TWO-STRIPED GARTER SNAKE

Thamnophis hammondii (Kennicott 1860)

Status Summary

Thamnophis hammondii is a Priority 2 Species of Special Concern, receiving a Total Score/Total Possible of 57% (63/110). During the previous evaluation, it was also considered a Species of Special Concern (Jennings and Hayes 1994a).

Identification

Thamnophis hammondii is a medium-sized snake (102 cm TL) with keeled scales and a head slightly wider than its body (Stebbins 2003). It is called the two-striped garter snake because it lacks the longitudinal middorsal stripe that typifies many garter snakes. The middorsal stripe is either entirely absent or represented only by a nuchal spot at the base of the head (Fitch 1948, Stebbins 1985). Color is highly variable in this species, but there are two primary color morphs: striped/spotted and striped/non-spotted (Larson 1984, Stebbins, 2003). Both morphs have yellowish to gray stripes on each side with a ground color of olive, brown, or brownish gray, and both lack any red coloration dorsally or laterally. The ventral coloration is dull yellowish to orange red or salmon, with or without slight dusky markings (Stebbins 2003). The striped/spotted morph

Two-Striped Garter Snake: Risk Factors

Ranking Criteria (Maximum Score)	Score
i. Range size (10)	5
ii. Distribution trend (25)	15
iii. Population concentration/ migration (10)	10
iv. Endemism (10)	3
v. Ecological tolerance (10)	3
vi. Population trend (25)	10
vii. Vulnerability to climate change (10)	7
viii. Projected impacts (10)	10
Total Score	63
Total Possible	110
Total Score/Total Possible	0.57

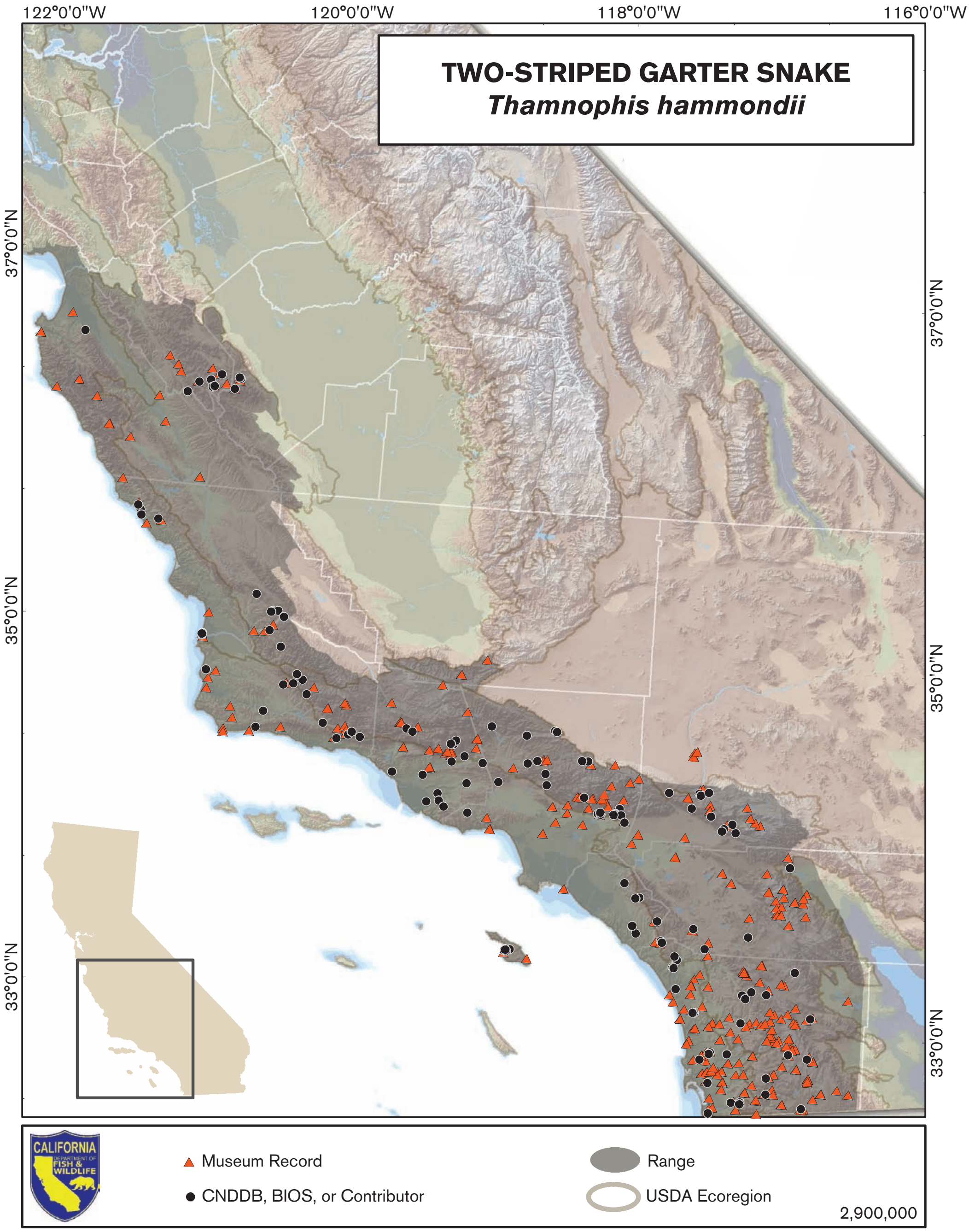

PHOTO ON PREVIOUS PAGE: Two-striped garter snake, Los Angeles County, California. Courtesy of Robert Hess.

has one or two rows of small, alternately spaced dark spots on each side of the dorsum between the lateral stripes (Fitch 1940, Fox 1951, Larson 1984, Stebbins 2003). The striped/non-spotted morph either lacks dark spots on the dorsum or only has very small ones next to the lateral stripes on the anterior part of the body (Larson 1984, Stebbins 2003). Other color variants include non-striped/spotted, with no lateral stripes and one or two rows of dark spots on each side, sometimes appearing checkered, and non-striped/non-spotted (Brown 1980, Larson 1984, Stebbins 2003). A melanistic morph, sometimes with obscure lateral stripes and/or spots, occurs along the outer coast from Oceano to San Simeon State Park in San Luis Obispo County, and can be expected from Gaviota State Beach in Santa Barbara County to Monterey Bay (Bellemin and Stewart 1977, Larson 1984, Stebbins 2003). All color morphs exhibit varying degrees of light flecking dorsally due to whitish pigment on the inter-scale skin and margins of scales (Larson 1984). Dark green and dull red color morphs occur in northeastern Ventura County (Stebbins 2003).

The lack of a vertebral stripe and absence of red coloration on the head and sides distinguishes *T. hammondii* from the co-occurring aquatic garter snake (*T. atratus*), the western terrestrial garter snake (*T. elegans*), and the common garter snake (*T. sirtalis*).

Taxonomic Relationships

Like several other garter snakes, *Thamnophis hammondii* has a complex taxonomic history. This species has at various times been considered a subspecies of the Sierra garter snake (*T. couchii*) (e.g., Cooper 1870, Rossman 1979, Lawson and Dessauer 1979), the northwestern garter snake (*T. ordinoides*) (e.g., Grinnell and Camp 1917), and the western terrestrial garter snake (*T. elegans*) (e.g., Fitch 1948). Rossman and Stewart (1987) most recently elevated *T. hammondii* to full species status. McGuire and Grismer (1993) synonymized the Baja California Sur garter snake (*T. digueti*) with *T. hammondii*.

Life History

In California, *Thamnophis hammondii* can be active for much of the year and has been found from January through November (R. Hansen and R. Tremper, unpublished data in Rossman et al. 1996). Ervin and Fisher (2001) reported *T. hammondii* foraging and basking at a site in San Diego County from early February to October. Rathbun et al. (1993) conducted surveys in San Simeon State Park and nearby Pico Creek in San Luis Obispo County and found that large snakes (>30 cm) were most often observed in the summer, peaking in May and June, while smaller animals were seen from late August through early November. Surface activity appears to be strongly affected by the availability of surface water (E. Ervin and R. Fisher, unpublished data). Southern populations receive less rainfall and experience greater variation in rainfall, likely resulting in shorter and less predictable activity periods than northern populations.

Mating has been observed in the field in late March (Cunningham 1959b), and females are known to store sperm (Fox 1956, Stewart 1972). Like all members of the genus, *T. hammondii* is live-bearing, with litters produced from July to late October (Ernst and Ernst 2003). Hansen and Tremper (unpublished data in Rossman et al. 1996) documented an average of 15.6 offspring from 7 litters (range 3–36). Young were born in late July and August and were 20.3–21.7 cm TL (R. Hansen and R. Tremper, unpublished data in Rossman et al. 1996). Cunningham (1959b) found a 46.1 cm SVL female that contained 6 embryos. Another 64.9 cm SVL female contained 19 eggs (Cunningham 1959b). Males mature at 37.3 cm SVL and females at 38.8 cm (Wright and Wright 1957).

Cunningham (1966) reported a mean body temperature of 14 field-active individuals of 22.6°C (range 18.6–31.8°C). Five of these animals were swimming in water between 14°C and 27°C (Cunningham 1966). Inactive snakes found under cover objects had body temperatures ranging from 7.2°C to 23.6°C (Cunningham 1966).

One radiotelemetry study has collected data on the movement ecology of this species at San Simeon State Park (Rathbun et al. 1993). Activity ranges of radio-tracked snakes were greater and more distant from water in the winter than in the summer. Average summer activity ranges for seven adult females were 1498.9 ± 1847.6 m^2 (mean ± s.d.), although the duration of the study was short (range 4–29 days), and activity may have increased with more time. Average winter activity ranges for two females and one male were 3395.7 ± 4803.5 m^2 (mean ± s.d.), with animals tracked for 29–57 days. Average daily distance to water was 7.2 m in summer, compared to 98.8 m in winter (Rathbun et al. 1993).

Thamnophis hammondii is a generalized predator on a variety of prey including fish, fish eggs, frogs, salamanders, leeches, and earthworms (Van Denburgh 1897, Klauber 1931, Fitch 1940, Fitch 1941, Cunningham 1959b, Bell and Haglund 1978, Rathbun et al. 1993, Rodríguez-Robles and Galina-Tessaro 2006). This species will eat introduced prey, such as sunfish, African clawed frogs, and bullfrogs (Ervin and Fisher 2001, Mullin et al. 2004, Ervin and Fisher 2007).

Habitat Requirements

Thamnophis hammondii is among the most aquatic of the garter snakes and is often found in or near permanent and intermittent freshwater streams, creeks, and pools (Grinnell and Grinnell 1907, Fitch 1940; R. Hansen and R. Tremper, unpublished data in Rossman et al. 1996). Associated vegetation types include willow, oak woodlands, cedar, coastal sage scrub, sparse pine, scrub oak, and chaparral (R. Hansen and R. Tremper, unpublished data, in Rossman et al. 1996, Ernst and Ernst 2003). *Thamnophis hammondii* will also use artificial aquatic habitats such as cattle ponds (Jennings and Hayes 1994a, Ervin and Fisher 2001, Ervin and Fisher 2007).

Surveys in San Simeon State Park in San Luis Obispo County from July to December 1992 resulted in 45 snake sightings: 33.3% on land, 53.3% on banks, and 6.7% in the water (Rathbun et al. 1993). Almost all of the sightings (44/45) were in or near pooled water sources. Sixty percent of snakes were sighted in low vegetation (e.g., herbs and grasses), 28.9% in tall vegetation (e.g., cattails), 11.1% in open areas with no vegetation, and zero in wooded areas (e.g., willow; Rathbun et al. 1993).

Habitat and movement ecology may vary seasonally, although this requires further study. *Thamnophis hammondii* have been observed to concentrate their habitat use in vernal pools in the spring and in remnant pools formed from ephemeral creeks in the summer (R. Fisher, pers. comm.). Nine radio-tracked snakes in San Simeon State Park used streamside habitats more in the summer, while chaparral and grassland upland sites were used for overwintering (Rathbun et al. 1993). Ninety-five percent of diurnal locations of radio-tracked animals were on land, usually underground. Animals were underground, presumably in rodent burrows, in 87.9% of locations on land (Rathbun et al. 1993). Two of the animals had home ranges that overlapped Highway 1 (a major highway with heavy traffic), suggesting that potential road mortality may be a management issue. Although it is generally considered to be a very aquatic snake, these observations suggest that terrestrial upland habitats and rodent burrows can be important habitat components for *T. hammondii*.

Distribution (Past and Present)

Thamnophis hammondii occurs in California from Salinas, Monterey County, south along the coast into Baja California, Mexico, occurring in the South Coast, Peninsular, and Transverse ranges (Boundy 1990, Ely 1992, McGuire and Grismer 1993). Isolated populations also occur in Baja California Sur and on Santa Catalina Island (Brown 1980, Stebbins 2003). While *T. hammondii* occurs mostly west of the deserts in California, there are populations in some perennial desert slope streams in San Bernardino, Riverside, and San Diego Counties (Perkins 1938, Fitch 1940, Boundy 1990). The elevational range is from sea level to 2450 m (Atsatt 1913). Jennings and Hayes (1994a) estimated that *T. hammondii* has been extirpated from ~40% of its historic range in California during the second half of the twentieth century. This snake may be patchily distributed even when abundant suitable habitat is available. For example, snakes were readily observed at San Simeon Creek, San Luis Obispo County, in 1992, but similar habitat about 5 km away in Pico Creek had very few snakes, even though the latter experiences less human disturbance (Rathbun et al. 1993).

Trends in Abundance

Declines in abundance appear to be less severe in the southern compared to the northern part of the range, but few quantitative data are available to support this interpretation (Jennings and Hayes 1994a). Variation in abundance over time at a particular site may be partially explained by reduction in surface activity during drought periods and not necessarily reflect mortality and declines (E. Ervin and R. Fisher, unpublished data). *Thamnophis hammondii* were rare in Carmel River fish traps in 2003–2005 (S. Barry, unpublished data) and were never encountered in extensive fieldwork in and near the Hastings Reservation in the upper Carmel Valley from 1992 to 1998 (B. Shaffer, unpublished data). Jennings and Hayes (1994a) noted that *T. hammondii* was common only in San Diego County. However, other populations in the south may be robust, such as along the Santa Clara River in Los Angeles County, along Sespe Creek in Ventura County, and in the Angeles, Los Padres, and San Bernardino national forests (S. Barry, pers. comm.). The Santa Catalina Island population was reported as small (~30 individuals) and isolated in the 1970s (Brown 1980) and is suspected to have declined since (Jennings and Hayes 1994a).

Nature and Degree of Threat

Declines in the south are thought to be due to urbanization, reservoir construction, and flood control (Jennings and Hayes 1994a). Further north, declines are suspected to have been caused by a combination of factors including habitat modification by livestock, predation by introduced vertebrates, loss of native prey, and drought (Jennings and Hayes 1994a). However, negative interactions with nonnative species have not been well documented, and in some cases *T. hammondii* may benefit from availability of introduced prey. Reliance on aquatic habitat and prey may contribute to drought sensitivity in this species (Jennings and Hayes 1994a; R. Fisher, pers. comm.).

Under climate change, mean annual temperatures are projected to increase throughout the range of *T. hammondii*, with warmer winters and summers and earlier spring warming expected (reviewed in PRBO 2011). There is less certainty about future precipitation patterns, with estimates ranging from little change to roughly 30% decreases in rainfall (Snyder and Sloan 2005, PRBO 2011). Snowpack reductions of up to 90% are predicted in the southern part of the range (Snyder et al. 2004). Warmer and potentially drier conditions may affect availability of intermittent and ephemeral water bodies and therefore limit activity. In the more northern part of the range, the probability of large (>200 ha) fires is expected to increase (Westerling and Bryant 2008) and the area burned is expected to increase by up to 50% (Lenihan et al. 2008). Both increases and decreases in fire probability and extent have been predicted for southern California under different climate change scenarios. There is little consensus on future fire dynamics in this part of the range because of the difficulty in modeling Santa Ana weather events (Westerling et al. 2004, Westerling and Bryant 2008). How *T. hammondii* may respond to fire needs to be studied. Fire may have direct mortality effects and may alter aquatic and terrestrial habitat quality. Predicted vegetation shifts due to climate change include decreases in chaparral, shrubland, and woodland, and increases in grassland area (Lenihan et al. 2008, PRBO 2011). The impact of these shifts on *T. hammondii* populations will likely be negative.

Status Determination

Thamnophis hammondii has undergone declines and extirpations and occurs in an area of high human population density and development, resulting in a Priority 2 Species of Special Concern status.

Management Recommendations

Given this species' association with aquatic habitat and apparent willingness to use artificial habitats, restoration of aquatic habitat and supplementation with artificial wetlands should be explored as a management option in extirpated sites. Eradication efforts aimed at nonnative aquatic species should consider the potential effect on *T. hammondii* populations, particularly if native prey is not abundant (Mullin et al. 2004). Rathbun et al. (1993) documented the use of upland terrestrial habitat by *T. hammondii*, and the potential importance of rodent burrows for overwintering. In order to maintain access to these habitats, they suggested protecting terrestrial habitats within 500 m of aquatic habitats, although additional study across habitat types is needed.

Monitoring, Research, and Survey Needs

Surveys to determine the abundance and distribution of remaining populations are needed and they should be conducted by individuals that are well trained to distinguish among *Thamnophis* species. Additional data on movement ecology and habitat requirements are also necessary to facilitate the design of protected areas around known aquatic habitats and to inform possible restoration efforts. The degree to which *T. hammondii* is dependent upon introduced prey should be assessed, and the quality of those introduced prey compared to native prey should be evaluated. It may be necessary to manage for both *T. hammondii* and native prey populations simultaneously for effective recovery. Finally, landscape genetic data on the degree of differentiation at the regional and watershed levels would be valuable both for the identification of management units and for possible repatriation efforts.