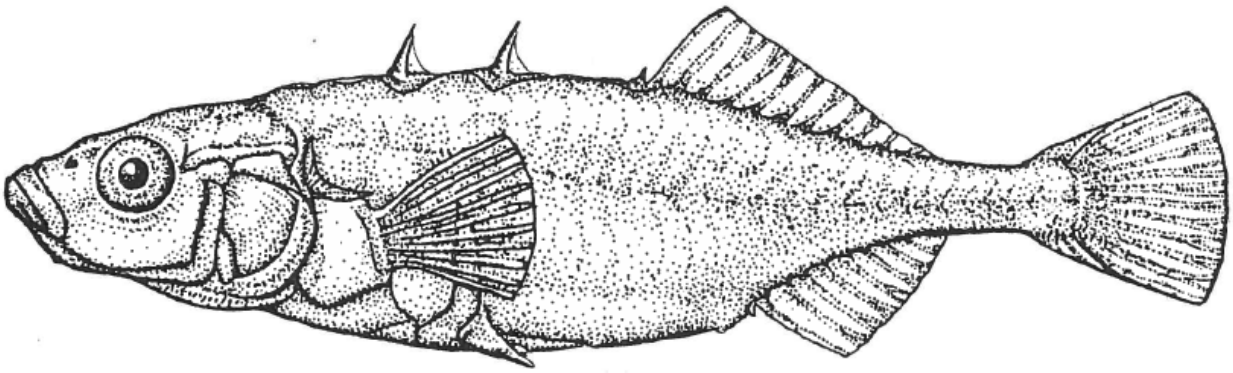
Unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*)

5-Year Review: Summary and Evaluation



U.S. Fish and Wildlife Service
Ventura Fish and Wildlife Office
Ventura, California

April 2021

GENERAL INFORMATION:

Species: Unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*)
Date listed: October 13, 1970
FR citation(s): 35 FR 16047
Classification: Endangered

BACKGROUND:

Most recent status review:

U.S. Fish and Wildlife Service (Service). 2009. Unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service Ventura Fish and Wildlife Office, Ventura, CA. 36 pp.

FR Notice citation announcing this status review:

Initiation of 5-Year Status Reviews of 66 species in California and Nevada. Notice of initiation of reviews; request for information (85 FR 4692), January 27, 2020.

Critical Habitat Designation:

Determination that the designation of critical habitat should not be made (67 FR 58580), September 17, 2002.

State Listing:

Listed as endangered by the State of California under the California Endangered Species Act and State of California fully protected species under Fish and Game Code 5515, June 27, 1971.

ASSESSMENT:

Species Overview

The unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*) is a small, scaleless, freshwater fish (approximately 5 centimeters in length), inhabiting slow-moving reaches or quiet-water microhabitats in streams and rivers. Fish typically live one year, with most breeding activity occurring between February and September. Historically, unarmored threespine sticklebacks were found throughout a much larger area including the Los Angeles, San Gabriel, and Santa Ana Rivers, but were extirpated from these areas as a result of habitat loss and degradation due to urbanization. Unarmored threespine sticklebacks were also present in the Santa Maria River drainage in San Luis Obispo County, where they were lost to introgression. Unarmored threespine sticklebacks are currently restricted to a few small, local sites in the Santa Clara River watershed in Los Angeles County, the San Antonio Creek drainage in Santa Barbara County, and isolated occurrences in inland San Bernardino and San Diego counties.

Data Review

This 5-year review was conducted by the Service's Ventura Fish and Wildlife Office. Data for this review were solicited from interested parties through a Federal Register notice announcing this review on January 27, 2020 (85 FR 4692). We did not receive any information about unarmored threespine sticklebacks in response to this request. For this review, we used information from the revised recovery plan (Service 1985, entire), information from the 2009 5-Year Review (Service 2009, entire), information from Federal and State partners, and information from species experts. We also conducted a literature review.

Habitat

Unarmored threespine sticklebacks prefer rivers or streams with a slow, continuous flow of water with moderate algal cover (Baskin 1974, p. 18), which is typical of the conditions in headwaters and tributaries that they tend to occupy. However, unarmored threespine sticklebacks have been observed in rivers with rapid flows (to 1 meter per second) to static pools with virtually no surface flow (Baskin 1974, p. 14). In habitats where water velocity is higher, unarmored threespine sticklebacks reside along the channel edge in areas occupied by aquatic vegetation (watercress, *Nasturtium* spp.), under the edge of algal (*Cladophora* spp.) mats, or behind obstructions (Baskin 1974, p. 19; Service 1985, p. 10). Unarmored threespine sticklebacks are not distributed uniformly throughout the rivers and streams in which they occur (Service 2009, p. 12). Sand or gravel substrates, with the presence of detritus and aquatic vegetation, are required for reproduction (Service 1985, p. 11; Baskin 1974, p. 42).

Distribution and Abundance

Historically, the unarmored threespine stickleback was considered widespread in southern California, including the headwaters of the Santa Clara River and low gradient parts of the Los Angeles River, San Gabriel River, and Santa Ana River in the Los Angeles Basin (Miller and Hubbs 1969, p. 62), the Santa Maria River drainage in San Luis Obispo County (Swift *et al.* 1993, p. 125), and San Antonio Creek in Santa Barbara County (Swift *et al.* 1993, p. 127).

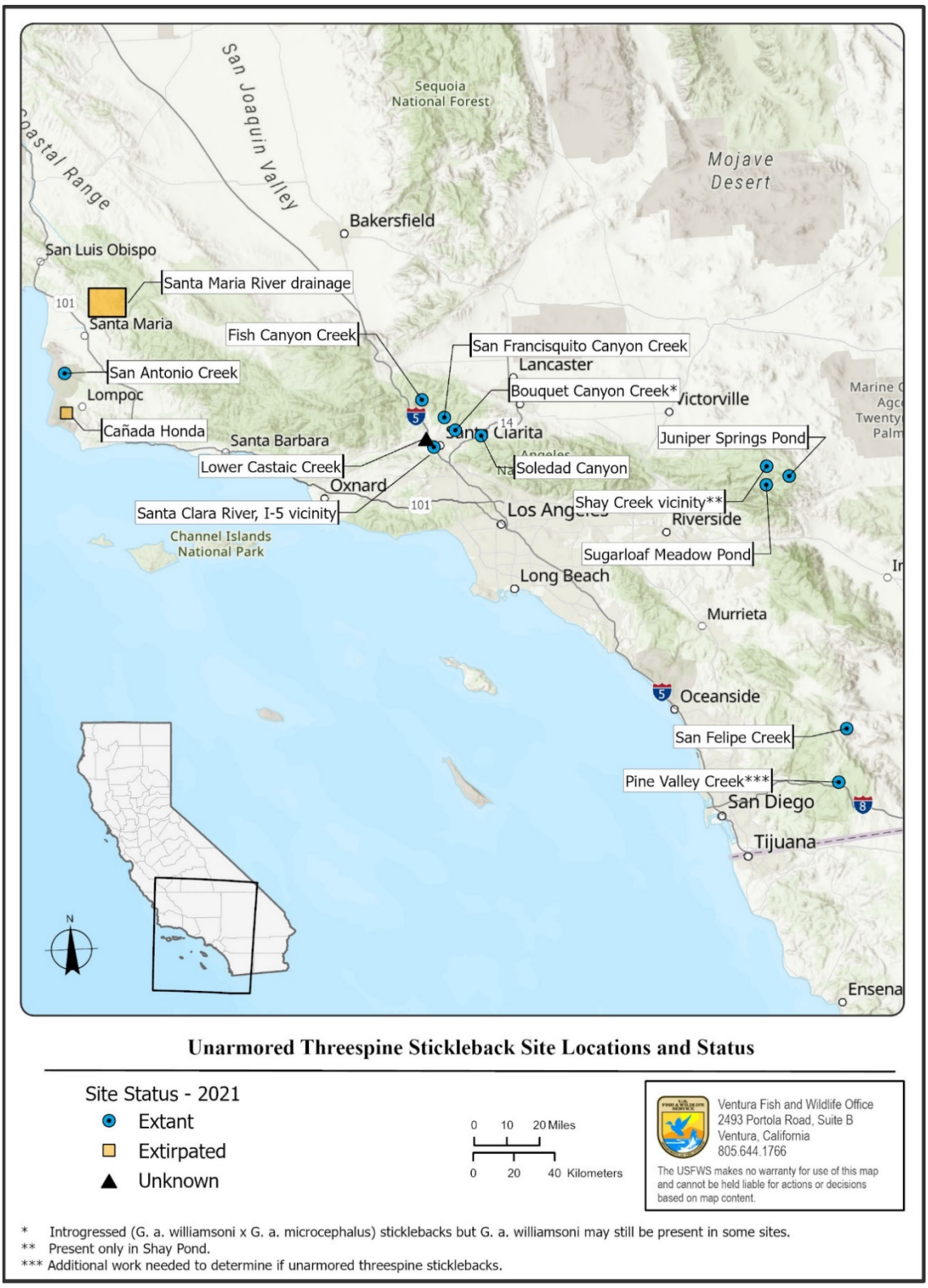
Several historically occupied sites in the Santa Clara River watershed have become extirpated, including upper Piru Creek in Ventura and Los Angeles counties, and upper Castaic Creek, Elizabeth Lake Canyon, and Escondido Canyon in Los Angeles County (Miller and Hubbs 1969, p. 56 table 1; Swift *et al.* 1993, p. 125). Unarmored threespine sticklebacks have been absent from the Los Angeles Basin since 1951, or earlier depending on location (Swift *et al.* 1993, p. 125). The areas in the Los Angeles Basin which formerly supported unarmored threespine sticklebacks now harbor no unarmored threespine sticklebacks and few, if any, other native fishes. Based on collections prior to 1940, unarmored threespine sticklebacks in the Santa Maria River drainage in upper Huasna River and its tributary Alamo Creek were lost to introgression with partially armored threespine sticklebacks (*Gasterosteus aculeatus microcephalus*) (Swift *et al.* 1993, p. 125).

At the time of listing, no abundance data were available and unarmored threespine sticklebacks were only known to occur in the upper reaches of the Santa Clara River, including Soledad Canyon (Baskin 1974, p. 13 of 134). At the time of the 2009 5-Year Review, unarmored threespine sticklebacks were thought to be restricted to the upper Santa Clara River and its tributaries in Los Angeles County, San Antonio Creek in Santa Barbara County, and a cluster of sites in San Bernardino County (Service 2009, p. 1). Additionally, the 2009 5-Year Review identified a transplanted unarmored threespine stickleback site outside the native range in upper San Felipe Creek in San Diego County, but its status was unknown (Service 2009, p. 1).

Currently, unarmored threespine sticklebacks occur in most of the locations identified in the 2009 5-Year Review. An additional location has been established in Fish Canyon Creek, another tributary of the Santa Clara River. Also, a potential previously unrecognized unarmored threespine stickleback site may occur in Pine Valley Creek, San Diego County.

See Figure 1 for unarmored threespine stickleback locations and current status.

Figure 1. Unarmored threespine stickleback locations and current status.



No range-wide, long-term monitoring program is conducted for unarmored threespine sticklebacks, and data on population dynamics are limited. Annual surveys are typically conducted in some locations; however, few surveys for unarmored threespine sticklebacks were conducted in 2020 due to COVID-19. Nonetheless, assessments of presence and absence have been conducted at some locations. Unarmored threespine stickleback locations are described below, including current status and any available information on the abundance. See Table 1 for current status of unarmored threespine stickleback locations.

Santa Barbara and San Luis Obispo Counties
Unarmored threespine sticklebacks in the Santa Maria River drainage in San Luis Obispo County were lost to introgression several decades ago. The 2009 5-Year Review identified one extant unarmored threespine stickleback location in Santa Barbara County and another transplanted location that had become extirpated. Each occurs within a separate riverine drainage and has no connection to the other.

Santa Maria River System (San Luis Obispo County):
Both sites where unarmored threespine sticklebacks historically occurred in the Santa Maria River, upper Huasna River and its tributary Alamo Creek, were lost to introgression with partially armored threespine sticklebacks (*G. a. microcephalus*) that were introduced from the Santa Ynez River in 1940 (Miller and Hubbs 1969, pp. 63-64; Swift *et al*. 1993, p. 125; Service 2009, p. 6). The partially armored threespine stickleback was inadvertently introduced to this drainage with the introduction of trout for a recreational fishery (Miller and Hubbs 1969, p. 63). The current status of unarmored threespine sticklebacks in the Santa Maria River system is considered extirpated.

San Antonio Creek (Santa Barbara County):
San Antonio Creek is located on Vandenberg Air Force Base between the Santa Maria River to the north and Santa Ynez River to the south. Since our 2009 Five-Year Review, unarmored threespine sticklebacks were observed in San Antonio Creek in multiple locations during surveys conducted in 2012 (ManTech 2013, pp. 22, 24) and 2019 (ManTech 2019, p. 15). Unarmored threespine sticklebacks are currently presumed extant.

Previous studies on unarmored threespine sticklebacks in San Antonio Creek have suggested that they may be unique and warrant further investigation for taxonomic reclassification (Buth 1984, p. 13; Haglund and Buth 1988, entire; Swift *et al*. 1993, p. 127). Work remains to be completed to address this matter.

Cañada Honda Creek (Santa Barbara County):
Cañada Honda Creek is located on Vandenberg Air Force Base between the Santa Ynez River to the north and Point Conception to the south. Approximately 850 unarmored threespine sticklebacks were introduced into Cañada Honda Creek from San Antonio Creek in 1984 (Swift *et al*. 1993, p. 127) and this site appears to have been extirpated (Service 2009, p. 6). As of 2008, no individuals had been observed in Cañada Honda Creek in 13 years (Devenoge *in litt*. 2008, as cited in Service 2009, p. 6; Ball *et al*. 2009, p. 22). Unarmored threespine sticklebacks in Cañada Honda Creek are considered extirpated.

Los Angeles County, Santa Clara River Watershed
The 2009 5-Year Review identified multiple unarmored threespine stickleback sites in Los Angeles County. Each site is located within the Santa Clara River Watershed. Since the 2009 5-Year Review, a new location in the Santa Clara River Watershed has been established. Over time, the unarmored threespine stickleback is known to have been observed in three tributaries to the Santa Clara River and in two distinct locations in the main stem of the river that are separated by dry reaches.

Soledad Canyon (Los Angeles County):
Soledad Canyon is within the upper Santa Clara River, not far from its headwaters. The unarmored threespine stickleback was first described from Soledad Canyon in 1854 (Girard 1854, p. 133) and is considered the ancestral genetic strain (Richmond *et al*. 2015, p. 97). Unarmored threespine sticklebacks in Soledad Canyon are extant and have been the subject of multiple translocation efforts since the 2009 5-Year Review.

In April 2016, unarmored threespine sticklebacks were observed in pools and stream segments that were drying out in lower Soledad Canyon (near River's End Campground). The California Department of Fish and Wildlife (CDFW) conducted an emergency rescue and translocated approximately 1,600 unarmored threespine sticklebacks upstream within Soledad Canyon to the Angeles National Forest.

In the summer of 2016, the Sand Fire burned upstream of and adjacent to areas in Soledad Canyon that were occupied by unarmored threespine sticklebacks. The survival of unarmored threespine sticklebacks in Soledad Canyon was threatened by potential for ash transport (toxic to fish) and sediment flows from winter rains. The Service, CDFW, and U.S. Forest Service (USFS) conducted an emergency rescue in October 2016. The unarmored threespine sticklebacks were temporarily held overwinter in the CDFW Fillmore Fish Hatchery and released into a newly identified location at Fish Canyon Creek in April 2017 (see Fish Canyon Creek (Los Angeles County) below for details).

In August 2018, CDFW translocated over 300 unarmored threespine sticklebacks from San Felipe Creek to Stickleback Ranch in Soledad Canyon in two emergency rescue efforts because San Felipe Creek was drying out (CDFW 2018, entire) (See San Felipe Creek (San Diego County) below).

In October 2020, CDFW translocated approximately 300 unarmored threespine sticklebacks from Fish Canyon Creek to three locations in Soledad Canyon in an emergency rescue (CDFW 2020b, entire).

Santa Clara River, Interstate 5 vicinity (Los Angeles County):
The Santa Clara River, Interstate 5 vicinity includes a reach of the Santa Clara River downstream of Soledad Canyon where the Los Angeles Aqueduct crosses the river and ends downstream near the Ventura-Los Angeles County line. The distribution of unarmored threespine sticklebacks shifts in this portion of the Santa Clara River due to seasonal changes in water availability (portions of the river go dry during the summer months) and the availability of suitable habitat (adequate vegetation and low flow velocities). Surveys are not regularly conducted throughout

the multiple sites in this location. No unarmored threespine sticklebacks were observed during surveys conducted at one site in 2019 (CDFW 2019b, entire). In our 2009 5-Year Review, unarmored threespine sticklebacks were extant in this location (Service 2009, pp. 3, 7, Figure 1). The current status of unarmored threespine sticklebacks in the Santa Clara River, Interstate 5 vicinity is unknown but presumed extant.

Castaic Creek

Castaic Creek is a tributary to the Santa Clara River in the Interstate 5 vicinity and was identified as an unarmored threespine stickleback location in the 2009 5-Year Review. The part of Castaic Creek that was identified as an unarmored threespine stickleback location in the previous 5-Year Review would be more accurately described as lower Castaic Creek. Unarmored threespine sticklebacks have been observed in lower Castaic Creek at its confluence with the Santa Clara River and upstream of the Interstate 5 Freeway Bridge at certain times when water is present (Service 2009, p. 9). Additionally, because the location where unarmored threespine sticklebacks have been observed is in close proximity to the Santa Clara River, it may be more accurate to include this location as a site associated with the Santa Clara River, Interstate 5 vicinity. Surveys are not regularly conducted at this location, as it is often dry; the current status of unarmored threespine sticklebacks in lower Castaic Creek is unknown.

San Francisquito Canyon Creek (Los Angeles County):

San Francisquito Canyon Creek is a tributary to the Santa Clara River; its confluence with the river occurs east of Interstate 5, near McBean Parkway in the City of Santa Clarita. In our 2009 5-Year Review, we identified that the unarmored threespine stickleback had become extirpated from San Francisquito Canyon due to effects from post-fire debris flows in the winter of 2004-2005 resulting from the 2002 Copper Fire (Service 2009, p. 9).

In 2014, the Service, CDFW, and USFS translocated unarmored threespine sticklebacks from the Santa Clara River, upstream of Interstate 5 and released the fish at two locations in San Francisquito Canyon (CDFW 2014a, entire; CDFW 2014b, entire) in an effort to reestablish the subspecies. These fish were emergency rescued from habitat that was drying out in the Santa Clara River, upstream of Interstate 5 (CDFW 2014a, entire; CDFW 2014b, entire). Since 2014, surveys have been conducted annually in San Francisquito Canyon. In 2018, unarmored threespine sticklebacks were observed in only one of the release sites (Backlin *et al.* 2018) and again only at the same site in October 2019 (E. Morrissette pers. obs. 2019). Unarmored threespine sticklebacks are currently presumed extant in San Francisquito Canyon at this site, but appear to be extirpated from the other release location.

Bouquet Canyon Creek (Los Angeles County):

Bouquet Canyon is east of San Francisquito Canyon and also is a tributary to the Santa Clara River; its confluence with the Santa Clara River is near Bouquet Canyon Road in the City of Santa Clarita.

Introgression between unarmored threespine sticklebacks and partially armored sticklebacks, sourced from the lower Santa Clara River below the Piru Gap, has occurred in multiple locations within Bouquet Canyon Creek (Richmond *et al.* 2015, pp. 88-96). The extent of remaining pure unarmored threespine sticklebacks is unknown. Surveys were conducted at multiple locations in

Bouquet Canyon Creek in July 2019 (CDFW 2019c, entire). Bouquet Canyon Creek unarmored threespine sticklebacks are presumed extant, but introgressed.

Fish Canyon Creek (Los Angeles County):
Fish Canyon Creek is a tributary to Castaic Creek located in the Angeles National Forest and is a new unarmored threespine stickleback location since the 2009 5-Year Review. Unarmored threespine sticklebacks were established in Fish Canyon Creek in April 2017. The fish were sourced from an emergency rescue of unarmored threespine sticklebacks from Soledad Canyon in October 2016 that were held overwinter in CDFW's Fillmore Fish Hatchery. Surveys have been conducted at this site annually since establishment.

On July 22, 2016, the Sand Fire burned upstream of and adjacent to areas in Soledad Canyon occupied by unarmored threespine sticklebacks and emergency rescue was deemed appropriate. On August 25, 2016, the Service, CDFW, U.S. Geological Survey (USGS), and USFS conducted a site assessment of Fish Canyon Creek as a potential relocation site. At the site, all agencies jointly determined the site suitable. In October 2016, approximately 170 unarmored threespine sticklebacks were captured from Soledad Canyon with the intent to translocate them to Fish Canyon Creek. However, due to multiple rainfall events that fall, Fish Canyon Creek became filled-in with sediment and the velocity of flows were too fast for release of the fish. The fish were instead moved to CDFW's Fillmore Fish Hatchery for temporary holding. After approximately 6 months, sediment transport had ceased in Fish Canyon Creek, and the flows subsided such that the release site was suitable for translocation. On April 14, 2017, the Service and CDFW translocated 151 unarmored threespine sticklebacks (all surviving individuals) from the Fillmore Fish Hatchery and released the fish into Fish Canyon Creek. The Service and CDFW conducted post-release site assessments at 42 days post-release and observed spawning behavior. At 53 days post-release, larval unarmored threespine sticklebacks were observed indicating successful reproduction at this site.

In the summer of 2019, CDFW conducted an emergency rescue and translocation of unarmored threespine sticklebacks in lower Fish Canyon Creek. The habitat was drying out in lower Fish Canyon Creek and the fish were translocated upstream to suitable habitat in the same drainage (CDFW 2019a, entire).

In August 2020, the Lake Fire burned more than 31,000 acres of the Angeles National Forest, including most of upper Fish Canyon Creek watershed (InciWeb 2020, entire). After the fire, the Service, CDFW, USGS, and USFS conducted habitat assessments and visual surveys of Fish Canyon Creek and determined an emergency rescue and translocation were warranted to prevent fish from being lost to post-fire sedimentation resulting from winter rains and debris flows. Soledad Canyon was assessed in September 2020 and three areas were found to be suitable as release sites (CDFW 2020a, entire). CDFW conducted the post-fire emergency rescue of unarmored threespine sticklebacks in Fish Canyon Creek on October 9, 2020; approximately 300 unarmored threespine sticklebacks were translocated to three locations in Soledad Canyon (CDFW 2020b, entire). Not all unarmored threespine sticklebacks were captured; some remained in Fish Canyon Creek.

The status of unarmored threespine sticklebacks in Fish Canyon Creek was extant at the time of 2020 emergency rescue, which occurred prior to winter rains. Since the emergency rescue, a large rainfall event occurred in January 2021. On February 5, 2021, CDFW conducted a habitat assessment and unarmored threespine stickleback survey, and found no sedimentation to habitat and that unarmored threespine sticklebacks were present (Pareti *in litt.* 2021). Unarmored threespine sticklebacks in Fish Canyon Creek are presumed extant.

San Bernardino County:
In the 2009 5-Year Review, we referred to all unarmored threespine stickleback sites in San Bernardino County as the "Shay Creek vicinity." However, Sugarloaf Meadow Pond and Juniper Springs Pond are not in the vicinity of Shay Creek. We will now use "Shay Creek vicinity" to describe the stream and pond habitats of Shay Creek and its terminus at Baldwin Lake. When referring to all unarmored threespine stickleback sites in San Bernardino County, we will describe them as sites in the "San Bernardino Mountains."

Historically, unarmored threespine sticklebacks have been observed in three areas in the San Bernardino Mountains: Shay Creek vicinity, Juniper Springs Pond, and Sugarloaf Meadow Pond. Each of these locations occurs within a separate drainage and has no connection to the other. A regular survey and monitoring program is not being conducted for these locations and some sites may be surveyed more often than others.

Researchers have identified the unarmored threespine sticklebacks in the San Bernardino Mountains as the "Shay Creek stickleback," and suggest, based on genetic and phenotypic differences from *G. a. williamsoni*, that it may warrant further investigation for taxonomic reclassification (Haglund and Buth 1988, entire; Malcolm 1992, p. 213; Buth and Haglund 1994, p. 80; Richmond *et al*. 2013, p. 6).

A general overview of sticklebacks and background information on locations and habitat in the San Bernardino Mountains, from the discovery in 1981 up to 1992, is summarized from Malcolm (1992, pp. 214, 215, 218):

> *Sticklebacks were discovered in the San Bernardino Mountains in 1981. Locations of observations in the 1980s were Shay Creek, Weibe's Pond, and Baldwin Lake. Low rainfall in 1984 and early 1985, combined with increased harvesting of water for human use, led to Shay Creek drying up along most of its length and Baldwin Lake eventually evaporated. Two deeper pools persisted and the Community Services District (the water company) began pumping water into one of these pools in August 1985. Shay Creek has not flowed, except for occasional storm run-off, since then and Baldwin Lake has remained dry. In 1989, fish were observed in Weibe's Pond but the pool in Shay Creek that was not maintained by the water company was reduced to such a low level that no fish survived.*
>
> *In October 1988, approximately 300 unarmored threespine sticklebacks from Shay Creek and 125 that were reared in captivity were introduced into a pond in Sugarloaf Meadow. This population has persisted. A second introduction occurred when aquatic plants were moved from Shay Creek to a private pond 1 mile east of Baldwin Lake that accidentally*

included sticklebacks. As of November 1992, sticklebacks exist in one artificially maintained pool in Shay Creek and in two transplant populations.

The current status of unarmored threespine sticklebacks in the San Bernardino Mountains is provided below. We are uncertain of the location of the private pond where unarmored threespine sticklebacks were accidentally introduced and do not include a discussion of this site because we have no further records of presence at this location. Additionally, captive rearing of unarmored threespine sticklebacks from the San Bernardino Mountains occurred at the University of Redlands from 1985-1990, but is no longer active in an approved or permitted program.

Shay Creek vicinity (San Bernardino County)

The Shay Creek vicinity unarmored threespine stickleback sites are comprised of stream and pond habitats in the Baldwin Lake Basin at the east end of the Big Bear Valley in San Bernardino County (Malcolm 1992, p. 218). In the Shay Creek vicinity, unarmored threespine sticklebacks have been observed at some point in time at five sites that are connected along the Shay Creek watercourse: Motorcycle Pond, Shay Pond, Shay Creek, Weibe's Pond, and Baldwin Lake. Sticklebacks were first observed in this area in Shay Creek, Weibe's Pond, and Baldwin Lake in the 1980s (Malcolm 1992, pp. 214-216). Currently, Shay Pond would be the natural source of unarmored threespine sticklebacks for any of the other sites in the Shay Creek vicinity.

Motorcycle Pond is an ephemeral pond located near Shay Pond at the upstream extent of Shay Creek. This site is often dry. Surveys are not regularly conducted at this site. We describe the current status of unarmored threespine sticklebacks in Motorcycle Pond as intermittent, meaning that unarmored threespine sticklebacks could be present when water is present and habitat is suitable, but unarmored threespine sticklebacks are typically not found in Motorcycle Pond because it's usually dry and suitable habitat is not usually present.

Shay Pond is a deepened section of Shay Creek located near the upstream extent of the stream. Shay Pond and the adjacent areas are owned and managed by cooperating public and private entities. Shay Pond was historically fed by springs and perennial water; currently, it is provided supplemental water to prevent desiccation. Periodically, pond cleanouts occur to remove encroaching vegetation and maintain areas of open water. The most recent cleanout occurred in 2018. In our 2009 5-Year Review, unarmored threespine sticklebacks were extant in this location (Service 2009, p. 10, Figure 2). The current status of unarmored threespine sticklebacks in Shay Pond is unknown but presumed extant.

Shay Creek runs through periodically wet meadow (Shay Meadow) habitat and is a tributary to Baldwin Lake. Historically, Shay Creek was fed by several springs and was a perennial stream system. However, over the past several decades water supply and environmental conditions have changed so that unarmored threespine sticklebacks within the Shay Creek system are now confined to Shay Pond located in the upper end of the Shay Meadow (see description of Shay Pond, above). Shay Creek is now ephemeral and is often dry. Surveys are not regularly conducted at this site. We describe the current status of unarmored threespine sticklebacks in Shay Creek as intermittent.

Weibe's Pond is described as being on the shores of Baldwin Lake (Malcom 1992, p. 214), but we are uncertain of its precise location, and we have not been able to find additional records of this unarmored threespine stickleback site.

Baldwin Lake has become ephemeral and occurs at the downstream extent of Shay Creek. This site is often dry. Surveys are not regularly conducted at this site. We describe the current status of unarmored threespine sticklebacks in Baldwin Lake as intermittent.

Juniper Springs Pond (San Bernardino County)
Juniper Springs Pond occurs in the San Bernardino National Forest and is located adjacent to Forest Road 2N64Y. Surveys are not regularly conducted for unarmored threespine stickleback at this location, but USFS staff visit the site three times per year (USFS 2015, p. 19). In 2020 during site visits by USFS staff, unarmored threespine sticklebacks were opportunistically observed and habitat remained suitable (USFS 2020, p. 5). Unarmored threespine sticklebacks in Juniper Springs Pond are presumed extant.

Sugarloaf Meadow Pond (San Bernardino County)
Sugarloaf Meadow Pond occurs south and west of all other unarmored threespine stickleback locations in the San Bernardino Mountains and occurs in the San Bernardino National Forest. In October 1988, over 400 unarmored threespine sticklebacks were introduced into this pond in Sugarloaf Meadow (Malcolm 1992, p. 218). In 2014, silt was removed from Sugarloaf Meadow Pond increasing depth and area (USFS 2015, p. 10).

Surveys are not regularly conducted for unarmored threespine stickleback at this location but USFS staff visit the site twice annually (USFS 2015, p. 19). In 2020 during site visits by USFS staff, unarmored threespine sticklebacks were opportunistically observed and habitat remained suitable (USFS 2020, p. 5). Unarmored threespine sticklebacks in Sugarloaf Meadow Pond are presumed extant.

San Diego County
The 2009 5-Year Review identified a single unarmored threespine stickleback location in San Diego County at San Felipe Creek. Currently, Pine Valley Creek may be an additional unarmored threespine stickleback location.

San Felipe Creek (San Diego County):
San Felipe Creek is located in the eastern portion of San Diego County in the Salton Sea Basin. Unarmored threespine sticklebacks were initially transplanted to San Felipe Creek in 1972 and 1973 when 458 unarmored threespine sticklebacks were translocated from Soledad Canyon (Swift *et al.* 1993, p. 125). After the winter of 1979-1980, they were believed to have become extirpated. In 1981, approximately 180 sticklebacks from Soledad Canyon were again translocated to San Felipe Creek (Swift *et al.* 1993, p. 125).

Since 2014, surveys for unarmored threespine sticklebacks in San Felipe Creek have been conducted multiple times per year (CDFW 2019d, p. 1 of 8). These surveys have repeatedly shown that specific downstream sites dry up every summer around July stranding hundreds of sticklebacks and ultimately resulting in the death of these fish (CDFW 2019d, p. 1 of 8).

In the summer of 2018, CDFW conducted multiple emergency rescue events in San Felipe Creek. On July 31, 2018, 47 unarmored threespine sticklebacks were rescued from an area of San Felipe Creek that was drying out and translocated to an upstream site within the same drainage (Barabe *in litt*. 2018a). On August 9, 2018, 78 unarmored threespine sticklebacks were translocated from this upper release site in San Felipe Creek to Stickleback Ranch in Soledad Canyon because San Felipe Creek was continuing to dry out and contract in wetted extent (CDFW 2018a, entire). On August 24, 2018, another emergency rescue was conducted to salvage fish from lower sections of San Felipe Creek that were drying out. Approximately, 33 fish were rescued from the lower section of San Felipe Creek that was drying out and translocated to an upstream site within the same drainage (Barabe *in litt*. 2018b). On August 27, 2018, 233 unarmored threespine sticklebacks were translocated from San Felipe Creek to Stickleback Ranch in Soledad Canyon in an additional emergency rescue (CDFW 2018b, entire). Over course of these rescue efforts, over 300 unarmored threespine sticklebacks were translocated from San Felipe Creek to Stickleback Ranch in Soledad Canyon to assist with augmenting or reestablishing fish in Soledad Canyon after the habitat had been altered from post-Sand Fire sedimentation (see Soledad Canyon (Los Angeles County), above).

In the winter of 2018-2019, heavy rains caused parts of San Felipe Creek to fill with sediment, prompting additional emergency rescue efforts in the summer of 2019 (Burg *in litt*. 2019). CDFW conducted two emergency rescues. Unarmored threespine sticklebacks were rescued from lower sections of San Felipe Creek that were drying out and translocated to an upstream location within the same drainage (CDFW 2019d, entire; CDFW 2019e, entire).

In 2020, CDFW conducted surveys throughout the year for unarmored threespine sticklebacks at multiple sites along San Felipe Creek and individuals were observed in each survey (Barabe *in litt*. 2021). Unarmored threespine sticklebacks in San Felipe Creek have been regularly monitored over the past several years and are presumed extant.

Pine Valley Creek (San Diego County):
Sticklebacks have been known to occur in Pine Valley Creek since the early 1970s (Hubbs *in litt*. 1973). In 2020, USGS observed sticklebacks in Pine Valley Creek upstream and downstream of Interstate 8 near the community of Pine Valley, California. This location was not included in the 2009 5-Year Review. However, results from recent research indicate that average plate counts for sampled individuals may be similar to other unarmored threespine stickleback sites (Richmond *in litt*. 2021) and genetics appear similar to unarmored threespine sticklebacks in the upper Santa Clara River (Richmond *in litt*. 2020).

Surveys for sticklebacks are not regularly conducted in Pine Valley Creek. However, USGS anecdotally observed sticklebacks during surveys that were being conducted for western pond turtles (*Actinemys pallida*) in October 2020 (Molden *in litt*. 2021). Sticklebacks are presumed extant at this location, but additional work is needed to determine if these sticklebacks are unarmored threespine sticklebacks.

Table 1. Status of unarmored threespine stickleback sites at the time of our last 5-Year Review (Service, 2009) and present, 2021.

Location	County	Status: 2009 5-Year Review	Current Status: 2021 5-Year Review
Santa Maria River drainage	San Luis Obispo	Extirpated	Extirpated
San Antonio Creek	Santa Barbara	Extant	Extant
Cañada Honda	Santa Barbara	Extirpated	Extirpated
Lower Castaic Creek	Los Angeles	Intermittent	Unknown
Santa Clara River, I-5 vicinity	Los Angeles	Extant	Extant
Fish Canyon Creek	Los Angeles	-not occupied-	Extant
San Francisquito Canyon Creek	Los Angeles	Extirpated	Extant
Bouquet Canyon Creek	Los Angeles	Extant*	Extant*
Soledad Canyon	Los Angeles	Extant	Extant
Sugarloaf Meadow Pond	San Bernardino	Extant	Extant
Shay Creek vicinity	San Bernardino	Extant	Extant**
Juniper Springs Pond	San Bernardino	Extant	Extant
San Felipe Creek	San Diego	Unknown	Extant
Pine Valley Creek	San Diego	Unknown	Extant***

* Introgressed (*G. a. williamsoni* x *G. a. microcephalus*) sticklebacks but *G. a. williamsoni* may still be present in some sites.
** Present only in Shay Pond.
*** Additional work needed to determine if unarmored threespine sticklebacks.

Threats

The unarmored threespine stickleback was listed as endangered on October 13, 1970 (13 FR 16047) under the Endangered Species Preservation Act of 1966. Specific threats to the subspecies at the time were not identified. The 1985 Recovery Plan (Service 1985, pp. 13-27) identified the following threats: stream channelization, urbanization, introduction of predators and competitors, introgression, agricultural impacts, oxygen reduction, groundwater removal, transpiration, off-road vehicles, water releases from Drinkwater Reservoir, toxic spills and discharges, addition of water, and impoundment of water.

In the 2009 5-Year Review (Service 2009, pp. 13-26), all threats identified in the 1985 recovery plan remained matters of concern. The ongoing effects of urbanization, eutrophication, stream channelization, addition of water (water releases), groundwater removal, and water quality were identified as the most critical threats to the unarmored threespine stickleback. In addition, non-native predators, disease, introgression, competition, and stochastic extinction were identified as threats.

Currently, the threats identified in the 2009 5-Year Review are on-going, with the addition of increased climate-related threats, including severe drought and flooding, and large-scale wildfire. The drying-out of wetted areas occupied by unarmored threespine sticklebacks creates a

mortality risk from desiccation or terrestrial predators as they become stranded. Heavy flooding can flush and scour occupied habitat resulting in habitat alteration and extirpations. Debris flows, resulting from wildfire and major rain events that bring large quantities of sediment into a watershed, can also substantially alter or destroy suitable habitat for unarmored threespine sticklebacks, resulting in extirpations. A recent synthesis of climate change effects for the Los Angeles area (Hall *et al.* 2018, entire) projects increasing temperatures under all scenarios, and greater likelihoods of extreme storms and drought.

Since the 2009 5-Year Review, unarmored threespine stickleback rescues have been undertaken at multiple sites, including Soledad Canyon, San Francisquito Canyon, Fish Canyon, and San Felipe Creek, due to severe drought, severe flooding, and/or debris flow events following large-scale wildfires (see Distribution and Abundance, above). Given climate change projections, we expect the effects of climate related threats on unarmored threespine sticklebacks to increase in the future.

Evaluation of Recovery Action Progress

The objective of the 1985 recovery plan is to prevent extinction of the unarmored threespine stickleback and to improve and maintain its status at a point where it can be safely delisted (Service 1985, p. 28):

Downlisting can be considered when:

(1) The factors responsible for threatening the integrity of the known remaining habitats have been identified and actions have been taken to stabilize habitat conditions.

Factors responsible for threatening the integrity of the known remaining habitats have been identified in most cases. Actions still need to be taken to stabilize habitat conditions, as appropriate. Therefore, this criterion has not been met.

(2) The other known threats to extant populations have been addressed in a manner that assures the continued existence of these populations.

Other threats, including non-native predators and introgression, have not been addressed or eliminated and therefore this criterion has not been met.

(3) At least three self-sustaining populations have been maintained within the historical range of the unarmored threespine stickleback for a period of 5 consecutive years without significant threats to their continued existence.

All currently extant sites have one or more significant threats. Several sites have required fish to be rescued since the 2009 5-Year Review. Therefore, this criterion has not been met.

Delisting can be considered when numbers 1 and 2 above have been met and:

(4) At least five self-sustaining populations have been maintained within the historical range of the unarmored threespine stickleback for a period of 5 consecutive years without significant threats to their continued existence. This criterion can be satisfied by successfully reintroducing unarmored threespine stickleback to reach a total of five secure populations, by discovering additional population in secure historical habitats, or by some combination of reintroductions and new discoveries.

As above under number 3, all currently extant sites have one or more significant threats. Several sites have required fish to be rescued since the 2009 5-Year Review. A strategic plan for reintroduction has not been developed. Therefore, this criterion has not been met.

CONCLUSION:

The unarmored threespine stickleback remains a highly restricted subspecies known from small, local sites in the Santa Clara River watershed in Los Angeles County, the San Antonio Creek drainage in Santa Barbara County, and isolated occurrences in inland San Bernardino and San Diego counties.

The ongoing effects of urbanization, eutrophication, stream channelization, addition of water, groundwater removal, water quality, stochastic extinction, and climate-related threats continue to threaten the unarmored threespine stickleback across its range, leading to a continuous cycle of local extirpations, which have required fish to be rescued. Given climate change projections, we expect climate related threats to continue to increase in the future. In addition, the threats of non-native predators, disease, introgression, and competition are present at many sites.

Based on these ongoing threats and the small number and isolation of existing sites, we find that the unarmored threespine stickleback continues to be in danger of extinction throughout its range and, thus, remains an endangered species.

RECOMMENDATIONS FOR FUTURE ACTIONS:

In 2018, the Service formed the unarmored threespine stickleback Recovery Team. The following is a summary of the Team's recommendations to prevent extinction and promote recovery of the subspecies:

1. Reintroduce unarmored threespine sticklebacks to increase the number of occupied locations. If wild unarmored threespine sticklebacks are in trouble, conduct rescue. Translocate unarmored threespine sticklebacks from sites that contain high enough abundance to reintroduce into extirpated sites, new sites, or bolster existing sites that need assistance. Conduct rescues and reintroductions with as many fish as possible with consideration of not depleting the source (unless it is thought to be eliminated if not rescued) and the carrying capacity of the receiving site.

2. Undertake captive propagation of the Soledad Canyon genetic strain for bolstering existing sites, reintroduction into recently extirpated sites, and additional suitable sites.

The Soledad Canyon genetic strain is the ancestral strain and can be used to reintroduce fish to all sites in the Santa Clara River watershed. Captive bred fish from this strain should be reintroduced into Soledad Canyon sites, Fish Canyon Creek, San Francisquito Canyon Creek, and mainstem Santa Clara River to bolster existing sites and/or repatriate recently extirpated sites. Monitor effectiveness.

3. Investigate unoccupied sites inside and outside of the historic range for reintroduction of unarmored threespine sticklebacks.
Evaluate unoccupied sites for reintroduction of unarmored threespine sticklebacks to increase redundancy and reduce the risk of extinction from catastrophic events. Once sites are determined to be suitable, wild translocated or captive reared fish can be introduced.

4. Undertake restoration of unarmored threespine sticklebacks in Bouquet Canyon.
Determine the best way to eradicate hybrids. Reintroduce wild translocated or captive reared fish. Monitor effectiveness.

5. Further understanding of unarmored threespine stickleback genetics
Verify the genetic source of Pine Valley. Provide a definitive genetic test of whether the different unarmored threespine stickleback populations have evolved in parallel, or whether they share a more recent common ancestor with each other versus other populations.

APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approved STEPHEN HENRY Digitally signed by STEPHEN HENRY Date: 2021.04.07 09:19:27 -07'00'

References Cited

Ball, M., J. LaBonte, A. Abela, P. Nieto, and C. Page. 2009. Status of the unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*) in San Antonio and Cañada Honda Creeks, Vandenberg Air Force Base, California. Prepared for: 30th Space Wind Environmental Flight. Prepared by ManTech SRS Technologies, Inc. and Aquatic Resource Specialists. February 10, 2009.

Backlin, A.R., E.A. Gallegos, C.J. Hitchcock, and R.N. Fisher. 2018. Draft final fish community assessments in San Francisquito Canyon, 2001-2018. U.S. Geological Survey, Western Ecological Research Center. 21 pp. + iv.

Baskin, J.N. 1974. Final report on the status of the unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*), in the upper Santa Clara River, California. 134 pages.

Buth, D.A. 1984. Genetic affinities of freshwater populations of *Gasterosteus aculeatus* with special reference to *Gasterosteus aculeatus williamsoni*. Report submitted to U.S. Forest Service, Pasadena, California. Dated January 27, 1984. 70 pages.

Buth, D.G., and T.R. Haglund. 1994. Allozyme variation in the *Gasterosteus aculeatus* complex. *In* Bell, M.A., and S.A. Foster, eds. 1994. The evolutionary biology of the threespine stickleback. Oxford University Press, Oxford. Pages 64-84

[CDFW] California Department of Fish and Wildlife. 2014a. Inland Fisheries Survey Memorandum. Unarmored threespine stickleback, Santa Clara River rescue and release in San Francisquito Creek. Dated April 30, 2014 and May 1, 2014. 17 pages.

[CDFW] California Department of Fish and Wildlife. 2014b. Inland Fisheries Survey Memorandum. Unarmored threespine stickleback, Santa Clara River rescue and release in San Francisquito Creek. Dated May 23, 2014. 3 pages.

[CDFW] California Department of Fish and Wildlife. 2018a. Inland Fisheries Survey Memorandum. Unarmored threespine stickleback, San Felipe Creek rescue and translocation and release at Stickleback Ranch in Soledad Canyon. Dated August 9, 2018.

[CDFW] California Department of Fish and Wildlife. 2018b. Inland Fisheries Survey Memorandum. Unarmored threespine stickleback, second San Felipe Creek rescue, translocation and release at Stickleback Ranch in Soledad Canyon. Dated August 27, 2018.

[CDFW] California Department of Fish and Wildlife. 2019a. Unarmored threespine stickleback Fish Canyon Creek/Castaic Creek Confluence Rescue/Relocations, July 2019. Report. 5 pages.

[CDFW] California Department of Fish and Wildlife. 2019b. Inland Fisheries Survey Memorandum. Unarmored threespine stickleback, Santa Clara River and Stickleback Ranch. Dated October 17, 2019. 3 pages.

[CDFW] California Department of Fish and Wildlife. 2019c. Inland Fisheries Survey Memorandum. Bouquet Canyon Creek. Dated July 18, 2019. 6 pages.

[CDFW] California Department of Fish and Wildlife. 2019d. San Felipe Creek rescue and translocation, July 22, 2019. Report. 8 pages.

[CDFW] California Department of Fish and Wildlife. 2019e. San Felipe Creek rescue and translocation, 2019. [undated]. Report. 18 pages.

[CDFW] California Department of Fish and Wildlife. 2020a. Unarmored threespine stickleback Fish Creek and Soledad Canyon Survey Report. September 24, 2020. Prepared by Jennifer Pareti. 8 pages.

[CDFW] California Department of Fish and Wildlife. 2020b. Unarmored threespine stickleback Fish Creek rescue and release to Soledad Canyon. Report. Prepared by Jennifer Pareti. October 9, 2020. 8 pages.

Girard, C. 1854. Descriptions of new fishes, collected by Dr. A. L. Heerman, naturalist attached to the survey of the Pacific railroad route, under Lieut. R. S. Williamson, U.S.A. Proc. Acad. Natur. Sci. Philadelphia 7:129–142.

Haglund, T.R., and D. G. Buth. 1988. Allozymes of the unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*) and identification of the Shay Creek population. Department of Biology, University of California, Los Angeles. 1 page.

Hall, A., N. Berg, and K. Reich. 2018. Los Angeles Summary Report. California's Fourth Climate Change Assessment. Publication number: SUM-CCCA4-2018-007.

InciWeb. 2020. InciWeb – Incident Information System, Lake Fire. https://inciweb.nwcg.gov/incident/6953/

Malcolm, J.R. 1992. Supporting information for a petition to list as endangered or threatened. Shay Creek Stickleback. *In*: Moyle, P.B. and R.M. Yoshiyama. Fishes, aquatic diversity management areas, and endangered species: a plan to protect California's native aquatic biota. The California Policy Seminar, University of California 1992. 213–222.

[ManTech] ManTech SRS Technologies, Inc. 2013. Monitoring the effects of the San Antonio Creek bank stabilization on the California red-legged frog, unarmored threespine stickleback, and riparian birds. Project Completion Report for Clean Water Act 404 Permit #SPL-2007-00611. Prepared for 30th Space Wing, Installation Management Flight, Environmental Conservation, Vandenberg AFB.

[ManTech] ManTech SRS Technologies, Inc. 2019. California red-legged frog habitat assessment, and population status within San Antonio Creek on Vandenberg Air Force Base, California. Prepared for 30th Space Wing Installation Management Flight, Environmental Conservation, Vandenberg AFB. November 2019.

Miller, R.R., and C.L. Hubbs. 1969. Systematics of Gasterosteus aculeatus with particular reference to intergradation and introgression along the Pacific Coast of North American: a commentary on a recent contribution. Copeia 1969:52–69.

Richmond, J.Q., A.R. Backlin, and R.N. Fisher. 2013. Population genetics and preliminary phylogeography of unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*) in the San Bernardino Mountains of southern California. U.S. Geological Survey. Summary report for the U.S. Forest Service and U.S. Fish and Wildlife Service. 7 pages + figures.

Richmond, J.Q., D.K. Jacobs, A.R. Backlin, C.C. Swift, C. Dellith, and R.N. Fisher. 2015. Ephemeral stream reaches preserve the evolutionary and distributional history of threespine stickleback in the Santa Clara and Ventura River watersheds of southern California. Conservation Genetics 16:85–101.

[Service] U.S. Fish and Wildlife Service. 1985. Unarmored threespine stickleback recovery plan (revised). U.S. Fish and Wildlife Service. Portland, Oregon. 80pp.

[Service] U.S. Fish and Wildlife Service. 2009. Unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*) 5-year review: summary and evaluation. Ventura Fish and Wildlife Office. Ventura, California.

[USFS] U.S. Forest Service. 2015. Annual Report for San Bernardino National Forest, Riparian BO (FWS-SB/WRIV-08B0680-09F0227). Monitoring Tables. 23 pages.

[USFS] U.S. Forest Service. 2020. Four southern California National Forests annual monitoring report. 16 pages.

Swift, C.C., T.R. Haglund, M. Ruiz, and R.N. Fisher. 1993. The status and distribution of the freshwater fishes of southern California. Bulletin Southern California Academy of Sciences. 92:101–167.

In Litteris

Barabe, R. 2018a. Email to USFWS and CDFW staff. Subject: San Felipe Rescue. Dated July 31, 2018.

Barabe, R. 2018b. Email to USFWS and CDFW staff. Subject: San Felipe Rescue. Dated August 24, 2018.

Barabe, R. 2021. Email to Eric Morrissette, USFWS. Subject: Re: UTS-San Felipe Creek. Dated February 5, 2021.

Burg, R. 2019. Email to USFWS staff. Subject: San Felipe Creek (San Diego County) UTS rescue. Dated July 16, 2019.

Hubbs, C. 1973. Memorandum on Source of Sticklebacks in Pine Valley Creek, San Diego County, California. Dated March 14, 1973.

Molden, J. 2021. Email with attachments to Eric Morrissette, USFWS. Subject: Re: Pine Valley Creek Turtle Surveys. Dated January 28, 2021.

Pareti, J. 2021. Email to USFWS, USFS, and CDFW staff. Subject: Re: Fish Canyon. Dated February 24, 2021.

Richmond, J. 2020. Email with attachments to USFWS staff. Subject: Re: UTS question. Dated February 24, 2020.

Richmond, J. 2021. Email to USFWS and USGS staff. Subject: Re: Pine Valley Creek stickleback. Dated March 2, 2021.

Personal Observations

Morrissette, E. 2019. Field notes from unarmored threespine stickleback surveys in San Francisquito Canyon, October 16, 2019.