carter et al. (1992) updated this estimate to 7,209 birds (~3,600 pairs), based on data gathered at 7 colonies in 1989-1991 and substituting past estimates for 5 colonies (again including the Farallones and Castle Rock). However, in 1992, the Farallones estimate was revised from ~2,000 pairs to ~995 pairs (Sydeman et al. 1998). Using this 1992 value, the California breeding population size in 1989-1992 was 5,199 birds (~2,600 pairs). Approximately 99% of the population bred on 4 island groups: Farallones (38%), Santa Barbara Island (28%), San Miguel Island (26%), and Santa Cruz Island (6%). These past estimates do not include any birds breeding in Baja California, Mexico but only a few birds have been confirmed to breed there.

Table 1 provides the most recent and best available estimates of numbers of breeding ASSP at all documented breeding locations in California and Baja California. A majority of these data do not have confidence intervals or ranges specified in the reference materials. Most importantly, a recent updated population estimate is available from the Farallones in 2010-2012 (Nur et al. 2013) and recent estimates are available for several small colonies in Mendocino County (Carter et al. 2015), Point Reyes National Seashore (Becker et al. 2016), and Santa Cruz Island (McIver et al. 2016). However, most recent breeding population estimates for the largest colonies in the Channel Islands at Prince Island and Santa Barbara Island (including Sutil Island) were determined over two decades ago in 1991 and certain small colonies have not been re-estimated since 1968 (Castle Rock, at San Miguel Island), 1977 (Gull Island), and 1991 (Diablo Rocks, Willow Anchorage Rocks, and Scorpion Rocks). ASSP mist-netting has been conducted in 2004-2007 and 2014-2015 at Santa Barbara Island, Prince Island and Scorpion Rock (adjacent to Santa Cruz Island), however these data have not been utilized to calculate breeding population estimates for these locations (Adams 2016; D. Mazurkiewicz, pers. comm.; also see Russell 2011 for discussion on issues of using capture/recapture methodology to obtain ASSP population estimates). In addition, limited effort has been expended to obtain estimates of small numbers breeding at Anacapa Island (Harvey et al. 2016), though more work is needed. Prior to 2013, insufficient effort had been expended to obtain estimates of small numbers breeding at the Coronado Islands in Baja California; however since then GECI has conducted yearly monitoring, nest searches in suitable habitat, preformed spot-light surveys, and utilized automated audio-recording units without finding ASSP nests. Moreover, it was recently discovered that the ASSP at Santa Catalina Island were actually Leach's storm-petrel (hereafter LHSP) (Carter et al. 2016b). This finding points to the need to confirm species identification at other Channel Islands as well as colonies in Baja California.

For this plan, we have summed these "most-recent" estimates to obtain a total breeding population of 4,679 pairs (9,538 breeding individuals – see caution below). Based on this estimate, approximately 96% of the population breeds at 4 island groups: Farallones (60%), Santa Barbara Island (15%), San Miguel Island (14%), and Santa Cruz Island (7%). Caution should be taken when reviewing this summary of colony estimates as these estimates may not be an accurate reflection of the true proportions of the current breeding populations at these four island groups because:

(1) mist-net based population estimates at the three largest island populations have used different effort, and have not been cross-validated;

(2) large fluctuations in numbers of ASSP visiting colonies in any given year have been detected, especially at the Farallones, where monitoring effort has been most consistent; and

(3) estimates from Santa Barbara Island and San Miguel Island from 1991, based on limited mist-net efforts, are outdated and have no confidence intervals or ranges associated with them.

Despite the uncertain quality of these data, the vast majority of the world breeding population nests at these four island groups. These data alone indicate that roughly half of the world population breeds at the Farallones and half at three Channel Islands (Santa Barbara, San Miguel, and Santa Cruz). However, some researchers indicate that there may be a "mismatch" between at-sea numbers and island population estimates for the Farallones versus central California waters and Channel Islands versus southern California waters. This hypothesis is based on greater numbers of ASSP being counted at-sea in the northern portion of the range (nearer the Farallones) and in similar numbers to breeding estimates at the Farallones as compared to fewer ASSP counted at-sea in the southern portion of the range (nearer to the Channel Islands) and in lower numbers than the estimated breeding population at the Channel Islands (Ainley *in* Ainley et al. 2015; D. Ainley, pers. comm.). For instance, Briggs et al. (1987) reported that numbers of ASSP seen at sea off central California were 4-8 times higher than off southern California. Thus, the at-sea survey numbers do not support the colony-based data that roughly half of the ASSP population is breeding in the Channel Islands area. Possible explanations for the observed "mismatch" are: a) the Farallon/Northern California breeding population is under-estimated; b) the Channel Island/Southern California breeding population is over-estimated; c) the colony estimate and at-sea survey data are not appropriate for comparisons, particularly at the regional scale described above (i.e., the two concentrations of breeding populations occur together at-sea); or d) a large(r) population of non-breeders (i.e., floating population) exists in Northern California associated with the breeding colonies there and an equivalent population in the southern portion of the range does not exist or has not yet to be discovered. Analysis of at-sea data and greater survey effort at major colonies in the future hopefully will refine our knowledge of such proportions as well as population trends at these locations. To calculate the world population size, one can add estimated numbers of subadults (based on demographic predictions)

to the breeding population, as well as addressing the 'floating population' size. This process of calculation will also require many assumptions to be deliberated and quantified.

At-sea Surveys and World Population Estimates

At-sea population surveys provide an independent method of estimating the world population size of seabird species and have been shown to be accurate as long as the entire at-sea range of a seabird is covered and the general demographic structure of the species is known (i.e., proportion of non-breeders; Clarke et al. 2003). Such surveys include both breeding and non-breeding birds. Given that ASSP are resident year round in the southern California Current region, and the complete at-sea range has been fairly well covered, the species lends itself to such an analysis. Population estimates obtained at the colony typically focus on breeding birds that visit the colony and attend nests during the breeding season (Ainley 1995; Sydeman et al. 1998; McIver et al. 2009a, 2009b, 2016). Mist-netting at colonies likely captures both breeding and non-breeding birds but it is difficult to distinguish between them. Non-breeding birds may attend the colony less or more frequently than adults, depending largely on the age of subadults, size of the non-breeding portion of the population, time within the breeding season, and annual variation in at-sea conditions. At-sea surveys are affected by these issues in contrary fashion, e.g. fewer ASSP seen at sea when visitation of colonies is high and vice versa (e.g. Ainley *in* Ainley et al. 1995). ASSP spatial distribution at-sea varies between seasons as well as from year to year and is largely driven by upwelling areas and food resources, which in turn can affect the degree of island visitation (Briggs et al. 1987; Mason et al. 2007; Ainley *in* Ainley et al. 1995; Ainley & Hyrenbach 2010). Perhaps to the advantage of management (and a detriment in the case of an oil spill), ASSP have been documented in large concentrations during the fall, mostly composed of molting individuals (P. Pyle, pers. comm.). For example, large flocks of ASSP have been documented in Monterey Bay ranging in size from 1000s to 7,000- 10,000 birds (Ainley 1976; Roberson 1985; Briggs et al. 1987; D. Shearwater, pers. comm.). It is possible that regardless of breeding site, ASSP congregate in a fairly small area during the molt. Otherwise, with a distribution that has high patchiness, a rigorous and relatively high-effort sampling design would be needed to obtain the best estimates of population size. However, compared with many other seabird species with larger population sizes, greater variation in the timing of colony attendance and breeding and greater migratory behavior, variation in ASSP population sizes at-sea around the major breeding colonies at the Farallones and Channel Islands is reduced. A thoughtful analysis of available at-sea survey data is needed to independently estimate current world population size (adult and subadults). This estimate can be compared to colony estimates of breeding adults plus estimated subadults to help validate true overall population size and ensure that colony estimates are reasonable.

Some existing at-sea studies have estimated ASSP population sizes, although not all of these surveys were specifically designed for this purpose. Briggs et al. (1987) estimated 1,400 ASSP south of Point Buchon and a range of 5,600 - 11,200 north of Point Buchon for a total population of between 7,000 and 12,600 ASSP in California. Spear & Ainley (2007) estimated the ASSP

population at 4,500 – 9,100 (95% confidence interval) north of Point Buchon (between 38.5° N and 36.5° N). Mason et al. (2007) indicated that densities of ASSP south of Point Buchon increased between 1975-1983 and 1999-2002. Ainley and Hyrenbach (2010) for central California noted annual fluctuation in at-sea numbers; while the average number indicated an abrupt decrease in the early 1990s, confidence intervals were broad enough to indicate the possibility of no overall change, thus indicating the need for caution in interpretation. Similarly, Joyce et al. (2016) noted no change in at-sea numbers of ASSP between 1988 and 2014.

Threats

In 2013, the U.S. Fish and Wildlife Service (2013) prepared a species report during its evaluation of whether or not to list the ASSP under the U.S. Endangered Species Act of 1973. The USFWS species report summarized a list of threats from various sources. This list of threats has been replicated in this plan, supplemented with additional information and each threat is briefly commented on below (see Table 2).

Climate Change: Coastal and marine warming may affect the timing and degree of prey availability (Roemmich & McGowan 1995). Low lying nest locations, particularly sea caves and low lying islets, are at risk of losing nesting habitat (e.g., McIver et al. 2016).

Human Presence: ASSP are prone to disturbance, including from researchers (Ainley & Boekelheide 1990). All breeding colonies are currently protected, though level of management varies. Except on nearshore rocks and islets within the California Coastal National Monument, humans are not permitted on breeding colonies without permission. Some sea cave colonies at Santa Cruz Island are visited by humans without permits but no impacts have been noted (e.g., McIver et al. 2016a, D. Mazurkiewicz, pers. comm.).

Introduced non-native vegetation: Introduced non-native vegetation may help increase populations of introduced house mouse at SE Farallon Island and native deer mouse at Santa Barbara Island by providing cover and food resources. Increases in these mouse populations have been attributed to increased predation of ASSP both directly and indirectly (Harvey et al. 2013; Mills 2016; Nur et al., in review). In addition, some non-native vegetation, for example New Zealand spinach (*Tetragonia tetragonoides*), forms dense mats that can cover rock crevice breeding habitat and likely render those breeding sites inaccessible to ASSP or delay ASSP from quickly entering the nest site thus making the bird more susceptible to depredation (G. McChesney, pers. comm.).

Military Activities: Bright lights and noise in nearshore waters could lead to disturbance of nests at San Clemente Island but nesting habitat at South Rock Seal Cove and adjacent cliffs are not directly affected by current activities. Past military activities (e.g., bombing exercises in the

1940s and 1960s) have affected nesting habitats at Prince Island but these legacy impacts have not been determined.

Scientific Purposes: Research activities can disturb ASSP, specifically repeated opening of cavities or checking of nest sites to inspect occupants can disturb ASSP (Ainley and Boekelheide 1990). Extensive egg collecting for museum and private collections may have impacted colonies at the Farallones and Santa Cruz Island in the late 19th and early 20th centuries. Egg collecting for organochlorine pollution studies occurred in 1992-1997 and 2008 at Santa Cruz Island area and the small Orizaba Rock colony may have been impacted in 1992 when 15 eggs were collect for this study (Carter et al. 2008b; McIver et al. 2016a).

Recreational Purposes: Some sea cave colonies at Santa Cruz Island are visited by kayakers without National Park Service permits and Orizaba Rock also has been visited apparently by recreationalists. No impacts were noted at these sites (McIver et al. 2016a). The nearshore islets that are included in the California Coastal National Monument are currently open to the public for recreational purposes. Kayakers and perhaps other boaters may be accessing these sites without permits. However, recreationalists accessing ASSP colonies within the California Coastal National Monument are not currently a known problem, though Point Reyes Headland and Bird Rock are occasionally visited by recreationists traveling by boat and Chimney Rock (at Point Reyes Headland), is accessed by hikers during low tide events.

Avian Predation: Avian predation has been recorded at SE Farallon Island (burrowing owls and western gulls) and Santa Cruz Island (common ravens and barn owls). These avian predators find their way to these islands without human assistance. Elevated burrowing owl predation at SE Farallon Island is a seasonal compensation once large cyclic populations of introduced house mouse have decreased (Chandler 2015; Mills 2016; for further details see below "Reduction of Predation At Breeding Colonies" and Nur et al., in review). The western gull breeding population on the Farallones has increased and expanded dramatically since the early 1970s (10,000 vs. 25,000 gulls) and they now occur abundantly in prime ASSP breeding habitat (Ainley et al. 1990; Penniman et al. 1990). More recently, though, western gull numbers have been decreasing on the Farallones (down to about 10,000 birds in 2016, R. Bradley, pers. comm.). Common ravens have become an issue in recent years at certain sea caves on Santa Cruz Island and Orizaba Rock (McIver et al. 2016a).

Mammalian Predation: ASSP typically do not breed at locations with mammalian predators. In the Channel Islands where there are native, endemic mammals, their presence is likely the reason that any storm-petrel nesting is relegated to inaccessible terrain (e.g., steep cliffs and sea caves). On occasion, extensive predation by island spotted skunks has been noted at Bat Cave and Cavern Point Cove Caves at Santa Cruz Island (Carter et al. 2008a; McIver et al. 2009b). House mouse occasionally prey on ASSP chicks at SE Farallon Island but this predation is not

considered to have a significant impact on ASSP population viability (Ainley and Boekelheide 1990). Deer mouse may prey upon ASSP eggs or chicks at Santa Barbara Island but to date predation or scavenging at this site has only been documented on Scripps's murrelet (*Synthliboramphus scrippsi*) and Cassin's auklet. At Anacapa Island and San Miguel Island, introduced black rats likely have restricted ASSP to nesting in inaccessible habitats (Harvey et al. 2016). Rats were eradicated at Anacapa Island in 2002 (Howald et al. 2005) and ASSP appear to have responded positively (Harvey et al. 2016). Rats remain on San Miguel Island proper and would pose a threat if they move to nearby colonies at Prince Island and Castle Rock. Coastal nearshore islets may occasionally experience predation by mammalian predators (e.g., river otters, raccoons *Procyon lotor*) as was reported in Carter et al. (2015) at Franklin Smith Rock and noted for storm-petrels nesting at sites in Trinidad Bay, extreme northern California (Leach's & Fork-tailed) (Carter et al. 1992). River otters are expanding their range and have been observed at nesting sites at Point Reyes National Seashore (Bouley et al. 2015; B. Becker, pers. comm.; S. Allen, pers. comm.).

Disease: No evidence of disease has been documented.

Artificial Lighting: Illumination of breeding colonies with bright lights at night can occur during squid fishing near islands and from other boats anchored near shore. Bright lights are thought to alter activity patterns, cause disorientation and facilitate predation when ASSP return to the colony at night. Impacts from squid boats were suspected at Orizaba Rock in 1995-1997 (Carter et al. 2008; McIver et al. 2016a) and researchers suspect predation increases on nights when SE Farallon Island is "lit up" by boats moored off the island (P. Warzybok, pers. comm.). Large numbers of ASSP were captured on research support vessels with bright deck lights anchored beside colonies in 1994-1996 at Orizaba Rock, Scorpion Rocks and Santa Barbara Island (McIver et al. 2016; H. Carter, unpubl. data). In addition, large numbers of storm-petrels have been noted on "long range" sport fishing vessels that are brightly lit near nesting island in Baja California Norte (D. Mazurkiewicz, pers. comm.). The storm-petrels appear to become disoriented and are sometimes depredated by gulls when they fly into the side of the vessel. Very little evidence of light attraction has been noted at offshore oil-drilling platforms off southern California (Hammer 2016); however there is some speculation that light wave-length or the appreciable height of the platform lights may be a factor.

Oil Pollution: Oiled ASSP have never been recovered on beaches or colonies, but, too, rarely has an ASSP been found dead on a beach. They likely die before reaching shore and are removed rapidly from the ocean surface and beaches by predators. A large oil spill where birds are concentrated at sea could have significant population level impacts for ASSP, especially if the spill occurs where large molting populations are congregated.

Organochlorine Pollution: Extensive pollution occurred in the Southern California Bight region from the 1940s to 1970. Pollutants are entrained in marine sediments and continue to be released into the environment. Impacts on ASSP, including eggshell thinning and reduced hatching success, were documented in 1992-1997 at Santa Cruz Island (Fry 1994; Kiff 1994; McIver 2002; McIver et al. 2009; Carter et al. 2008a, c). In 2008, pollutant levels were much reduced and hatching success had improved. These pollutants will likely continue to reduce reproductive success of some individuals for decades.

Ingestion of Plastics: Plastic ingestion has not been documented in ASSP but has been found to be common in storm-petrel species that frequent major, intense ocean fronts where plastic accumulates (e.g., Spear et al. 1995). Such fronts are not known in the California Current System. Impacts may include interference with digestion leading to starvation and introduction of toxic chemicals to birds.

Lack of Biosecurity Plan Implementation: Island biosecurity refers to the policies and measures to detect and prevent incursions with the overall objective of stopping the establishment of invasive alien species and protecting insular biodiversity and ecosystems (Russell et al. 2008). Along with the current strategy to eradicate invasive non-native mammals from ASSP breeding islands, implementation of effective bio-security plans is needed to prevent the spread to new islands (i.e., invasion) and prevent reinvasions. Biosecurity measures will protect the investment made in conservation efforts made previously (i.e., eradications) (Broome 2009).

For that reason, attention to incursions, including the detection of invasive species, is critical to eradicating an invading species before an island-wide population becomes established. Conducting eradication efforts during the incursion phase is a more cost-effective conservation measure in comparison to conducting an eradication campaign on a species that has “invaded” an island.

Section III. Conservation Actions

Conservation Action Prioritization Narrative

Each action for the conservation of the species has been assigned a priority according to a determination of what is most important for the conservation of the species based on the life history, ecology, distribution, abundance, threats, and knowledge gaps. Three categories of priorities have been developed:

Priority 1: An action that can be taken to prevent decline likely to lead to extirpation of a population, colony, or distinct geographic breeding locale (e.g., islet, rock, or sea cave).

Priority 2: An action that will provide essential information needed to advance the management and/or conservation of ASSP at a population, colony, or distinct geographic breeding locale (e.g., islet, rock, or sea cave).

Priority 3: An action that can be taken to prevent any decline of an ASSP population or some other negative impact short of extirpation, extensive decline or significant mortality.

Goals, Objectives, Strategies and Rationales

The following narrative discusses the goals, objectives, strategies and rationales that serve as the steps needed to develop and implement this conservation strategy for ASSP. A goal has been developed for each of the 4 areas of focus in this conservation action plan. The 4 areas of focus were identified by key stakeholders at the 15 October 2014 meeting at the National Fish and Wildlife Foundation office in San Francisco as follows:

- Index Monitoring Program
- Artificial Habitat/Nest Structures
- Predation Reduction
- Surveys and Research

A goal is a descriptive, broad statement of desired future conditions that conveys a purpose, but does not define measurable units. Goals direct objectives for improving the population and habitat for ASSP. Management actions (strategies) for ASSP populations are designed to meet the objectives.

An objective is a concise statement about what is to be achieved, the desired extent of the achievement, when and where the objective should be achieved, and who is responsible for the achievement. Objectives are based on input from key stakeholders (listed in the acknowledgements section of this plan) during discussions in 2015-2016 about the ASSP Conservation Action Plan and on additional information obtained from the published and unpublished scientific literature.

Strategies consist of actions, tools and techniques needed to achieve objectives.

Rationales for each objective provide the scientific basis such as past research, assumptions, and technical details.

Goals and Objectives

Index Monitoring Program Goal
Create and implement a range-wide monitoring program that can detect "biologically significant" trends in populations (e.g., population size, breeding success, adult survival) and emphasizes attributes of sampling design (e.g., randomization, bias, detection probability) and a desired level of precision. Monitoring will take place at representative sample colonies throughout the breeding range of ASSP and incorporate data collection from small to large colony sizes in both offshore and nearshore colonies in an effort to detect different types of conservation issues for ASSP in different habitats and geographic areas. To develop this program, a major group effort by seabird biologists and managers is needed to discuss various approaches. Salient concepts in the design and implementation of this program are summarized below. The ultimate goal for these monitoring efforts are: (1) to provide information that will assist and direct the long-term conservation and management of ASSP; and (2) to better understand the biology of this very interesting storm-petrel species which is endemic to California and northwest Baja California.

Range-wide Objective for Index Monitoring Program: Within 3 years of publication of this plan, an ASSP monitoring working group will complete an ASSP monitoring plan. The plan will: (1) select appropriate monitoring locations based on colony size, ease and reliability of access and location within the ASSP range; (2) determine parameters to be monitored (at a minimum to include an index of population size, reproductive success and adult survival); and (3) standardize methods and protocols for data collection, archiving and analysis. The resulting range-wide monitoring program will provide long-term time-series data to analyze significant changes in population parameters. In addition, the index monitoring program will fill in some existing data gaps about ASSP population sizes and trends, identified in the section on "Breeding Colony and Population Estimates". (Priority 2)

Strategies:

- Establish formal guidelines that outline a standardized, repeatable approach to measuring ASSP population size indices (i.e., estimating breeding population size or analyzing population trends), examining reproductive success and determining adult survival.
- Build upon or adjust existing monitoring programs and augment with additional locations and parameters to allow for trend monitoring analysis and comparisons across the breeding range of ASSP.
- Maintain the Farallones as the key monitoring and research location in the northern part of the range that will conduct annual monitoring of population size, reproductive success,

and adult survival. In addition, annual or periodic monitoring should be conducted at nearshore rocks for comparison (e.g. Bird Rock, Stormy Stack).

- Maintain the Santa Cruz Island area as a key monitoring and research location in the southern part of the range conducting annual monitoring of population size, reproductive success and adult survival.
- Establish other key monitoring location(s) in the Channel Islands region conducting annual monitoring of identified parameters. Candidate locations include Prince Island, and Santa Barbara Island as well as San Clemente Island (small colony size comparison).
- Establish key monitoring location(s) for conducting annual monitoring of identified parameters in Mexico. Candidate locations include Todos Santos and Coronado islands.
- Collate and analyze past mist-net data from the Channel Islands to provide the best historical information for comparison to newly-developed baseline data and investigate the possibility of reconciling mist-net data from the Farallones, ultimately to make the two efforts comparable.
- Identify secondary parameters (e.g., environmental variables, biotic variables, organochlorine pollutants) that will be used to aid the interpretation of monitored ASSP parameters.
- Obtain an at-sea estimate of the world ASSP population, first by analysis of existing data in order to provide a baseline ASSP population estimate. Ideally, a range-wide at-sea survey, similar to Briggs et al. (1987) will be conducted.

Rationale:
Ultimately, the long-term monitoring program should be effective at detecting significant changes in population size/trends, reproductive success or adult survival for the ASSP population. Currently, there is no monitoring plan or formal guidelines that exist describing a standardized, repeatable approach to monitoring ASSP across its range. However, protocols have been developed to describe and standardize data collection and management activities for certain types of ASSP monitoring at some colonies (e.g., Farallones, Santa Cruz Island, Prince Island)(see Nur et al., in review; McIver & Cater 1996; McIver and Carter 1998; Adams 2015). The needed monitoring program will track changes in parameters through time and implement these approaches throughout the ASSP range so that the population status of the ASSP can be tracked with high statistical confidence. In addition, conservation efforts aimed at protecting and maintaining a viable ASSP population can be effectively evaluated with these standardized protocols.

Because the ASSP population has two core breeding areas at Farallones and the Channel Islands, the monitoring programs must include key colonies (e.g. Farallones, Santa Barbara Island, Santa Cruz Island area, Prince Island) in these areas, as well as smaller colonies that represent different habitat types. In the northern portion of the species range, the monitoring of a large colony would likely occur at Farallones where ASSP monitoring has occurred since 1971. In addition, small

nearshore colonies at Bird Rock and Stormy Stack, monitored annually since 2012, also should be examined for comparison.

Within the Channel Islands area, ASSP populations are concentrated on 3 northern islands and their islets: San Miguel, Santa Cruz and Santa Barbara. Santa Cruz Island should be a focal location for monitoring in the Channel Islands because it is the only known location where reproductive success of a large number of nests (i.e., ~150 nests) and population size have been measured annually through nest monitoring since 1995 (McIver et al. 2015). However, population size should be monitored regularly at Prince Island and Santa Barbara Island as well. Estimates of ASSP population sizes have been made at various Channel Island colonies in 1975-1977 and 1991-1996 using a variety of techniques. All colonies should be resurveyed using standardized techniques to acquire a consistent baseline for future monitoring. Since 2012, population assessment and monitoring work has been conducted at San Clemente Island where a small population breeds on an islet and likely on adjacent main island cliffs. Finally, populations in Mexico should be monitored as, compared to California breeding locations, greater disturbance pressure from inhabitants and fishermen occurs there.

From the standpoint of ASSP conservation and management, trends in population size are the most important parameter to monitor in order to identify significant declines that may threaten species existence or result in loss of portions of the breeding range. However, evaluating causes of population change requires monitoring of reproductive success, predation and survival. Along with being long-lived, ASSP are a low-fecundity species in which adult survival is a key demographic parameter in population growth or decline (Nur & Sydeman 1999). As such, including adult survival in the ASSP monitoring program is important. Finally, monitoring the reproductive success of the ASSP also aids in detection of environmental conditions that have acute impacts (e.g., changes in prey resources or impacts from rising sea levels due to climate change, contaminants causing eggshell thinning, exposure of bright lights at a breeding colony, etc.).

An ASSP monitoring plan that establishes a standardized and repeatable approach to data collection and analysis will promote the conservation of the ASSP. Collaboration of current monitoring programs across regions is essential for the success of the plan. In addition, the integration of ASSP data with data from other ongoing marine environment monitoring programs (e.g., CalCOFI cruises, NMFS rockfish assessment cruises, OSPR surveys, etc.) will strengthen the interpretation of ASSP population trends.

Artificial Habitat/Nest Structures Goal

Goal: Provide and maintain appropriate artificial habitat and/or nest structures at breeding colonies to aid in the long-term survival of the ASSP colonies (and other co-occurring storm-petrel species, e.g., LHSP, black storm-petrel) through greater availability of nesting habitat, improved nesting success, or increased adult survival by reducing the risk of predation at the nest site.

SE Farallon Island - Objectives for Artificial Habitat/Nest Structures

SE Farallon Island (A): Farallon National Wildlife Refuge (NWR) will permanently maintain and when feasible enhance rock foundation walls on the Lighthouse Hill Trail, Auklet Trail, Helo Pad, and former Eggers House with dry stone construction in order to provide a minimum of 500 horizontal meters of potential nesting habitat (with 0.5 to 1.5 m of vertical elevation and minimum of 0.5 m width) with a moderate to high density of potential nesting sites. For monitored sites, the objective would be a minimum 10-year mean of 50% occupancy rate and a 10-year mean breeding success rate of 60%, recognizing that annual ocean conditions influence occupancy and success rates. Rock walls associated with the above mention infrastructure are the most difficult and expensive to maintain and enhance but they also contain most of the artificial habitats currently used by ASSP at SE Farallon Island, potentially with hundreds of egg-laying sites that constitute a fairly large proportion of the overall Farallones population. Most other rock walls on SE Farallon Island also will be maintained and when feasible enhanced for greater potential future use by ASSP. Low numbers of LHSP have been observed nesting in the rock walls. (Priority 1)

SE Farallon Island (B): Over the next 10 years, Farallon NWR will remove certain foundations of dismantled buildings on SE Farallon Island and repurpose the materials to create additional artificial breeding habitats, as appropriate and feasible. Creation of additional artificial habitats could potentially add scores of additional nest sites once they are colonized. LHSP also may use this new habitat which could increase population size. (Priority 3)

Strategies:

- Utilize rocks that have been dislodged from rock walls or other parts of the island to maintain and enhance (e.g. create additional) crevice nesting habitat along Lighthouse Hill Trail, Auklet Trail, Helo Pad, and old Eggers House.
- Utilize appropriate (e.g. contaminant-free) excess materials that may be available from demolished infrastructure (e.g., building foundations) to create additional crevice nesting habitat.
- Continue to monitor ASSP reproductive success on SE Farallon Island, maintaining a sample size of at least 70 previously occupied breeding sites.
- Every 5 years, provide for annual inspection of rock walls along the Lighthouse Hill Trail, Auklet Trail, Helo Pad and old Eggers House, particularly in areas where crevice nesting habitat for ASSP already occurs or has been created. Record damaged portions

for future repair utilizing dry stone construction or similar technique that creates crevice nesting habitat.
- Annually assess any newly constructed artificial nest sites for ASSP breeding activity.
- Utilize vocalization broadcasting and other social cues to encourage ASSP to occupy newly constructed artificial nest sites.

Rationale:
Historically, Farallones seabird populations were dramatically reduced by human harvesting of adults and eggs, disturbances and habitat degradation (Doughty 1971; Ainley &Lewis 1974; Ainley & Boekelheide 1990; White 1995; Carter et al. 2008, 2016a). In the mid- to late- 19th century, possible degradation of ASSP and LHSP nesting habitats on SE Farallon Island came in the form of utilization of rocks collected from the island to construct walls and other temporary structures (White 1995; USFWS 2009b; Carter et al. 2008, 2016). In most cases, no mortar, cement or other material was used to hold rock walls or foundations together (i.e., dry stone construction), allowing access for crevice-nesting species such as ASSP. It is unclear whether construction, using rocks from the island that created artificial nest sites for ASSP and may have originally provided natural crevices for ASSP, resulted in a net loss, net increase or stable number of available nest sites. Later construction with mortar to hold rock walls together, especially during the World War I and II eras, may have temporarily reduced artificial nesting habitat for ASSP (Carter et al. 2016a). On the other hand, construction of rock walls on the marine terrace (e.g., surrounding water catchment pads) created nesting habitat where there had been little to none (G. McChesney, pers. comm.).

The first record of ASSP breeding in natural cavities under rocks on SE Farallon Island was in 1885 (Ingersoll 1886). Between 1886 and 1911, extensive use of rock walls, rock slides and drift wood areas (i.e., on Franconia Beach; likely a.k.a. Shell Beach – see White 1995) was first noted (Dawson 1911; Loomis 1918). The ASSP population was thought to have increased during this period (Dawson 1911; Loomis 1918). Loomis (1918) speculated that the apparent increase was due to the cessation of egg harvesting at the island. This apparent increase in the ASSP population may have resulted from: (1) population recovery from a possible decline in the past due to various human activities on and off the island (e.g., habitat degradation by egg collectors, oil spill pollution) (Carter et al. 2008, 2016); or (2) greater use of “man-made” habitats (e.g., rock walls) likely making it easier to detect nesting ASSP (Dawson 1911; Ainley 1990; Carter et al. 2008, 2016). The extensive use of man-made rock walls by crevice nesting seabirds was documented although there is little information regarding the amount of man-made habitat that was available for ASSP nesting (Dawson 1911; Ainley 1990; Carter et al. 2008, 2016). However, Dawson (1911) specifically noted, however, that ASSP were “well distributed throughout the main island” using rock walls, rock slides, under driftwood on Franconia Beach (likely known as Shell Beach today) and “even burrow in the level ground in front of the keepers’ houses”. Dawson (1911) speculated that ASSP was the third most abundant seabird on the island at the time, only Cassin’s Auklets and Common Murres (*Uria aalge*) were more abundant. The relative

population size was unknown and many seabird populations at the Farallones were greatly reduced at this time due to egging and oil pollution (Dawson 1911; Ainley 1990; Carter et al. 2008, 2016). The amount of habitat that was available to storm-petrels on the Farallones in the late 1800s and early 1900s is unknown as well. Determining whether suitable habitat has been lost or gained and whether the population has declined or increased from this time period is based on inferences made from limited information available in the literature (Carter et al. 2008, 2016). Qualitative descriptions provided in the published reports of Dawson (1911) and Loomis (1918) would indicate that the current ASSP population at the Farallones may be reduced from the early 1900s. However, such comparisons are impossible to confirm and speculative at best.

The importance of the dry stone construction in providing nesting habitat for the ASSP is underscored by the extensive use of this artificial habitat as mentioned in some of the earliest known publications on ASSP nesting at the SE Farallon Islands (Dawson 1911; Loomis 1918). The dry stone construction, which forms the foundation for several sections of trail and in other structures on the island, creates crevices that are utilized by ASSP. Many of these “man-made” crevices also provide relatively easy access which allows for monitoring of ASSP reproductive success. In fact, the majority of monitored ASSP sites on SE Farallon Islands occur in habitat created by dry stone construction or occur under or adjacent to other man-made structures (Russ Bradley, pers. comm.). Very few monitored sites occur in “natural habitat” such as under boulders or natural rock scree (P. Warzybok, pers. comm.). Finding and following sites in natural habitat is difficult and often causes substantial disturbance to pinnipeds and surface nesting seabirds. The Lighthouse Hill Trail on SE Farallon Island is located within the nesting area of a large proportion of ASSP (Ainley et al. 1990). Maintaining this trail with a dry stone foundation, razing unused infrastructure and repurposing this material to create additional nesting habitat should aid the ASSP population, if adequate prey resources continue and high avian predation does not occur. This objective will also support objectives identified in the USFWS Regional Seabird Conservation Plan (Objective 1c) (USFWS 2005) and the Farallon National Wildlife Refuge Comprehensive Conservation Plan (Objective 2.1).

The metrics of 50% nest site occupancy for monitored sites (as described above) is based on mean site occupancy of 54.3% (Ainley et al. 1990) and the breeding success objective of 60% is based on the long-term mean of 67% for ASSP at SE Farallon Island (USFWS 2009b). However, occupancy rates and breeding success have been lower than these levels for the past several years (R. Bradley, pers. comm.; Point Blue Conservation Science unpubl. data).

Santa Cruz Island and associated islands, islets and sea caves - Objectives for Artificial Habitat/Nest Structures:

Santa Cruz Island area: At appropriate ASSP nesting locations with documented predation issues, Channel Islands National Park and its cooperators will maintain avian predator proof artificial nest sites in order to increase the availability of protected nest sites and reduce the

percentage of ASSP nest sites (adults, eggs and chicks) vulnerability to avian predation. The number of artificial nest sites deployed at selected locations will vary; with an objective of one predator proof artificial nest site provided for every five “natural” nest sites that are monitored or documented in a nesting location (based on a 5-year running average for number of nest sites). For artificial nest sites, the objective would be to observe a gradual increase in occupancy rate and breeding success over the first 5-years of artificial nest site deployment. In the fifth season after artificial nest site deployment, occupancy rate and breeding success are anticipated to be >30% and >45%, respectively, recognizing that annual ocean conditions influence occupancy and success rates and that these rates likely will vary between nesting locations. (Priority 1)

Strategies:

- Channel Islands National Park and it cooperators will continue to monitor ASSP population size and reproductive success in the Santa Cruz Island area (e.g., Orizaba Rock, Bat Cave, etc.). Monitoring efforts should be designed to allow for comparison with other monitoring programs throughout the range of the ASSP.
- Utilize appropriate artificial nest habitat designs that allow for protection of nesting ASSP from avian and mesopredator predation, as well as bright lights at certain colonies (e.g., Orizaba Rock; McIver et al. 2016a), and allow for effective monitoring of nest sites. In sea caves, evaluate the need and feasibility of placing artificial habitats on elevated platforms to reduce impacts from low to moderate amounts of flooding due to sea level rise and high water events from storm surges.
- As needed and appropriate, utilize social facilitation cues (e.g., sound recordings, olfactory cues, etc.) to encourage ASSP nesting in artificial nest habitat modules. Use of sound recordings may not be appropriate in these locations with elevated avian predation rates.
- As needed, utilize mesopredator traps in caves with ASSP nesting in an effort to reduce the risk of a predation event causing loss of adult breeding ASSP as well as eggs and chicks. Note: Island spotted skunks have not been documented in sea caves from 2009-2015; as such, current use of traps in sea caves is not recommended.
- Continue to educate Channel Island National Park visitors about ASSP nesting and sensitivity to disturbance and limit access to only permitted activities in ASSP nesting habitats.
- Conduct an analysis of demographic and depredation data (e.g., population viability analysis) to aid in refining this objective and determining appropriate conservation and management actions to protect ASSP nesting in the Santa Cruz Island area.

Rationale:

Santa Cruz Island is the largest of the eight major Channel Islands and is jointly managed by the Nature Conservancy and the National Park Service. ASSP have been found nesting at 12 locations at Santa Cruz Island, including islets, sea caves and Gull Island (see Table 1). The most recent estimated breeding population size at Santa Cruz Island is 327 nests (Table 1). This

number does not include estimates from suitable habitat that is inaccessible to researchers or not monitored. As such, most experts working on ASSP at Santa Cruz Island feel this number is an underestimate of the true breeding population (W. McIver, pers. comm.; D. Mazurkiewicz, pers. comm.). The estimate of 327 nests represents 7% of the estimated world breeding population and ~18% of the estimated Channel Islands breeding population. Since 1995, the reproductive performance and trends in population size of ASSP at Santa Cruz Island have been studied at 5 locations: Orizaba Rock, Bat Cave, Cave of the Birds' Eggs, Cavern Point Cove Caves, and Dry Sandy Beach Cave (McIver 2002; McIver et al. 2009b; McIver et al. 2016a, b). Prior to 1995, all information on the reproductive biology of ASSP was limited to work conducted at Southeast Farallon Island. Monitoring ASSP at Santa Cruz Island has provided key knowledge about population trends and breeding performance, and about impacts from various sources in the southern portion of the breeding range. Santa Cruz Island has been utilized as a monitoring site for ASSP because monitored locations are accessible under most weather conditions, nests are easily accessible (more so than all other nesting locations, except SE Farallon Island), and adequate sample sizes at each monitored location were available to assess both population trends and reproductive performance (McIver et al. 2009b, 2016).

The ASSP monitoring program at Santa Cruz Island has documented several important conservation issues over the years: (1) organochlorine contaminants have impacted reproductive success of ASSP in the southern portion of the range since the 1940s (Carter et al. 2008b; MSRP 2005; McIver et al. 2009b); (2) avian predation of adults and chicks by common ravens is relatively high and greatly impacting reproduction at certain locations (McIver et al. 2016a,b); (3) spotted skunk predation events, although infrequent, can result in the near extirpation of a breeding location from a "one time" predation event that impacts colony nesting numbers for years after the event (McIver et al. 2009a); (4) flooding of portions of low-lying nesting habitats in some sea caves (i.e., Cave of the Birds' Eggs and Dry Sandy Beach Cave) has been observed (McIver et al. 2016a) and is likely to increase in severity due to sea level rise and storm surges due to climate change; (5) bright lights (e.g., during squid fishing) can impact certain colonies (e.g., Orizaba Rock) and cause nest abandonment or mortality leading to a decrease in colony size (Carter et al. 2008a, McIver et al. 2016a); and (6) unauthorized human activities at locations with relatively easy access (e.g., park tourists landing kayaks at Bat Cave and exploring cave habitats) could reduce reproductive success and impact nesting success (McIver 2002, McIver et al. 2009b), although major impacts from this type of activity have not been documented to date.

Several of these conservation issues could be reduced with the use of artificial nest structures. Appropriately designed artificial nest structures could reduce avian and mesopredator predation of ASSP adults, chicks and eggs at nest sites and ensure the survival of ASSP. Common ravens and barn owls are suspected to be the main avian predators while spotted skunks have been infrequent but impactful mesopredators at Santa Cruz Island. From 1995-1997, 75 adults and 6 chicks were killed mainly by barn owls at Bat Cave and Orizaba Rock (McIver 2002). In 2005 and 2008, spotted skunks killed at least 75 adult ASSP in Bat Cave and 32 adult ASSP in Cavern

Point Cove Caves, respectively (McIver & Carter 2006; McIver et al. 2009b). Both colonies appeared to have taken several years to recover to pre-event breeding population sizes (McIver et al. 2013); although due to its larger relative population size (prior to 2005), Bat Cave has experienced complete recovery in terms of numbers of nesting ASSP (McIver et al. 2015). Evidence of common raven depredation of ASSP (i.e., carcasses and feather piles) was detected at Bat Cave in 2013 (n=42 predation events) and 2014 (n=22 predation events) and 2015 (n=44 predation events) (McIver et al. 2015, 2016a, unpubl. data). In addition, daytime images from reconnaissance cameras documented ravens preying on ASSP and searching through driftwood nesting habitats (McIver et al. 2015). To provide some protective habitat, 5 artificial nest modules, providing a total of 15 distinct nesting chambers) were deployed in Bat Cave in 2015; however eggs were not laid in the first year of deployment (D. Mazurkiewicz, pers. comm.). Depredation of ASSP is likely occurring while the ASSP are flying to and from the nest site (in the case of predation by barn owls) and directly at the nest site (in the case of predation by ravens) (McIver 2002; W. McIver, pers. comm.).

At Orizaba Rock, common ravens have been documented as being very adept at accessing artificial nest structures which allowed researcher access to the nest chamber for monitoring purposes (McIver et al. 2014). As such, artificial nest structures were modified in 2012-2013 to prevent ravens from gaining access to nesting ASSP but allow researchers to look into structures for monitoring purposes without direct access to the nest chamber" (McIver et al. 2016). Currently, this new ceramic design, dubbed the "bread loaf", is a three chambered module and is the preferred artificial habitat design being utilized in the Santa Cruz Island area. This improved design should also prevent spotted skunks from gaining access to nesting petrels, eggs and chicks. It is unclear if this design will aid in decreasing barn owl depredation. However, researchers believe it may reduce the number of ASSP chicks/fledglings killed when at the nest site and pre-fledglings commence wing exercises, a behavior that researchers believe draws the attention of cave roosting barn owls to ASSP fledglings (W. McIver, pers. comm.). In 2014, 10 ceramic artificial nest structures with a total of 30 nest sites (3 nest sites per structure) were deployed at Orizaba Rock but no eggs were laid that year. In 2015, eggs were laid in 4 sites and 1 chick fledged. This suggests that, over time, these redeveloped artificial nest structures will be utilized by ASSP even without vocalization broadcasting. More rapid initial use occurred in 2008 when artificial nest sites were initially deployed with vocalization broadcasting on Orizaba Rock and occupancy rates increased from 2008 to 2011 (McIver et al. 2016a). Similarly, European storm-petrels (*Hydrobates pelagicus*) nesting in caves were shown to utilize artificial nest boxes gradually over a period of 5 years with higher nesting success than at natural sites (De León and Mínguez 2003).

In sea caves, consideration should be given to deploying predator-proof artificial sites on elevated platforms, if feasible, to reduce impacts from flooding. Flooding of portions of sea caves, resulting in deaths of a few adults and some loss of nesting habitat, has been recorded in most years since 2008 at Cave of the Birds' Eggs (McIver et al. 2016) and in certain years at Dry

Sandy Beach Cave (W. McIver, pers. comm.). Flooding appears to result when storm conditions occur during high tide events. The flooding of sea caves is expected to increase in frequency and severity with increasing sea level and increasing frequency and magnitude of extremely high coastal wave events due to climate change (NAS 2012). A possibility of mitigating for flooding impacts to sea cave colonies might be to place artificial sites on elevated platforms. This action could ensure the survival of ASSP utilizing artificial sites during major flooding events that could affect the entire floors of sea caves. However, issues conflicting with Wilderness Act designation and the placement of infrastructure in the sea caves will need to be addressed (D. Mazurkiewicz, pers. com.).

Since the purchase of the eastern part of Santa Cruz Island by the National Park Service in 1996, Santa Cruz Island has become a popular destination for tourists. Each year, thousands of tourists come to this island to recreate (D. Mazurkiewicz, pers. comm.). Common activities along the shoreline include sea kayaking, fishing and diving. The exploration of the sea caves on eastern Santa Cruz Island is a common but unauthorized activity among visitors. Peak numbers of visitors to the island coincides with the pre-egg through incubation periods of the ASSP (roughly April through July). Visitors exploring sea caves could destroy ASSP nests that are made in shallow crevices among rocks, along cave walls and in driftwood resulting in the death of adults, chicks or eggs. The National Park Service and Nature Conservancy have made efforts to reduce impacts of visitors to seabirds nesting in sea caves by conducting interpretive and education programs for kayakers, as well as placing closure signs at the entrances to monitored sea caves. However, researchers still identify visitors accessing ASSP nesting locations (D. Mazurkiewicz, pers. comm.). The use of artificial nest structures would help protect some nesting ASSP in locations where visitors are known to regularly access sea caves and ASSP nest in vulnerable sites (e.g., amongst driftwood). The use of artificial nest structures for protecting ASSP nests from unauthorized visitor impacts might be particularly useful at Bat Cave and Cavern Cove Point Caves based on limited data that documents non-researcher visitation to these locations and their close proximity to the popular Scorpion Anchorage which likely increases human activity in this part of the island (McIver et al. 2009).

San Clemente Island and associated islands, islets and sea caves - Objectives for Artificial Habitat/Nest Structures:

San Clemente Island area (A): At Seal Cove South Rock, the U.S. Navy, Bureau of Land Management, and their cooperators will install a minimum of 30 artificial nest sites in order to maintain an eventual minimum occupancy rate of at least 50% and a breeding success rate > 50%. (Priority 1)

San Clemente Island area (B): At Seal Cove mainland, the U.S. Navy and its cooperators should conduct a trial effort to create a new colony in an accessible location at higher elevation along

the edge of the bluff top that prevents flooding and is protected from avian and mammalian predators. An appropriate number of avian predator and mesopredator proof artificial nest sites should be deployed, enhanced with vocalization broadcasting, at a protected location using a predator proof fence and other techniques as necessary. An eventual occupancy rate of at least 40% and an annual breeding success rate >45% would be expected. (Priority 1)

Strategies:

- Utilize an artificial nest habitat design that allows for nest site monitoring of reproductive success and provides protection of nesting ASSP, chicks, and eggs from avian predators and flooding on Seal Cove Rock South.
- As needed and appropriate, utilize social facilitation cues (e.g., sound recordings, olfactory cues, etc.) to encourage ASSP nesting in artificial nest habitat modules.
- Monitor ASSP nests at Seal Cove South Rock. Given that only a few nest crevices exist on this rock, limited nest monitoring efforts are appropriate to detect egg laying but are not currently sufficient for documenting reproductive success. Mist-net monitoring is being used to examine trends in population size at this rock and the nearby main island cliffs. This effort is designed to allow for comparison with other mist-net monitoring programs throughout the range of the ASSP.

Rationale:

At present, San Clemente Island appears to be maintaining the existence of a small breeding population of ASSP. In 2014, Carter and Henderson (2015) estimated a breeding population size of 35-40 pairs based on mist-net captures at Seal Cove South Rock. Nests have only been found on Seal Cove South Rock where these researchers documented 3 nest crevices containing 5 storm-petrel eggs in 2014 (Carter and Henderson 2015). The presence of multiple eggs in a crevice can suggest that nesting habitat is limited; assuming that multiple pairs of ASSP attempted to breed in the same crevice. The ASSP population at San Clemente Island likely has very limited available habitat on the main island due to mammalian predators including island fox, introduced black rat (*Rattus rattus*), and feral cat (*Felis catus*). Therefore, nesting is likely limited to one offshore islet that has suitable nesting habitat and is free of predators (Seal Cove South Rock) and possibly on inaccessible cliffs located on the main island at Seal Cove.

Maintaining this small breeding population at San Clemente Island is important in order to prevent the loss of a colony within the southern end of the breeding range. In the past, larger numbers likely bred at this island. For example, China Point Island has limited crevice-nesting habitat but no evidence of breeding found there in 1991 and 1994 (Carter et al. 1992, 2009). It is currently located inside a military weapons testing area and nesting habitats appear to have been altered by military activities and use of remaining crevices has likely been prevented by human disturbances (e.g., explosions, etc.) in this area. To assist this small population, artificial nest sites should be placed on Seal Cove South Rock to increase the number of nests on this mammalian-predator free islet which likely acts as the only refuge for breeding ASSP at this island. However, since this rock is low-lying and susceptible to impacts from flooding (e.g.,

wave wash – see above), an effort to establish breeding on the mainland within the cliff tops in the Seal Cove area will help ensure that ASSP do not cease nesting on San Clemente Island. These measures are needed until introduced black rats and feral cats are eradicated from San Clemente Island.

Control of feral cats has been underway at San Clemente Island for many years (Bridges et al. 2015). Since 2013, the U.S. Navy and the Institute for Wildlife Studies has implemented efforts to reduce black rat in the Seal Cove area on the main island in an effort to improve conditions for crevice nesting seabirds. Until introduced predators are eradicated on the main island, they pose a great threat to nesting ASSP and limit nesting to only one possible nesting area on the main island (i.e., cliffs at Seal Cove). If cats and rats were eradicated other areas where suitable habitat exists and has little or no visitation by island fox, also may become nesting habitat, especially with the use of artificial nest sites and by broadcasting vocalizations.

The first step for installing artificial nest sites at Seal Cove South Rock would be to increase the number of protected nest sites. In the absence of predation, adult survival would likely be increased for this small population. Adult survival has been demonstrated to be a key demographic in the persistence of ASSP populations (Sydeman et al. 1998; Nur et al. in review). The addition of suitable nest habitat would also aid in the reduction of nest-site competition and increase breeding success by reducing egg abandonment (Carter and Henderson 2015). This conservation action would aid in the development of a larger San Clemente Island ASSP population overall and increase the probability of continued breeding until colonies can be established on the main island and introduced mammals are eradicated there. Finally, the monitoring of additional nest sites created by the artificial habitat will allow nest monitoring to be used for determining population trends, rather than mist-net captures. Occupation of newly created nest sites would likely occur within two years but may take several years more to reach an occupancy of 50% for the proposed 30 additional nest sites (see McIver et al. 2013 – response of ASSP to artificial nesting habitat).

Coronado and Todos Santos islands – Objectives for Artificial Habitat/Nest Structure:

Coronado Islands: Conduct a social attraction project at Coronado Norte, Coronado Medio and Islote Medio by installing at least 60 artificial nest structures and two accompanying sound systems on each island. A visitation rate of 50% and 10 breeding pairs are expected within the artificial nest structures within the next 10 years for the whole archipelago. (Priority 1)

Todos Santos Islands: Conduct a social attraction project at Todos Santos Sur and Todos Santos Norte islands by installing at least 60 artificial nest structures and two accompanying sound systems on each island. A visitation rate of 50% and 10 breeding pairs within the artificial nest structures are expected within the next 10 years. (Priority 1)

Strategies:

- Utilize appropriate artificial nests and vocalization for ASSP. Vocalizations should be recorded locally or at the closest colony possible.
- Develop and conduct a monitoring plan for ASSP, LHSP and CAAU that measures use of artificial and natural habitats, reproductive success and changes in indices for overall breeding population size at Coronado and Todos Santos Islands. The monitoring protocol should be designed to allow for some means of comparison of monitored parameters across the species range (e.g., trends in population index).

Rationale:

The Coronado Islands consist of four islands that lie 11 km (7 miles) off mainland near Tijuana, Baja California, México. Altogether these islands have an area of 2.5 km^2. The islands' topography is steep and rugged and supports several vegetation communities (Oberbauer 1999a; MSRP 2005). Vegetation types are dominated by coastal succulent scrub and coastal sage scrub. A high proportion of the islands are suitable habitat for ASSP. These islands are an Important Bird Area (Birdlife International, 2014). Coronado Islands support nine endemic terrestrial species and subspecies of animals and plants, several of which are protected by the federal Mexican Official Norm NOM-059-SEMARNAT-2010. In addition, they host one of the most diverse seabird colonies off the Baja California coast that includes ten species of breeding seabirds, six of which are listed as threatened or endangered in México and/or the United States. ASSP breeds in sympatry with two other storm-petrel species: black storm-petrel and LHSP. The differentiation of nests between ASSP and LHSP is difficult and care needs to be taken to distinguish between these two species.

In order to protect and conserve the biodiversity of the islands, GECI eradicated three introduced species from Coronado Norte and Sur: goat (*Capra hircus*) in Coronado Sur (2003), donkey (*Equus asinus*) in Coronado Sur (2003) and feral cat on Coronado Norte (1995 and 1996) and Coronado Sur (2003). These species had done extensive damaged to the flora and fauna of these islands (Nogales *et al*. 2004, Aguirre *et al*. 2011). A small population of house mouse is still present on Coronado Sur. Eradication of house mice is feasible in a short amount of time (GECI unpubl. data).

Todos Santos Islands are located 18 km off Ensenada, B.C., comprised of two islands: Todos Santos Norte (34 ha), and Todos Santos Sur (89 ha). The dominant vegetation consists mainly of maritime desert scrub and dunes (Oberbauer 1999b). The physical characteristics of the islands provide suitable breeding sites for nine seabird species, 50% listed in a category of protection by the IUCN and Mexican law. These islands are considered Important Bird and Biodiversity Area (IBA) and due to the high number and diversity of endemic species are classified as high priority marine region by the Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO). Todos Santos are currently free of invasive species; important

conservation efforts included the eradication of rabbit and feral cat (1999-2000), and donkey (2004) from Todos Santos Norte, and feral cat (1997-1998/1999 and 2004) and rabbit (1997) from Todos Santos Sur. ASSP breeding on both islands was suspected before but it was confirmed in 2015 through mist-net capture, in-hand identification and adult measurements, vocalization responses at nest sites and nest searches. In 2016, a total of 17 ASSP nests were found on the Todos Santos Islands (Bedolla-Guzmán, GECI unpublished data).

Artificial nest sites are needed on Coronado and Todos Santos islands to reduce interspecific competition for nesting space, to monitor breeding success and to accurately identify the species. In mixed storm-petrel species colonies (e.g., Coronado Islands) competition for nesting space with larger species (e.g., black storm-petrel) could be limiting the growth of the ASSP breeding population. Therefore, artificial burrows with an entrance size suitable for this species may increase the probability of occupancy. Moreover, artificial burrows allow total access to breeding individuals and enable an accurate identification of species. ASSP and LHSP are very similar species and identification in natural crevices is often extremely difficult. In addition, on Todos Santos, there is evidence that other storm-petrel species are visiting the islands. The utilization of social attraction may entice these other species to nest at these islands.

On both islands, ASSP nests are often inaccessible. The use of these deep crevices typically does not allow the evaluation of breeding success. Artificial nest structures would permit access to chicks with low disturbance and would allow for a detailed account of chick growth and provisioning; two variables studied on species with high buffer capacity such as storm-petrels.

Ashy storm-petrel on a nest. Photo by D. Pereksta. Used with permission.

Reduction of Predation at Breeding Colonies Goal
Reduce avian and mammalian to a level where predation is no longer a significant risk to the continued survival of ASSP breeding colonies.

Farallones - Objectives for Reduction of Predation at Breeding Colonies:
Farallones (A): Within the next 2 years, the Farallon National Wildlife Refuge, Point Blue Conservation Science and other cooperators will work to reduce impacts of burrowing owl predation to the Farallones ASSP population by capturing and relocating owls to reduce the annual burrowing owl abundance index by at least 50% to $\leq$ 3.1 (based on mean owl abundance index of 6.29 for 2009-2012, – from Nur et al., in review) and maintain this reduced level until invasive, introduced house mouse eradication can be accomplished and its efficacy on reducing owl predation of ASSP assessed. (Priority 1)

Farallones (B): Within the next 5 years of the completion of this plan, complete the permitting process (e.g., EIS, etc.) and begin implementing identified methods to eradicate invasive, introduced house mouse from the Farallones in order to eliminate their negative impacts to ASSP and other native species of the FNWR. (Priority 1)

Farallones (C): Within 5 years of the completion of this plan, determine the extent of western gull predation on ASSP populations at the Farallones. If warranted and feasible, implement management options to reduce predation to levels that result in the projection of a stable ASSP population based on population index values obtained from mist-net capture studies. (Priority 2)

Strategies:
- Finalize and implement the South Farallon Islands Invasive House Mouse Eradication Project.
- Until mice are eradicated, capture and relocate burrowing owls that overwinter on Southeast Farallon Island to the mainland and evaluate the effectiveness of this program in increasing adult survival of ASSP.
- Continue to monitor ASSP reproductive success and population trends at the Farallones.
- Continue to conduct monitoring that will inform management decisions regarding predation of ASSP including but not limited to determining a monthly owl abundance index, monthly storm-petrel predation index and extent of western gull depredation on ASSP.

Rationale:
Since 2006/2007, the ASSP population at the Farallones has been in decline based on trend analysis of ASSP capture rates (Nur et al., in review). One major factor that has contributed to this recent decline is reduced adult survival of ASSP caused by burrowing owl predation (Nur et al., in review). To investigate the impact of owl predation on the Farallones ASSP population, Nur et al. (in review) considered three population growth scenarios when modeling plausible future populations trends based on reducing owl abundance at Farallones; Scenario A, the

"observed steep decline" = 7.19 percent annual decrease in ASSP population; Scenario B, "moderate decline" = 3.36 percent annual decline in ASSP population; and Scenario C, "near stable" = 0.63 percent annual increase in ASSP population. Results of the population modeling indicate that a 50% reduction in owl abundance is expected to increase survival probability by 2.4% to 3.8% (Nur et al., in review). This corresponds to changing a population that is strongly declining to weakly declining (Scenario A), from declining to nearly stable (Scenario B) or from nearly stable to increasing (Scenario C). This level of increase in survival rates, particularly in a long-lived species such as the ASSP, will have strong positive population impacts based on modeling with various assumptions. Of course, reducing owl abundance by more than 50% would likely result in higher ASSP survival rates which would translate into greater population growth potential. In short, Nur et al. (in review) presented a compelling argument for attributing the recent decline of the ASSP population at the Farallones mainly to burrowing owl predation. The Farallones population is likely to continue to decline as long as the documented level of owl predation continues.

Nur et al. (in review), as well as others (Mills 2006, 2016; USFWS 2009b; USFWS 2013b), argue that the high owl predation levels are due to a somewhat complex hyper-predation interaction between owls, non-native house mice and ASSP. In short, migrating owls arrive to the islands in the early fall and feed primarily upon the abundant mouse population. By late fall, ASSP populations at the islands reach their lowest levels of the year. In winter, mouse populations decline substantially and owls switch to preying upon storm-petrels (both ASSP and LHSP) that are returning in greater numbers to the island, to begin site attendance and courtship/breeding activities. Owls continue to prey upon storm-petrels until they leave the island in spring, presumably to migrate back to their breeding locations. It is anticipated that the eradication of house mouse from the Farallones would result in reduced numbers of fall migrant owls from remaining on the islands through the winter due to a lack of suitable food source and supply (USFWS 2009b and 2013).

The USFWS, Farallon National Wildlife Refuge staff have initiated the planning process to eradicate house mouse from the Farallones to benefit storm-petrel populations as well as other native species (e.g., endemic Farallon arboreal salamander, endemic Farallon camel cricket, etc.) residing on the Farallon National Wildlife Refuge (USFWS 2013b). However, the planning process will likely take several years before eradication efforts are initiated. As such, an immediate benefit to the Farallones ASSP population would occur by reducing owl predation via removal of owls from the island during the late fall and winter months. A reduction of 50% in the owl abundance index will likely aid in stabilizing the ASSP population at the Farallones until house mouse eradication is conducted.

Western gull predation was shown to have a negative impact on the ASSP population in the 1970s and 1980s, especially as gulls expanded their nesting distribution into prime ASSP nesting habitats on the slopes of Lighthouse Hill (Ainley et al. 1974; Sydeman et al. 1998). A very large gull population of 8,000 – 13,000 pairs has been present at least since 1959 (Penniman et al.

1990, Warzybok et al. 2015). Nur et al. (in review) did not specifically analyze the impact of western gull predation on storm-petrel populations, however a large number of western gulls likely would need to be culled to substantially reduce gull predation levels on storm-petrels island-wide (Bradley et al. 2011). However, local reductions in predation may be possible through discouraging or preventing gull nesting in certain habitats used by ASSP and where heavy predation of ASSP has been documented. Reducing gull predation likely would have benefits for the ASSP population, especially in certain areas, but the current analysis suggests that a reduction in gull predation is not required for reducing the decline currently documented in the ASSP population; a large reduction in burrowing owl predation will suffice. However, an assessment of impacts of gull predation on ASSP should be conducted to better evaluate the benefits of potential management actions needed to reduce WEGU predation on the Farallones.

San Miguel Island Area - Objectives for Prevention and Reduction of Predation at Breeding Colonies:

San Miguel Island Area (A): Implement biosecurity measures at Castle Rock and Prince Island in order to ensure the early detection of black rats that may disperse from San Miguel Island and eliminate any dispersed rats before they establish a substantial population. (Priority 1)

San Miguel Island (B): Within 5 years of the completion of this plan, investigate the feasibility of conducting black rat eradication on San Miguel Island. When feasible, begin rat eradication from San Miguel Island using the most appropriate and cost effective methods. (Priority 1)

Strategies:

- Until rats can be eradicated on San Miguel Island, establish protocols and processes to monitor for rat presence at Castle Rock and Prince Island and deploy eradication methods for these islets if any rats are detected.
- Implement biosecurity measures to ensure that visitors (e.g., researchers) to Castle Rock and Prince Island do not inadvertently introduce invasive species onto these islets.
- Conduct a feasibility study to determine the potential to eradicate rats from San Miguel Island, documenting rat distribution on the island, permitting and paperwork processes, and cost estimation.

Rationale:

San Miguel Island and its two major associated islets, Prince Island and Castle Rock, support important and diverse seabird colonies, including approximately one-third of the breeding seabirds in the Channel Islands (Carter et al. 1992; Wolf 2000). Approximately 14% - 15% of the entire ASSP breeding population occurs on Prince Island and Castle Rock and best estimates indicate that approximately 38% of the Channel Island National Park breeding population occurs at these locations. The island is owned by the U.S. Navy (USN) but is managed by USN and Channel Island National Park. Currently there is no active management for ASSP in the San

Miguel Island area but limited monitoring has been conducted in recent years by U.S. Geological Survey (USGS) and Channel Island National Park.

It is unclear when rats were introduced to San Miguel Island. In the late 1980s, a small rat population appeared to be restricted to the west side of the island along the shoreline, near Castle Rock (Erickson & Halvorson 1990). In 2004, a limited survey by Island Conservation documented rats distributed along shorelines and within canyons on the island. However, a more comprehensive survey would be needed to understand the full extent of rat distribution on the island. In 2007, the California Institute of Environmental Studies (CIES) and Carter Biological Consulting (CBC) documented black rat predation on Scripps's murrelet eggs on the east side of San Miguel Island at Bay Point (Carter et al. 2008c). Currently there are no rats on Prince Island or Castle Rock. However, these islands are located 0.8 km (0.5 miles) and 1.0 km (0.62 miles) from San Miguel Island, respectively. The presence of rats throughout most of San Miguel Island represents a serious threat to the ecologically and regionally important seabird colonies on Prince Island and Castle Rock. It is possible that rats could disperse to these adjacent islets and threaten these important seabird colonies. Rapid detection of such dispersal and removal of rats before larger rat populations develop would have major potential benefits to the ASSP populations. While the risk of biologists introducing rats is very low, implementing bio-security protocols can eliminate the risk of rat introduction by biologists at these islets, also a benefit to these populations.

In 2001 and 2002, the American Trader Trustee Council successfully implemented the Anacapa Island Restoration Project, which eradicated black rats in an effort to restore seabird populations on the island. Given the similar goals and biological setting between these projects, the Anacapa Island Restoration Project should serve as a successful model for the eradication of rats from San Miguel Island. In 2005, the Montrose Settlements Restoration Program released a seabird restoration plan which included rat removal from San Miguel Island as a potential seabird restoration project (MSRP 2005). However, subsequent planning determined that eradication was not feasible due to potential impacts to the then endangered island fox population. This fox population underwent a major population crash in the 1990s due mainly to golden eagle (*Aquila chrysaetos*) predation. Although currently not considered feasible, future eradication may be possible if new methods were developed that would not impact the island fox population (i.e., development of a rat-specific toxicant) or require taking hundreds of individual foxes into captivity. In addition, effective September 12, 2016, the population of island fox on San Miguel Island (as well as on Santa Rosa and Santa Cruz islands) will be removed from the endangered species list (USFWS 2016). This likely would decrease the difficulties in developing and implementing a black rat eradication plan. The non-target risk to island foxes involved in current black rat eradication methods would need to be evaluated. A rat eradication project on San Miguel Island likely would have important benefits for breeding crevice nesting seabirds as well as other nesting birds and native plants and wildlife. For example, after the eradication of rats from Anacapa Island the number of nesting Scripps's murrelets increased 14% per annum post-

eradication, reoccupation of previously vacant study plots occurred within 1 to 3 years and hatching success nearly tripled (Whitworth et al. 2013). The first breeding record of Cassin's auklets was documented less than one year after rat eradication (Whitworth et al. 2015). In addition, the first breeding record of ASSP was documented on Anacapa Island in 2012, approximately 10 years post rat eradication (Harvey et al. 2016). It is possible that remnant populations of Cassin's auklets and ASSP were present on Anacapa Island before eradication of rats (McChesney et al. 1998, Carter & Whitworth 2013, Harvey et al. 2016). Increased post-eradication monitoring or seabirds nesting in areas that were previously unavailable to them due to rat infestations and more easily accessible to researchers may have led to these newly documented nesting records. Regardless of whether or not these species were nesting on the island prior to eradication of rats, the eradication of invasive mammals from islands around the world has been shown to have positive benefits to numerous seabird populations (Jones et al. 2016).

The implementation of a rat eradication project on San Miguel Island, when feasible, should result in: 1) preventing extirpation of a small number of crevice nesting Scripps's murrelet (and possibly ASSP) breeding between Cuyler Harbor and Harris Point and at Hoffman and Bay points; 2) protection of the important seabird colonies on islets adjacent to San Miguel (e.g., Prince Island and Castle Rock); 3) decreased predation on other wildlife on San Miguel (e.g., other nesting birds); and 4) broad ecological benefits to the entire San Miguel Island ecosystem.

Santa Cruz Island Area - Objectives for Prevention and Reduction of Predation at Breeding Colonies:

Santa Cruz Island Area – (A): At appropriate ASSP nesting locations with documented depredation issues, Channel Island National Park and its cooperators will maintain avian predator proof artificial nest sites in order to increase the availability of protected nest sites and reduce the percentage of ASSP nest sites (adults, eggs and chicks) vulnerability to avian predation. The number of artificial nest sites deployed at selected locations will vary; with a general prescription of one predator proof artificial nest site provided for every five "natural" nest sites that are monitored or documented in a nesting location (based on a 5-year running average for number of nest sites). For artificial nest sites, a gradual increase in occupancy rate and breeding success over the first 5-years of artificial nest site deployment is anticipated. In the fifth season after artificial nest site deployment, occupancy rate and breeding success are expected to be >30% and >45%, respectively, recognizing that annual ocean conditions influence occupancy and success rates and that these rates likely will vary between nesting locations. (Priority 1)

Santa Cruz Island Area – (B): Channel Island National Park and its cooperators will begin attempting various management strategies to reduce avian predation at ASSP breeding locations with documented avian predation issues within the Santa Cruz Island area. Within 5 years of plan

approval, avian predation rates, as measured by counts of distinct feather piles, will be substantially reduced from current rates. (Priority 1)

Strategies:

- Continue to conduct nest monitoring that will inform management decisions regarding predation of ASSP including carcass/feather pile counts during nest check visits.
- Assess the status of common ravens, barn owls and island spotted skunks at Santa Cruz Island and examine impacts of predation on ASSP adult survival and breeding success. Specifically investigate common raven dynamics and determine if avian or other predation is a factor limiting population size.
- Evaluate additional measures that might be taken to reduce common raven predation on ASSP (e.g., reduction of food sources near ASSP nesting sites, targeted removal of individual common ravens, use of various innovative predator exclusion techniques).
- Utilize appropriate artificial nest habitat designs that allow for protection of nesting ASSP from avian and mesopredator predation, as well as bright lights at certain colonies (e.g., Orizaba Rock; McIver et al. 2016a), and allow for effective monitoring of nest sites. In sea caves, evaluate the need and feasibility of placing artificial habitats on elevated platforms to reduce impacts from low to moderate amounts of flooding due to sea level rise and high water events from storm surges.
- As needed and appropriate, utilize social facilitation cues (e.g., sound recordings, olfactory cues, etc.) to encourage ASSP nesting in artificial nest habitat modules. Use of sound recordings may not be appropriate in these locations as long as elevated avian predation rates continue.
- As needed, utilize mesopredator traps in caves with ASSP nesting in an effort to reduce the risk of a predation event causing loss of adult breeding ASSP as well as eggs and chicks. Note: Island spotted skunks have not been documented in sea caves from 2009-2015; as such, currently use of traps in sea caves is not recommended.
- Continue to educate park visitors about ASSP nesting and sensitivity to disturbance and limit access to only permitted activities in ASSP nesting habitats.
- Conduct an analysis of demographic and depredation data (e.g., population viability analysis) to aid in refining this objective and determining appropriate conservation and management actions to protect ASSP nesting in the Santa Cruz Island area.

Rationale:

The ASSP monitoring work that has been conducted at Santa Cruz Island since 1995 has documented the importance of this breeding location to the overall ASSP population (as noted above) as well as raising several concerns regarding predation on ASSP at Santa Cruz Island including: (1) avian predation of adults and chicks by barn owls and common ravens that may play a significant role in reducing the viability of certain colonies and the overall Santa Cruz

Island population and (2) spotted skunk predation events, although infrequent, can result in the near extirpation of a breeding location from a one-time predation event (McIver 2002; McIver et al. 2009). Management actions (e.g., limited trapping and avian proof artificial nest sites deployed) have been initiated to help reduce the impacts of predation on the Santa Cruz Island ASSP population. These actions will likely play a key role in maintaining higher population sizes at certain colonies and for the overall Santa Cruz Island population which comprises an important portion of the world breeding population and helps sustain the southern half of the breeding range.

Avian predation and impacts from mesopredators could be reduced or eliminated with the use of artificial nest structures and the deployment of lethal “body-grip” snap traps in ASSP caves (designed to target mesopredators). Appropriately designed artificial nest structures could reduce avian and mesopredator predation of ASSP adults, chicks and eggs at nest sites that are exposed or easily accessible, such as those that occurred in sea caves and on Orizaba Rock. Common ravens and barn owls are suspected to be the main avian predators while spotted skunks have been infrequent predators but with major impacts at Santa Cruz Island. From 1995-1997, 75 adults and 6 chicks were killed by barn owls at Bat Cave and Orizaba Rock although barn owls have not been identified as causing heavy predation in recent years (McIver 2002, W. McIver pers. comm.). In 2005 and 2008, spotted skunks killed at least 75 adult ASSP in Bat Cave and 32 adult ASSP in Cavern Point Cove Caves, respectively (McIver & Carter 2006; McIver et al. 2009). Bat Cave began to recover soon after the skunk predation event but Cavern Point Cove Caves has had a much delayed response but started to increase several years later; neither had recovered to pre-event population sizes by 2013 (McIver et al. 2015). Heavy predation by common ravens began to be observed in 2012 at Orizaba Rock and in 2013 at Bat Cave. In 2013, 45 distinct ASSP feather piles identified in Bat Cave were attributed to common raven predation (McIver et al. 2015). In 2014 and 2015, heavy predation by common ravens also occurred at Bat Cave and Orizaba Rock (D. Mazurkiewicz, pers. comm.).

Common ravens have been documented as being very adept at accessing initial artificial nest structures in 2008-2012 designed to allow researchers to access the nesting chamber of the artificial nest structure for monitoring purposes (McIver et al. 2016). While most sites accessed by ravens did not contain ASSP adults or chicks, a few did. To prevent raven impacts, artificial nest structures have been redeveloped in 2013. The new design prevents ravens from gaining access to nesting ASSP and limits researchers to only looking into structures for monitoring purposes (i.e., there is no direct access to the “nest chamber” for handling eggs or chicks). This design likely will also prevent spotted skunks from gaining access to nesting petrels, eggs and chicks although this has not been tested. In 2014, 10 ceramic artificial nest structures with a total of 30 nest sites (3 nest sites per structure) were deployed at Orizaba Rock without vocalization broadcasting. Active nests sites increased from two in 2014 to four in 2015 with two fledged ASSP. This suggests that, over time, these artificial nest structures will be utilized by ASSP without the use of vocalization broadcasting.

The current rate of common raven predation, as measured by ASSP feather piles collected during monitoring visits to the nesting sites, is alarming. To date, there has not been an analysis to determine the impacts of the documented predation on the Santa Cruz ASSP population. At a minimum, monthly monitoring should continue at all five locations to quantify predation until modeling can be conducted to examine its long-term impacts on breeding success and population size (see section on survey and research below). Additional efforts, beyond artificial nest structure implementation, should be considered for controlling common ravens, particularly at Bat Cave and Orizaba Rock, to prevent continued high impacts in the near future which will likely result in population decline.

Coronado Islands – Objectives for Prevention and Reduction of Predation at Breeding Colonies:

Coronado Islands Area (A): In the next 3 years, design and implement a biosecurity strategy for these islands in order to ensure protection against invasive species. (Priority 1)

Coronado Islands Area (B): In the next 5 years, assess the status of common raven, barn owls, and peregrine falcon (*Falco peregrinus*) at Coronado Islands and examine impacts of predation on ASSP adult survival and breeding success. Determine if avian predation is a factor limiting population size. (Priority 2)

Todos Santos - Objectives for Prevention and Reduction of Predation at Breeding Colonies:

Todos Santos Islands Area (A): Create a buffer zone of a minimum of 30 m adjacent to each natural and artificial ASSP nest, as determined during the 2015 breeding season in which WEGU nests are removed annually in order to decrease depredation of ASSP. (Priority 1)

Todos Santos Islands Area (B): Reduce the total breeding pairs of WEGU to 8,800 breeding pairs within the next 5 years and keep the WEGU population at this level over the next 10 years. It is important to note that this population estimate was determined in an anomalous climate year and the number could increase in “normal” years. (Priority 1)

Todos Santos Islands Area (C): In the next 3 years, design and implement a biosecurity strategy for these islands in order to ensure protection against invasive species. (Priority 1)

Todos Santos Islands Area (D): In the next 5 years, assess the status of common raven, barn owl, burrowing owl and peregrine falcon at Todos Santos Islands and examine impacts of predation on ASSP adult survival and breeding success. Determine if avian predation is a factor limiting population size. (Priority 2)

Strategies:

- Continue to monitor WEGU nesting and documenting population trends on Todos Santos Islands (Sur and Norte).
- Continue to conduct ASSP nest monitoring that will provide information for management decisions regarding predation of ASSP including carcass/feather pile counts during nest check visits.
- Create a buffer zone within 30m of each ASSP nest by preventing or destroying WEGU nests in this "WEGU nest-free" zone.
- Install avian predator proof artificial nest sites in order to provide protective cover for ASSP nesting in habitats that are accessible by avian predators.
- Assess the status of common ravens and barn owls at Todos Santos Island and examine impacts of predation on ASSP adult survival and breeding success. Determine if avian predation is a factor limiting population size.
- Evaluate additional measures that might be taken to reduce WEGU predation on ASSP (e.g., reduction of food sources near ASSP nesting sites, targeted removal of individual WEGU).
- Evaluate Coronado and Todos Santos Island visitation characteristics and design a biosecurity plan in collaboration with local users.

Rationale:

In 2015, GECI calculated between 5,846 and 9,598 WEGU nests on Todos Santos Sur Island and 2,248 and 3,691 WEGU nests on Todos Santos Norte (95% confidence interval and 26% error for both locations) (Bedolla-Guzmán, GECI, unpublished data). Since 2013 GECI has been conducted active conservation actions using social attraction techniques regarding ASSP amongst others, and monitoring the avifauna on the region (Bedolla-Guzmán, GECI, unpublished data). A 10% reduction in the number of ASSP carcasses found during nest searches is anticipated by maintaining a buffer zone around ASSP nests that is void of WEGU nesting.

Survey and Research Goal

Develop and conduct research to fill information gaps on known and potential threats as well as enhance other conservation actions necessary for the continued existence of ASSP. Conduct surveys to obtain population size information at important colonies (e.g. colonies with a history of large population size) without current data and at-sea to develop a world population estimate for ASSP. Conduct surveys at previously unsurveyed coastal rocks within the range of the ASSP to assess and identify breeding locations, relative breeding population size, suitable nesting habitat or evidence of ASSP presence. Develop and conduct research activities to fill information gaps on known and potential threats as well as to enhance the overall understanding of conservation actions necessary for the continued existence of ASSP.

Colony Survey and Colony Size Estimate Objectives

Southern Humboldt, Mendocino, Sonoma and Marin Counties: Conduct surveys for nesting ASSP at all accessible coastal rocks with suspected suitable nesting habitat from southern Humboldt County to Dillon Rocks, northern Marin County (excluding central Mendocino County between Kibesillah Rock and Franklin Smith Rock where ASSP nesting was documented in 2012) within 5 years of plan approval. Highest priorities are: (a) Steamboat Rock, Sugarloaf Island and False Cape Rocks in Humboldt County to determine status of ASSP at these possible breeding locations (note: ASSP eggs were collected from Steamboat Rock in 1914 suggesting that this site and other rocks nearby are likely to have ASSP breeding at them – see Carter et al. 2015); and (b) Fish Rocks and Gull Island in Mendocino County where LHSP nesting has been documented. (Priority 2)

San Francisco and San Mateo Counties: Conduct surveys for nesting ASSP at portions of the South Farallon Islands (i.e., West End Island and Islets), the North Farallon Islands, and nearshore rocks along the mainland within 10 years of plan approval. Highest priorities are: (a) West End Island and Islets because they may host an important portion of the population at the South Farallon Islands; and (b) Alcatraz Island, San Pedro Rock and Año Nuevo Island to evaluate past ASSP presence at these locations (note: ASSP specifically have not been confirmed at San Pedro rock but odor of storm-petrels has been detected in crevices but no storm-petrels have been observed; M. Parker, pers. observations). At the North Farallon Islands, three of the four major islets were surveyed for ASSP in September 1994. No ASSP were found and available habitat was considered to be limited (McChesney et al. 1994). (Priority 2)

Monterey, San Luis Obispo and northern Santa Barbara Counties: Conduct surveys for nesting ASSP at all accessible coastal rocks with suspected suitable nesting habitat from Bird Rock, Monterey County to Point Conception, Santa Barbara County within 10 years of plan approval. Highest priorities are: Cape San Martin and Point Piedras Blancas, the largest nearshore rocks in this region that has potential to host a relatively large population as well as rocks in the Diablo Canyon/Point Buchon area; (b) cliffs and offshore rocks near Vandenberg Air Force Base to

evaluate possible nesting near locations where ASSP have been captured in mist-nets and (c) cliffs at Point Arguello. (Priority 2)

Channel Islands within Santa Barbara, Ventura and Los Angeles counties: Conduct surveys for nesting ASSP on San Miguel Island, Santa Rosa Island, Santa Cruz Island and Santa Barbara Island, Sutil Island and Anacapa Island (exclude San Clemente and Santa Catalina islands which have been recently surveyed) within 10 years of plan approval. Highest priorities are: (a) Prince Island, Santa Barbara Island and Sutil Island to update mist-net based population size estimates for ASSP, LHSP and BLSP; (b) Castle Rock to determine status of ASSP nesting and estimate breeding population size; and (c) cliffs on the north sides of San Miguel and Santa Cruz islands for evaluation of potential breeding because these areas are suspected of hosting undetected populations. (Priority 2)

Baja California Norte: Conduct surveys for nesting ASSP at Coronado, Todos Santos, San Martín, San Jeronimo, and San Benito islands within 10 years of plan approval. Highest priority is: (a) Coronado Islands to update species ratios and develop population estimates for ASSP, LHSP and BLSP. (Priority 2)

Strategies:

- For previously unsurveyed habitats identified above, conduct searches for potential nesting habitat and nests (using small hand-held flashlights and burrow scopes as needed) and call playback (using vocalization recordings played at potential nest site entrances to elicit a vocal response) at accessible cliffs and rocks. Conduct surveys in the incubation period (June-July) to allow identification of incubating adults or in late summer-early fall (August-September) if necessary to avoid disturbance to surface nesting seabirds.
- To detect continued presence at known colonies, determine presence at unknown but suspected colonies and document presence/absence at hard to monitor locations, use automatic acoustic sensors (e.g., song meters) to detect vocalizations over the breeding season. This method could be important at colonies with surface nesting birds as recorders could be placed prior to the nesting season and retrieved after the breeding season.
- To estimate an index of population abundance at relatively large colonies, particularly those with large amounts of relatively inaccessible breeding habitat, use mist-netting with vocalization luring and banding on several nights within a breeding season to gather data related to species of storm-petrel present, adult survival, movements between colonies, conduct capture-recapture analyses and determine captured per unit effort.
- Estimate population sizes for relatively small colonies using numbers of nests found, estimated number of nest sites and estimated site occupancy. Insure that work clearly defines occupancy and suitable habitat assumptions and quantifies how any estimated parameters were produced.
- Continue to support on-going colony survey activities throughout the ASSP range.

Rationale:
Three major problems affect our knowledge of ASSP distribution and relative breeding population sizes: (1) surveying ASSP breeding colonies is very difficult given their rock crevice habitat and nocturnal colony behavior; (2) past surveys for ASSP breeding colonies in California and Baja California were incomplete, and many rocks were not searched either to avoid disturbance to surface-nesting seabirds, difficulty of access to nesting habitat or time limitations; and (3) current population size at several important colonies is poorly known, especially at Santa Barbara/Sutil islands (2rd largest colony) and Prince Island (part of the 3rd largest colony with Castle Rock and San Miguel Island; but 2nd largest single breeding locale) where sizes were determined with mist-netting in 1991 and recent information has been obtained but not analyzed to determine population estimates. In 2012, Carter et al. (2015) confirmed breeding by ASSP along the central coast of Mendocino County, California in a region where ASSP nesting had not been detected since 1926 despite major seabird surveys conducted in 1979-1980 (Sowls et al. 1980) and 1989 (Carter et al. 1992). Even more recently Carter et al. (2016a) also discovered that northernmost ASSP breeding was documented in 1914 at Steamboat Rock off Cape Mendocino. In this area, no surveys of rocks for breeding storm-petrels were conducted in 1979-1980 or 1989, yet large rocks exist with potential nesting habitats that may host a major population of ASSP or LHSP at Steamboat Rock, Sugarloaf Island and False Cape Rocks (Carter et al. 2015a, 2016a). In 1996 and 1997, McChesney et al. (2000) reported ASSP nesting in coastal rocks within Monterey County in areas that had not been searched before. It has become clear that much suitable nesting habitat in northern and central California has not been surveyed and may contain significant numbers of breeding birds or represent small poorly documented populations. To ensure that conservation actions are applied appropriately throughout the range of the species, knowledge of all larger colonies is imperative (e.g., Prince Island, Santa Barbara/Sutil islands, Santa Cruz Island). To ensure that ASSP are sufficiently protected throughout their range, knowledge of small colonies is needed. The additional knowledge of whether or not ASSP nest in these areas will be important to developing appropriate management, monitoring and conservation actions for agencies and organizations responsible for management of ASSP population in these areas.

Population estimates for ASSP at Prince Island and the Santa Barbara Island area were based on capture-recapture analyses in 1991 (Carter et al. 1992) and have not been re-estimated since then. Prince and Santa Barbara areas hold about 10% of the known ASSP breeding population; assuming the 1-year estimates from 1991 are still representative of the population size currently (Table 1). These colonies need to be resurveyed to verify 1991 population estimates and to determine if major changes have occurred. Populations have fluctuated at some nearby Santa Cruz Island colonies between 1995 and 2015 due mainly to reduction of organochlorine pollution impacts and major mammalian and avian predation events (McIver et al. 2016). Population estimates at Bird Rock (Marin County) in 1989 also had been based on capture-recapture analyses but extensive nest searches in almost all habitats in 2012-2015 did not find sufficient nests to support those estimates (Becker et al. 2016). In addition, Castle Rock off San

Miguel Island also has never been adequately assessed for estimating population size, mainly due to issues with access, disturbance to surface nesting seabirds and presence of marine mammals year round. Surveys in late summer or early fall on the east rock only (i.e., fewer marine mammals) are needed to assess population size. At Santa Barbara Island area, preliminary comparisons by Harvey et al. (2013) to earlier ASSP work (Wolf et al. 2000) suggests that this colony may have experienced a negative trend between 1991 and 2011. However, insufficient data was collected in both years for a valid comparison and much larger data sets gathered in 1991 (Carter et al. 1992) and 2005-2007 (Adams 2016) were not considered in this analysis. A new extensive updated survey is needed to both set a solid baseline for future comparisons and to compare with all past data sets to best assess current status.

ASSP populations at Todos Santos Islands were recently assessed using a variety of techniques including nest searches, mist-netting and recording calls. In 2015, a population size of 17 breeding pairs was estimated using these techniques (Table 1) (Bedolla-Guzmán, GECI, unpubl. data). However, populations at the Coronado Islands still need to be adequately assessed. Carter et al. (2006a) reported greater numbers of ASSP at Middle Rock than the few pairs reported for all 4 islands by Everett and Anderson (1991). However, LHSP and BLSP are known to breed at these islands in relatively large numbers, it was difficult to identify species of storm-petrel inside nest crevices, methods were not fully standardized between observers, and subsequent methods of separating ASSP from LHSP were considered suspect (Carter et al. 2016a,b). Extensive mist-netting may be the best approach available to assessing population size at the Coronado Islands and some past mist-net data exists for 1989-1991 for comparison (W.T. Everett, unpubl. data).

At-sea Survey Objectives

At-sea Survey – (A): Every decade or until ASSP specific survey methodology are developed and implemented (similar to Briggs et al. 1987), collate ASSP data from existing at-sea surveys using standardized protocols (Spear et al. 1992, 1995, 2004; Clarke et al. 2003) to determine at-sea distribution and world population size and collate information from non-standardized “bird-watching” trips. Compare estimated population size between periods for a general measurement of overall change in population size and to identify any changes in foraging hotspots. (Priority 2)

At-sea Survey – (B): Develop and implement at-sea survey methodologies specific for ASSP, likely utilizing adaptive sampling with a stratified random approach, to determine at-sea distribution and estimate world population size every 3 to 5 years. This objective likely would involve use of an aircraft to cover large areas in a short period of time. (Priority 2)

Strategies:

- Collate data from aerial surveys (e.g., Briggs et al. 1987, Mason et al. 2007)
- Collate data from shipboard surveys (e.g., Briggs et al. 1985; Spear et al. 2004; Spear and Ainley 2007)

- Until at-sea census specific for ASSP is developed and implemented, collate and analyze data from existing at-sea seabird surveys every decade and determine major changes in estimated population size and at-sea distribution
- Conduct a study to develop an at-sea survey protocol specific for ASSP that can effectively monitor trends in at-sea distribution and world population size (see study objectives below). Implement the developed protocol every 3-5 years or as needed based on colony-based information (e.g., decline in breeding population trends) in order to assess trends in the total ASSP population.
- Collate data from at-sea bird watching trips to assist in understanding at-sea distribution and world population size of ASSP.

Rationale:
An important part of conservation of the ASSP is to monitor population size and at-sea distribution in order to identify significant changes in populations over time and to identify marine conservation issues that may affect ASSP. Some experts have shown that for nocturnal cavity nesting seabirds, at-sea estimates can provide an independent estimate of the world population size over a period of time for validation of the traditional approach of determining world population size based on the sum total of colony-based estimates. Also, differences in at-sea estimates between periods of time can be compared with colony-based measures of trends to determine if trends at those colonies represent the entire population. Given the restricted range of the ASSP and their behavior of aggregating (especially during fall months), at-sea surveys for ASSP may be relatively accurate compared with more wide ranging seabird species. Collating and summarizing information on the at-sea distribution of ASSP also is critical for assessing potential at-sea impacts (e.g., oil pollution, military activities at sea, commercial fisheries, etc.) and changes in prey resources and the marine environment expected with climate change throughout the range of ASSP.

Furthermore, a well designed at-sea survey specific for ASSP, would likely allow for the best estimate of the world ASSP population. Given the restricted range of the ASSP and the ability to survey ASSP via aircraft, conducting periodic, broad-scale, nearly instantaneous at-sea surveys to estimate total population size of ASSP may be the best method to analyze world population trends and evaluate the cumulative success of conservation efforts at the world population level.

Research Objectives

Santa Barbara Island Area: Determine the current extent of predation on ASSP nesting on Santa Barbara and Sutil islands and investigate need for management actions (e.g., barn owl roost site alterations, mouse control, owl removals) to benefit the ASSP populations in the Santa Barbara Island area. (Priority 2)

Strategies:

- Continue efforts similar to Thomsen et al. (2014) to include ASSP in the study.
- Conduct ASSP population estimates/monitoring on Santa Barbara Island and Sutil Island.
- Investigate roost site alterations as a means to reduce barn owl predation on ASSP.
- Monitor native deer mouse, western gull and peregrine falcon population sizes/trends and their impacts on ASSP populations.
- Consider developing marked populations on Santa Barbara and Sutil islands to assess degree of visitation by individuals between these two nesting areas. This will aid in making management decisions between the two breeding sites.

Rationale:
Currently the breeding population size of ASSP in the Santa Barbara Island area (including the main island, Sutil Island and Shag Rock) is estimated at 731 breeding pairs and comprises the second largest ASSP breeding area. However, this population estimate is dated and is based on mist-net captures conducted at the main island and Sutil in 1991 (Carter et al. 1992) and 1 nest found on Shag Rock in 1996 during an incomplete nest survey (H. Carter, pers. comm.). It is unclear what current ASSP population size and trends are in the Santa Barbara Island area. Several studies have implicated barn owls as potentially having an impact on the ASSP population in this area, although no direct evidence has been obtained (Wolf et al. 2000; Whitworth et al. 2011; Harvey et al. 2013). In addition to barn owl predation, ASSP adults have been documented being preyed upon by western gulls and ASSP eggs and chicks have been taken by native deer mice (Wolf et al. 2000, Whitworth et al. 2011). Conducting population size/trend studies in conjunction with a predation study is warranted given the significant impacts that predation, particularly owl predation, has been shown to have on ASSP populations at the Farallones (Nur et al., in review).

Santa Cruz Island Area: Determine the current extent of avian predation on ASSP nesting in the Santa Cruz Island area (particularly at Bat Cave and Orizaba Rock) and investigate need for management actions (e.g., barn owl roost site alterations, common raven mitigation) to benefit the ASSP populations in the Santa Cruz Island area (Priority 2).

Strategies:
- Conduct ASSP population trend analysis and reproductive monitoring in the Santa Cruz Island area
- Investigate roost site alterations as a means to reduce barn owl predation on ASSP
- Conduct an evaluation of raven distribution and abundance at Santa Cruz Island, similar to Boarman and Coe (2002)
- Conduct an evaluation of raven responses to human presence at Santa Cruz Island, similar to Marzluff and Neatherlin (2006)
- Conduct and evaluation of barn owl predation on ASSP, similar to Thomsen and Plumb (2014)

Rationale:
Heavy predation by common ravens began to be observed in 2012 at Orizaba Rock and in 2013 at Bat Cave. In 2013, a "majority" of the 45 distinct ASSP feather piles identified in Bat Cave were attributed to common raven predation although some may have been caused by barn owls (McIver et al. 2015). In 2014 and 2015, heavy predation by common ravens appears to have continued at Bat Cave and Orizaba Rock (D. Mazurkiewicz, pers. comm.). The Santa Cruz Island area holds the 4th largest nesting population of ASSP with an estimated 327 breeding pairs.

Blake (1887) described common ravens as common breeders at Santa Cruz Island. The main food source available for ravens from the mid-19th century to the late 20th century was dead livestock which ravens scavenged (Blake 1887, Schuyler 1993). Management of most of the island moved from a private ranch to The Nature Conservancy in the 1970s, although management of the east end did not move from a smaller private ranch to the NPS until the late 1990s (Schuyler 1993; Faulkner and Kessler 2011). Once included in the Channel Island National Park, the east end and Scorpion Ranch were opened for public use and now receives thousands of visitors to the island for day use and camping each year. It is the busiest location in the Channel Islands National Park and receives the majority of Park visitors annually (D. Mazurkiewicz, pers. comm.). The primary campground is located at Scorpion Ranch and Scorpion Anchorage which is about 1 km from Bat Cave. Marzluff and Neatherlin (2006) hypothesize that food is the most important anthropogenic resource driving the increase of corvids near campgrounds. Ravens are known to be adept at obtaining food from campgrounds, including using techniques such as opening gate latches, backpack zippers and food containers (Janiskee 2010) and individuals can become specialized in their feeding behaviors (Marzluff and Angell 2005). Ravens visiting Orizaba Rock appeared to have learned how to access one type of artificial nest site in order to access the nest contents (McIver et al. 2016; W. McIver, pers. comm.). In recent years, ravens appear to have learned that ASSP nesting at Orizaba Rock and Bat Cave in shallow natural crevices and under driftwood are easily accessible to them (W. McIver, pers. comm.).

The current rate of predation, as measured by ASSP feather piles collected during monitoring visits to the nesting sites, is concerning. To date, there has not been an analysis to determine the impacts of the documented predation on the Santa Cruz ASSP population. However, studies at the Farallones have indicated that heavy and increased predation on adult storm-petrels resulted in a decrease in annual storm-petrel survival and a significant population decline of nearly 6% per annum over a 5-year period (Nur et al., in review). It is necessary to assess the impacts of avian predation on the Santa Cruz Island ASSP population in order to determine: (1) if management actions are warranted to protect this nesting population and (2) if action is warranted, utilize the best information available to implement the most appropriate and effective management actions in order to protect the ASSP breeding at this important location.

Throughout the ASSP Range: Investigate the impacts to ASSP from artificial nocturnal lighting that is emitted from oil platforms and recreational and commercial vessels working near breeding colonies. (Priority 2)

Strategies:

- Design and implement a study of ASSP breeding colonies located near anchorages or squid boat operations with brightly lit lights (See Gillespie et al 2016).
- Investigate ASSP response to light emitted from oil platforms and potential impacts on increased predation by peregrine falcons due to increased at-sea perches/roosts and the ability to hunt at night due to infrastructure lighting (See Hamer et al. 2014).
- Determine light levels that are currently emanating from squid boats with shields.
- Examine effects of recreational and commercial boat lights anchored or operating near colonies on ASSP and nocturnal predator behavior under differing environmental conditions.
- Conduct study of ASSP response to differing light intensities and wavelengths to obtain a better understanding of attractions and potential ways to reduce attraction.

Rationale:

Evidence from several studies on seabird attractions to lights and anecdotal observations specific to ASSP indicate that ASSP are likely attracted to lights (Carter et al. 2000, Carter et al. pers. comm., D. Pereksta, pers. comm.). Hamer et al. (2014) did not find any evidence of ASSP being attracted to lights on two oil platforms located within the Santa Barbara Channel. However, limitations existed from the use of radar on the platforms themselves and the authors recommended additional studies to verify that ASSP are not attracted to oil platform lights (Hamer et al. 2014). In addition, bright lights used by squid fishing boats operating near Orizaba Rock may have contributed to reduced reproductive success (McIver et al. 2016). Furthermore, peregrine falcons have been observed preying on Scripps's murrelets at night utilizing the lights from offshore oil platforms to allow for this type of hunting (Hamer et al. 2014). Very little is known about the impacts of this light attraction and possible increased predation risk by falcons utilizing offshore oil platforms. It is necessary to assess the impacts of bright lights on ASSP in order to determine: (1) if management actions are warranted to protect nesting populations where bright light impacts may be occurring and (2) if management actions are warranted on offshore oil platforms to aid in the reduction of light impacts from possible collisions and possible increased predation by peregrine falcons.

Throughout the ASSP Range: Investigate the impacts of offshore wind energy development projects proposed off the California coast on ASSP to inform effects analysis and decision making. (Priority 2)

Strategies:

- Ensure that the appropriate permitting and resource agencies are considering effects to ASSP from proposed offshore wind energy developments off the California coast.
- Revise and analyze at-sea seabird distribution surveys (See Mason et al. 2007).
- Assess the vulnerability of the ASSP range-wide population to wind energy infrastructure in the California Current System. Include information such as identifying the area over which biological impacts may occur, displacement issues, collision mortality potential, and connectivity between key populations (see Ainley et al. 2015).
- If development is permitted, investigate and develop methodology to monitor collision mortality at-sea.
- Collect baseline information and if development is permitted, monitor in order to determine responses to construction and operation of wind energy infrastructure.

Rationale:
In March 2016, Bureau of Ocean Energy Management (BOEM) announced it would be taking the first steps toward potential leasing for commercial offshore wind energy development in California. These steps are being taken in response to a January 2016 lease request by Trident Winds, LLC. The lease request proposed a project that would be located approximately 30 miles northwest of Morro Bay in waters ranging in depth from 2,600 to 3,300 feet and in an area covering 68,000 acres. The project would utilize approximately 100 floating foundations anchored to the seafloor, each supporting an 8 megawatt turbine. The proposal indicates that the project could be expanded to generate up to 1,000 megawatts in the future. In August 2016, BOEM published a Federal Register notice to describe an unsolicited proposal by Trident Winds, LLC to acquire an outer continental shelf commercial wind lease, determine if there is competitive interest in the lease area requested by Trident Winds and acquire public input regarding the lease area described in the notice (BOEM 2016). Specifically, BOEM is seeking input on site conditions, uses in the project area (e.g. commercial, military, etc.) and potential impacts of the proposed project. Regardless of competitive interest, BOEM anticipates moving forward with the leasing processes in some manner (i.e., competitive or non-competitive leasing process). In addition, BOEM will use responses to the Federal Register notice to inform decision-making about the proposed project and to identify potential issues for NEPA analysis.

Impacts to ASSP are likely during the construction and operational phases of the project. Bailey et al. (2014) assessed the environmental impacts of offshore wind farms and identified a number of concerns for seabirds including: 1) spatial distribution and flight heights are needed for the development of collision risk models in order to determine likelihood of co-occurrence with wind turbine blades and their avoidance response to estimate mortality risk (see Ainley et al. 2015); 2) focus should not only be on mortality but also on the energetic consequences of avoidance and displacement behaviors and their impacts on survival and reproductive success; 3) vulnerability and mortality at offshore wind turbines will likely be related to a combination of

site-specific, species-specific and seasonal factors as documented in onshore wind turbines. ASSP appear to utilize the area in the vicinity of the proposed Trident Winds project (Hunt et al. 1979; Briggs et al. 1987; Mason et al. 2007; Adams & Takekawa 2008). In addition, the project area is located in the middle of the 2 breeding population centers and may impact movement between these areas. It will be important to ensure that impacts of offshore wind energy projects on ASSP are properly considered and if projects are permitted appropriate mitigation measures are implemented.

Ashy storm-petrel at-sea. Photo by D. Pereksta. Used with permission.

Section IV. Consideration For Other Storm-Petrel Species

This plan serves to summarize key published and unpublished information on ASSP for aiding conservation and management of this species. By identifying priority management, restoration and research need, greater cooperation will result between management agencies, researchers and advocacy groups. In addition, the implementation of this conservation plan will aid in the protection of LHSP and black storm-petrels that breed at some of the same islands in California and Baja California as ASSP, as described briefly below.

Leach's Storm-Petrel, Townsend's Storm-Petrel and Ainley's Storm-Petrel

LHSP is one of the most widespread nesting seabirds in the northern hemisphere (Huntington et al. 1996). In the Pacific Ocean, they breed from Japan, across the Aleutian Islands and south to central western Baja California, Mexico. The species has several phenotype variations as identified in Power & Ainley (1986), Howell et al. (2009) and identified by Clements check list (Clements et al. 2016). Along the Pacific Coast these include:

(1) *O. leucorhoa leucorhoa*: breed from North Atlantic Ocean and eastern North Pacific Ocean from the Aleutians to the Farallones and perhaps as far south as the Channel Islands;

(2) *O. l. chapmani*: breeds on the Coronado Islands and San Benito Islands; with intergrades of *leucorhoa* found from the Coronado Islands to the Farallones off central California (Howell et al. 2009 and Howell 2012).

In addition, there are two storm-petrels formerly classified as LHSP but recently classified as separate species by the American Ornithologists' Union (Ainley 1980; Power & Ainley 1986; Birt & Friesen 2009; Chesser et al. 2016). Both species breed at Guadalupe Island off Baja California and appear to have become differentiated by separate breeding schedules and vocalizations; Townsend's storm-petrel (*O. socorroensis*) breeding in summer and Ainley's storm-petrel (*O. cheimomnestes*) breeding in winter.

LHSP breeding colonies occur the length of the California coastline and half way south of the Baja California coast line. Colonies are largest in the north and the south, asymmetrical with ASSP. The largest LHSP colonies off California occur in northern California at Castle Rock (Del Norte County), Trinidad Bay Rocks and Little River Rock, on the basis of surveys in 1989 (Carter et al. 1992). Recent assessments conducted by Parker et al. (2013) in 2012 indicated a substantial decline in breeding birds at Trinidad Bay Rocks and Little River Rock since 1989, probably due to river otter predation; only a few hundred birds likely remain at Trinidad Bay Rocks. Small numbers of LHSP are known at the Farallones, Prince Island, Santa Barbara Island, Sutil Island, and Santa Catalina Island, with a combined population estimate of less than <1000 breeding birds (Ainley et al. 1990; Carter et al. 1992, 2016a). In Baja California, LHSP are known to breed on Coronado Islands and San Benito Islands. The LHSP population on the Coronado Islands was estimated at less than 100 pairs in 1968 (Crossin 1974, Everett &

Anderson 1991), while LHSP at the San Benito Islands were estimated at 50,000 birds in 1968 (Crossin 1974), "hundreds of thousands, possibly even millions" of breeding birds in the 1970s (Boswall 1978), and at roughly 1.2 million birds in the 2000s (Wolf et al. 2006). At Guadalupe Island, Townsend's storm-petrel has been estimated at around 7,000 birds (Crossin 1974) and Ainley's storm-petrel is likely not in "excess of a few thousand birds" (Howell et al. 2009).

Goals and objectives in this ASSP Conservation Action Plan to conduct mist-net population estimates at Prince Island (San Miguel Island area), Santa Barbara Island, Sutil Island and Coronado Islands should include updating LHSP population estimates. In addition, certain management actions geared toward ASSP that are implemented at breeding locations on the Farallones, Prince Island, Santa Barbara Island, Sutil Island, Santa Catalina Island and Coronado Islands may benefit these populations of LHSP, although the apparent asymmetry in occurrence may indicate some sort of direct competition between ASSP and LHSP. Like ASSP, LHSP nest in rock crevices in the southern portion of their range from Central California (Farallones) to Guadalupe Island. However, conservation issues and efforts for the vulnerable populations of LHSP at Todos Santos Islands, San Benito Islands and Guadalupe Island are not identified in this ASSP conservation plan.

Black Storm-Petrel

Black storm-petrels breed primarily on islands in the Gulf of California, Mexico and off the west coast of Baja California, on Coronado and San Benito islands (Everett & Anderson 1991; Howell 2009), extending north to Santa Barbara and Sutil islands off southern California (Carter et al. 1992). Everett and Anderson (1991) considered this species to be the second most abundant seabird in the Gulf of California while population numbers on the west coast of Baja California range from "200 to 300 birds" at Coronado Islands (Everett & Anderson 1991) to perhaps tens to hundreds of thousands at San Benito Islands (Crossin 1974, Boswall 1978, Everett & Anderson 1991, Wolf et al. 2006). However, lack of information provided by Crossin and Boswall on survey methods and the lack of information since these informal assessments were conducted gives good reason to look at this rough estimate cautiously. In California, Carter et al. (1992) estimated 200 and 74 breeding birds at Santa Barbara Island and Sutil Island, respectively. The total world population is thought to be >500,000 pairs (Brooke 2004).

Goals and objectives in this ASSP Conservation Action Plan to conduct mist-net population estimates at Santa Barbara Island, Sutil Island and Coronado Islands should include updating BLSP population estimates. At Prince Island, BLSP were found in small numbers in 1991 and may breed with ASSP and LHSP (Carter et al. 1992). In addition, certain management actions geared toward ASSP that are implemented at Prince Island, Santa Barbara Island, Sutil Island, and the Coronado Islands, will also benefit BLSP.

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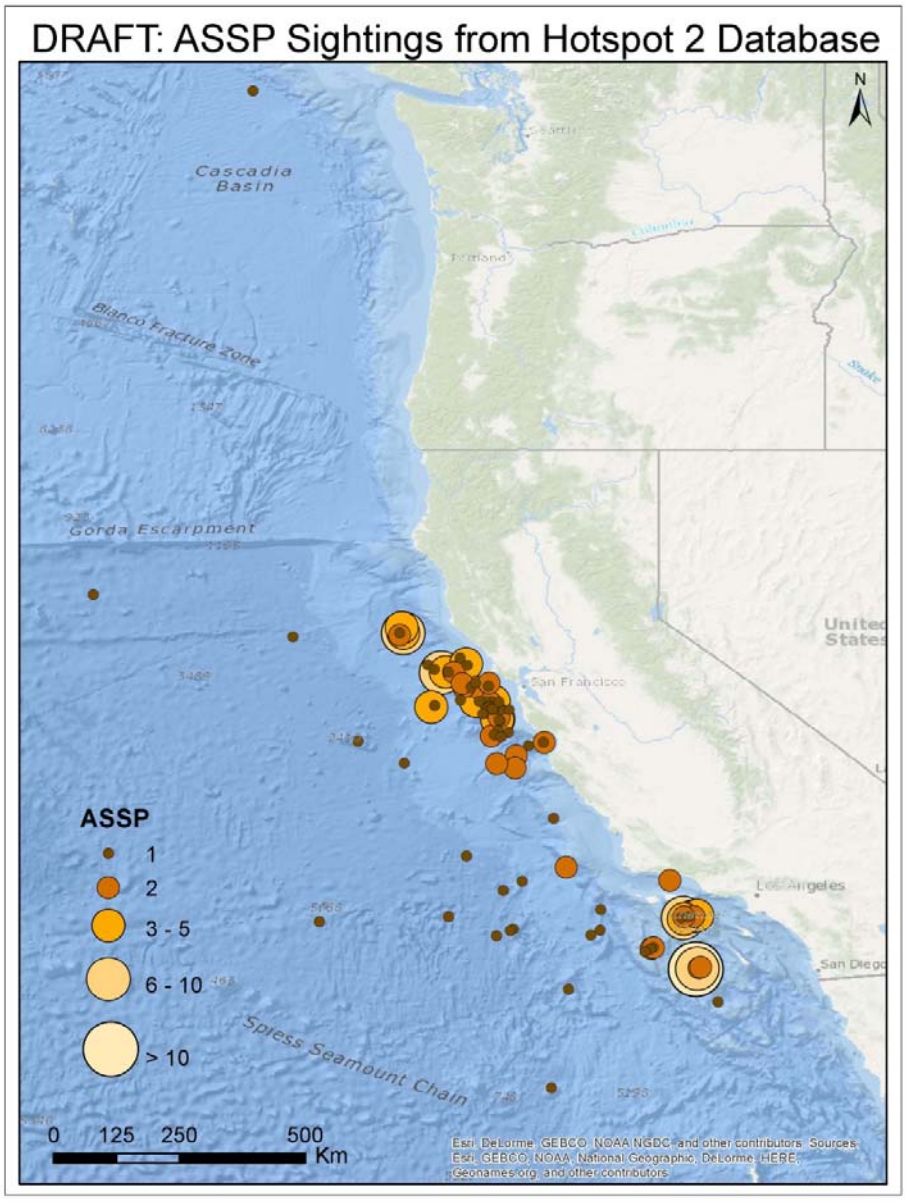

Figure 1. Location of ashy storm-petrels in the eastern North Pacific Ocean; areas of concentration during the upwelling season. **Data were obtained from at-sea surveys by eight research and monitoring programs including: 1. California Co-operative Oceanic Fisheries Investigation (CalCOFI, 1997-2007); 2. National Marine Fisheries Service California Current Ecosystem Study (National Marine Fisheries Service NMFS CCES - National Oceanic and Atmospheric Administration [NOAA]; 2006-2008); 3. California Current Cetacean and Ecosystem Assessment Surveys (NOAA Southwest Fisheries Science Center; 2001-2008; 4. Line P and other North Pacific surveys (Canadian Wildlife Service [CWS] and Environment Canada; 1997-2010); 5. NMFS Rockfish Surveys (1998-2009); 6. NMFS Sardine Surveys (2006-2008); 7. Global Ocean Ecosystem Dynamics Northeast Pacific Northern California Current (GLOBEC NEP NCC; 2000-2002); and 8. Ocean Salmon Ecology (OSE), Southern Resident Killer Whale (SRKW) and Ships-of-Opportunity (SoO) surveys (NOAA Northwest Fisheries Science Center; 2003-2012). Map produced by Dori Dick, Point Blue Conservation Science.**

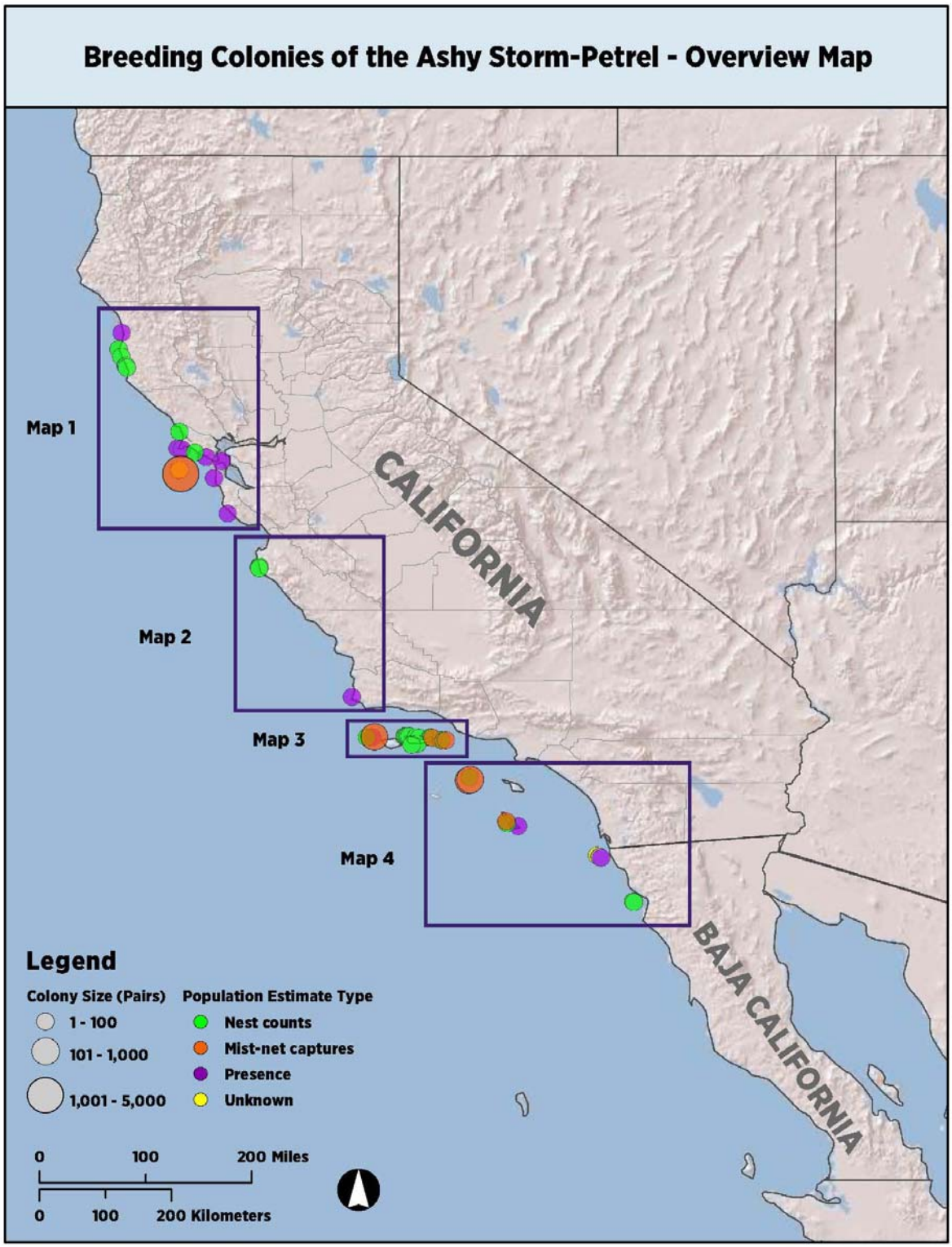

Figure 2. Map of ashy storm-petrel breeding distribution in California and Mexico.

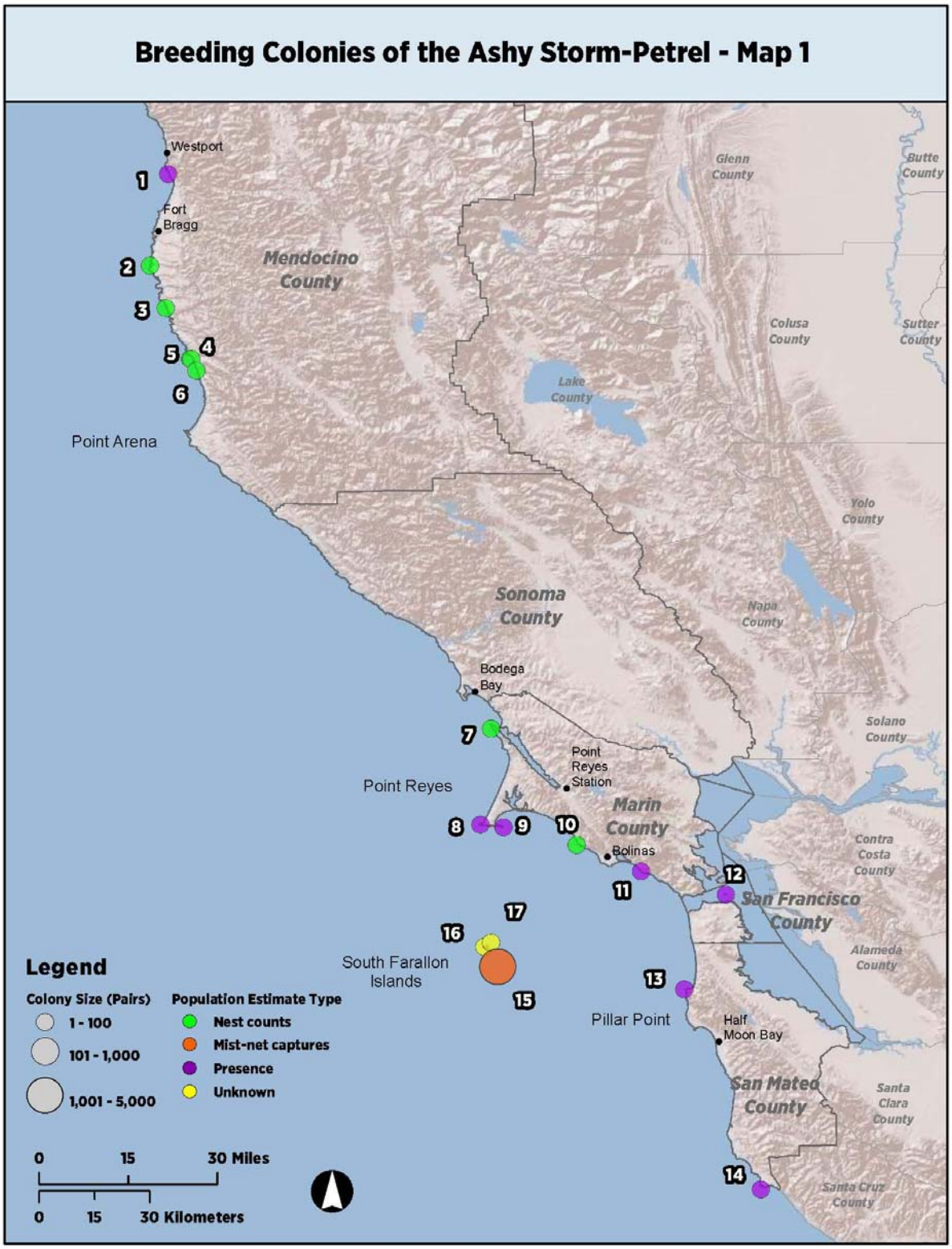

Figure 3. Map of ashy storm-petrel breeding distribution in Mendocino, Sonoma, Marin, San Mateo and northern Santa Cruz counties, California.

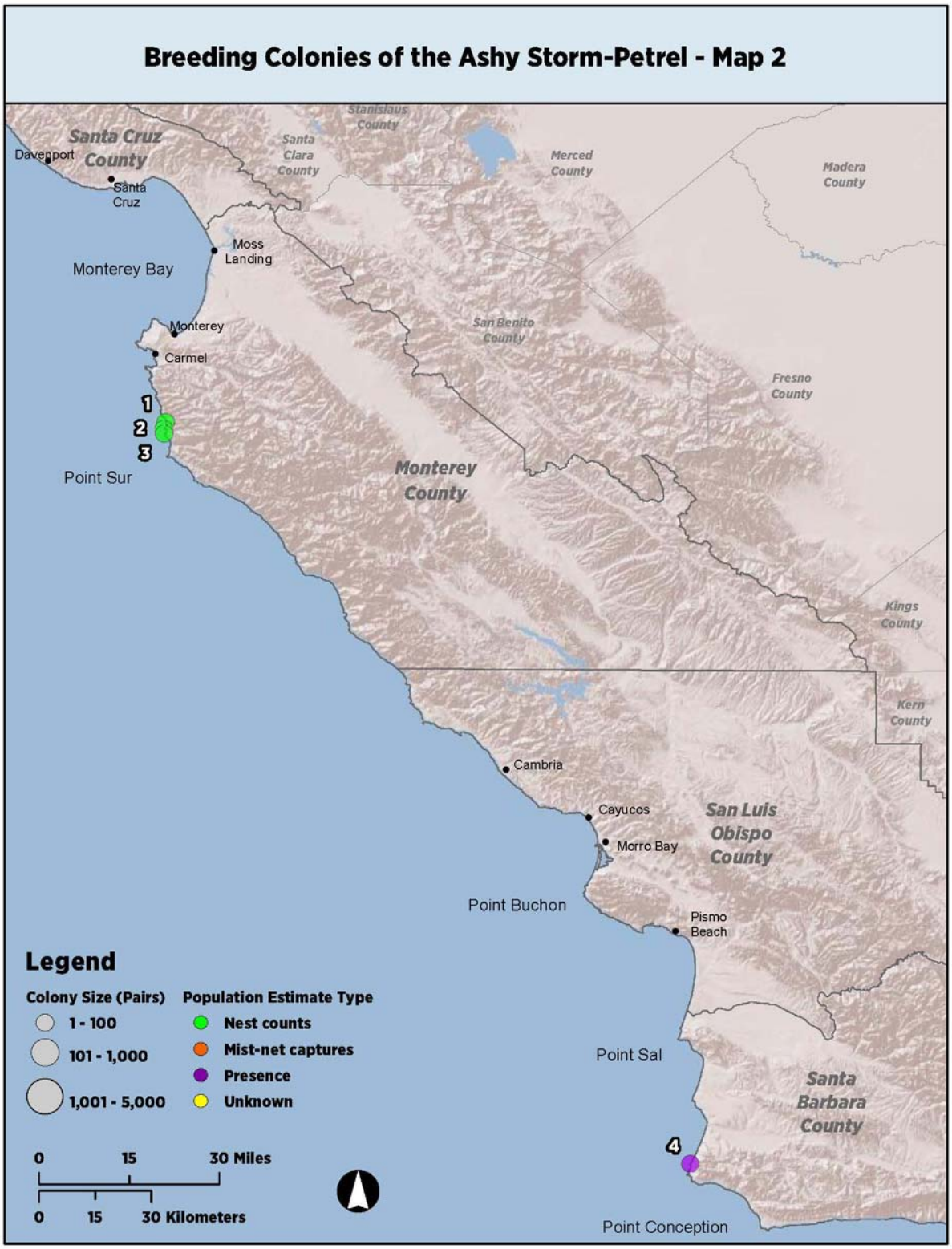

Figure 4. Map of ashy storm-petrel breeding distribution in southern Santa Cruz, Monterey, San Luis Obispo and Santa Barbara counties, California.

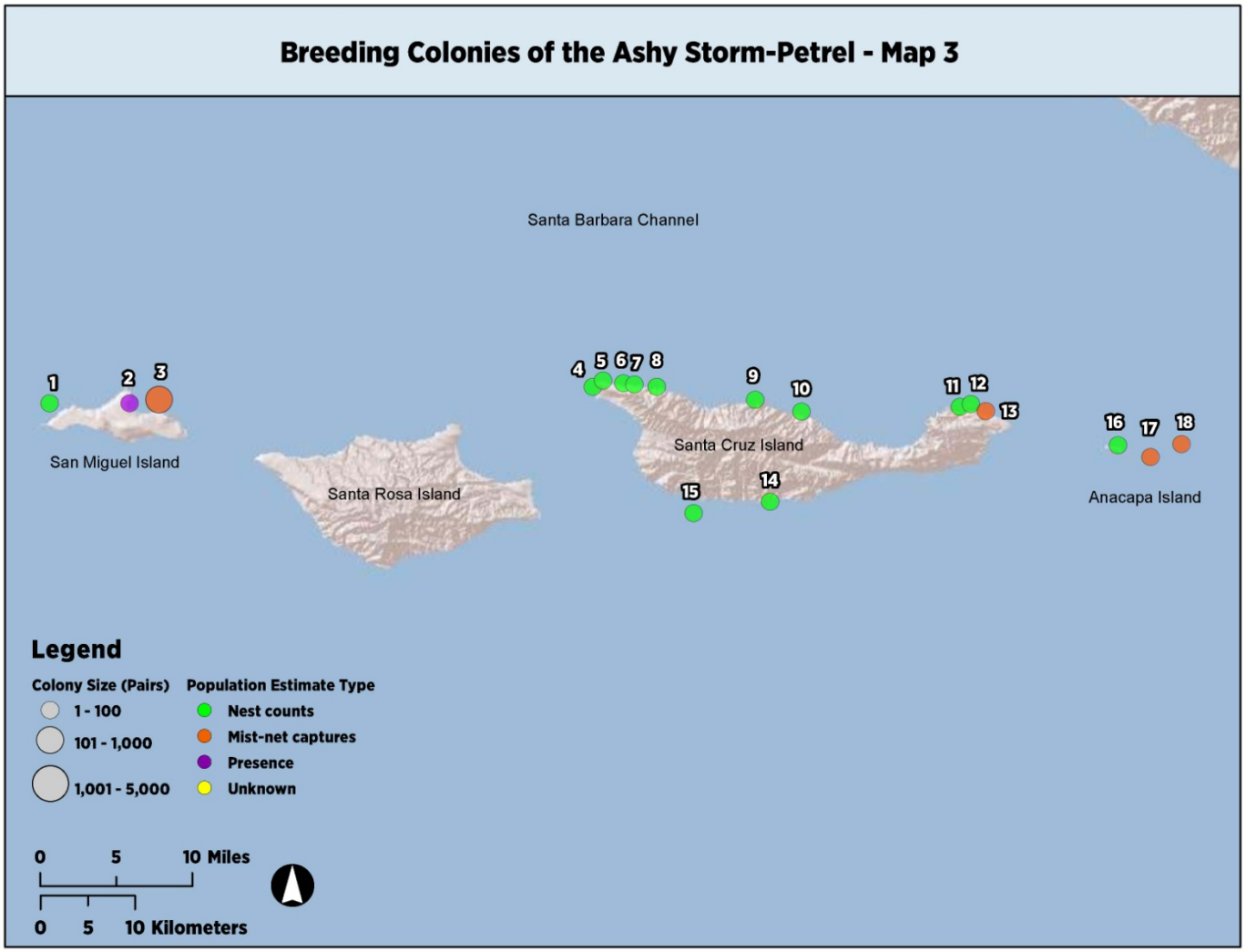

Figure 5. Map of the ashy storm-petrel breeding distribution on San Miguel, Santa Rosa, Santa Cruz and Anacapa islands, California.

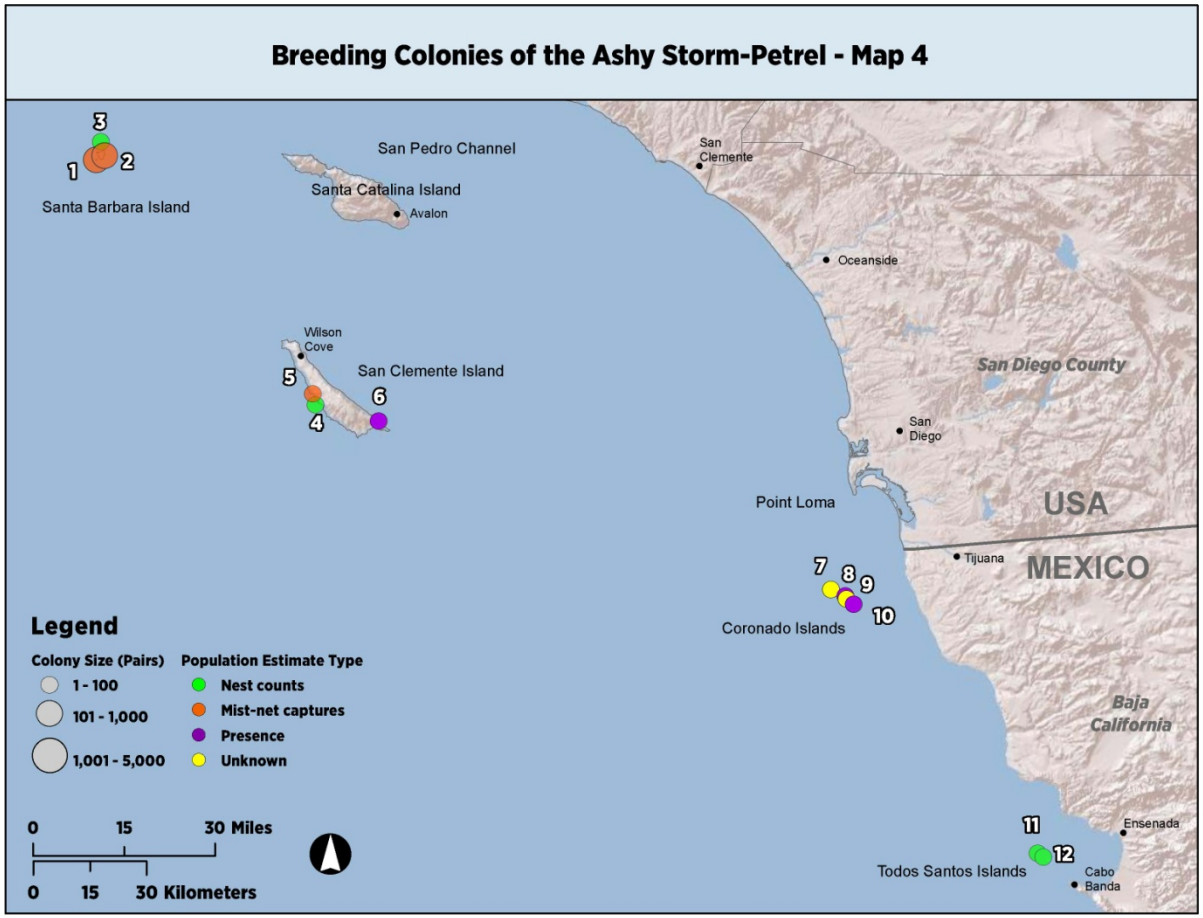

Figure 6. Map of ashy storm-petrel Santa Barbara, Santa Catalina, and San Clemente islands, California, USA and Coronado, Todos Santos islands, Baja, Mexico.

Table 1. Breeding population estimates for ashy storm-petrels.

Colony Name	Map No. – Location No.	Most Recent Survey Year for Estimate	Survey Method[1]	No. of Breeding Pairs[11]	Population Size Category (Pairs)[11]	Source
Humboldt and Mendocino County Coast						
Steamboat Rock	unmapped	1914	EC	X	X	Carter et al. 2016
Kibesillah Rock	1-1	2012	NS	P	P	Carter et al. 2015a
Casper-Point Cabrillo Rock	1-2	1926	EC	X	X	Carter et al. 2015a
Stillwell Point Rock	1-3	2012	NS	1-10[2]	1-100	Carter et al. 2015a
Casket Rock	1-4	2012	NS	1-10[2]	1-100	Carter et al. 2015a
Wharf Rocks	1-5	2012	NS	1-10[2]	1-100	Carter et al. 2015a
Franklin Smith Rock	1-6	2012	NS	1-20[2]	1-100	Carter et al. 2015a
Subtotal				*4-50*		
Point Reyes National Seashore						
Bird Rock	1-7	2015	NS	5-10	1-100	Becker et al. 2016
Point Reyes Lighthouse	1-8	2013	MN	P	P	Becker et al. 2016
Chimney Rock	1-9	2001	MN	P	P	Becker et al. 2016
Stormy Stack	1-10	2015	NS	10-15	1-100	Becker et al. 2016
Subtotal				*15-25*	*1-100*	
Golden Gate Area						
Steep Ravine	1-11	2001	V	P	P	Whitworth et al. 2002
Alcatraz Island	1-12	2014	DB	P	P	Carter et al. 2015b
Unnamed Island*	Unmapped	2016	NS	1-10	1-10	M Parker & H. Carter, unpubl. data*
Subtotal				P		
San Mateo County Coast						
San Pedro Rock	1-13	1998	NS	P	P	USFWS, unpubl. data
Año Nuevo Island	1-14	2005	MN	P	P	Carle et al. 2014

Colony Name	Map No. – Location No.	Most Recent Survey Year for Estimate	Survey Method[1]	No. of Breeding Pairs[11]	Population Size Category (Pairs)[11]	Source
Subtotal				P		
South Farallon Islands						
SE Farallon Island	1-15	2010-2012	MN	2,884	1,001-5,000	Nur et al. 2013
West End Island	1-16	?	MN	P?	P?	Carter et al. 1992
Islets	1-17	?	MN	P?	P?	Carter et al. 1992
Subtotal				*2,884*	*1001-5000*	
Monterey County Coast						
Bench Mark-227x	2-1	1997	NS	2-10[2,6]	1-100	McChesney et al. 2000
Castle Rocks and Mainland	2-2	1997	NS	1-5[2,6]	1-100	McChesney et al. 2000
Hurricane Point Rocks	2-3	1997	NS	1-15[2,6]	1-100	McChesney et al. 2000
Subtotal				*4-30*	*1-100*	
Northern Santa Barbara County Coast						
Vandenberg Air Force Base	2-4	2001	MN	P	P	Brown et al. 2003
San Miguel Island						
Castle Rock	3-1	1968	NS	100[3]	1-100	Crossin and Brownell 1968
San Miguel Island (Harris Point to Cuyler Harbor)	3-2	1976	MN	P	P	
Prince Island	3-3	1991	MN	577	101-1,000	Carter et al. 1992
Subtotal				*677*	*101-1000*	

Colony Name	Map No. – Location No.	Most Recent Survey Year for Estimate	Survey Method[1]	No. of Breeding Pairs[11]	Population Size Category (Pairs)[11]	Source
Santa Cruz Island						
Shipwreck Cave	3-4	1997	NS	7[4]	1-100	H.R. Carter, unpubl. data
Dry Sandy Beach Cave	3-5	2010	NS	29[4]	1-100	McIver et al. 2011
Del Mar Rock	3-6	1991	NS	1[5]	1-100	Carter et al. 1992
Cave of the Bird's Eggs	3-7	2014	NS	30	1-100	W.R. McIver and D. Mazurkiewicz, unpubl. data
Painted Cave	3-8	1994	NS	0[5]	0	H.R. Carter, unpubl. data
Diablo Rocks	3-9	1994	NS	4[5]	1-100	H.R. Carter, unpubl. data
Orizaba Rock	3-10	2014	NS	32[4]	1-100	W.R. McIver and D. Mazurkiewicz, unpubl. data
Bat Cave	3-11	2014	NS	92[4]	1-100	W.R. McIver and D. Mazurkiewicz, unpubl. data
Cavern Point Cove Caves	3-12	2014	NS	5[4]	1-100	W.R. McIver and D. Mazurkiewicz, unpubl. data
Scorpion Rocks	3-13	1991	MN	70[7]	1-100	Carter et al. 1992
Willows Anchorage Rocks	3-14	1991	SC	56	1-100	Carter et al. 1992
Gull Island	3-15	1991	NS	1[4,8]	1-100	Hunt et al. 1979
Subtotal				*327*	*101-1000*	

Colony Name	Map No. – Location No.	Most Recent Survey Year for Estimate	Survey Method[1]	No. of Breeding Pairs[11]	Population Size Category (Pairs)[11]	Source
Santa Barbara Island						
Sutil Island	4-1	1991	MN	293	101-100	Carter et al. 1992
SBI (main island)	4-2	1991	MN	437	101-100	Carter et al. 1992
Shag Rock	4-3	1996	NS	1[5]	1-100	H.R. Carter, unpubl. data
Subtotal				*731*	*101-1000*	
San Clemente Island						
Seal Cove South Rock	4-4	2015	NS	2	1-100	Carter and Henderson 2016
Seal Cove Cliffs	4-5	2015	MN	33-43	1-100	Carter and Henderson 2016
Knob Canyon	4-6	2013	MN	P	P	Carter and Henderson 2016
Subtotal				*35-45*	*1-100*	
Coronado Islands[10]						
North Island	4-7	?	?	?	?	
Middle Rock	4-8	2005	NS	X	X	Everett and Anderson 1991
Middle Island	4-9	?	?	?	?	
South Island	4-10	2005	NS	?	?	Everett and Anderson 1991
Subtotal				?	?	
Todos Santos Islands						
North Island	4-11	2015	NS	5	1-100	Bedolla-Guzmán, GECI, unpubl. data
South Island	4-12	2015	NS	12	1-100	Bedolla-Guzmán, GECI, unpubl. data
Subtotal				17	*1-100*	

Colony Name	Map No. – Location No.	Most Recent Survey Year for Estimate	Survey Method[1]	No. of Breeding Pairs[11]	Population Size Category (Pairs)[11]	Source
All Known Breeding Sites						
Totals				*4,695-4,796*		

[1] NS, nest search; MN, mist-net captures with estimates based on mark-recapture data; SC, site count; V, vocalizing heard only; DB, dead bird only; EC, egg collection.
[2] Low end of range = number of nests found; high end of range = estimated number of pairs.
[3] Rough estimate of "several hundred birds". One nest was found in October 1991.
[4] Complete nest count in all suitable nesting habitat.
[5] Incomplete nest count with some inaccessible habitat.
[6] Estimate of 10-30 breeding pairs divided into nearby colonies based on nests found and amount of suitable habitat.
[7] No nests were found in 1991 but most of this colony is inaccessible. In recent years, a couple of nests have been found on Scorpion Rock (D.M. Mazurkiewicz, unpubl. data).
[8] No nests were found during a nest search in October 1991 but eggshells may have been missed (Carter et al. 1992).
[9] Past breeding by small numbers.
[10] 22 storm-petrel nests were found on the Coronado Islands in 2015 but species identification could not be confirmed. Work to confirm species identification will continue in 2016 and beyond.
[11]Symbol definitions: X= a confirmed nesting location as a nesting bird or egg was documented at the location but no population estimates have been made for the location; P=Only presence was noted and no population estimate provided (scent or calls heard); P?=presence likely due to proximity to a major colony but no nest documented; ? information unavailable for this location but storm-petrel species have been documented and ASSP possibly occur at the location.
*M. Parker and H. Carter documented ASSP, based on vocalization confirmation, nesting on an unnamed rock within the Golden Gate National Recreation area on 9 September 2016. The small nearshore rock is on the northern side of the Golden Gate area approximately 0.70 km west of the Golden Gate Bridge.

Table 2. Potential threats to ashy storm-petrels.

THREAT	LOCATION WHERE THREAT IS PRESENT
Climate Change: Warming: Increased El Niño years and decreased ocean productivity	Entire Range
Climate Change: Ocean acidification	Entire Range
Climate Change: Sea level rise	Low lying nest locations, particularly sea caves (e.g., Santa Cruz Island) and low lying islets (e.g., Orizaba Rock)
Human presence	Entire Range except SE Farallon Island
Introduced non-native vegetation (e.g., New Zealand spinach)	SE Farallon Island – may occur elsewhere
Military Activities	San Clemente Island, Seal Cove Rocks
Scientific purposes	Everywhere nests are accessible
Recreational purposes	All locations, except for SE Farallon Island
Burrowing Owl predation	SE Farallon Island
Western Gull predation	SE Farallon Island, Santa Barbara Island, Santa Cruz Island and Todos Santos Island – may occur elsewhere
Mouse predation	Santa Cruz Island, SE Farallon Island (eggs), potential on San Miguel Island and Santa Barbara Island
Common Raven predation	Santa Cruz Island area (e.g., sea caves, Orizaba Rock)
Barn Owl predation	Santa Barbara Island, Santa Cruz Island
Island spotted skunk predation	Santa Cruz sea caves
River Otter predation	Nearshore rocks; Pt. Reyes headlands, Bird Island, Franklin Smith Rock – may occur elsewhere
Disease	Entire range – potential
Artificial light: Squid fishery, sport fishery and recreational boats	Everywhere squid fishing is permitted
Artificial light: Oil platforms	Channel Island breeding locations
Oil spill: Offshore energy platforms	Channel Island breeding locations
Oil spill: Vessels	Entire range
Organochlorine contaminants	Entire range
Ingestion of plastics	Entire range
Lack of Bio-security plan implementation	Entire range
Offshore wind energy development	Entire range; current proposal off Morro Bay

Appendix 1. Conservation objectives in order of priority (rankings) as determined by ASSP working group members in 2016. A total of 19 working group members voted (30 members were invited to vote). Each member cast from 0-5 votes for each objective, with a total of 30 votes allocated to each working group member.

Category	Location	Brief Objective Descriptions	Priority	Feasibility	Prob. Of Success	Relative Local Impact	Relative Impact – Range-wide	Cost Range	Anticipated Outcome	Totals
Reduce Predation	South Farallones (B)	Within the next 5 years of the completion of this plan, complete the permitting process (e.g., EIS, etc.) and begin implementing identified methods to eradicate invasive, introduced house mouse from the South Farallon Islands in order to eliminate their negative impacts to ASSP and other native species of the FNWR.	1	3	1	1	1	3	Eradicate house mouse, reduce BUOW presence, increase ASSP adult survival	59
Index Monitoring	Range-wide	Development of an ASSP monitoring plan.	2	2	2	1	1	2	Standardized methods and approaches to ASSP data collection are developed (e.g. reproductive success, population estimates); long-term datasets are continued or initiated and trends are comparable across the range of the species	54
Artificial Habitat/Nest Structure	Santa Cruz Island	At appropriate ASSP nesting locations with documented predation issues, Channel Island National Park and its cooperators will maintain avian predator proof artificial nest sites in order to increase the availability of protected nest sites and reduce the percentage of ASSP nest sites (adults, eggs and chicks) vulnerability to avian predation.	1	1	2	2	2	2	Reduce number of nest site vulnerable to avian predation	30

Reduce Predation	San Miguel Island (B)	Within 5 years of the completion of this plan, investigate the feasibility of conducting black rat (Rattus rattus) eradication on San Miguel Island. When feasible, begin rat eradication from San Miguel Island using the most appropriate and cost effective methods.	1	3	1	1	2	3	Eradicate rats from San Miguel and re-establish a secure breeding population of ASSP on the main island and protect existing colonies on adjacent islets	30
Survey and Research (Survey)	Channel Islands	Conduct surveys for nesting ASSP on San Miguel Island, Santa Rosa Island, Santa Cruz Island, Santa Barbara Island, Sutil Island and Anacapa Island (exclude San Clemente and Santa Catalina islands which have been recently surveyed) within 10 years of plan approval.	2	2	1	1	1	2	Population estimates are needed for "larger" colonies as current information is decades old; this information is important for providing baseline data for looking at populations across the range and importance observed in any trends data collected in the future	29
Reduce Predation	South Farallones (A)	Within the next 2 years, the Farallon National Wildlife Refuge, Point Blue Conservation Science and other cooperators will work to reduce impacts of burrowing owl (Athene cunicularia) predation to the South Farallon Islands ASSP population by capturing and relocating burrowing owls.	1	2	1	1	2	1	Reduce ASSP adult mortality, increase survival, prevent ~50-100 ASSP from being depredated annually, slow population decline	28
Survey and Research (Survey)	At-sea survey (B)	Develop and implement at-sea survey methodologies specific for ASSP, likely utilizing adaptive sampling with a stratified random approach, to determine at-sea distribution and estimate world population size every 3 to 5 years. This objective likely would involve use of an aircraft to cover large areas in a short period of time.	2	2	2	1	1	3	Develop aerial survey for determining at-sea distribution and world population of ASSP; Obtain estimate of world ASSP population; essential to interpretation of trends data collected at colonies	28

Artificial Habitat/Nest Structure	SE Farallones	Farallon National Wildlife Refuge (NWR) will permanently maintain and when feasible enhance rock foundation walls on the Lighthouse Hill Trail, Auklet Trail, Helo Pad, and former Eggers House with dry stone construction in order to provide a minimum of 500 horizontal meters of potential nesting habitat (with 0.5 to 1.5 m of vertical elevation and minimum of 0.5 m width) with a moderate to high density of potential nesting sites.	1	1	1	1	2	2	Maintain current core breeding habitat.	25
Artificial Habitat/Nest Structure	Coronado Islands	Conduct a social attraction project at Coronado Norte, Coronado Medio and Islote Medio by installing at least 60 artificial nest structures and two accompanying sound systems on each island.	1	2	2	2	2	2	Re-establish breeding ASSP at Coronado Islands;	24
Artificial Habitat/Nest Structures	Todos Santos Island	Conduct a social attraction project at Todos Santos Sur and Todos Santos Norte island by installing at least 60 artificial nest structures and two accompanying sound systems on each island.	1	2	1	2	2	2	Aid in preventing the loss of this colony as a nesting location	21
Reduce Predation	San Miguel Island Area (A)	Implement biosecurity measures at Castle Rock and Prince Island in order to ensure the early detection of black rats that may disperse from San Miguel Island and eliminate any dispersed rats before they establish a substantial population.	1	2	1	1	2	2	Prevent invasive species from establishing on this island	21

Survey and Research	Baja California Norte	Conduct surveys for nesting ASSP at Coronado, Todos Santos, San Martín, San Jeronimo, and San Benito islands within 10 years of plan approval.	2	2	1	1	1	2	Population estimates are needed for "larger" colonies as current information is decades old; this information is important for providing baseline data for looking at populations across the range and importance observed in any trends data collected in the future	21
Artificial Habitat/Nest Structure	SE Farallones	SE Farallon Island (B): Over the next 10 years, Farallon NWR will remove certain foundations of dismantled buildings on SE Farallon Island and repurpose the materials to create additional artificial breeding habitats, as appropriate and feasible.	3	2	1	2	3	2	Add breeding habitat for potential population increase	17
Artificial Habitat/Nest Structure	San Clemente Island – Seal Cove South Rock	At Seal Cove South Rock, the U.S. Navy, Bureau of Land Management, and their cooperators will install a minimum of 30 artificial nest sites in order to maintain an eventual minimum occupancy rate of at least 50% and a breeding success rate > 50% .	1	3	1	1	2	3	Increase number of nesting ASSP at San Clemente Island; provide additional predator-free habitat as this resource may be limited; prevent the loss of this colony	17
Reduce Predation	Coronado Islands Area (A)	In the next 3 years, design and implement a biosecurity strategy for these islands in order to ensure protection against invasive species.	1	2	1	1	2	2	Prevent invasive species from establishing on this island	16
Survey and Research (Survey)	Southern Humboldt, Mendocino, Sonoma, Marin counties	Conduct surveys for nesting ASSP at all accessible coastal rocks with suspected suitable nesting habitat from southern Humboldt County to Dillon Beach, northern Marin County (excluding central Mendocino County between Kibesillah Rock and Franklin Smith Rock where ASSP nesting was documented in 2012) within 10 years of plan approval.	2	2	1	2	2	2	Fill large information gap on ASSP populations in areas unsurveyed for years	16

Survey and Research (Survey)	Monterey, San Luis Obispo, no. Santa Barbara co.	Conduct surveys for nesting ASSP at all accessible coastal rocks with suspected suitable nesting habitat from Bird Rock, Monterey County to Point Conception, Santa Barbara County within 10 years of plan approval.	2	2	1	2	2	2	Improve knowledge of ASSP nesting on these nearshore rocks where little or no information is available	16
Reduce Predation	Santa Cruz Island Area (B)	Channel Island National Park and its cooperators will begin attempting various management strategies to reduce avian predation at ASSP breeding locations with documented avian predation issues within the Santa Cruz Island area.	1	2	2	1	1	2	Reduce avian predation at impacted nesting areas	12
Survey and Research (Survey)	At-sea survey (A) – rangewide	Every decade or until ASSP specific survey methodology are developed and implemented, collate ASSP data from existing at-sea surveys using standardized protocols to determine at-sea distribution and world population size and collate information from non-standardized "bird-watching" trips.	2	2	2	1	1	2	Obtain estimate of world ASSP population; essential to interpretation of trends data collected at colonies	11
Reduce Predation	Todos Santos Island Area (C)	In the next 3 years, design and implement a biosecurity strategy for these islands in order to ensure protection against invasive species.	1	2	1	1	2	2	Prevent invasive species from establishing on this island	10
Survey and Research (Survey)	San Francisco and San Mateo Co.	Conduct surveys for nesting ASSP at portions of the South Farallon Islands (i.e., West End Island and Islets), the North Farallon Islands, and nearshore rocks along the mainland within 10 years of plan approval.	2	1	1	2	2	2	Enhance information on potential available nesting habitat at Farallons	10

Artificial Habitat/Nest Structure	San Clemente Island – Seal Cove Mainland	At Seal Cove mainland, the U.S. Navy, Bureau of Land Management, and their cooperators should conduct a trial effort to create a new colony in an accessible location at higher elevation along the edge of the bluff top that prevents flooding and is protected from avian and mammalian predators.	1	3	2	1	2	3	Establish a second secure breeding location; aid in preventing the loss of this colony	9
Reduce Predation	Santa Cruz Island Area (A)	At appropriate ASSP nesting locations with documented depredation issues, Channel Island National Park and its cooperators will maintain avian predator proof artificial nest sites in order to increase the availability of protected nest sites and reduce the percentage of ASSP nest sites (adults, eggs and chicks) vulnerability to avian predation.	1	1	2	2	2	2	Reduce number of nest site vulnerable to avian predation	9
Survey and Research (Research)	Range-wide	Investigate the impacts to ASSP from artificial nocturnal lighting that is emitted from oil platforms and recreational and commercial vessels working near breeding colonies.	2	2	1	2	2	2	Likely multiple studies looking at light impacts on ASSP from various sources	9
Survey and Research (Research)	Santa Barbara Island area	Determine the current extent of predation on ASSP nesting on Santa Barbara and Sutil islands and investigate need for management actions (e.g., barn owl roost site alterations, mouse control, owl removals) to benefit the ASSP populations in the Santa Barbara Island area.	2	1	2	1	2	2	Determine impact of avian predation on ASSP at this island	8

Survey and Research (Research)	Santa Cruz Island area	Determine the current extent of avian predation on ASSP nesting in the Santa Cruz Island area (particularly at Bat Cave and Orizaba Rock) and investigate need for management actions (e.g., barn owl roost site alterations, common raven mitigation) to benefit the ASSP populations in the Santa Cruz Island area	2	2	1	1	2	2	Determine impact of avian predation on ASSP at this island	7
Reduce Predation	South Farallones (C)	Within 5 years of the completion of this plan, determine the extent of western gull (Larus occidentalis) predation on ASSP populations at the South Farallon Islands. If warranted and feasible, implement management options to reduce predation to levels that result in the projection of a stable ASSP population based on population index values obtained from mist-net capture studies.	1	3	2	1	2	2	Quantitatively evaluate gull predation impacts, reduce ASSP mortality, increase survival	6
Survey and Research (Research)	Range-wide	Investigate the impacts of offshore wind energy development projects proposed off the California coast on ASSP.	2	2	2	1	1	3	Provide essential information to inform the BOEM lease and environmental permitting processes for offshore wind energy development	6
Reduce Predation	Coronado Islands Area (B)	In the next 5 years, assess the status of common raven, barn owls, and peregrine falcon at Coronado Islands and examine impacts of predation on ASSP adult survival and breeding success. Determine if avian predation is a factor limiting population size.	2	2	1	1	2	2	Obtain important information needed on avian predation in order to advance management and conservation of ASSP	2

Reduce Predation	Todos Santos Island Area (D)	In the next 5 years, assess the status of common raven, barn owl, burrowing owl and peregrine falcon at Todos Santos Islands and examine impacts of predation on ASSP adult survival and breeding success. Determine if avian predation is a factor limiting population size.	2	2	1	1	2	2	Obtain important information needed on avian predation in order to advance management and conservation of ASSP	2
Reduce Predation	Todos Santos Island Area (A)	Create a buffer zone of a minimum of 30 m adjacent to each natural and artificial ASSP nest, as determined during the 2015 breeding season in which WEGU nests are removed annually in order to decrease depredation of ASSP.	1	2	2	1	2	2	Reduce predation of ASSP visiting or breeding in nesting areas;	1
Reduce Predation	Todos Santos Island Area (B)	Reduce the total breeding pairs of WEGU to 8,800 breeding pairs within the next 5 years and keep the WEGU population at this level over the next 10 years.	1	2	2	1	2	2	Reduce WEGU population; reduce predation pressure on ASSP nesting in this area	1

Note: Two additional objectives (listed below) were added by a member of the working group late in the process of writing this plan. No other members of the team voted on these objectives and thus they are not included in the above table at this time. Although these items may be warranted to be included in the plan, they were unable to be incorporated into the plan fully due to the time constraints associated with completing this plan and the lack of input from other members of the working group. They are included here in an effect to be inclusive and complete but with the recognition that these objectives were not fully vetted by the working group.

1. Conduct a genetic study to determine relatedness of coastal and offshore colonies.
2. Determine population size, partitioning between breeders and non-breeders using the same standardized techniques at all major colonies. (Note: This is similar to what is proposed in the Index Monitoring program objective).