

**U.S. Fish and Wildlife Service**

**Island Night Lizard (*Xantusia riversiana*)  
Draft Post-Delisting Monitoring Plan**



Island night lizard (*Xantusia riversiana*). Photo credit: Dr. William Mautz.

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**October 2012**

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Recommended citation:

U.S. Fish and Wildlife Service. 2012. Island night lizard (*Xantusia riversiana*) post-delisting monitoring plan. U.S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, California. 29 pp.

## **Acknowledgments**

This Post-Delisting Monitoring plan for the island night lizard (*Xantusia riversiana*) was developed by the U.S. Fish and Wildlife Service in cooperation with the U.S. Navy and National Park Service. This plan was initially drafted by Brian Spears of the Upper Columbia Fish and Wildlife Office, Spokane, Washington, and was completed by Jason Stayer of the Carlsbad Fish and Wildlife Office, Carlsbad, California. We wish to acknowledge the assistance and cooperation we received in preparing this plan from the following people: Melissa Booker and Bryan Munson (U.S. Navy on San Clemente Island); Grace Smith and Martin Ruane (U.S. Navy on San Nicolas Island); Dirk Rodriguez and Helen Fitting (Channel Islands National Park—Santa Barbara Island); Gary Fellers and Charles Drost (U.S. Geological Survey); and William Mautz (University of Hawaii at Hilo).

## **Anti-deficiency Act Disclaimer**

Post-Delisting Monitoring is a cooperative effort between the U.S. Fish and Wildlife Service, State and Tribal governments, other Federal agencies, and nongovernmental partners. Funding of Post-Delisting Monitoring presents a challenge for all partners committed to ensuring the continued viability of the island night lizard following removal of protections afforded under the Endangered Species Act, as amended. To the extent feasible, the Service and our partners intend to provide funding for Post-Delisting Monitoring efforts through the annual appropriations process. Nonetheless, nothing in this Post-Delisting Monitoring plan should be construed as a commitment or requirement that any Federal agency obligate or pay funds in contravention of the Anti-Deficiency Act, 31 U.S.C. 1341, or any other law or regulation.

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## I. Introduction

Post-delisting monitoring (PDM) refers to activities undertaken to verify that a species delisted due to recovery remains secure from risk of extinction after the protections of the Endangered Species Act (Act) are no longer applicable. A primary goal of PDM is to monitor the species to ensure the status does not deteriorate, and if a substantial decline in the species (numbers of individuals or populations) or an increase in threats is identified, to enact measures to halt the decline so that re-proposing the species as threatened or endangered is not needed.

Section 4(g) of the Act requires the Secretary to implement a system in cooperation with states to monitor for not less than 5 years the status of all species that have recovered and been removed from the Federal List of Endangered and Threatened Wildlife (List). Section 4(g)(2) of the Act directs the U.S. Fish and Wildlife Service (Service) to make prompt use of its emergency listing authorities under section 4(b)(7) to prevent significant risk to the well-being of any recovered species. While not specifically mentioned in section 4(g), authorities to list species in accordance with the process prescribed in sections 4(b)(5) and 4(b)(6) may also be used to reinstate species on the List, if warranted.

The Service and states have latitude to determine the extent and intensity of PDM that is needed and appropriate. The Act does not require the development of a formal PDM “plan”. However, the Service generally desires to follow a written planning document to provide for the effective implementation of section 4(g) by guiding collection and evaluation of pertinent information over the monitoring period and articulating the associated funding needs. This document was prepared to describe the PDM plan for the island night lizard (*Xantusia riversiana*) and follows the Service’s August 2008, *Post-Delisting Monitoring Plan Guidance Under the Endangered Species Act*.

## II. Species Listing History

The island night lizard was listed as threatened under the Act on August 11, 1977, due to habitat loss and modification from the introduction of nonnative herbivores, and nonnative plant species, and predation (42 FR 40682). On February 4, 2013, the Service published a 12-month finding and proposed rule to remove the island night lizard from the List (78 FR 7908). The proposal was based on a finding that the best available scientific and commercial information indicated that the island night lizard has recovered due to the amelioration of all substantial threats and ongoing management of potential threats to the species and its habitat by the U.S. (Navy) and National Park Service (NPS). For additional background information on the island night lizard, refer to the final listing rule published in the *Federal Register* on August 11, 1977 (Service 1977); California Channel Islands Species Recovery Plan finalized on January 26, 1984 (Service 1984); 5-year reviews finalized on September 26, 2006 (Service 2006), and October 5, 2012 (Service 2012a); and the proposed delisting rule published in the *Federal Register* on February 4, 2013 (78 FR 7908).

### III. Summary of Species Status at Time of Delisting

#### A. Distribution

The island night lizard is a reptile endemic to three Channel Islands (San Clemente, San Nicolas, and Santa Barbara) located off the southern California coast (Goldberg and Bezy 1974, pp. 355–358; Fellers and Drost 1991, p. 28) (Figure 1). Additionally, since listing, the island night lizard was identified on a small islet (Sutil Island) located just offshore and to the southwest of Santa Barbara Island (Bezy *et al.* 1980, p. 579) (Figure 2). All islands occupied by the island night lizard are currently federally owned; San Clemente and San Nicolas Islands are owned by the Navy, and Santa Barbara and Sutil Islands are owned by the NPS.

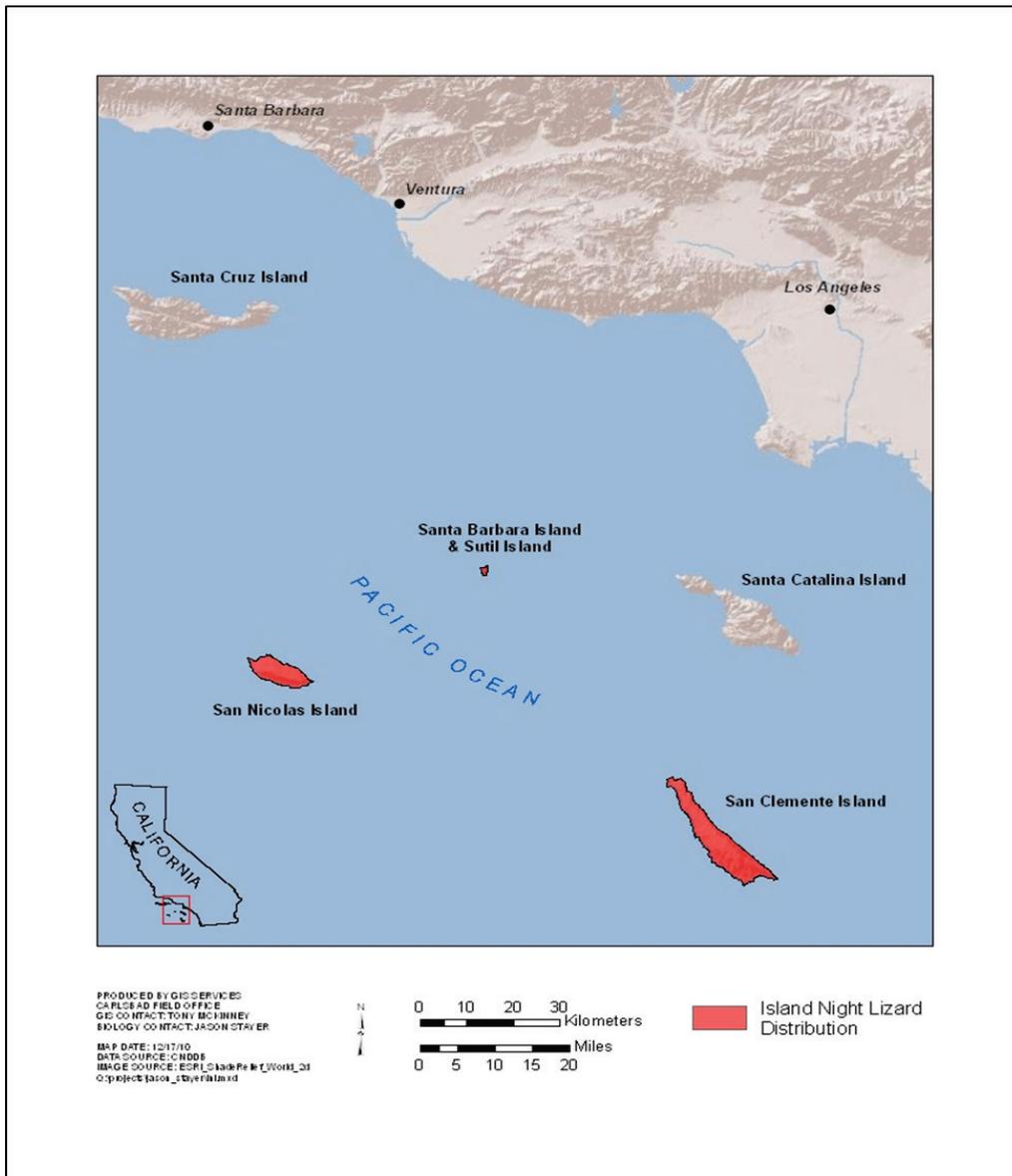


Figure 1. Island night lizard distribution.



**Figure 2. Proximity of Santa Barbara and Sutil Islands.**

**B. Habitat**

Island night lizard habitats on San Clemente, San Nicolas, and Santa Barbara Islands vary due to the island sizes and the introduction of a variety of nonnative herbivores and omnivores (from the mid-1800s to the mid-1900s), which modified, reduced, or destroyed significant amounts of native habitat known to support island night lizards. Different surveys and descriptions of the vegetation types on San Clemente, San Nicolas, and Santa Barbara Islands have referred to the

habitat supporting island night lizards under various names and descriptions. Two vegetation types identified by Sawyer *et al.* (2009) support most of the known, dominant, plant taxa associated with the lizard. These are Coast prickly pear scrub, in which cacti such as *Opuntia littoralis* (coastal prickly pear), *Opuntia oricola* (chaparral prickly pear), and *Cylindropuntia prolifera* (coast cholla) are dominant or codominant among the shrub canopy (Sawyer *et al.* 2009, pp. 599–601); and *Lycium californicum* (boxthorn) Provisional Shrubland Alliance, characterized by the prevalence of *L. californicum* (Sawyer *et al.* 2009, p. 588) (Figure 3).



**Figure 3. High-quality island night lizard habitat (above and below). Photo credit: Jason Stayer (Service).**



*Cylindropuntia prolifera* is referred to by its older Latin name, *Opuntia prolifera*, in numerous references cited in this document (for example, Fellers and Drost 1991, pp. 34, 68; Mautz 2001, p. 17; Navy 2002, p. 3.54). While the Service recognizes that *C. prolifera* is the currently accepted name of this species and is used in

discussions that reference current literature (for example Sawyer *et al.* 2009 and the NPS *in litt.* 2011), we will use the older name of *O. prolifera* when referencing previous literature.

Vegetation now classified as Coast prickly pear scrub includes communities variously referred to as Maritime Succulent Scrub and Maritime Desert Scrub in several references cited within this document (Fellers and Drost 1991, pp. 34, 68; Mautz 2001, p. 17; Navy 2002, p. 3.54). *Lycium californicum* Provisional Shrubland Alliance (Sawyer *et al.* 2009, p. 588) is a vegetative community in which *L. californicum* is a dominant or codominant species and taxa such as *Coreopsis gigantea* (giant coreopsis), *Bergerocactus emoryi* (golden-spined cereus), and *C. prolifera* are present. This is also referred to as Maritime Succulent Scrub, Maritime Desert Scrub, or boxthorn habitat by numerous references within this document (for example, Fellers and Drost 1991, pp. 34, 68; Mautz 2001, p. 17; Navy 2002, p. 3.54). To eliminate any confusion we refer to the vegetation types that comprise high-quality habitat as *L. californicum* and *Opuntia* spp. habitats.

Surveys conducted on the islands occupied by the island night lizard indicate strong preferences for *Lycium californicum* and *Opuntia* spp. habitats (Fellers and Drost 1991, p. 34; Schwemm 1996, pp. 3–4; Mautz 2001, p. 23; Mautz 2004, p. 18). These habitats are considered high-

quality because they contain high densities of island night lizards, offer suitable cover to protect the species from predation, and allow sufficient amounts of sunlight to penetrate to the ground providing a range of temperatures for thermal regulation (Mautz 2001, pp. 9–11, 17–18). Additionally, high densities of island night lizards are found in rocky outcrops on San Clemente and Santa Barbara Islands, and in a cobble and driftwood habitat on San Nicolas Island (Fellers *et al.* 1998, pp. 9, 13). Island night lizards are also known to occupy low- to moderate-quality habitats such as grasslands, *Coreopsis gigantea* stands, and mixed shrub communities (Fellers and Drost 1991, p. 34; Schwemm 1996, pp. 3–4; Mautz 2001, p. 23; Mautz 2004, p. 18). Loose rocks or crevices in clay soils are also important habitat components within island night lizard habitat (Fellers and Drost 1991, p. 53; Mautz 2001, p. 17).

### *San Clemente Island*

San Clemente Island is the largest and southernmost of the Channel Islands occupied by island night lizards and encompasses 37,200 acres (ac) (15,054 hectares (ha)) of land (Navy 2002, p. 1.10). In 2002, the Navy's Integrated Natural Resources Management Plan (INRMP) indicated that San Clemente Island supports approximately 19,640 ac (7,948 ha) of high-quality island night lizard habitat distributed primarily along the western marine terraces (Navy 2002, p. 3.54). The INRMP indicated that approximately 13,791 ac (5,581 ha) of *Opuntia* spp. habitat and 5,849 ac (2,367 ha) of *Lycium californicum* habitat existed on the island (Navy 2002, p. 3.54) (Figure 4). The INRMP also indicated that low- to moderate-quality habitat consisting of *Artemisia* spp. (sagebrush), *Eriogonum* spp. (buckwheat), *Deinandra clementina* (as *Hemizonia clementina*) (Catalina tarweed), as well as *Lycium californicum* and *Opuntia* spp., occupied approximately 386 ac (156 ha) of the northeastern escarpment of the island (Navy 2002, p. 3.65); and low-quality grassland habitat occupied approximately 11,831 ac (4,788 ha) on the central plateau and eastern scarp of the island (Navy 2002, p. 3.54). Currently, a new preliminary vegetative analysis of San Clemente Island is being drafted by the Navy and initial results indicate an increase in high-quality habitat. However, this has not been confirmed by ground surveys or finalized in a report (Navy 2012, *in litt.*; Booker 2012, pers. obs.)

### *San Nicolas Island*

San Nicolas Island is the second largest and westernmost of the three Channel Islands inhabited by the island night lizard and encompasses approximately 14,258 ac (5,772 ha) of land (Navy 2010, p. 1.3). In 1998, Fellers *et al.* (1998, p. 46) estimated approximately 1.9 ac (0.8 ha) of high-quality island night lizard habitat and about 161 ac (65 ha) of lower-quality mixed shrub habitat for the island night lizard existed on San Nicolas Island. In 2003, Junak (2003, p. 7) revised the estimate to approximately 11.2 ac (4.6 ha) of high-quality habitat (*Lycium californicum* and *Opuntia* spp.) on the island. This high-quality habitat is patchily distributed throughout otherwise relatively low-quality habitat. The lower quality habitat is a mixed shrub plant community on the eastern half of the island (Fellers *et al.* 1998, pp. 13–14) (Figure 5). This mixed shrub community consists primarily of *Haploppapus* spp., *Calystegia macrostegia* (island morning-glory), *Coreopsis gigantea*, *Atriplex semibaccata*, *Deinandra clementina*, *Lupinus albifrons* (silver lupine), *Baccharis pilularis* (coyote brush), and *Artemesia* spp. (Fellers *et al.* 1998, pp. 16–17).

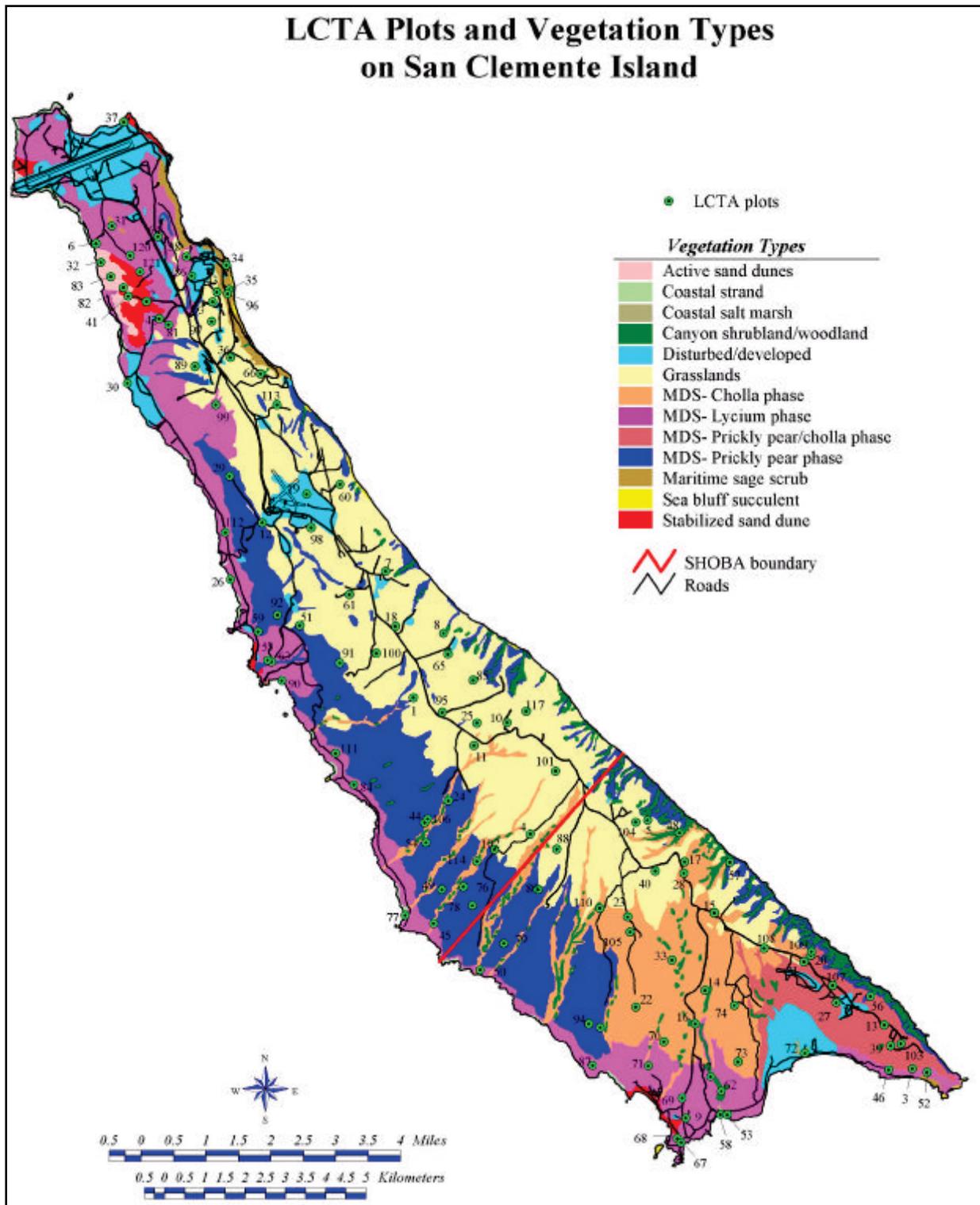
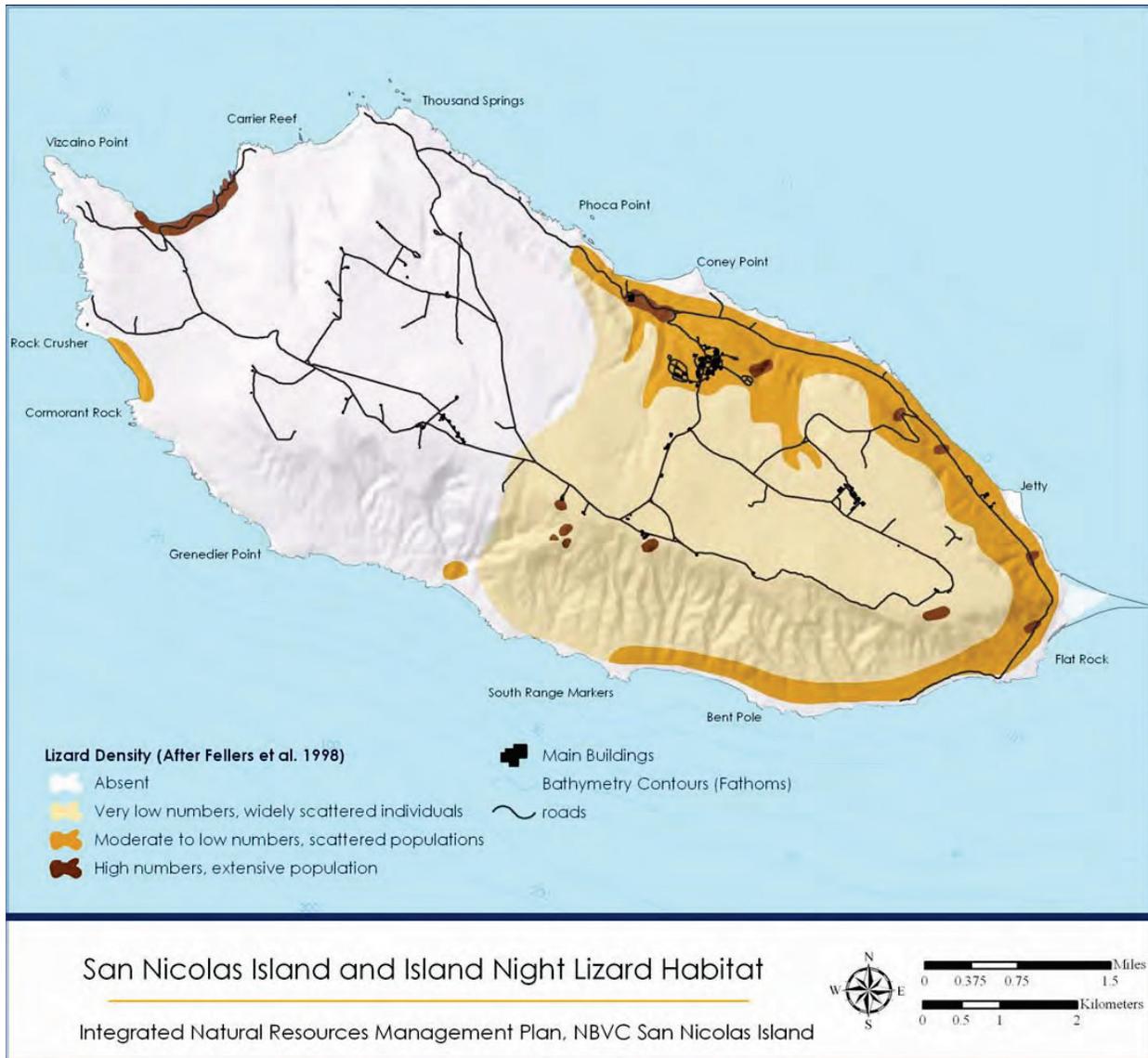


Figure 4. Distribution of vegetation communities and Land Condition Trend Analysis (LCTA) monitoring plots on San Clemente Island including high-quality island night lizard habitat (identified as Maritime Desert Scrub (MDS) vegetation types) (Shore Bombardment Area (SHOBA)). Excerpted from Tierra Data Inc. (2010, p. 8).



**Figure 5. Distribution of island night lizard densities on San Nicolas Island. Excerpted from Navy (2010, p. 3.47).**

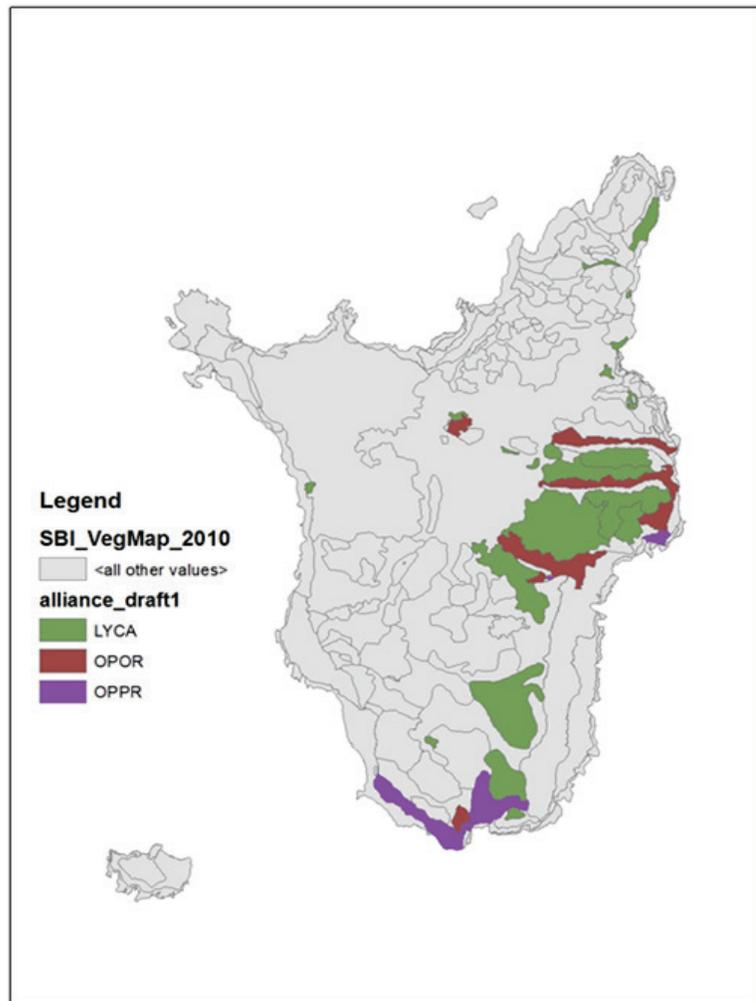
Island night lizards sparsely inhabit the western half of San Nicolas Island due to a lack of suitable vegetative or rock cover. Exceptions are a small area of low to moderate quality habitat between Cormorant Rock and Rock Crusher Beach and a 0.6 ac (0.2 ha) cobble and driftwood habitat at Redeye Beach (Navy 2010, p. 3.47). The cobble and driftwood habitat, which is unique to San Nicolas Island, located just above the intertidal zone between Vizcaino Point and Carrier Reef, supports the highest density of lizards on the island (Figure 5) (Fellers *et al.* 1998, p. 11).

## Santa Barbara Island

Santa Barbara Island is the smallest and northernmost island occupied by island night lizards and encompasses approximately 640 ac (259 ha) of land (Fellers and Drost 1991, p. 29). Habitat on Santa Barbara Island is limited due to the small size of the island and the extensive habitat damage that occurred historically when goats (*Capra* spp.), sheep (*Ovis* spp.), and European rabbits (*Oryctolagus cuniculus*) were present (Service 1984, pp. 45–46; Fellers and Drost 1991, p. 70). Using aerial photographs of the island from 1983 and ground surveys, Fellers and Drost (1991, p. 68) identified approximately 14.8 ac (6 ha) of high-quality habitat on Santa Barbara Island that included *Lycium californicum*, *Opuntia* spp., and rocky outcrops. Low- to moderate-quality habitat on the island contains some *L. californicum* and *Opuntia* spp., but is more dominated by *Coreopsis gigantea*, *Eriogonum giganteum* var. *compactum* (Santa Barbara Island buckwheat), *Eriophyllum nevinii* (silver-lace) (Fellers and Drost 1991, p. 70) and are patchily distributed in grasslands across a majority of the island (Halvorson *et al.* 1988, p. 111). A new preliminary vegetative analysis of Santa Barbara Island is being prepared by the NPS but has not been finalized (NPS 2011, *in litt.*) (Figure 6). Results from surveys indicate that approximately 16.6 ac (6.7 ha) of *L. californicum* and 9.3 ac (3.8 ha) of *Opuntia oricola* habitats exist, in which these species comprise greater than 39 percent of the vegetative cover (Rodriguez 2012, pers. obs.). Preliminary analysis for *Cylindropuntia prolifera*, another documented habitat for the lizard, is not yet available (Rodriguez 2012, pers. obs.).

## Sutil Island

Little is known about the habitat on Sutil Island. Sutil Island encompasses approximately 13.7 ac (5.5 ha) of land (R. Rudolph 2011, pers. obs.), much of it unbroken bedrock, with some vegetation identified as island night



**Figure 6. High quality habitat distribution on Santa Barbara Island. (LYCA – *Lycium californicum*; OPOR – *Opuntia oricola*; OPPR – *Cylindropuntia prolifera*) (D. Rodriguez 2012, pers. obs.; NPS 2011, *in litt.*).**

lizard habitat, such as low shrub species, *Lycium californicum*, and rocks and fissures, but these are sparsely distributed over the island (Drost 2011, pers. obs.).

### C. Population

Island night lizards appear to be more abundant in certain habitat types (Fellers and Drost 1991, p. 68; Mautz 2001, pp. 17–19); however, determining an overall population estimate is difficult due to the sedentary and reclusive behavior of the species. The highest lizard population densities are observed in *Lycium californicum* and *Opuntia* spp. habitats (Fellers and Drost 1991, pp. 34, 68; Mautz 2001, p. 17). Lizards are found in lower densities throughout shrub communities, rocky outcrops, grasslands, and in stands of *Coreopsis gigantea* (Service 1984, p. 93; Fellers and Drost 1991, p. 35; Mautz 2001, pp. 17–22).

#### *San Clemente Island*

The San Clemente Island population is the largest estimated at 21.3 million lizards (Mautz 2001, pp. 21–23). Approximately half of the population (estimated 10.4 million) occurs within the high-quality habitats on the lower marine terraces of the west side of the island (Mautz 2001, p. 29), recognized as the Island Night Lizard Management Area since 1997 by the Navy (Service 1977, p. 5). From 1991 to 1998, researchers calculated island night lizard population density using data collected from pitfall traps, cover boards, and rock turn surveys within high-quality island night lizard habitat (Mautz 2001, pp. 17–23, 43–54). Density estimates were assessed by analyzing capture rates and mark-recapture data using two methodologies: (1) Lincoln Index resulting in a possible underestimate of 16.71 million lizards; and (2) Regression Index resulting in a possible overestimate of 25.89 million lizards (Mautz 2001, pp. 21–23). A midpoint (average) between the Lincoln and Regression indexes was used to estimate island night lizard density on San Clemente Island at 21.3 million lizards on the island (Mautz 2001, pp. 21–23). The midpoint result estimated densities in high-quality habitat on San Clemente Island of 1,934 lizards per 2.47 ac (1 ha) in *Lycium californicum*; 2,558 lizards per 2.47 ac (1 ha) in *Opuntia littoralis* and *O. oricola*; and 1,423 lizards per 2.47 ac (1 ha) in *O. prolifera* (Mautz 2001, p. 23). Island night lizards were also estimated at 1,142 lizards per 2.47 ac (1 ha) in upland plateau grasslands and 926 lizards per 2.47 ac (1.0 ha) in scarp grassland and coastal sage (Mautz 2001, p. 23). No lizards were found in canyon woodland and active sand dunes on the island (Mautz 2001, p. 23).

#### *San Nicolas Island*

The island night lizard population on San Nicolas Island was estimated at 15,350 lizards (Fellers *et al.* 1998, p. 20). Population size was determined using density estimates from Fellers *et al.* (1998, p. 19) research on San Nicolas Island for the cobble and driftwood habitat, and density estimates for the remaining habitats established on Santa Barbara Island. Fellers *et al.* (1998, p. 19) extrapolated these estimates to corresponding habitats on San Nicolas Island. Estimates of distribution and extent of habitat on San Nicolas Island were determined using aerial photographs and field surveys (Fellers *et al.* 1998, p. 46). Junak (2003, p. 7) revised the estimated amount of *Opuntia* spp. and *Lycium californicum* on San Nicolas Island (see *San*

*Nicolas Island* under Habitat, p. 5) and concluded an increase in these habitats. A new population assessment of island night lizards on San Nicolas Island has not been conducted and, as a result, the Navy's 2010 INRMP for San Nicolas Island continues to recognize the population size of approximately 15,000 lizards established by Fellers *et al.* (1998, p. 20) as the current population estimate (Navy 2010, p. 3.43).

#### *Santa Barbara Island*

The island night lizard population on Santa Barbara Island is estimated at approximately 17,600 lizards based on estimates of available habitat types and extrapolation of island night lizard densities within those habitat types (Fellers and Drost 1991, p. 68). Island night lizard densities were estimated at 3,213 lizards per 2.47 ac (1 ha) in *Lycium californicum* habitat, 2,476 lizards per 2.47 ac (1 ha) in *Opuntia* spp. habitat, and 1,665 lizards per 2.47 ac (1 ha) in rock habitat (Fellers and Drost 1991, p. 68). Although preliminary analysis indicates there has been an apparent increase in high-quality island night lizard habitats (see *Santa Barbara Island* under Habitat, p. 8), the Service does not have any current estimates of densities within these high-quality habitats on the island. The NPS continues to recognize the estimate of approximately 17,600 lizards established by Fellers and Drost (1991, p. 68) (NPS 2006).

#### *Sutil Island*

Sutil Island was not known to be occupied at the time the island night lizard was listed. In 1978, a survey of Sutil Island was conducted and 12 lizards were identified (Wilson 1979 as cited in Power 1979, p. 8.5). The Service is unaware of any surveys for the island night lizard on Sutil Island since 1978. In 1991, Drost (2011, pers. obs.) visited the island and though there was little habitat that could be searched, he observed one lizard in a rock crevice. He noted that the amount of vegetative cover on the island was sparse; however, there were surface cracks, fissures, and bolder cover that could provide cover. Because Sutil Island was not identified at listing as occupied by the island night lizard, is within close proximity to Santa Barbara Island (approximately 0.4 mile (mi) (0.65 kilometer (km))), has very few to no visitors annually, and like Santa Barbara Island is managed by the NPS, we will incorporate Sutil Island in the discussion of Santa Barbara Island for PDM.

#### D. Residual Threats

Potential threats from the introduction of nonnative plant species, land use and development, fire, and erosion on San Clemente and San Nicolas Islands; and predation by feral cats and rats on San Clemente Island, are currently managed through actions implemented through the Navy's INRMPS on both islands and a Fire Management Plan on San Clemente Island, all in accordance with the Sikes Act Improvement Act of 1997, Federal Noxious Weed Act of 1974, and Soil Conservation and Domestic Allotment Act of 1935 (as amended). Potential threats to island night lizards on Santa Barbara Island include the introduction of nonnative plants, fire, and erosion, which are currently managed through actions defined within the NPS's current management policies, and Fire Management Plan in place for the Channel Islands National Park,

in accordance with the Organic Act of 1916 (as amended). These policies implement active management programs to inventory, monitor, restore, and maintain listed species and their habitats. Currently, it is unknown how climate change will affect San Clemente, San Nicolas, and Santa Barbara Islands specifically. While we recognize that climate change may have potential impacts to the lizard and its habitat, we currently lack adequate information to make accurate predictions regarding impacts to the species and its habitat.

#### **IV. Purpose and Objectives**

The purpose of PDM for the island night lizard is to monitor the species and its habitat to ensure the status does not deteriorate to a point that re-proposing the species as threatened or endangered under the Act is necessary. The primary objective of this PDM plan is to monitor the abundance of island night lizard habitat to detect any changes that may indicate negative impacts to the continued stability of the species' population on each of the islands. Previously collected data will provide guidelines to evaluate indices of island night lizard population health. Monitoring under this PDM plan will focus on population sampling, assessment of recruitment, and an evaluation of habitat abundance. Additionally, weather conditions such as rainfall and temperature, will be monitored as they are primary stochastic drivers in lizard activity, reproduction, and overall health.

#### **V. Implementation**

All islands occupied by the island night lizard are federally owned. San Clemente and San Nicolas Islands are managed by the Navy, and Santa Barbara Island (including Sutil Island) is managed by the NPS as a unit of the Channel Islands National Park (Fellers and Drost 1991, p. 28; Fellers *et al.* 1998, p. 3; Navy 2002, p. 1.1). Section 4(g) of the Act explicitly requires cooperation with states in development and implementation of PDM programs, but the Service remains responsible for compliance with section 4(g) and therefore, must remain actively engaged in all phases of PDM. Because island night lizards only occur on federally owned lands, the Service will develop and implement the PDM plan in cooperation with the Navy and the NPS.

#### **VI. Summary of Roles of all Cooperators in the Post-delisting Monitoring Planning Effort**

##### U.S. Fish and Wildlife Service

The Service is responsible for ensuring that effective PDM of the island night lizard is accomplished through participation and maintaining oversight of all activities implemented in cooperation with the Navy on San Clemente and San Nicolas Islands and the NPS on Santa Barbara Island. At this time, the Service does not anticipate having sufficient personnel and resources available for conducting the necessary field work, data analysis, and reporting required for the PDM effort. Therefore, the Service will work with our partners to seek funding opportunities through existing grant programs.

### U.S. Navy

The Service has requested the Navy's assistance in developing and implementing a long-term management plan for the island night lizard on San Clemente and San Nicolas Islands. After the lizard is delisted, the Navy will assist in PDM on these islands for the island night lizard and its habitat through implementation of PDM efforts discussed below (see **Sampling Methodology**, p. 14). The Service will cooperate with the Navy to use existing grant programs and Navy-administered monies to adequately fund PDM activities.

### National Park Service

The Service requested the NPS's assistance in developing and implementing a long-term monitoring plan for the island night lizard on Santa Barbara Island. The NPS will assist in PDM on Santa Barbara Island for the island night lizard and its habitat through implementation of PDM efforts discussed below (see **Sampling Methodology**, p. 14). The Service will cooperate with the NPS to use existing grant programs and the NPS-administered monies to adequately fund PDM activities.

### California Department of Fish and Game

The Act specifically requires the Service to cooperate with State agencies, including the California Department of Fish and Game (CDFG), when implementing PDM efforts. The range of the island night lizard is limited to three islands currently under Federal ownership, and thus CDFG has limited involvement with this species. The Service and CDFG are assessing monitoring methods for lizard species with similar biological characteristics. These methods have the potential to be implemented into island night lizard PDM.

## **VII. Monitoring Focus**

The focus of PDM for the island night lizard will consist of two components: (1) A population health based component consisting of assessments of island night lizard densities and recruitment; and (2) a habitat-based component consisting of an assessment of island night lizard habitat abundance (acreage) with additional focus on high-quality habitat. Data will be acquired through population sampling, a neonate-to-adult ratio, and habitat mapping. Due to the demonstrated stability of island night lizard populations on San Clemente, San Nicolas, and Santa Barbara Islands, we do not expect to observe significant trends in population densities during a short timeframe, unless a large scale change in the vegetative composition of one or more of the inhabited islands occurs. Therefore, the 5-years of monitoring, as described in the PDM guidance, will be conducted every other year over a longer duration. Monitoring of island night lizards as described in this PDM plan will therefore take place for 9 years, following the delisting of the species to better assess how the lizard is recovering. A PDM planning and implementation schedule is provided in Table 6 (Appendix B).

The island night lizard is addressed in the Service’s California Channel Islands Species Recovery Plan (Service 1984, pp. 88–103). The overarching goal of the Recovery Plan is...

*“...to restore endangered and threatened species to non-listed status by restoring and protecting habitat that can support viable self-sustaining populations.”*

The Recovery Plan does not identify specific numeric targets to determine what constitutes a viable, self-sustaining population of island night lizards. Therefore, density, recruitment, and habitat trends will be used to assess the status of the species.

#### A. Population Health Assessment

##### *Density*

Determining an overall population estimate is difficult due to the sedentary and reclusive behavior of the island night lizard, and that most of the population occupies inaccessible dense vegetation (Mautz 2001, pp. 19–20). On San Clemente Island where the largest population occurs, access to some areas of the island is restricted due to unexploded ordnance (Service 2008, pp. 56–57; Navy 2009, p. 1.13). Mautz (2001, p. 44) suggested that trap capture rate was proportional to the average population density in each habitat and therefore can provide a relative index of lizard densities within those habitats. Over time, this index can be used to better understand how the lizards are doing in each habitat compared to previous years or baseline conditions. High recapture rates, in conjunction with large survey grids relative to their home range size, indicate that standardized trapping provides a good estimate of local densities (White 1982, p. 130). Therefore, trapping in suitable vegetative cover can be a good indicator of relative lizard population density (Mautz 2001, p. 17).

##### *Recruitment*

Island night lizards are slow growing, late maturing, and have a low reproductive rate (Goldberg and Bezy 1974, pp. 355–358; Fellers and Drost 1991, pp. 36–42; Mautz 1993, p. 417). Island night lizards are viviparous (bearing live young) and reach sexual maturity at approximately 3 to 4 years of age (Goldberg and Bezy 1974, p. 355; Fellers and Drost 1991, p. 40). Annual reproduction is correlated with annual rainfall and appears to be a primary driver affecting resources that support individual island night lizards and populations (Fellers and Drost 1991, pp. 33–37; Fellers *et al.* 1998, p. 22; Mautz 2004, pp. 20–32). Even though island night lizards may be able to withstand periods of low recruitment (Mautz 2004, pp. 20, 32), long-term periods of low recruitment could be indicative of declining population health. Consequently, monitoring neonate-to-adult ratios will be beneficial as this measure serves as a good index of recruitment.

##### *Weather Condition Assessment*

Island night lizard activity, recruitment, and habitat are all affected by weather conditions. Lower rainfall amounts can reduce the percent cover of available habitat and food resources for

the island night lizard, and in turn affect reproduction of the species. Additionally, lower temperatures reduce island night lizard activity and in turn, lizards might not be captured as easily during sampling which takes place during cooler periods of time. Therefore, daily temperatures and rainfall amounts will be monitored during PDM to allow for comparison with population health assessment variables to ensure that weather does not confound the population health-related data. This will allow the Service to more effectively assess the overall health of the population in the future.

### *Summary of Population Health Assessment*

Overall health of an island night lizard population can be determined by assessing trap capture rates in conjunction with recruitment of island night lizards (Mautz 2001, p. 38). Given that available data suggests that weather conditions are correlated with trap capture rates and recruitment, a decreasing trend in annual rainfall could adversely affect resources and long-term island night lizard stability. This stressor could potentially be exacerbated by other factors, including habitat modification or disturbance (Mautz 2004, p. 32). Consequently, evaluating weather conditions will provide insight into recruitment, and the long-term stability of the species; therefore, PDM will track annual rainfall on San Clemente, San Nicolas, and Santa Barbara Islands.

### B. Habitat Assessment

For the purpose of PDM for the island night lizard, we will focus monitoring on the distribution and abundance (acreage) of high-quality habitat including *Lycium californicum*, *Opuntia* spp., and *Cylindropuntia prolifera* on San Clemente, San Nicolas, and Santa Barbara Islands. We do not expect that significant habitat modifications will be observed during the monitoring period unless subject to fire.

## **VIII. Sampling Methodology**

We designed this PDM plan to maximize data continuity and comparability with existing studies and current methodologies to best determine island night lizard density, recruitment, and habitat trends. Monitoring methods outlined below follow those previously used and recommended by other researchers on each of the islands where the island night lizard occurs (Fellers and Drost 1991, pp. 30–33; Fellers *et al.* 1998, pp. 7–8; Mautz 2001, pp. 58–64). Following delisting of the species, five survey efforts will be conducted in 2-year intervals each consisting of two sampling periods. In each sampling year, sampling periods will be conducted in October and May and will be conducted over a 2 week period depending on weather and biologist availability. Sutil Island will not be subject to PDM as it was not identified at listing as being occupied by the island night lizard, is limited in size, and is difficult to access.

## A. Density Assessment

Surveys on all islands will take place during both sampling periods each sampling year. Surveys will be conducted at previously established sampling sites using several methodologies including pitfall traps, rock-turn surveys, and coverboards; they will be arranged in grid arrays or transects, each of which are dependent upon the soil regime and biologist preference for each island surveyed (Appendix A). Pitfall traps are the predominant method used to sample lizards on San Clemente Island, while coverboards are predominantly used on San Nicolas and Santa Barbara Islands (Appendix A). Surveys and trap maintenance activities will follow trapping protocols conducted by the Navy and provided by Mautz (2001, pp. 58–64) for San Clemente Island; conducted by the Navy and provided by Fellers *et al.* (1998, pp. 7–8) on San Nicolas Island; and conducted by the NPS and provided by Fellers *et al.* (1988, pp. 1–5) on Santa Barbara Island. Sampling site names, dominant vegetation types, and sampling methodologies are provided in Tables 2–4 (Appendix A).

The Service would like to see an effort put forth to sample all sites within each sampling period; however, due to the number of sampling sites, varying sampling methodologies for each island (see Appendix A), surveyor availability, and funding requirements, we recognize that all sampling sites might not be monitored each sampling period. Therefore, we recommend that a combination of sites be sampled each sampling period throughout all available habitats with the priority placed on high-quality habitat, compared to low- to moderate-quality habitat. Because we recognize not all sites can be monitored each sampling period, we recommend that all sampling sites be monitored at least once every 2 sampling years and twice throughout PDM.

Although trap capture rates will be assessed for both sampling periods (October and May), we expect that rates in the October sampling period will be less than those in the May sampling period due to temperature differences and correlated island night lizard activity. Therefore, monitoring the trend of trap capture rates in each habitat (high-quality and low- to moderate-quality) during the May sampling period, when weather conditions are more favorable and consistent, the availability of food is greater, and when island night lizards are more active, will be our primary focus to assess population density stability. Trap capture rate will be determined using the following equation.

$$\text{Trap Capture Rate} = (\text{total \# of lizards captured}) / (\text{total \# of times all traps were visited})$$

Additionally, we are recommending that new and randomly selected sampling sites be established and trapping efforts conducted on all islands. We are suggesting this because previously established traps have been utilized for the past 10 to 30 years. We feel new sampling areas in comparison to the older ones can give us a better understanding and assessment of island night lizard densities, distribution, and population numbers across each island. With establishment of new sites, we suggest that sites be sampled using previously established methodologies (Appendix A) for comparison of data with older sites. Additionally, we suggest a methodology that would be consistent among the islands for comparison of data among the

islands. We understand that surveying efforts (time and availability), sampling efforts (methodologies), area accessibility, and funding requirements for additional surveys will vary for each island; and thus we leave the decision to conduct this sampling to the discretion of each island's land management agency. However, we strongly recommend that land managers on each island conduct monitoring in new areas consisting of different habitats at least once during PDM with a focus on high-quality habitat.

## B. Recruitment Assessment

Surveys to assess recruitment in each sampling year will be conducted in October, soon after the neonates of the year are born. October has been chosen for these surveys to allow biologists to more easily identify neonate island night lizards (if these surveys were conducted in May, neonates could be easily confused with yearlings). All island night lizards captured will be measured from snout to vent with a measuring tape to the nearest millimeter (mm). Captured lizards will be categorized as neonates (measuring less than 40 mm (Goldberg and Bezy 1974, p. 353; Fellers and Drost 1991, p. 38; Fellers *et al.* 2009, p. 6)), or reproducing adults (lizards measuring greater than 64 mm (Goldberg and Bezy 1974, pp. 355–356; Fellers and Drost 1991, p. 39; Mautz 1993, p. 417)). Lizards captured measuring 40 to 64 mm in length are considered to be 1 to 4 years of age and not sexually mature (Goldberg and Bezy 1974, p. 355; Fellers and Drost 1991, p. 40) therefore they will not be incorporated in the assessment of recruitment. Recruitment for each island will be assessed using a neonate-to-adult ratio using the following equation.

$$\text{Neonate-to-Adult Ratio} = (\# \text{ of captured neonate lizards}) / (\# \text{ of captured adult lizards})$$

## C. Habitat Monitoring

The Navy and the NPS have recently completed or are in the process of completing newly established island-wide habitat maps for each island where island night lizards occur. These maps will be utilized as the baseline assessment to compare with future mapping efforts. Therefore, comprehensive high-quality habitat surveys will be conducted to assess habitat stability during the month of May in years 3 and 9 following delisting (Appendix B, Table 6).

High-quality habitat surveys for San Clemente Island will consist of analyzing aerial photos via Geographic Information System (GIS), and on-the-ground surveying efforts to the maximum extent possible due to access restrictions to some areas of the island because of unexploded ordnance. On San Nicolas and Santa Barbara Islands, high-quality habitat surveys will only consist of on-the-ground surveying efforts due to the small size of the islands, limited available high-quality habitats, and a better ability to access habitat on the islands. Hand-held Global Positioning System (GPS) units will be used to map and track the boundaries of these habitats as discussed in Fellers and Drost (1991, p. 31). GPS tracks will then be uploaded into a GIS program (ArcGIS) to map and assess distribution and abundance of high-quality island night lizard habitats. This will produce the most accurate, real-time maps of high-quality island night

lizard habitat and allow for an evaluation of changes in habitats over time. One limitation to this technique is that maps relying on aerial photos of the habitat are subject to the availability of updated photos.

If fire does occur, additional field surveys will take place within a year in any areas affected by the fire to assess habitat loss. The post-fire habitat surveys will include GIS mapping of the boundaries of the burned area using hand-held GPS units. If fire does occur in island night lizard habitat, surveys in the area of the fire will be conducted in May of each remaining monitoring year to assess the status of the habitat.

The purpose of the habitat assessment is to evaluate any habitat changes occurring during the PDM period. This will be accomplished using at least two updated island-wide maps that will be developed within 1 year of the habitat sampling surveys conducted in years 3 and 9 following delisting (Appendix B, Table 6). Those implementing this PDM plan might need to adjust survey efforts and timeframes accordingly depending on availability of aerial photos, access, weather, and unforeseen circumstances.

## **IX. Triggers for Considering Relisting and Potential Management Actions**

Cumulative available data will be evaluated periodically throughout the PDM effort (see Section **X. Analysis and Reporting**, p. 19). If the data suggest a decline in island night lizard density (trap capture rates), in recruitment, or a reduction of high-quality habitat (*Lycium californicum*, *Opuntia* ssp., *Cylindropuntia prolifera*), such that the species is likely to become threatened or endangered, the Service may determine it necessary to extend the PDM term beyond 9 years, or may initiate a status review to consider if relisting the island night lizard as threatened or endangered is warranted.

### A. Evaluation of Population Health

#### *Density*

Island night lizard activity is affected by weather conditions, with individuals being less active during colder periods of the day. Therefore, isolated instances of relatively lower trap capture rate under this PDM would not necessarily indicate lower density nor would it necessarily be a cause for concern. Although each site might not be sampled each sampling year, if overall island night lizard-capture rates per island in high-quality habitats decline for three consecutive sampling years, which could be indicative of a declining population, the Service may initiate a formal status review to consider whether a proposal for relisting under the Act is warranted. If no clear trends are established, but data in the last two sampling years indicate a possible decline in trap capture rates, monitoring will be extended for another sampling year.

## *Recruitment*

As discussed above, island night lizard reproduction is correlated with annual rainfall (Fellers and Drost 1991, pp. 33–37; Fellers *et al.* 1998, p. 22; Mautz 2004, pp. 20–32). Additionally, island night lizard communities are able to withstand periods of low recruitment (Mautz 2004, pp. 20, 32). Therefore isolated instances of low recruitment would not necessarily be a cause for concern. However, a continuous decline of neonate-to-adult ratios for three consecutive sampling periods may be indicative of poor recruitment. Under such a scenario, especially if rainfall data do not indicate dry conditions, the Service may initiate a formal status review, to consider whether a proposal for relisting under the Act is warranted. If data in the last two sampling years indicate a possible decline in recruitment, monitoring will be extended for another sampling year.

## B. Evaluation of Habitat

Assessing specific population numbers for this species is difficult. However, the population of island night lizards is strongly correlated with the high-quality habitat the species occupies on San Clemente, San Nicolas, and Santa Barbara Islands (see C. Population under **III. Summary of Species Status at Time of Delisting**, p. 8). Therefore, the abundance of high-quality habitat will be used to assess current populations and trends. As previously discussed, (see C. Habitat Monitoring under **VIII. Sampling Methodology**, p. 16) recent vegetation analyses and habitat assessments have been conducted on each island. These results will be used as the baseline status of the habitat at the time of delisting. High-quality habitat will be monitored for 2 of the 9 years (years 3 and 9) after delisting. A decrease in the percentage of high-quality habitat from this baseline will be used as a trigger to: (1) take action to assess the cause of a high-quality habitat decrease, (2) implement management actions to reverse the decrease or (3) conduct a status review of the island night lizard to consider if relisting is warranted. Initiation of specific options will be dependent on the extent of the decrease, as described below. PDM may be extended beyond the current plan if the high-quality habitat decreases by 10 percent or more during the final year of monitoring (year 9).

Previous monitoring indicates that high-quality habitat on the islands is stable so a decrease of 10 percent could be of concern to the island night lizard (Fellers 2012c, pers. obs.; Mautz 2012b, pers. obs.). If habitat monitoring indicates a decline in abundance and distribution of high-quality habitat by at least 10 percent on any island or across the island night lizard's range, the Service will work collaboratively with the Navy and the NPS to assess the cause of this decrease in the percentage of high-quality habitat.

A decrease of high-quality habitat by at least 20 percent will require more than an assessment (Fellers 2012c, pers. obs.; Mautz 2012b, pers. obs.). With a decrease of 20 percent or more, management actions should be considered by the Navy and the NPS to reverse the decrease in high-quality habitat. Actions to reverse the decrease could include restrictions in land use activities or closures in high-quality habitat.

A decrease of high-quality habitat by at least 30 percent will likely severely impact the island night lizard (Fellers 2012c, pers. obs.; Mautz 2012b, pers. obs.). With a 30 percent or greater decrease in high-quality habitat, the Service will assess the cause of the decrease and will consider management actions, but will also initiate a status review to determine whether a proposal for relisting under the Act is warranted.

#### Summary of Triggers for Considering Relisting and Potential Management Actions

If there is a declining trend in trap capture rates or recruitment for more than 3 consecutive sampling years occurs, the Service may initiate a formal status review to consider whether a proposal for relisting under the Act is warranted.

If habitat monitoring indicates a decrease of high-quality habitat distribution and abundance of 10 percent, then the Service will work collaboratively with the Navy and the NPS to assess the cause of the decrease. If there is a decrease of high-quality habitat by at least 20 percent, management actions should be considered by the Navy and the NPS to high-quality habitat. If there is a decrease of high-quality habitat of at least 30 percent, the Service will initiate a formal status review to determine whether a proposal for relisting under the Act is warranted.

#### C. Additional Concerns Related to Triggers for Considering Relisting

Although a decrease in abundance of island night lizards on any one of the three islands could occur, it will be important to consider the cause of the decline and how it may relate to the overall status of the species in the context of threats and the regulating mechanism listing would provide to address those threats. The island night lizard was primarily listed due to the presence of nonnative herbivores and the effects of historical overgrazing leading to a loss in available habitat across its range (Service 1977, pp. 40683–40684). Additionally, the presence of feral pigs on San Clemente Island was a major threat to the species until their removal from the island (Service 1977, pp. 40683–40684). In 2010, the Montrose Settlements Restoration Program completed removal of all feral cats from San Nicolas Island (Hanson and Bonham 2010, p. 2), and although still present on San Clemente Island, there are predation control efforts administered by the Navy to manage them (Service 2008, p. 59). If however, feral pigs are reintroduced to any of the islands, or feral cats introduced to San Nicolas or Santa Barbara Islands, new monitoring and management efforts would need to be constructed and implemented in a timely manner to assure these nonnative species do not impact the island night lizard populations to the point that they be relisted.

## **X. Analyses and Reporting**

Raw data and reports summarizing the activities, data collected, and results of each component of this PDM plan should be submitted to the Service's Carlsbad Fish and Wildlife Office within six months after completion of each sampling year. This will allow proper time for the Service, in cooperation with its partners in PDM plan implementation, to evaluate whether adequate data are being collected, ensure the monitoring program continues to be efficient, adaptively manage monitoring (if necessary), and allow for periodic assessment of the status of the species. At the end of the monitoring period specified in this PDM plan, the Service will publish a final report evaluating the status of the species since delisting and whether further action is needed to ensure the continued conservation of the species.

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Island Night Lizard Draft Post-delisting Monitoring Plan

October 2012

U.S. Fish and Wildlife Service

Region 8

Carlsbad Fish and Wildlife Office

Carlsbad, California



Regional Director  
Pacific Southwest Region  
U.S. Fish and Wildlife Service

November 8, 2012

Date

## Appendix A: Monitoring Timeline and List of Monitoring Sites

**Table 1. Timeline for 5-years of post-delisting monitoring for the island night lizard. Sampling will be conducted every other year, over a 9 year period.\***

<b>Sampling Period</b>	<b>Year 1</b>	<b>Year 3</b>	<b>Year 5</b>	<b>Year 7</b>	<b>Year 9</b>
<b>October</b>	Density Recruitment	Density Recruitment	Density Recruitment	Density Recruitment	Density Recruitment
<b>May</b>	Density	HQ Habitat Density	Density	Density	HQ Habitat Density

\*Baseline data for habitat assessments was conducted between 2010 and 2012 for all islands.

### Monitoring Definitions

**Density:** Assessment of Trap Capture Rate (see discussion of Trap Capture Rate above)

**Recruitment:** Assessment of Neonate-to-Adult Ratio (see discussion of Neonate-to-Adult Ratio above)

**HQ Habitat:** Assessment of High-Quality Habitat (see discussion of Habitat above)

**Table 2. Previously established sampling sites on San Clemente Island.**

San Clemente Island	Dominant Vegetation	Sampling Methodology (# of traps / coverboards)*
Harding South	<i>Lycium californicum</i>	Pitfall Traps (10 random) / Rock-turn Surveys
Harding North	<i>Lycium californicum</i>	Pitfall Trap Array (25) / Coverboard Transect (6)
Terrace	<i>Opuntia</i> spp.	Pitfall Trap Transect (25) / Coverboard Transect (6)
Landfill	<i>Opuntia</i> spp.	Pitfall Trap Array (25) / Coverboard Transect (6)
Scarp	Grassland / Oak Groves / Artemesia Scrub	Pitfall Trap Array (25), Transect (25)/Coverboard Transect (6)
Stipa	Grassland	Pitfall Trap Array (25) / Coverboard Transect (6)
Wilson Burn 1	<i>Lycium californicum</i>	Pitfall Trap Transect (25)
Wilson Burn 2	<i>Lycium californicum</i>	Pitfall Trap Transect (25)
Thirst Burn	<i>Cylindropuntia prolifera</i>	Coverboard Transects (12) (6-burned, 6-unburned)

\* See Mautz 2001(pp. 65–69) and Mautz 2012a (pers. obs.) for sampling site locations and specific details and descriptions for each sampling methodology.

**Table 3. Previously established sampling sites on San Nicolas Island.**

San Nicolas Island	Dominant Vegetation	Sampling Methodology (# of coverboards)*
West End	Stable Dune	Coverboard Transect (20)
Magazine Road	Stable Dune / Lupine	Coverboard Transect (20)
Ocean Coreopsis	<i>Coreopsis gigantea</i>	Coverboard Transect (20)
Chukar PP	<i>Opuntia</i> spp.	Coverboard Transect (10)
Barber Pole	<i>Opuntia</i> spp.	Coverboard Transect (10)
Beach Cholla	<i>Cylindropuntia prolifera</i>	Coverboard Transect (9)
Beach PP	<i>Opuntia</i> spp.	Coverboard Transect (10)
Airstrip	Avena / Bromus Grassland	Coverboard Transect (20)
SE Cholla	<i>Cylindropuntia prolifera</i>	Coverboard Transect (11)
Red-eye	Dune Association	Coverboard Transect (20)
SW Terrace	Haplopappus Scrub	Coverboard Transect (20)
Bunker	Baccharis Grassland	Coverboard Transect (20)
Monroe	Avena Grassland	Coverboard Transect (20)
Daytona West	Haplopappus Scrub	Coverboard Transect (20)
Daytona East	Haplopappus Scrub	Coverboard Transect (20)
Tufts-Shannon	Haplopappus Scrub	Coverboard Transect (20)
Thousand Springs	Bush Lupine	Coverboard Transect (20)
Lighthouse	Haplopappus Grassland	Coverboard Transect (51)

Eucalyptus	Eucalyptus / Lavatera / <i>Haplopappus</i>	Coverboard Transect (22)
Terrace Cholla	<i>Cylindropuntia prolifera</i>	Coverboard Transect (5)
Daytona BBQ	Haplopappus scrub	Pitfall Trap Grid (25)
Coreopsis Grid	<i>Coreopsis gigantea</i>	Pitfall Trap Grid (25)
NAVFAC Boxthorn	<i>Lycium californicum</i>	Coverboard Transect (9)
NAVFAC Grid	Grassland / <i>Lycium californicum</i>	Pitfall Trap Grid (25)
Theodolite	<i>Opuntia</i> spp.	Coverboard Transect (12)
East NAVFAC	<i>Haplopappus</i>	Coverboard Transect (20)
Corral harbor	Lupine	Coverboard Transect (20)
Tranquility	Mixed Scrub	Coverboard Transect (21)
Central Stipa	Stipa Grassland	Coverboard Transect (20)
Celery Canyon	<i>Coreopsis gigantea</i> / Lupine / Baccharis Scrub	Coverboard Transect (22)
Board 904	Baccharis / Coreopsis / <i>Haplopappus</i>	Coverboard (1)
Beach Boxthorn	<i>Lycium californicum</i>	Coverboard Transect (20)
Taxiway	Haplopappus Grassland	Coverboard Transect (3)
Sewage Ponds	Mixed Scrub / Grassland	Coverboard Transect (3)
Antenna Field	Mixed Scrub / Grassland	Coverboard Transect (4)
Wind Turbines	Barren	Coverboard Transects (32) (8 groups of 4 boards)
Vandal	Mixed Scrub / Lupine (sandy substrate)	Coverboard Transect (8)

\* See Fellers *et al.* 1998 (pp. 63–66), Fellers 2012a (pers. obs.), Fellers 2012b (pers. obs.) for sampling site locations and specific details and descriptions for each sampling methodology.

**Table 4. Previously established sampling sites on Santa Barbara Island.**

Santa Barbara Island	Dominant Vegetation	Sampling Methodology (# of coverboards)*
Cave-Middle	<i>Lycium californicum</i>	Coverboard Transect (60)
Middle-Graveyard	<i>Lycium californicum</i>	Coverboard Transect (60)
Terrace Grassland	Grassland	Coverboard Transect (60)
Webster Point	<i>Suaeda californica</i>	Coverboard Transect (60)

\* See Fellers *et al.* 1988 (pp. 1–5) and Fitting 2012 (pers. obs.) for sampling site locations and specific details and descriptions for each sampling methodology

## Appendix B: Estimated Funding Requirements and Implementation Schedule

**Table 5. Estimated cost analysis for post-delisting monitoring for the island night lizard.**

<b>Monitoring Action</b>	<b>San Clemente<sup>1</sup></b>	<b>San Nicolas<sup>1</sup></b>	<b>Santa Barbara<sup>2</sup></b>
Data Collection	\$101,000	\$75,500	\$33,500
Maintenance Activities		\$7,500	\$1,500
High-Quality Habitat Assessment <sup>3</sup>	\$80,000	\$25,000	\$10,000
Data Analysis and Reporting	\$72,000	\$26,500	\$14,000
Overhead	Included in Data Analysis and Reporting	\$54,000	\$9,000
<b>Island Total</b>	<b>\$253,000</b>	<b>\$188,500</b>	<b>\$68,000</b>
<b>PDM Total</b>	<b>\$509,500</b>		

<sup>1</sup>Funding Acquired by the Navy

<sup>2</sup>Funding Acquired by the NPS

<sup>3</sup>Service Estimate (Working with Navy and NPS on cost estimates)

**Table 6. Implementation schedule for post-delisting monitoring for the island night lizard.**

<b>Monitoring Action</b>		<b>Year 1a</b>	<b>Year 1b</b>	<b>Year 3a</b>	<b>Year 3b</b>	<b>Year 5a</b>	<b>Year 5b</b>	<b>Year 7a</b>	<b>Year 7b</b>	<b>Year 9a</b>	<b>Year 9b</b>
Data Collection	Density (Trap Capture Rate)	X	X	X	X	X	X	X	X	X	X
	Recruitment (Neonate-to-Adult Ratio)	X		X		X		X		X	
Trap Maintenance Activities		X	X	X	X	X	X	X	X	X	X
High-Quality Habitat Assessment					X						X
Data Analysis and Reporting		X	X	X	X	X	X	X	X	X	X

a – October Sampling Period

b – May Sampling Period