



Department of Defense Legacy Resource Management Program

Recommended Best Management Practices for the Western Spadefoot on Department of Defense Installations

Department of Defense Partners in Amphibian and Reptile Conservation



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Introduction

The Western Spadefoot (*Spea hammondi*) is considered an at-risk species that has been petitioned for listing under the Endangered Species Act (ESA) and is currently being evaluated for listing by the U.S. Fish and Wildlife Service (USFWS). The Department of Defense (DoD), through its Partners in Amphibian and Reptile Conservation (PARC) network have developed Best Management Practices (BMPs) for the Western Spadefoot. The management practices described in this document were developed specifically for DoD installations but are also suitable for implementation throughout the range of this species.

The management practices described in this report are intended to serve as guidelines that DoD resource managers can use to help plan, prioritize, and implement conservation and management actions that provide a conservation benefit to the Western Spadefoot, while also providing information to comply with regulatory processes such as Environmental Protection Agency's National Environmental Policy Act (NEPA) and associated components (i.e., Environmental Assessments and Environmental Impact Statements). Implementation of these BMP guidelines should support military readiness activities, be documented in installation Integrated Natural Resource Management Plans (INRMPs), and should align with existing efforts among the DoD, federal/state agencies, and non-governmental organizations (NGOs) to prevent this species decline and preclude ESA-listing.

Species Profile

Description: The Western Spadefoot is a medium-sized toad with adults reaching a maximum of 2.5 inches (6.35 centimeters [cm]) snout to vent length. The skin is loose with small vertebral tubercles. The head is as wide as the body, having a rounded snout with an upward tilt and large protuberant eyes (Figure 1). Eyes are a pale gold in color with vertical pupils. The parotoid glands are small and not distinct. Forelimbs and hindlimbs are short and stout, with the foreleg having dorsal tubercles. The feet have well-developed webbing between the toes. The main distinguishing features of this species are the single semicircular black "spade" (keratinized inner metatarsal tubercle) on each heel (Figure 2), and vertical pupils.

The dorsal ground color range varies in color from green, brown, cream, or gray, often with 4 irregular light stripes and dark blotches on the back, and reddish spots at tips of skin tubercles. A pair of light-colored spots is present, one on each side of the anus. Body tubercles can be orange to red. Usually a pair of light-colored paravertebral stripes is present, extending from behind the eyes. Ventrally, the color is whitish to creamy-yellow and unmarked. Males will often develop a dark throat patch.

Tadpoles can grow up to 3 inches in length (7.5 cm) but typically they transform at a smaller size. They are olive-brown, gray, and greenish black in color with a pale iridescent vent.

Range: The Western Spadefoot is endemic to California and northern Baja California. Populations are found as far north as Redding, California, southward throughout the Great Central Valley and its associated foothills, through the South Coast Ranges into coastal southern California south of the Transverse mountains and west of the Peninsular mountains, into northwest Baja California (Figure 3).

Western Spadefoots occur mostly below 3,000 feet (900 meters [m]) in elevation (Stebbins 2012). The average elevation of sites where the species still occurs is significantly higher than the average elevation for historical sites, suggesting that declines have been more pronounced in lowlands (USFWS 2005).

Figure 1. Adult Western Spadefoot

Picture by Kyle McCann



Figure 2. Keratinized Inner Metatarsal Tubercle (“spade”) on rear leg of Western Spadefoot

Picture by Kyle McCann



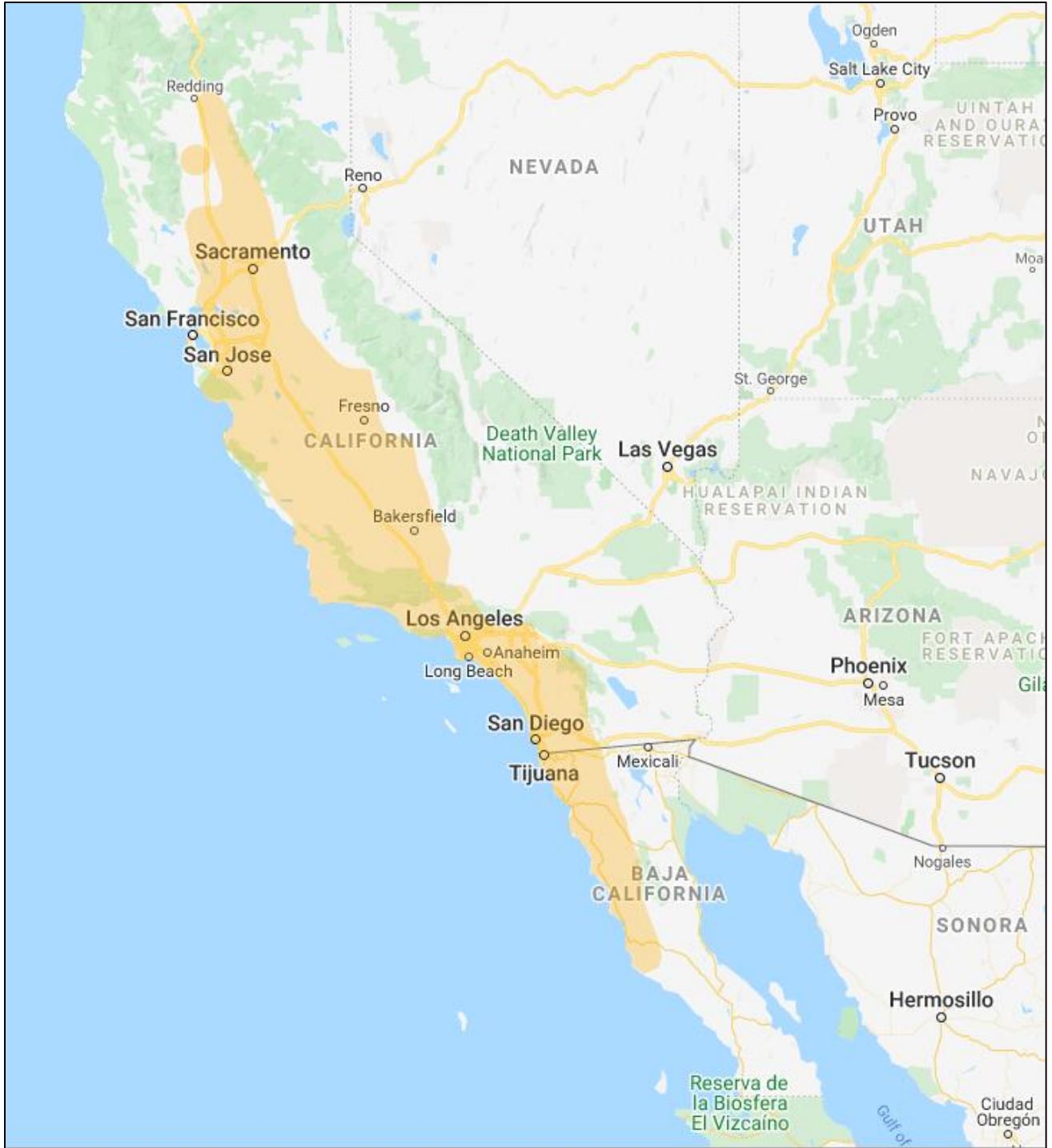


Figure 3. Western Spadefoot Range
(map developed from data on Amphibiaweb.com)

Distribution on Military Sites:

The Western Spadefoot is confirmed present on the following 9 military sites:

- Air Force: Vandenburg Space Force Base (California)
- Army: Fort Hunter Liggett (California); Camp Roberts Training Site (California)
- Marine Corps: Marine Corps Air Station Pendleton (California); Marine Corps Air Station Miramar (California); Marine Corps Base Camp Pendleton (California)
- Navy: Naval Air Station Lemoore (California); Naval Base Coronado Remote Training Site Warner Springs (California); Naval Weapons Station Seal Beach Detachment Fallbrook (California)

The Western Spadefoot is considered unconfirmed and potentially present on the following military sites; specimens have been found in the same county as a particular military site, but not within the boundaries of the installation:

- Air Force: Beale AFB (California); March AFB (California); Travis AFB (California)
- Army: Fort Ord (California); Camp San Luis Obispo (California)
- Marine Corps: None
- Navy: Camp Michael Monsoor (California); Naval Base San Diego (California); Naval Weapons Station Seal Beach (California); Naval Radio Transmitter Facility Dixon (California)

Habitat: Western Spadefoots require two distinct habitat components to complete their life cycle, and these habitats may need to be in proximity to one another (USFWS 2005). These components are the presence of an aquatic habitat for breeding and a terrestrial habitat for feeding and aestivation (prolonged dormancy during a hot or dry period). Western Spadefoots are mostly terrestrial using upland habitats to feed and burrow in for their long dry-season dormancy. Recent research has determined that habitat within a 2,000-m buffer of a Western Spadefoot occurrence is the best predictor of occurrence, indicating that is likely the scale at which local populations are utilizing habitat (Halstead et al. 2022).

Western Spadefoots primarily breed in vernal pools (Figure 4), pools associated with ephemeral streams, and other seasonally filled bodies of water (Figure 5) and larval development can take from 4 to 11 weeks (Morey 1998). Reproduction takes place in water when temperatures are between 9°C and 30°C (48°F and 86°F), and water must be present for more than 4 weeks for the toad to undergo complete metamorphosis (Jennings and Hayes 1994). Optimal habitat, including vernal pools and other temporary wetlands used for reproduction, is free of native and nonnative

predators. The presence of these predators may impair recruitment by Western Spadefoot (Jennings and Hayes 1994).

Open foraging and aestivation habitats preferred by Western Spadefoots including grassland, coastal scrub, chaparral, and oak woodland still exist at mid-elevation outside of major urban areas (Morey 2005). Western Spadefoots typically inhabit lowland habitats such as washes, river floodplains, alluvial fans, playas, and alkali flats (Stebbins 2003). This species can also be found in the foothills and mountains (USFWS 2005). They select areas with sandy or gravelly soil with open vegetation and short grasses. Radio-tracking of Western Spadefoots in two sites in southern California showed that individuals prefer to burrow in soils with higher sand and silt content and avoid sites with high clay content (Baumberger et al. 2019). Vegetation communities where this species aestivate include valley and foothill grasslands, open chaparral, and pine-oak woodland (USFWS 2005).



Figure 4. Western Spadefoot Occupied Breeding Habitat (Vernal Pool)
Source: <http://www.californiaherps.com/frogs/pages/s.hammondii.html>



Figure 5. Western Spadefoot Occupied Breeding Habitat (Road Pool)
Source: <http://www.californiaherps.com/frogs/pages/s.hammondii.html>

Behavior: Most of adult Western Spadefoots lives are spent burrowed in terrestrial habitat, where they aestivate until rainfall events. Emerging during/after rain events to breed and feed, adults migrate from upland habitat to ephemeral water sources to breed. Adults will take advantage of a variety of seasonal water bodies to breed (Morey and Guinn 1992). Historically Western Spadefoots were considered vernal pool obligates, but development and cohabitation with humans has expanded the water sources where adults breed. Road pools/ruts, stock ponds and other manmade water sources have been documented as breeding grounds for spadefoot (Tierra Data 2015). Depending on temperature and annual rains, Western Spadefoot breeding and oviposition generally occurs from October to May, most often in temporary pools and non-flowing drainage areas from winter or spring rains (Stebbins 1985; Thomson et al. 2016).

Reproduction is aquatic, with males calling for females from breeding habitat (Figure 6). Females lay eggs in water, usually attached to twigs or pieces of vegetation. Females deposit eggs in numerous, small, and irregular cylindrical clusters of 10 to 42 eggs, with an average of 24 eggs (Storer 1925; Stebbins and McGinnis 2012). Females may lay 300 to 500 eggs in one season (Morey 2005). Eggs hatch in 0.6 to 6 days depending on the temperature (Brown 1967). Larval development is flexible and dependent upon habitat characteristics, most importantly the amount of water in the pool. On average, metamorphosis takes 58 days (Morey 1998), but can happen in as few as 4 weeks if pools begin to dry. Larvae commonly desiccate and die in pools

that dry before metamorphosis is complete (Feaver 1971; TDI 2013). Once legs are fully formed and the tail begins to be absorbed, metamorphosed individuals spend a few days at the natal pool before dispersing (Figure 7). During these dispersals, metamorphosed individuals take nocturnal trips out of the natal pool. It is believed that metamorphosed individuals have similar habitat requirements as adults, although little is known about the subject (AmphibiaWeb 2015).

Threats: Threats to Western Spadefoots include habitat fragmentation and development, pollution, siltation and encroachment of vegetation into breeding pools, drought (reducing the availability and longevity of breeding pools), noise, wildland fire, climate change, and invasive species including predators and competitors such as: American Bullfrogs (*Lithobates catesbeianus*), crayfish and fish. Disease outbreaks caused by *Batrachochytrium dendrobatidis* (chytrid fungus) can also put populations at risk.

Conservation Status

Western Spadefoots have declined in most of their range due primarily to the loss of breeding habitat. They are designated a species of special concern in the state of California and have been petitioned for federal listing under the ESA. The Western Spadefoot was petitioned for federal listing status in 2012 and the USFWS made a 90-day substantial finding in 2015 (USFWS 2015), stating that there is “substantial information indicating that the petitioned listing may be warranted,” and the species is scheduled for a listing determination in fiscal year 2023 (USFWS 2022).



Figure 6. Western Spadefoot in Amplexus in Breeding Pool. Picture by Kyle McCann



Figure 7. Western Spadefoot tadpole (left) and recent metamorph (right) collected from the same breeding pool (quarter shown for scale). Picture by Kyle McCann

Recommended Conservation Implementation Strategies and Best Management Practices for Western Spadefoot on Military Sites

In general, implementation of the specific BMP's listed below should not be performed if they have potential to negatively impact an existing Western Spadefoot population. Implementation of habitat management practices can be performed when the toads are not active to reduce potential negative impacts. Make sure to document performance of any of the following BMP's, whether current or future, in your installation's INRMP. The USFWS may consider these proactive conservation actions prior to making a listing determination for this species.

- 1. Identify and Protect Western Spadefoot Breeding Habitat/Pools on Military Properties.** Review aerial photography and installation Geographical Information System (GIS) data to identify potentially suitable vernal pools and other ephemeral water sources. As mentioned above, wetland habitat for Western Spadefoots typically consists of vernal pools, stock tanks, road pools/ruts and other locations where water pools/ponds, after rain events. Keep in mind that a population of Western Spadefoots tend to occupy an array of pools, rather than a single wetland. Follow-up by ground-truthing prospective areas immediately after significant rain events, and if the areas support suitable habitat, or are known to support Western Spadefoots. Post as necessary with official signage along roads and other human travel corridors to inform personnel about the actual or potential presence of spadefoot toads and their vulnerability to military operations and other human activities. This is particularly important at road pools or ruts. If possible, direct traffic around these pools, as driving through them will cause direct mortality of eggs, tadpoles, and adults throughout the breeding season. Include a contact number on signage to report observations of illegal and/or unauthorized operations and activities.
- 2. Prohibit Collection of Western Spadefoots on Your Installation.** Collection of Western Spadefoots for commercial or scientific purposes can have negative impacts to local populations due to their highly isolated populations and their punctuated breeding period. As a state species of special concern, it is also illegal to collect them in California. We recommend that military natural resource managers explicitly prohibit collection of Western Spadefoots on military sites, even if collection has not yet become a well-documented problem.
- 3. Develop Fact Sheets and Outreach Tools.** Educational fact sheets and pamphlets, like the one at the following link (<https://denix.osd.mil/dodparc/parc-resources/education-and-outreach/woodhouses-toad-fact-sheet/>) can be developed specifically for Western Spadefoot and then shared with military and civilian personnel to inform them about this at-risk species.
- 4. Survey Existing Western Spadefoot Populations on Military Sites.** Surveying existing Western Spadefoot populations is critical to understanding if a population is increasing or

decreasing. This point is especially important considering the increased severity of droughts that have reduced surface water availability across the western United States in recent years. Survey methods and level of effort are variable and can be tailored to available time and funding constraints. Typically, surveys performed in the evenings immediately after a rainfall event are most productive. In southern California, ideal survey months are November to March. Consider conducting surveys for this species on your military installation.

5. **Establish Long-term Monitoring Stations at Known Breeding Pools.** Monitoring known breeding pools will allow for the collection of two datasets: the establishment of a baseline (abundance, success of breeding attempts, breeding phenology) of Western Spadefoot at known locations; and the ability to compare data of the population over time. Monitoring stations can be established across habitat types, areas impacted by different military training regiments, and under various levels of management protection. Monitoring stations should be surveyed for Western Spadefoots after large rainfall events. Once Western Spadefoot are detected at pools, periodic visits to the pool can provide breeding phenology/breeding success data that can be compared across survey years.
6. **Conduct Upland Habitat Use and Natal Pool Dispersal Studies.** Little is known about upland habitat use and natal pool dispersal in Western Spadefoots. Military natural resource managers in California have a unique opportunity to gather data on these two microhabitats. Given the protected status of land on military installations, conducting studies of individuals leaving natal pools or utilizing upland habitat could be conducted on military installations with few complications (land-use, public interference, etc.). Radiotelemetry and systematic pit-fall trap surveys could accomplish this data collection and surveys could be conducted by military natural resource personnel, university/college students or paid, third-party consultants. For more information on these two survey methods, see *Inventory and Monitoring: Recommended Techniques for Reptiles and Amphibians*, produced by the Partners in Amphibian and Reptile Conservation network (Graeter et al. 2012).
7. **Maintain Upland Aestivation Habitat and Connectivity Between Breeding Locations.** As mentioned previously, Western Spadefoots have two distinct habitats necessary for their continued survival: aquatic (ephemeral) breeding habitats and upland aestivation/foraging zones. We recommend protection of upland habitats surrounding known ephemeral water sources. We also recommend connectivity between multiple breeding locations be maintained to facilitate genetic exchange and recolonization.
8. **Avoid the Use of All Vehicles in Breeding Pool Habitats Used by Western Spadefoots.** If possible, avoid use of military vehicles (including all-terrain vehicles) in

all breeding pools and establish signage surrounding these sites. Install barriers in areas where unauthorized pool crossings will significantly damage breeding pools. Operation of vehicles in the soft soils in or around breeding pools may cause reduction in the pool's longevity, smash individuals in the habitat around pools, kill sensitive vegetation, and lead to serious erosion and water quality issues. Any known breeding pool or vernal pool that is damaged by vehicles, especially those that have had the hardpan (bottom clay layer) broken by vehicular damage, should be restored to original condition. Restoration during the dry season and without further impact to the hardpan is preferred.

- 9. Control or Remove Invasive and Non-native Species.** Invasive species may include various plants that grow at unnaturally high densities, thereby changing physical habitat structure and decreasing wetland hydroperiod, both of which adversely impact the Western Spadefoots. Non-native plants such as Saharan mustard (*Brassica tournefortii*) and fennel (*Foeniculum vulgare*) can have negative impacts to vernal pools by outcompeting native vernal pool plants and filling in pools that would have otherwise had a viable hydroperiod. Predatory invasive species may include American Bullfrog, crayfish, feral cats, African Clawed Frogs (*Xenopus laevis*) and all non-native fish that depredate or compete with Western Spadefoots for resources. Predatory invasive species are especially damaging to the tadpole life stage as they make easy prey being isolated in breeding pools. The best procedures for controlling invasive species are those that both effectively limit their proliferation, as well as minimize potentially harmful impacts to Western Spadefoots. Control procedures will vary according to the invasive species in need of control, and numerous criteria specific to each installation. Therefore, consult your natural resources staff for invasive species control guidelines for your installation.
- 10. Mechanical/Chemical Restoration of Vernal Pools.** Vernal pools are known and well documented on military bases in California where Western Spadefoots are known or may potentially be present. These areas could be expanded, or new vernal pools could be established, using mechanical equipment that allows for altering the physical structure of the habitat and/or with chemical removal/reduction of non-natives/invasive plant species in areas where vernal pools were previously documented. Experts should be consulted before undertaking mechanical or chemical methods for restoration, and timing should try to avoid upland movements of Western Spadefoots during summer and fall when animals are aestivating.
- 11. Avoid Ditching and Draining of Ephemeral Water Sources.** Any activities such as ditching or draining that result in a decrease in the natural hydroperiod of known or potential breeding pools in which Western Spadefoots are present should be avoided.

Lowering water levels after rainfall events could dramatically reduce the survivorship of spadefoot eggs or tadpoles in the pools.

12. Consider Western Spadefoots When Conducting Habitat Mitigation. Western Spadefoots are readily able to find and use novel ephemeral water sources. Mitigation sites are typically situated in areas less prone to human interference and military training, can be constructed in areas adjacent to known Western Spadefoot populations, and can easily incorporate areas where water can pool after rainfall events. Therefore, it is recommended that military environmental planners consider constructing new mitigation sites in areas adjacent to known Western Spadefoot populations.

13. Protection and Maintenance of Upland Aestivation Habitats. Aestivation occurs as temperatures increase and breeding pools begin to desiccate, and all Western Spadefoots are typically underground by the summer. All maintenance and ground-disturbing activities in areas of known Western Spadefoot aestivation would best be conducted in the summer and fall when they will be less impacted by work in their habitat.

Benefits of Western Spadefoot Best Management Practices to Military Training Operation

1. Protection of habitats and individuals of this species can result in reducing costly and prohibitive legal protections at the federal and state levels, thus avoiding further risk to the military training and testing mission.
2. Identification of vernal pools/ephemeral water sources enables military planners to consider these sensitive habitats when developing and/or scheduling training and maneuvering activities.
3. Management of invasive species lessens the damage they may cause to training and maneuver area conditions and provide natural, realistic training environments.
4. Minimum setbacks ensure long-term stability of military training areas.
5. Western Spadefoot breeding habitat is often also essential habitat for other threatened and endangered species (fairy shrimp, sensitive vernal pool plant species); the protection of these pools will also protect habitat for other listed species.

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Additional Sources of Information on Western Spadefoot

Californiaherps: <http://www.californiaherps.com/frogs/pages/s.hammondii.html>

NatureServe Explorer:

https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.100387/Spa_hammondii

Amphibiaweb: https://amphibiaweb.org/cgi/amphib_query?where-scientific_name=Spa+hammondii+%&rel-scientific_name=contains&include_synonymies=Yes

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