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Relative Abundance and Distribution of Fishes within an Established Area of Critical Environmental Concern, of the Amargosa River Canyon and Willow Creek, Inyo and San Bernardino Counties, California

Open-File Report 2011–1161

U.S. Department of the Interior
U.S. Geological Survey

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U.S. Department of the Interior
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Conversion Factors

SI to Inch/Pound

Multiply	By	To obtain
	Length	
millimeter (mm)	0.03937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
	Area	
square meter (m^2)	0.0002471	acre
hectare (ha)	2.471	acre
	Flow rate	
cubic meter per second (m^3/s)	70.07	acre-foot per day (acre-ft/d)
cubic meter per second (m^3/s)	35.31	cubic foot per second (ft^3/s)

Inch/Pound to SI

Multiply	By	To obtain
	Area	
acre	4,047	square meter (m^2)
acre	0.4047	hectare (ha)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:
°F=(1.8×°C)+32.

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25 °C).

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Datums

Vertical coordinate information is referenced to North American Vertical Datum of 1988 (NAVD 88).
Horizontal coordinate information is referenced to North American Datum of 1983 (NAD 83).
Altitude, as used in this report, refers to distance above the vertical datum.

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Abstract

The Amargosa River Canyon of San Bernardino and Inyo County, California, has been designated by the Bureau of Land Management as an Area of Critical Environmental Concern, due in part to its unique flora and fauna. As a task of the Area of Critical Environmental Concern implementation plan, a survey of native fishes was conducted from June 21 to August 12, 2010. Geographic Information System tools were used to map sampling locations, which were spaced at 50-meter intervals. Global Positioning Systems were used to locate sampling stations, and stations with adequate water for successful trapping were sampled with baited minnow traps. Amargosa River pupfish (*Cyprinodon nevadensis amargosae*) and speckled dace (*Rhinichthys osculus* spp.) were widespread throughout Armargosa River Canyon. Throughout the study area 8,558 pupfish were captured at 194 stations; 3,472 speckled dace were captured at 210 stations; 238 red-swamp crayfish (*Procambarus clarkia*) were captured at 83 stations; and 1,095 western mosquitofish (*Gambusia affinus*) were captured at 110 stations. Pupfish were most abundant in open water habitat with native riparian vegetation, and they were significantly less abundant where the stream was completely covered by cattails or where saltcedar (*Tamarix* sp.) dominated the riparian corridor. There was no relationship between stream cover and speckled dace distribution. Non-native western mosquitofish and red-swamp crayfish densities were significantly higher in stream reaches dominated by saltcedar. The continued spread of saltcedar threatens to negatively affect pupfish and potentially reduce speckled dace abundance throughout the Amargosa River Canyon. This study can serve as baseline information for observing native fish populations in the future, as related to potential changes to the Amargosa River Canyon ecosystem.

Introduction

The Amargosa River supports wetlands in North America's hottest and driest region, the Mojave Desert. The odd combination of moist habitat within an excessively dry landscape has fostered an area of high biodiversity (Williams and others, 1984; Sada, 1990; Deacon and Deacon-Williams, 1991). Flowing in its entirety in the Late Pleistocene, the Amargosa River is now represented by disjunct spring-fed reaches, each sufficiently isolated to have divergent flora and fauna (Hubbs and Miller, 1948), making these desert oases hotspots for endemic flora and fauna. Many of these wetland relics of the Pluvial Amargosa River are under public ownership (Bureau of Land Management, U.S. Fish and Wildlife Service, and National Park Service) or owned and managed by The Nature Conservancy.

The Amargosa River Canyon, of Inyo and San Bernardino Counties in California, is the longest perennial reach of the Amargosa River today. Due to the biological importance, historical and cultural values, and scenic beauty of the Amargosa River, the Bureau of Land Management designated 21,552 acres surrounding the river and its tributaries from south of Shoshone to Sperry as an Area of Critical Environmental Concern (ACEC) (fig. 1). This survey of the Amargosa River Canyon lies in the southern portion of the ACEC and extends south past the border of the ACEC. All sampling locations that lie outside the ACEC were dry and therefore not sampled for fish. The ACEC designation led to an implementation plan aimed at protecting the canyon. The plan outlines an inventory and monitoring strategy that includes a survey of the Amargosa River pupfish (*Cyprinodon nevadensis amargosae*) and speckled dace (*Rhinichthys osculus* spp.). The last documented survey of Amargosa River Canyon fishes occurred in 1981 (Williams and others, 1982), before the establishment of the ACEC. Due to cattle grazing, less vegetation covered the stream in 1981 (Anthony Chavez, Rangeland Management Specialist/Weed Coordinator, Bureau of Land Management, Barstow, CA, oral commun., 2010).

We conducted a fish survey in the Amargosa River Canyon during the summer of 2010, almost 10 years after cattle grazing ceased. Since the 1982 survey of the Amargosa River Canyon conducted by Williams and others (1982), non-native saltcedar has proliferated in some stream reaches of the canyon (Jack Williams, Senior Scientist, Trout Unlimited, Medford OR, oral commun., 2010). Because saltcedar has been implicated in causing the decline of native species (Kennedy and others, 2005), we tested the effect of relative native versus non-native riparian stream cover on fishes and crayfish abundance.

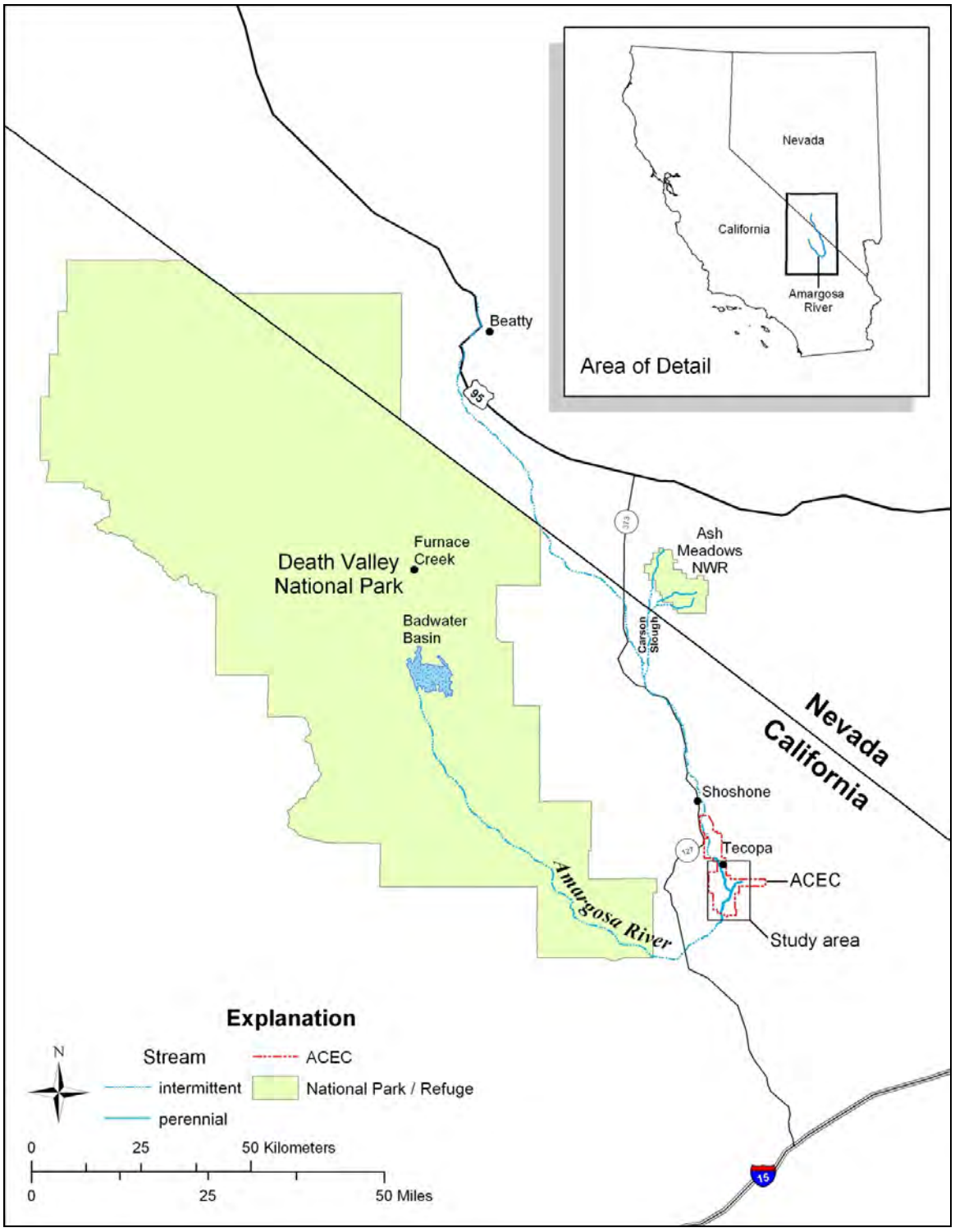

Figure 1. Amargosa River Canyon study area and Bureau of Land Management Area of Critical Environmental Concern (ACEC) in relation to the Amargosa River, California and Nevada.

Description of Area

The Amargosa River Canyon is situated 90 km southeast of the Death Valley National Park headquarters at Furnace Creek, California (fig. 1). The perennial flow within this region originates from springs and seeps beginning just north of Old Spanish Trail Highway (OSTH) (403 m elevation) and from several springs and seeps along its course. During the time of our study, June 21–August 12, 2010, streamflow at the U.S. Geological Survey gaging station near OSTH ranged from 2.83×10^{-4} to 1.42×10^{-3}; streamflow was 2.55×10^{-2} m^3/s 8.5 km downstream of OSTH.

During periods of intense rainfall, streamflows have exceeded 453×10^{3} m^3/s. From our survey start at OSTH to just south of Sperry, there were changes in dominant riparian vegetation and relative stream coverage, which we categorized into three broad habitat types: (1) riparian corridor predominated by native vegetation (NV), with riparian vegetation comprised of various combinations of cattail (*Typha* sp.), bulrush (*Scirpus*), or common reed (*Phragmites* sp.) and occasional willow (*Salix* sp.), mesquite (*Prosopis*), or saltcedar (*Tamarix* sp.), with much of the water surface open and typically receiving sunlight; (2) riparian corridor predominated and shaded by saltcedar (SC) with intermittent dense stand of cattail along the stream edge; (3) stream covered with a dense stand of cattail or common reed (CCR) lying over the stream such that locating water required forceful movement through dense vegetation.

Willow Creek is Amargosa River Canyon's largest tributary and connects at river km 8.8 (fig. 2). The creek originates from springs and seeps and was being diverted for irrigation during our survey. Much of the stream channel was dry, and maximum flow was judged to be $<2.83 \times 10^{-4}$ m^3/s. The stream channel was shaded along its entire course, primarily with native vegetation. The upper 1.5 km of the channel is lined with willow, cottonwoods, and mesquite, and the lower 2.0 km is primarily mesquite.

Non-native aquatic species known to the Amargosa River Canyon system include western mosquitofish (*Gambusia affinis*), bullfrog (*Rana catesbeiana*), red swamp crayfish (*Procambarus clarkii*), and red-rimmed melania (*Melanodes tuberculata*).

Materials and Methods

We used Geographic Information System (GIS) tools in ArcGIS 10 (ESRI, 2010), and the National Agricultural Imagery Program (NAIP) to trace stream channels and to determine locations of sampling stations, which were set at 50-m intervals. A total of 405 sampling stations were established, 335 along 16.75 km of the Amargosa River Canyon and 70 stations along 3.5 km of the Willow Creek (fig. 2). Each sampling station location was downloaded into Garmin© Global Positioning System (GPS) units. These units typically put us within a 2-m radius of a specific station. Once a station was located, a 3.3 mm mesh Standard Gee minnow trap, baited with dry dog food was set, and typically fished overnight for 15–24 hr. Fish captured were identified to species, 10 individuals per trap (when available) were measured to either fork length or total length (as appropriate), and the remainder were enumerated by species. Red swamp crayfish also were enumerated and measured from the tip of the rostrum to the tip of the uropods. We also measured water depth and water temperature at each trap location, and noted vegetative type, lat/long and UTM coordinates, distance from OSTH, and habitat type, for the 405 potential sample stations (table A1).

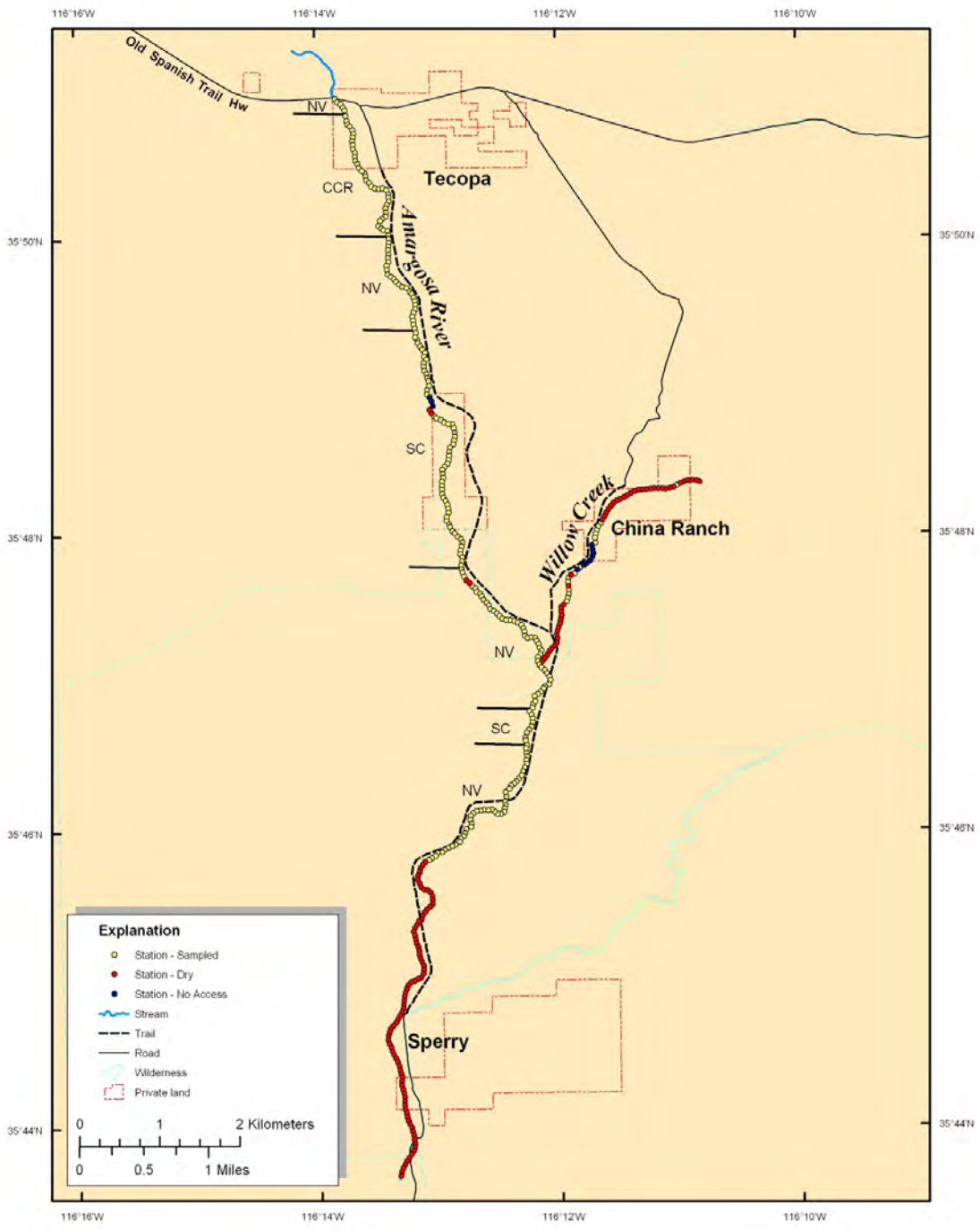

Figure 2. Study area with established sampling stations for fishes along Amargosa River Canyon (n = 335) and Willow Creek (n = 70). Predominant vegetation types also are shown as native vegetation (NV), closed cattail, common reed (CCR), and saltcedar (SC), Inyo and San Bernardino Counties, California.

A Hydrolab DataSonde® 5 was used to measure water temperature, dissolved oxygen, conductivity, and pH at five locations along the Amargosa River Canyon and three along Willow Creek. Sampling locations were spread along the length of each of the two streams, but were influenced by stream accessibility. Measurements were made on July 27, 2010.

The data collected in our sampling effort were used to develop species specific GIS maps using ArcGIS 10 (ESRI, 2010), which display species relative abundance and distribution. We analyzed the data post hoc using a Kruskal-Wallis single factor analysis of variance to test whether pupfish and speckled dace densities were negatively influenced by heavily shaded reaches (SC and CCR).

Results

Of 335 stations established along the Amargosa River Canyon, three stations were inaccessible due to a dense stand of saltcedar, and 94 were dry or water was too shallow to set a trap (fig. 2). Of 238 traps fished, 225 captured native fishes (figs. 3, 4, and 5). Speckled dace were slightly more widespread and occurred in 206 traps compared to 194 for pupfish. But total captures were higher for pupfish (n= 8,558) than speckled dace (n=3,429) (table A2). The disparity in capture success among traps suggests that neither pupfish nor speckled dace are evenly distributed throughout the Amargosa River Canyon.

Pupfish capture success was significantly higher (df = 1, $\chi^2 = 11.30$, $p = 0.006$) in stream reaches predominated by native riparian vegetation (NV) with open water than those reaches heavily shaded with saltcedar vegetation (SC). Pupfish densities were significantly greater (df = 1, $\chi^2 = 56.03$, $p<0.001$) in stream reaches predominated by native riparian vegetation (NV) with open water than those reaches heavily shaded with cattail/common reed vegetation (CCR). Pupfish ranged from 16 to 71 mm in total length with a mean length of 41.6 mm (fig. 6). The large majority of pupfish captured were equal to or greater than 31mm in length, indicating that they were sexually mature (Moyle, 2002). The longest fish captured (71 mm) during our systematic sampling effort was a female; however, in supplemental sampling to recapture this large fish for a photograph, we captured a female 75 mm in length (fig. A1).

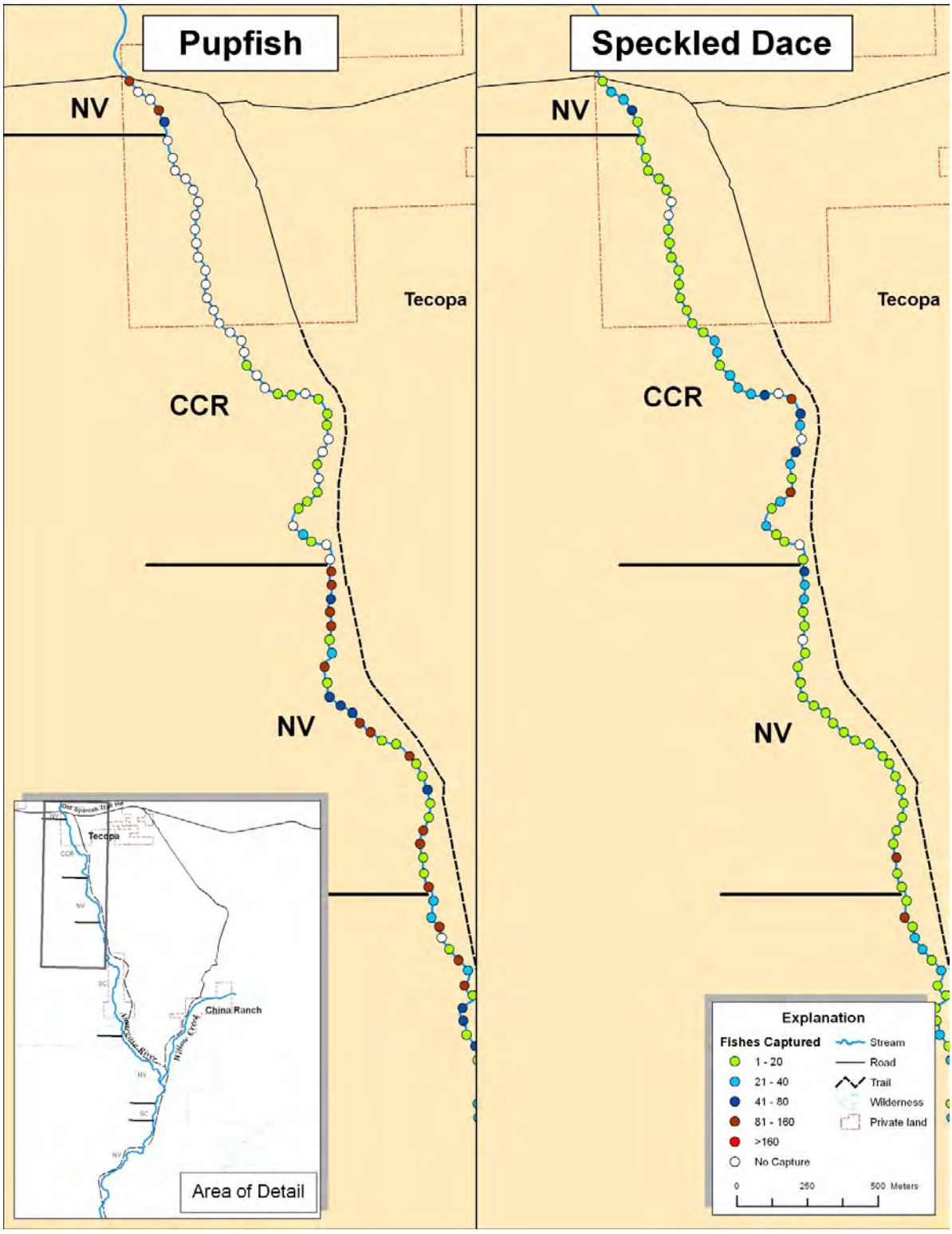

Figure 3. Distribution and relative abundance of Amargosa River pupfish (*Cyprinodon nevadensis amargosae*) and speckled dace (*Rhinichthys osculus* spp.) in the upper reach of the Amargosa River Canyon (river km 0–3.50) in the summer of 2010, California.

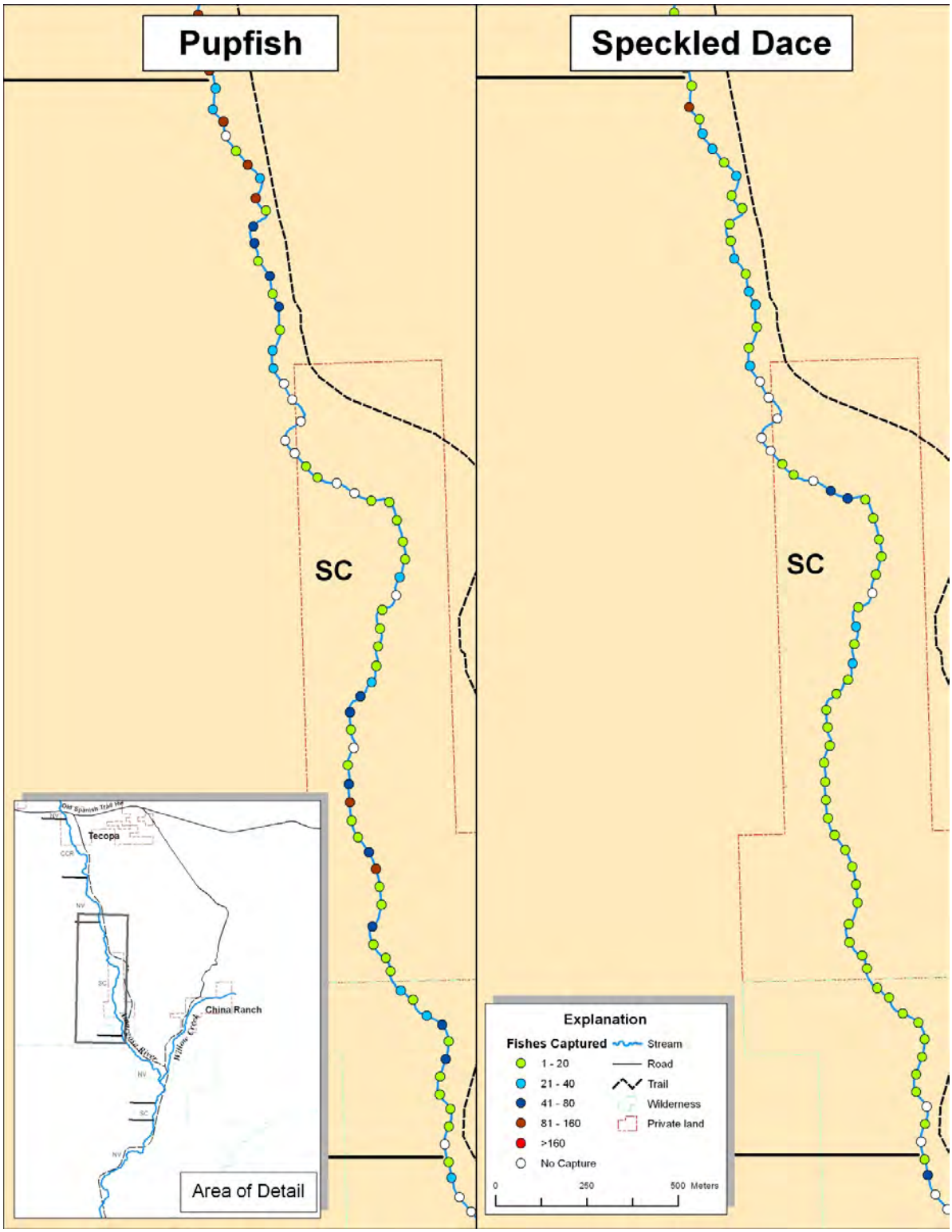

Figure 4. Distribution and relative abundance of Amargosa River pupfish (*Cyprinodon nevadensis amargosae*) and speckled dace (*Rhinichthys osculus* spp.) in the middle reach of the Amargosa River Canyon (river km 3.55–6.85) in the summer of 2010, California.

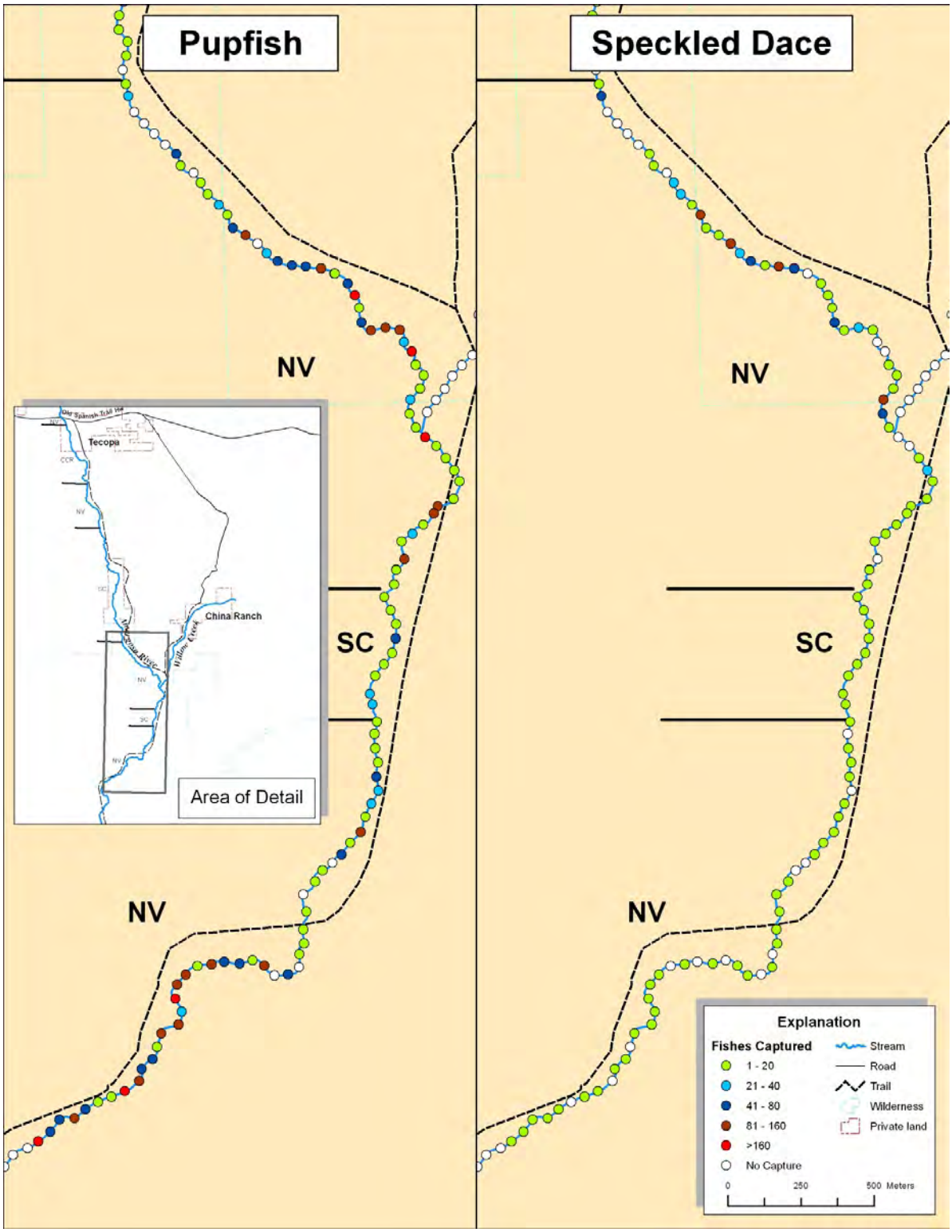

Figure 5. Distribution and relative abundance of Amargosa River pupfish (*Cyprinodon nevadensis amargosae*) and speckled dace (*Rhinichthys osculus* spp.) in the lower reach of the Amargosa River Canyon (river km 6.90–12.25) in the summer of 2010, California.

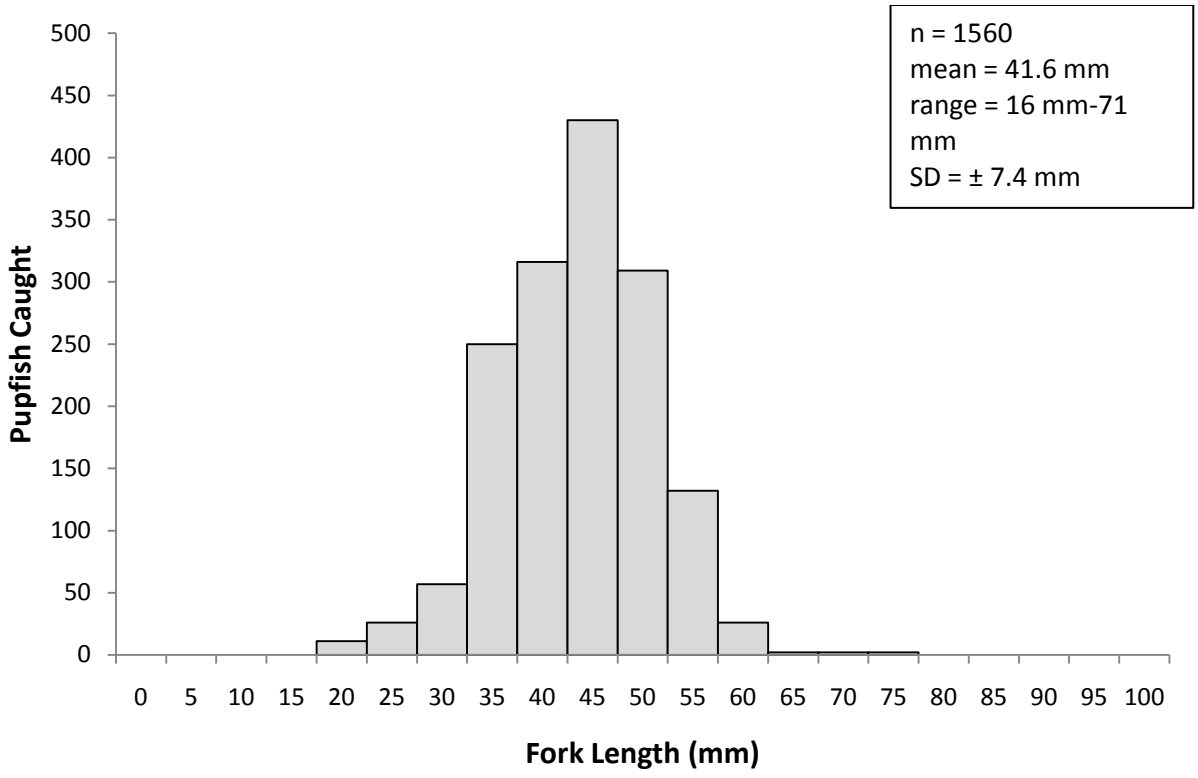

Figure 6. Length frequency of Amargosa River pupfish (*Cyprinodon nevadensis amargosae*) caught during the summer 2010 survey of the Amargosa River Canyon, California.

The distribution pattern for speckled dace along the Amargosa River Canyon differed from pupfish (figs. 3, 4, and 5). There was no significant difference in speckled dace use of open or covered reaches; NV versus SC was (df = 1, $\chi^2 = 0.92$, $p = 0.338$), and NV versus CCR was (df = 1, $\chi^2 = 3.20$, $p=0.074$). Speckled dace density was conspicuously lower near the terminus of the Amargosa River Canyon. Speckled dace ranged from 20 to 92 mm in fork length with a mean of 51.4 mm (fig. 7).

Crayfish were captured in 76 of 253 traps (n = 195), and mosquitofish in 110 (n = 1,095), (figs. A2 and A3). Both of these invasive species were widespread, but there were significantly more crayfish (df = 1, $\chi^2 = 6.94$, $p=0.009$) and mosquitofish (df = 1, $\chi^2 = 37.79$, $p<0.001$) in SC than NV. There also was a significantly (df = 1, $\chi^2 = 37.79$, $p < 0.001$) greater density of crayfish in CCR than NV, but no significant difference (df = 1, $\chi^2 = 0.002$, $p=0.886$) in mosquitofish between the two habitat types. Figures A4 and A5 give the length frequency of captured crayfish and mosquitofish.

Of the 70 Willow Creek stations, 47 were dry or had too little water to set a trap, 8 were inaccessible, and 15 were sampled. Speckled dace were captured in only 4 of the 15 stations trapped (n = 43) (fig. 8) and ranged from 21 to 61 mm in fork length. No mosquitofish were seen or captured, but a total of 43 crayfish were captured in 7 traps.

Water-quality conditions differed between the Amargosa River Canyon and Willow Creek. The Amargosa River Canyon water temperatures had slight variation, ranging from 23.4 to 24.8 °C, dissolved oxygen ranged from 6.2 to 8.6 mg/L, conductivity ranged from 2,044 to 5,318 µS/cm, and pH ranged from 7.9 to 8.3 (table A3). In Willow Creek, water temperatures generally were warmer than the Amargosa River Canyon and ranged from 25.2 to 28.7 °C, dissolved oxygen generally were higher (7.1–12.1 mg/L), conductivity was lower (1,027–1,082 µS/cm), and pH had a broader range (7.6–8.4). The inordinately high dissolved oxygen (12.1 mg/L) probably was due to the lower station having shallow water (<4 cm deep), with little flow, and exposure to the sun, all of which are conditions promoting higher photosynthesis.

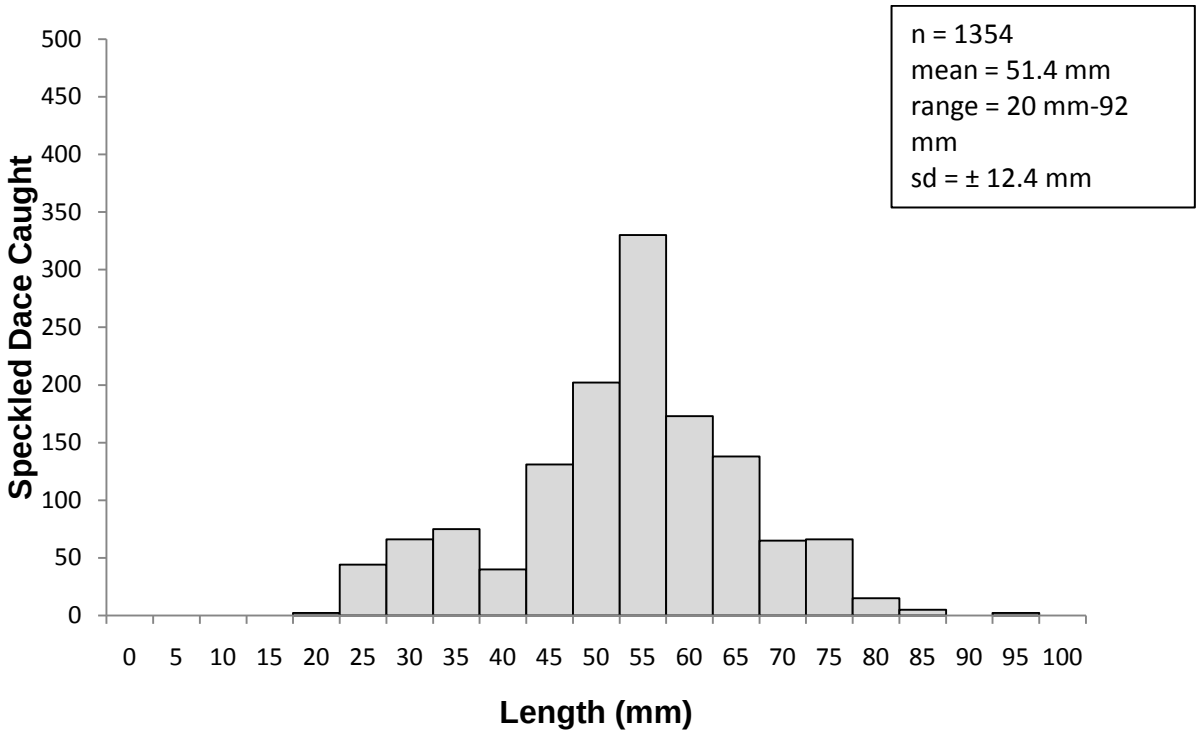

Figure 7. Length frequency of speckled dace (*Rhinichthys osculus* spp.) caught during the summer 2010 survey of the Amargosa River Canyon, California.

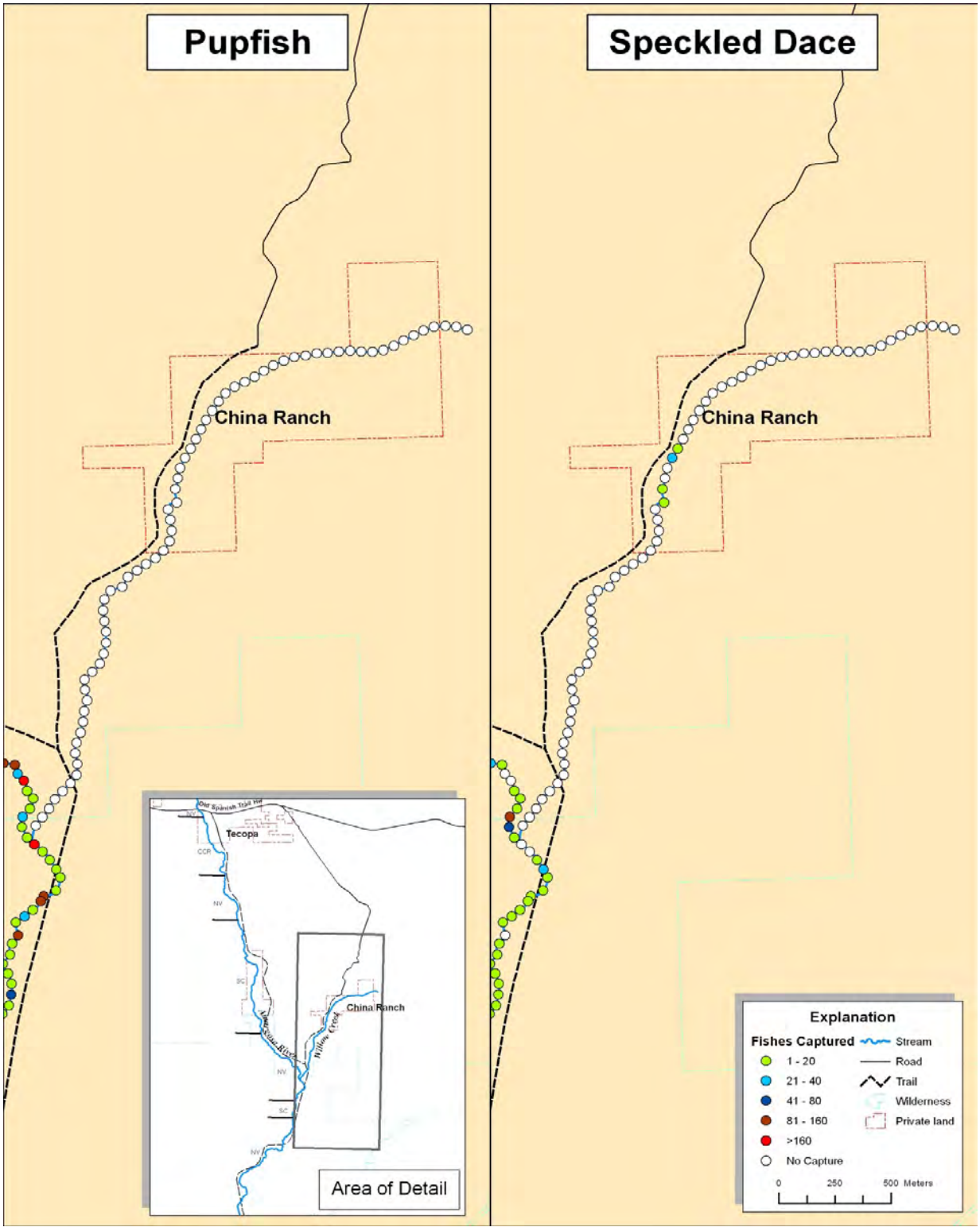

Figure 8. Relative distribution and abundance of Amargosa River pupfish (*Cyprinodon nevadensis amargosae*) and speckled dace (*Rhinichthys osculus* spp.) in Willow Creek, a tributary of the Amargosa River Canyon in the summer of 2010, California.

Discussion

Native fishes were found throughout the Amargosa River Canyon area. Pupfish density was significantly higher within native riparian vegetation reaches with open water rather than heavily shaded reaches. Similarly, Kennedy and others (2005) found that Ash Meadows pupfish (*Cyprinodon navedensis mionectes*) numbers were reduced where saltcedar shaded their habitat. Algae is the primary food item consumed by Ash Meadows pupfish as well as the Amargosa River pupfish (Naiman, 1975; Kennedy and others, 2005) and algae production is negatively affected by a saltcedar canopy, this in turn reduces pupfish density (Kennedy and Hobbie, 2004; Kennedy and others, 2005). Speckled dace are more carnivorous than pupfish, feeding more on aquatic and terrestrial invertebrates, which are not necessarily relegated to open water habitat (Osborne and Herricks, 1987; Lancaster and others, 1996). The only region of the stream where speckled dace were scarce was in the lowest reach. This reach is subject to desiccation; we observed pupfish mortality caused by stranding and pool desiccation. It was unclear whether speckled dace scarcity in this reach constitutes stranding avoidance by the species.

Results from Williams and others (1982) indicated speckled dace were rare within the Amargosa River Canyon area compared with pupfish, while this study found both species supported in robust numbers. There are two plausible reasons for the difference in results. First, Williams and others (1982) used a seine for sampling, which is limited to sampling open water pools where pupfish were high in numbers. Second, the Amargosa River Canyon was being grazed at the time of the Williams and others (1982) study, keeping the stream channel open, which we suspect favored pupfish. In sun exposed pools, male pupfish tend to be more territorial (Lema and Nevitt, 2004), which may lead to some degree of speckled dace avoidance. Saltcedar appears to be spreading throughout Amargosa River Canyon, probably at the expense of native fish populations. Our data supports the findings of Kennedy and others (2005) that pupfish are suppressed by a saltcedar canopy while the invasive red swamp crayfish and western mosquitofish are promoted.

Crayfish and mosquitofish have been found to impact native fish populations negatively in previous studies; crayfish compete with and prey upon native fishes (Guan and Wiles, 1997; Light, 2005), and mosquitofish probably compete with speckled dace for food because they share trophic resources (Caiola and de Soston, 2005). Mosquitofish also are a known predator of fish larvae and eggs (Meffe, 1985; Swanson and others, 1996; Mills and others, 2004). The highest density of these two invasive species was within reaches shaded by saltcedar. Thus, native fishes within these reaches are potentially subjected not only to reduced productivity due to shade, but also to increased probably of competition and predation from invasive species. Adult red swamp crayfish are opportunistic feeders, but tend toward herbivory (Harper and others, 2002), and they can survive by consuming saltcedar leaves. In contrast, saltcedar leaves have little direct or indirect nutritive value for pupfish or speckled dace (Kennedy and others, 2005). Our capture data suggest that crayfish were not abundant in the Amargosa River Canyon area. Why they were found in such low numbers can only be speculated upon; however, the continued spread of saltcedar may enhance the crayfish and mosquitofish populations.

Only speckled dace were found in Willow Creek, and whether pupfish historically occurred there is unknown. With little water in the channel, speckled dace were greatly restricted in distribution and crayfish were abundant. The combination of restricted distribution and low water volume and velocity probably enhance the negative effects of crayfish on the speckled dace population. We suggest the speckled dace population in Willow Creek be closely monitored.

Amargosa River Canyon native fish numbers appeared relatively robust in this study, but we have no analogous historical capture information with which to compare our data. Presumably, native fish were in greater abundance prior to the invasion of saltcedar, crayfish, and mosquitofish, all of which have been found to negatively impact native fish populations. Saltcedar threatens to continue proliferating throughout the river. Historically, fire and flood were stochastic events serving to keep the stream channel open and dynamic (Benda and others, 2003; Kozlowski and others, 2010), but now such events also serve as agents for the spread of saltcedar (Wiesenborn, 1996), threatening to form a saltcedar monoculture along the river and throughout the floodplain. With the increase in saltcedar, populations of native fishes are expected to decrease in size due to the increase in crayfish and mosquitofish, the reduction in primary production, and the drafting of substantially greater water by saltcedar when compared with native vegetation (Duncan and McDaniel, 1998). Other potential threats to native fish include an ever increasing human demand for water, and future increase in drafting from the aquifer(s) supplying the Amargosa River. The introduction of other non-native species also is a threat (Moyle, 2002).

Acknowledgments

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Appendix A. Photograph of an Amargosa River Pupfish, Distribution and Size Range of Crayfish and Mosquito Fish Captured, Sampling Locations, Capture Summary, and Water Quality of Select Locations in the Amargosa River Canyon and Willow Creek in the Summer of 2010.

Figure A1. Photograph of largest Amargosa River pupfish (*Cyprinodon nevadensis amargosae*), a female with a total length of 75 mm, caught during the summer 2010 survey of the Amargosa River Canyon, California.

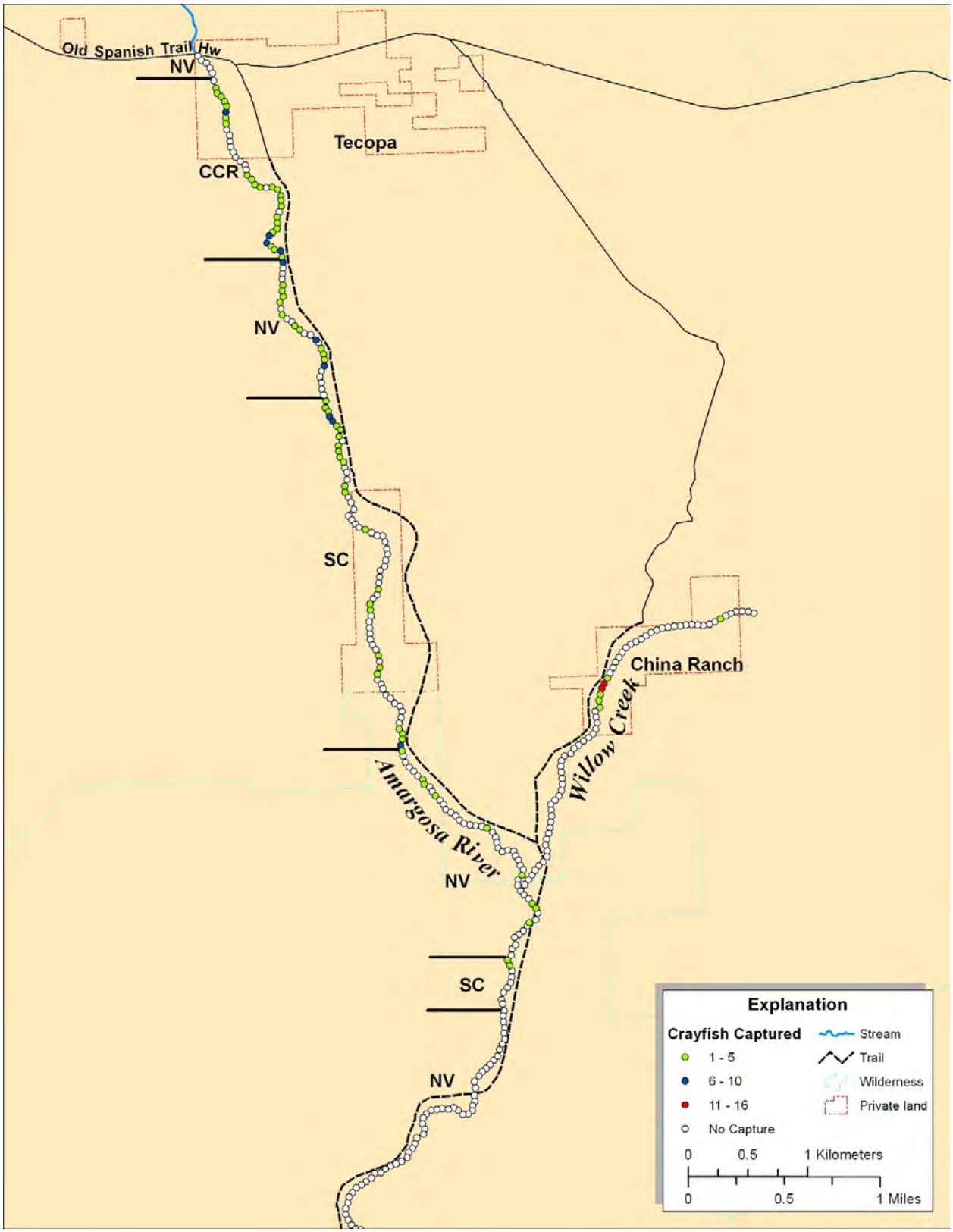

Figure A2. Distribution and relative abundance of red swamp crayfish (*Procambarus clarkii*) in the Amargosa River Canyon and Willow Creek in the summer of 2010, California.

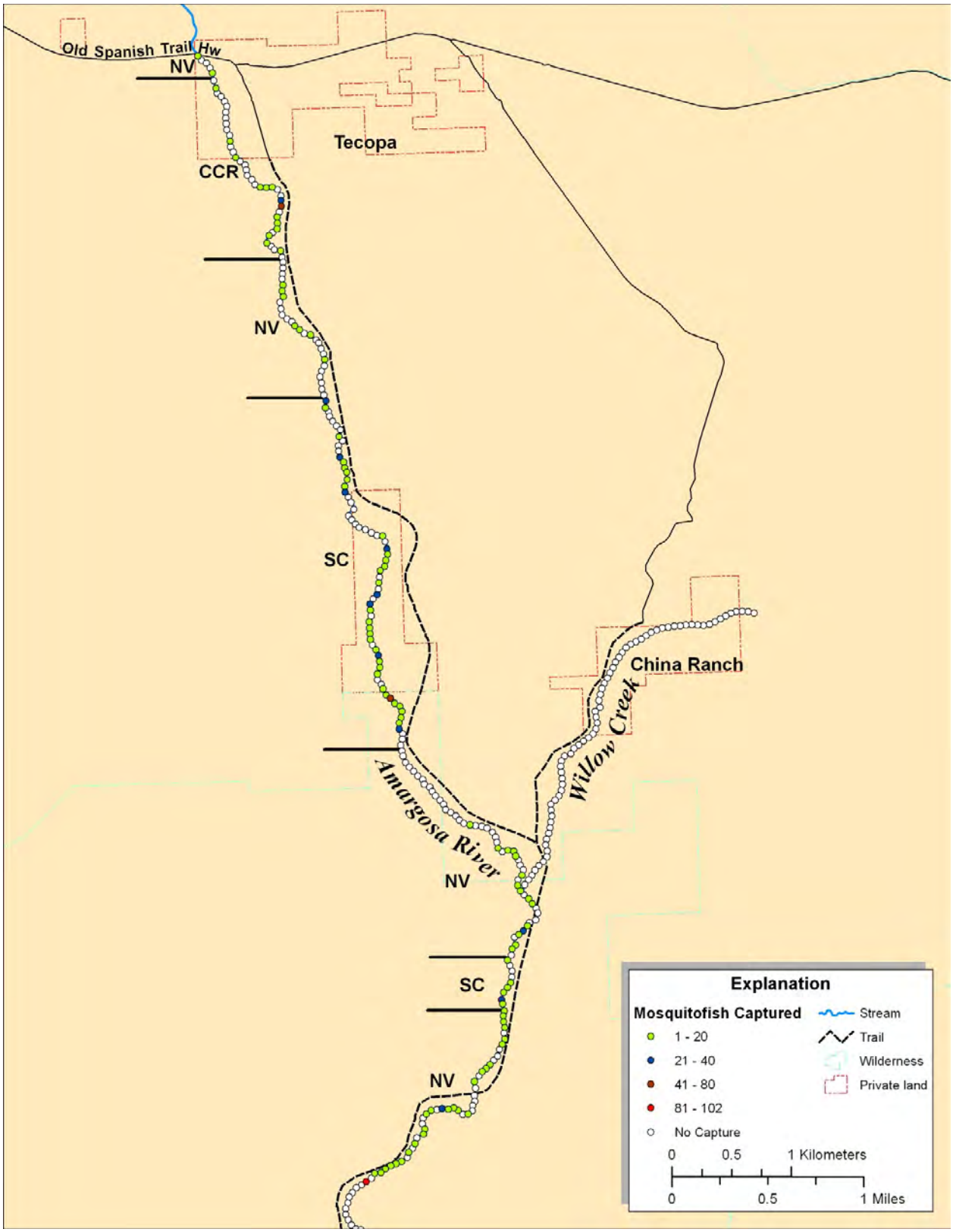

Figure A3. Distribution and relative abundance of western mosquitofish (*Gambusia affinis*) in the Amargosa River Canyon and Willow Creek in the summer of 2010, California.

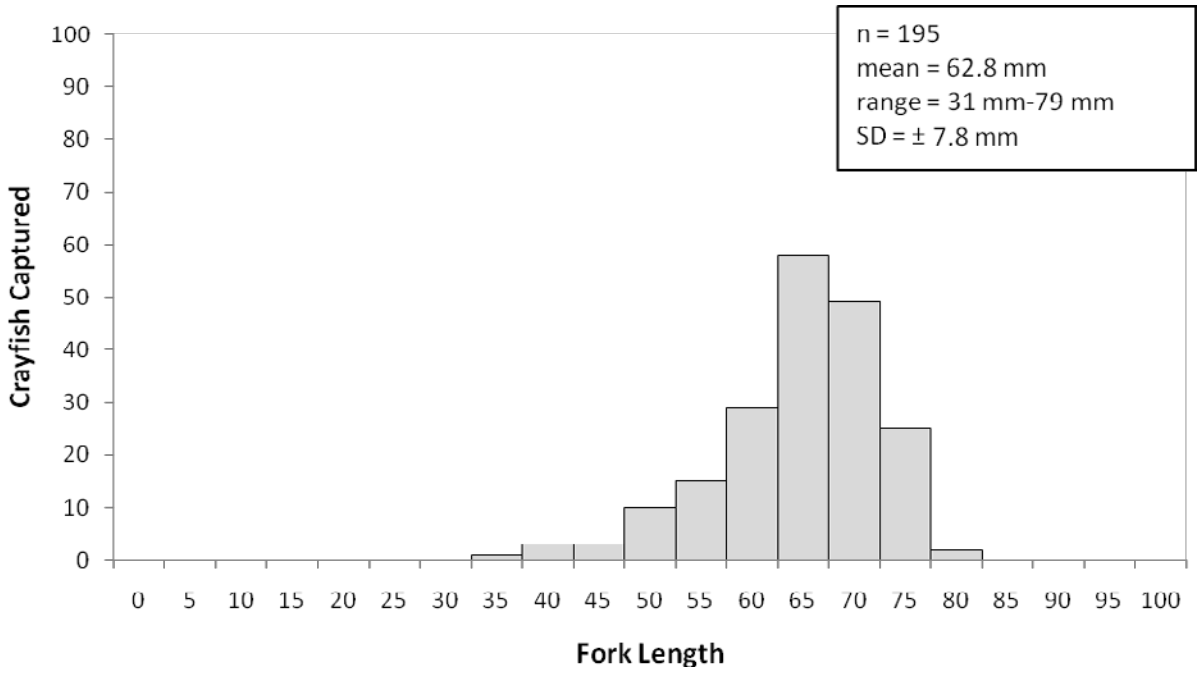

Figure A4. Length frequency of red swamp crayfish (*Procambarus clarkii*) caught during the summer 2010 survey of the Amargosa River Canyon and Willow Creek, California.

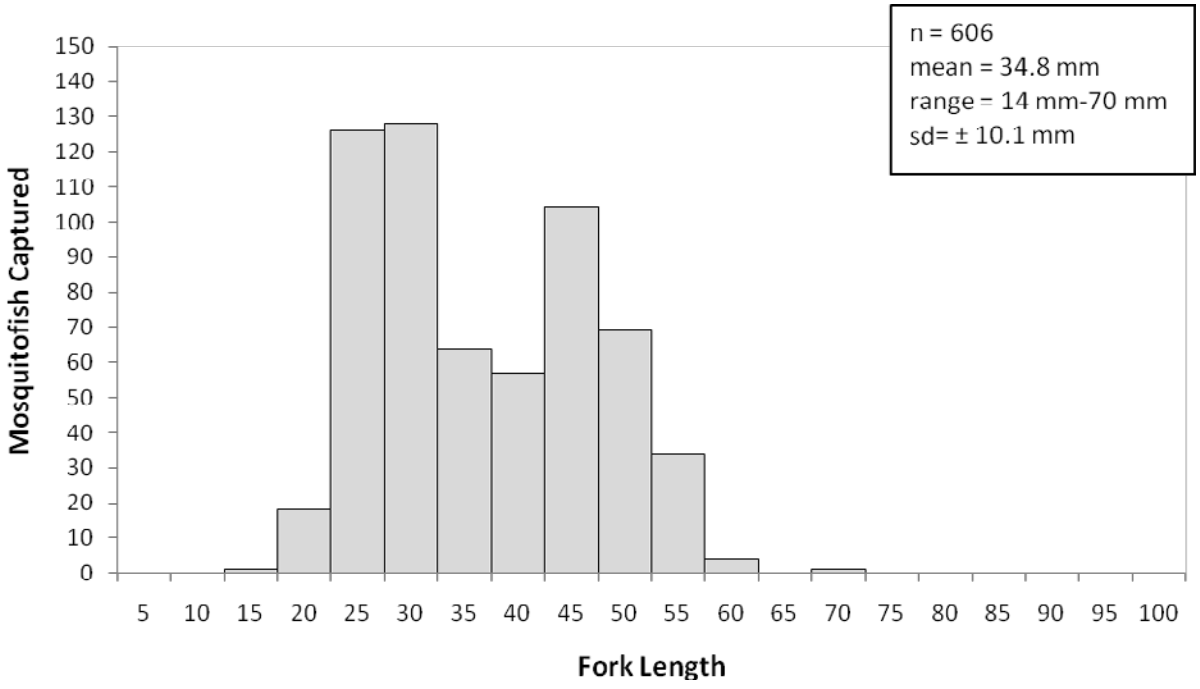

Figure A5. Length frequency of western mosquitofish (*Gambusia affinis*) caught during the summer 2010 survey of the Amargosa River Canyon, California.

Table A1. Geographic location, distance, habitat, temperature, and depth (if available) of the 405 established stations in the summer 2010 survey of the Amargosa River Canyon and Willow Creek, California.

[NV = native, CCR = cattail/rush, SC = saltcedar. Latitude and longitude are decimal degree NAD 83; UTM's are Zone 11, NAD 83]

Stream	Stream Distance (m) Sampling Station ID	Riparian Habitat	Temperature (°C)	Depth (mm)	Status	Latitude	Longitude	Northing	Easting
AMARGOSA	00000	NV	25.0	640	SAMPLED	35.849153	-116.230518	3967490	569484
AMARGOSA	00050	NV	23.0	110	SAMPLED	35.848804	-116.230191	3967452	569513
AMARGOSA	00100	NV	22.0	92	SAMPLED	35.848563	-116.229725	3967426	569556
AMARGOSA	00150	NV	25.0	324	SAMPLED	35.848204	-116.229401	3967386	569585
AMARGOSA	00200	NV	26.0	110	SAMPLED	35.847834	-116.229201	3967345	569604
AMARGOSA	00250	CCR	19.0	40	SAMPLED	35.847230	-116.229080	3967278	569615
AMARGOSA	00300	CCR	19.0	60	SAMPLED	35.846669	-116.228906	3967216	569631
AMARGOSA	00350	CCR	18.0	100	SAMPLED	35.846263	-116.228823	3967171	569639
AMARGOSA	00400	CCR	18.0	130	SAMPLED	35.846010	-116.228433	3967143	569675
AMARGOSA	00450	CCR	18.0	140	SAMPLED	35.845640	-116.228135	3967102	569702
AMARGOSA	00500	CCR	17.0	90	SAMPLED	35.845252	-116.227963	3967060	569718
AMARGOSA	00550	CCR	19.0	50	SAMPLED	35.844825	-116.228075	3967012	569708
AMARGOSA	00600	CCR	24.0	300	SAMPLED	35.844381	-116.228105	3966963	569706
AMARGOSA	00650	CCR	24.0	270	SAMPLED	35.843947	-116.228075	3966915	569709
AMARGOSA	00700	CCR	23.0	220	SAMPLED	35.843494	-116.228016	3966865	569715
AMARGOSA	00750	CCR	21.0	140	SAMPLED	35.843075	-116.227749	3966818	569739
AMARGOSA	00800	CCR	21.0	230	SAMPLED	35.842627	-116.227748	3966769	569739
AMARGOSA	00850	CCR	21.0	90	SAMPLED	35.842185	-116.227724	3966720	569742
AMARGOSA	00900	CCR	21.0	225	SAMPLED	35.841785	-116.227473	3966675	569765
AMARGOSA	00950	CCR	21.0	195	SAMPLED	35.841373	-116.227262	3966630	569784
AMARGOSA	01000	CCR	21.0	1500	SAMPLED	35.841069	-116.226855	3966596	569821
AMARGOSA	01050	CCR	21.0	1050	SAMPLED	35.840798	-116.226414	3966567	569862
AMARGOSA	01100	CCR	20.0	160	SAMPLED	35.840429	-116.226331	3966526	569869
AMARGOSA	01150	CCR	20.0	310	SAMPLED	35.840002	-116.226240	3966478	569878
AMARGOSA	01200	CCR	20.0	580	SAMPLED	35.839684	-116.225853	3966443	569913
AMARGOSA	01250	CCR	20.5	300	SAMPLED	35.839271	-116.225549	3966398	569941
AMARGOSA	01300	CCR	20.0	225	SAMPLED	35.839070	-116.225056	3966376	569986
AMARGOSA	01350	CCR	23.0	750	SAMPLED	35.839019	-116.224520	3966371	570034
AMARGOSA	01400	CCR	24.0	90	SAMPLED	35.839050	-116.223973	3966375	570084
AMARGOSA	01450	CCR	20.0	1250	SAMPLED	35.838865	-116.223471	3966354	570129
AMARGOSA	01500	CCR	22.0	1010	SAMPLED	35.838386	-116.223148	3966301	570159
AMARGOSA	01550	CCR	23.0	1130	SAMPLED	35.838033	-116.223172	3966262	570157
AMARGOSA	01600	CCR	20.0	175	SAMPLED	35.837584	-116.223132	3966213	570161
AMARGOSA	01650	CCR	24.0	235	SAMPLED	35.837186	-116.223372	3966168	570139
AMARGOSA	01700	CCR	23.0	315	SAMPLED	35.836786	-116.223597	3966124	570119
AMARGOSA	01750	CCR	24.0	115	SAMPLED	35.836337	-116.223556	3966074	570124
AMARGOSA	01800	CCR	23.0	445	SAMPLED	35.835898	-116.223616	3966025	570119
AMARGOSA	01850	CCR	23.0	295	SAMPLED	35.835616	-116.224032	3965994	570081
AMARGOSA	01900	CCR	19.0	268	SAMPLED	35.835393	-116.224370	3965969	570051
AMARGOSA	01950	CCR	19.0	348	SAMPLED	35.834850	-116.224598	3965908	570031
AMARGOSA	02000	CCR	20.0	350	SAMPLED	35.834571	-116.224219	3965878	570065
AMARGOSA	02050	CCR	19.0	227	SAMPLED	35.834330	-116.223912	3965851	570093
AMARGOSA	02100	CCR	19.0	125	SAMPLED	35.834231	-116.223321	3965840	570147
AMARGOSA	02150	NV	23.0	270	SAMPLED	35.833754	-116.223207	3965788	570157
AMARGOSA	02200	NV	23.0	315	SAMPLED	35.833354	-116.223155	3965743	570162
AMARGOSA	02250	NV	19.5	278	SAMPLED	35.832929	-116.223165	3965696	570162
AMARGOSA	02300	NV	20.0	575	SAMPLED	35.832489	-116.223206	3965647	570159
AMARGOSA	02350	NV	20.0	300	SAMPLED	35.832077	-116.223264	3965602	570154
AMARGOSA	02400	NV	21.0	317	SAMPLED	35.831631	-116.223218	3965552	570158
AMARGOSA	02450	NV	20.0	120	SAMPLED	35.831196	-116.223315	3965504	570150
AMARGOSA	02500	NV	23.0	160	SAMPLED	35.830770	-116.223219	3965457	570159
AMARGOSA	02550	NV	22.0	180	SAMPLED	35.830335	-116.223534	3965408	570131
AMARGOSA	02600	NV	22.0	230	SAMPLED	35.829833	-116.223440	3965353	570140
AMARGOSA	02650	NV	23.0	390	SAMPLED	35.829380	-116.223378	3965302	570146

Table A1. Geographic location, distance, habitat, temperature, and depth (if available) of the 405 established stations in the summer 2010 survey of the Amargosa River Canyon and Willow Creek, California, USA.—Continued

[NV = native, CCR = cattail/rush, SC = saltcedar. Latitude and longitude are decimal degree NAD 83; UTM's are Zone 11, NAD 83]

Stream	Stream Distance (m) Sampling Station ID	Riparian Habitat	Temperature (°C)	Depth (mm)	Status	Latitude	Longitude	Northing	Easting
AMARGOSA	02700	NV	22.0	210	SAMPLED	35.829081	-116.222939	3965270	570186
AMARGOSA	02750	NV	22.0	410	SAMPLED	35.828843	-116.222487	3965243	570227
AMARGOSA	02800	NV	22.0	275	SAMPLED	35.828506	-116.222212	3965206	570252
AMARGOSA	02850	NV	23.0	180	SAMPLED	35.828213	-116.221797	3965174	570290
AMARGOSA	02900	NV	23.0	165	SAMPLED	35.827933	-116.221378	3965143	570328
AMARGOSA	02950	NV	22.0	145	SAMPLED	35.827814	-116.220805	3965131	570380
AMARGOSA	03000	NV	23.0	350	SAMPLED	35.827416	-116.220300	3965087	570426
AMARGOSA	03050	NV	23.0	125	SAMPLED	35.827172	-116.220044	3965060	570449
AMARGOSA	03100	NV	23.0	170	SAMPLED	35.826757	-116.219830	3965014	570469
AMARGOSA	03150	NV	22.0	405	SAMPLED	35.826332	-116.219649	3964967	570485
AMARGOSA	03200	NV	22.0	220	SAMPLED	35.825890	-116.219542	3964918	570495
AMARGOSA	03250	NV	22.0	280	SAMPLED	35.825446	-116.219618	3964869	570489
AMARGOSA	03300	NV	21.0	550	SAMPLED	35.825034	-116.219841	3964823	570469
AMARGOSA	03350	NV	21.0	400	SAMPLED	35.824607	-116.219995	3964775	570456
AMARGOSA	03400	NV	22.0	500	SAMPLED	35.824169	-116.219883	3964727	570466
AMARGOSA	03450	NV	22.0	200	SAMPLED	35.823658	-116.219869	3964670	570468
AMARGOSA	03500	NV	22.0	300	SAMPLED	35.823230	-116.219707	3964623	570483
AMARGOSA	03550	SC	22.0	250	SAMPLED	35.821954	-116.219330	3964482	570518
AMARGOSA	03600	SC	20.0	200	SAMPLED	35.822266	-116.219625	3964516	570491
AMARGOSA	03650	SC	20.0	285	SAMPLED	35.821962	-116.219323	3964483	570519
AMARGOSA	03700	SC	20.0	460	SAMPLED	35.821603	-116.219252	3964443	570525
AMARGOSA	03750	SC	20.0	260	SAMPLED	35.821223	-116.218960	3964401	570552
AMARGOSA	03800	SC	20.0	370	SAMPLED	35.820876	-116.218616	3964363	570583
AMARGOSA	03850	SC	21.0	310	SAMPLED	35.820541	-116.218257	3964326	570616
AMARGOSA	03900	SC	23.0	250	SAMPLED	35.820052	-116.218410	3964271	570603
AMARGOSA	03950	SC	22.0	200	SAMPLED	35.819741	-116.218103	3964237	570631
AMARGOSA	04000	SC	23.0	500	SAMPLED	35.819353	-116.218503	3964194	570595
AMARGOSA	04050	SC	22.0	305	SAMPLED	35.818944	-116.218487	3964148	570597
AMARGOSA	04100	SC	22.0	N/A	SAMPLED	35.818495	-116.218389	3964099	570606
AMARGOSA	04150	SC	24.0	300	SAMPLED	35.818118	-116.218054	3964057	570637
AMARGOSA	04200	SC	24.0	300	SAMPLED	35.817672	-116.217981	3964008	570644
AMARGOSA	04250	SC	25.0	780	SAMPLED	35.817347	-116.217792	3963972	570661
AMARGOSA	04300	SC	24.0	300	SAMPLED	35.816787	-116.217777	3963910	570663
AMARGOSA	04350	SC	25.0	280	SAMPLED	35.816289	-116.218029	3963854	570641
AMARGOSA	04400	SC	25.0	250	SAMPLED	35.815839	-116.218013	3963804	570642
AMARGOSA	04450	SC	N/A	N/A	INACCESSIBLE	35.815453	-116.217716	3963762	570670
AMARGOSA	04500	SC	N/A	N/A	INACCESSIBLE	35.815050	-116.217470	3963717	570692
AMARGOSA	04550	SC	N/A	N/A	INACCESSIBLE	35.814520	-116.217228	3963659	570714
AMARGOSA	04600	SC	20.0	20	DRY	35.814055	-116.217718	3963607	570671
AMARGOSA	04650	SC	20.0	90	DRY	35.813732	-116.217453	3963571	570695
AMARGOSA	04700	SC	19.0	65	SAMPLED	35.813395	-116.217114	3963534	570726
AMARGOSA	04750	SC	19.0	110	SAMPLED	35.813117	-116.216772	3963503	570757
AMARGOSA	04800	SC	18.0	180	SAMPLED	35.812963	-116.216190	3963487	570810
AMARGOSA	04850	SC	18.0	175	SAMPLED	35.812703	-116.215670	3963458	570857
AMARGOSA	04900	SC	18.0	155	SAMPLED	35.812506	-116.215164	3963437	570903
AMARGOSA	04950	SC	22.0	210	SAMPLED	35.812462	-116.214625	3963432	570951
AMARGOSA	05000	SC	21.0	188	SAMPLED	35.812004	-116.214404	3963382	570972
AMARGOSA	05050	SC	20.0	160	SAMPLED	35.811472	-116.214250	3963323	570986
AMARGOSA	05100	SC	21.0	185	SAMPLED	35.811043	-116.214195	3963275	570992
AMARGOSA	05150	SC	21.0	190	SAMPLED	35.810608	-116.214378	3963227	570975
AMARGOSA	05200	SC	20.0	170	SAMPLED	35.810158	-116.214499	3963177	570965
AMARGOSA	05250	SC	20.0	200	SAMPLED	35.809814	-116.214932	3963138	570926
AMARGOSA	05300	SC	21.0	300	SAMPLED	35.809347	-116.215014	3963086	570919
AMARGOSA	05350	SC	21.0	220	SAMPLED	35.808904	-116.215090	3963037	570913

Table A1. Geographic location, distance, habitat, temperature, and depth (if available) of the 405 established stations in the summer 2010 survey of the Amargosa River Canyon and Willow Creek, California, USA.—Continued

[NV = native, CCR = cattail/rush, SC = saltcedar. Latitude and longitude are decimal degree NAD 83; UTM's are Zone 11, NAD 83]

Stream	Stream Distance (m) Sampling Station ID	Riparian Habitat	Temperature (°C)	Depth (mm)	Status	Latitude	Longitude	Northing	Easting
AMARGOSA	05400	SC	21.0	640	SAMPLED	35.808430	-116.215156	3962985	570907
AMARGOSA	05450	SC	22.0	195	SAMPLED	35.808033	-116.215315	3962941	570893
AMARGOSA	05500	SC	22.0	265	SAMPLED	35.807691	-116.215675	3962902	570861
AMARGOSA	05550	SC	22.0	262	SAMPLED	35.807309	-116.215994	3962860	570832
AMARGOSA	05600	SC	20.0	190	SAMPLED	35.806875	-116.215977	3962812	570834
AMARGOSA	05650	SC	21.0	194	SAMPLED	35.806423	-116.215922	3962761	570840
AMARGOSA	05700	SC	22.0	180	SAMPLED	35.806004	-116.216107	3962715	570823
AMARGOSA	05750	SC	23.0	205	SAMPLED	35.805533	-116.216090	3962663	570825
AMARGOSA	05800	SC	23.0	137	SAMPLED	35.805083	-116.216081	3962613	570826
AMARGOSA	05850	SC	23.0	162	SAMPLED	35.804634	-116.216035	3962563	570831
AMARGOSA	05900	SC	23.0	145	SAMPLED	35.804214	-116.215855	3962517	570848
AMARGOSA	05950	SC	23.0	318	SAMPLED	35.803842	-116.215542	3962476	570876
AMARGOSA	06000	SC	23.0	172	SAMPLED	35.803424	-116.215342	3962429	570895
AMARGOSA	06050	SC	22.0	159	SAMPLED	35.802982	-116.215246	3962380	570904
AMARGOSA	06100	SC	21.0	148	SAMPLED	35.802533	-116.215214	3962331	570907
AMARGOSA	06150	SC	22.0	177	SAMPLED	35.802008	-116.215497	3962272	570882
AMARGOSA	06200	SC	23.0	228	SAMPLED	35.801564	-116.215493	3962223	570883
AMARGOSA	06250	SC	22.0	156	SAMPLED	35.801221	-116.215122	3962185	570917
AMARGOSA	06300	SC	22.0	200	SAMPLED	35.800895	-116.214991	3962149	570929
AMARGOSA	06350	SC	22.0	207	SAMPLED	35.800413	-116.214695	3962096	570956
AMARGOSA	06400	SC	22.0	162	SAMPLED	35.800167	-116.214335	3962069	570989
AMARGOSA	06450	SC	22.0	150	SAMPLED	35.799769	-116.213940	3962025	571025
AMARGOSA	06500	SC	21.0	173	SAMPLED	35.799536	-116.213473	3961999	571067
AMARGOSA	06550	SC	20.0	175	SAMPLED	35.799121	-116.213293	3961954	571084
AMARGOSA	06600	SC	21.0	179	SAMPLED	35.798680	-116.213395	3961905	571075
AMARGOSA	06650	SC	20.0	134	SAMPLED	35.798257	-116.213586	3961857	571058
AMARGOSA	06700	SC	22.0	216	SAMPLED	35.797823	-116.213606	3961809	571057
AMARGOSA	06750	SC	23.0	160	SAMPLED	35.797455	-116.213294	3961769	571085
AMARGOSA	06800	SC	23.0	175	SAMPLED	35.797023	-116.213360	3961721	571079
AMARGOSA	06850	SC	23.0	170	SAMPLED	35.796591	-116.213498	3961673	571067
AMARGOSA	06900	SC	22.0	125	SAMPLED	35.796150	-116.213401	3961624	571077
AMARGOSA	06950	SC	23.0	120	SAMPLED	35.795765	-116.213321	3961581	571084
AMARGOSA	07050	SC	23.0	N/A	SAMPLED	35.795274	-116.213106	3961527	571104
AMARGOSA	07100	SC	N/A	N/A	DRY	35.794909	-116.212760	3961487	571136
AMARGOSA	07150	NV	N/A	N/A	DRY	35.794588	-116.212374	3961451	571171
AMARGOSA	07200	NV	23.0	n/a	SAMPLED	35.794242	-116.211987	3961413	571206
AMARGOSA	07250	NV	23.0	N/A	SAMPLED	35.793946	-116.211569	3961381	571244
AMARGOSA	07300	NV	23.0	N/A	SAMPLED	35.793580	-116.211420	3961340	571258
AMARGOSA	07350	NV	21.0	175	SAMPLED	35.793348	-116.210931	3961315	571302
AMARGOSA	07400	NV	21.0	n/a	SAMPLED	35.793036	-116.210679	3961280	571325
AMARGOSA	07450	NV	21.0	500	SAMPLED	35.792685	-116.210419	3961242	571349
AMARGOSA	07500	NV	21.0	380	SAMPLED	35.792334	-116.210006	3961203	571387
AMARGOSA	07550	NV	21.0	260	SAMPLED	35.792022	-116.209704	3961169	571414
AMARGOSA	07600	NV	21.0	300	SAMPLED	35.791616	-116.209504	3961124	571433
AMARGOSA	07650	NV	21.0	240	SAMPLED	35.791378	-116.209038	3961098	571475
AMARGOSA	07700	NV	23.0	190	SAMPLED	35.791119	-116.208586	3961069	571516
AMARGOSA	07750	NV	22.0	220	SAMPLED	35.790810	-116.208254	3961035	571546
AMARGOSA	07800	NV	22.0	500	SAMPLED	35.790552	-116.207845	3961007	571584
AMARGOSA	07850	NV	22.0	110	SAMPLED	35.790411	-116.207308	3960992	571632
AMARGOSA	07900	NV	22.0	N/A	SAMPLED	35.790361	-116.206784	3960987	571680
AMARGOSA	07950	NV	22.0	N/A	SAMPLED	35.790290	-116.206211	3960979	571732
AMARGOSA	08000	NV	N/A	N/A	SAMPLED	35.790116	-116.205710	3960960	571777
AMARGOSA	08050	NV	N/A	N/A	SAMPLED	35.789800	-116.205226	3960926	571821
AMARGOSA	08100	NV	27.0	N/A	SAMPLED	35.789423	-116.204964	3960884	571845

Table A1. Geographic location, distance, habitat, temperature, and depth (if available) of the 405 established stations in the summer 2010 survey of the Amargosa River Canyon and Willow Creek, California, USA.—Continued

[NV = native, CCR = cattail/rush, SC = saltcedar. Latitude and longitude are decimal degree NAD 83; UTM's are Zone 11, NAD 83]

Stream	Stream Distance(m) Sampling Station ID	Riparian Habitat	Temperature (°C)	Depth (mm)	Status	Latitude	Longitude	Northing	Easting
AMARGOSA	08150	NV	25.0	N/A	SAMPLED	35.789031	-116.204816	3960841	571859
AMARGOSA	08200	NV	24.0	N/A	SAMPLED	35.788585	-116.204740	3960791	571866
AMARGOSA	08250	NV	25.0	N/A	SAMPLED	35.788336	-116.204386	3960764	571898
AMARGOSA	08300	NV	25.0	N/A	SAMPLED	35.788402	-116.203839	3960772	571948
AMARGOSA	08350	NV	28.0	N/A	SAMPLED	35.788322	-116.203302	3960763	571996
AMARGOSA	08400	NV	32.0	N/A	SAMPLED	35.787948	-116.203155	3960722	572010
AMARGOSA	08450	NV	30.0	N/A	SAMPLED	35.787651	-116.202863	3960689	572036
AMARGOSA	08500	NV	25.0	N/A	SAMPLED	35.787236	-116.202738	3960643	572048
AMARGOSA	08550	NV	25.0	N/A	SAMPLED	35.786907	-116.202440	3960607	572075
AMARGOSA	08600	NV	25.0	N/A	SAMPLED	35.786494	-116.202604	3960561	572061
AMARGOSA	08650	NV	24.0	170	SAMPLED	35.786164	-116.202975	3960524	572028
AMARGOSA	08700	NV	24.0	275	SAMPLED	35.785733	-116.203021	3960476	572024
AMARGOSA	08750	NV	25.0	235	SAMPLED	35.785307	-116.202793	3960429	572045
AMARGOSA	08800	NV	26.0	305	SAMPLED	35.785000	-116.202450	3960395	572076
AMARGOSA	08850	NV	26.0	173	SAMPLED	35.784710	-116.202040	3960363	572113
AMARGOSA	08900	NV	27.0	263	SAMPLED	35.784334	-116.201698	3960322	572145
AMARGOSA	08950	NV	27.0	215	SAMPLED	35.783958	-116.201398	3960280	572172
AMARGOSA	09000	NV	27.0	235	SAMPLED	35.783602	-116.201214	3960241	572189
AMARGOSA	09050	NV	25.0	170	SAMPLED	35.783073	-116.201447	3960182	572169
AMARGOSA	09100	NV	26.0	450	SAMPLED	35.782863	-116.202054	3960158	572114
AMARGOSA	09150	NV	26.0	245	SAMPLED	35.782643	-116.202216	3960134	572099
AMARGOSA	09200	NV	26.0	150	SAMPLED	35.782300	-116.202622	3960096	572063
AMARGOSA	09250	NV	27.0	215	SAMPLED	35.782038	-116.203030	3960066	572026
AMARGOSA	09300	NV	26.0	124	SAMPLED	35.781804	-116.203464	3960040	571987
AMARGOSA	09350	NV	30.0	87	SAMPLED	35.781258	-116.203369	3959979	571997
AMARGOSA	09400	NV	30.0	145	SAMPLED	35.780932	-116.203692	3959943	571968
AMARGOSA	09450	NV	26.5	150	SAMPLED	35.780480	-116.203790	3959893	571959
AMARGOSA	09500	NV	22.0	195	SAMPLED	35.780099	-116.204166	3959850	571926
AMARGOSA	09550	NV	22.0	210	SAMPLED	35.779691	-116.203945	3959805	571946
AMARGOSA	09600	NV	22.0	420	SAMPLED	35.779265	-116.203770	3959758	571962
AMARGOSA	09650	NV	22.0	410	SAMPLED	35.778819	-116.203790	3959709	571961
AMARGOSA	09700	NV	22.0	300	SAMPLED	35.778383	-116.203931	3959660	571948
AMARGOSA	09750	SC	21.0	130	SAMPLED	35.778027	-116.204258	3959620	571919
AMARGOSA	09800	SC	21.0	90	SAMPLED	35.777680	-116.204607	3959582	571888
AMARGOSA	09850	SC	21.0	85	SAMPLED	35.777127	-116.204827	3959520	571868
AMARGOSA	09900	SC	20.0	250	SAMPLED	35.776802	-116.204742	3959484	571876
AMARGOSA	09950	SC	22.0	100	SAMPLED	35.776264	-116.204587	3959425	571891
AMARGOSA	10000	SC	23.0	85	SAMPLED	35.775906	-116.204692	3959385	571882
AMARGOSA	10050	SC	22.0	200	SAMPLED	35.775457	-116.204680	3959335	571883
AMARGOSA	10100	SC	22.0	100	SAMPLED	35.775014	-116.204585	3959286	571892
AMARGOSA	10150	SC	22.0	200	SAMPLED	35.774572	-116.204670	3959237	571885
AMARGOSA	10200	NV	22.0	150	SAMPLED	35.774143	-116.204610	3959189	571891
AMARGOSA	10250	NV	22.0	110	SAMPLED	35.773752	-116.204880	3959146	571867
AMARGOSA	10300	NV	N/A	600	SAMPLED	35.773351	-116.205130	3959101	571844
AMARGOSA	10350	NV	N/A	150	SAMPLED	35.772878	-116.205319	3959049	571828
AMARGOSA	10400	NV	N/A	165	SAMPLED	35.772555	-116.205728	3959012	571791
AMARGOSA	10450	NV	N/A	165	SAMPLED	35.772217	-116.206077	3958975	571760
AMARGOSA	10500	NV	25.0	70	SAMPLED	35.771963	-116.206420	3958946	571729
AMARGOSA	10550	NV	24.5	135	SAMPLED	35.771737	-116.206805	3958921	571695
AMARGOSA	10600	NV	23.0	165	SAMPLED	35.771406	-116.207100	3958884	571668
AMARGOSA	10650	NV	24.0	145	SAMPLED	35.771005	-116.207570	3958839	571626
AMARGOSA	10700	NV	23.0	110	SAMPLED	35.770485	-116.207465	3958782	571636
AMARGOSA	10750	NV	23.0	145	SAMPLED	35.769940	-116.207610	3958721	571623

Table A1. Geographic location, distance, habitat, temperature, and depth (if available) of the 405 established stations in the summer 2010 survey of the Amargosa River Canyon and Willow Creek, California, USA.—Continued

[NV = native, CCR = cattail/rush, SC = saltcedar. Latitude and longitude are decimal degree NAD 83; UTM's are Zone 11, NAD 83]

Stream	Stream Distance (m) Sampling Station ID	Riparian Habitat	Temperature (°C)	Depth (mm)	Status	Latitude	Longitude	Northing	Easting
AMARGOSA	10800	NV	23.0	115	SAMPLED	35.769503	-116.207588	3958673	571626
AMARGOSA	10850	NV	23.0	135	SAMPLED	35.769177	-116.207768	3958636	571610
AMARGOSA	10900	NV	23.0	115	SAMPLED	35.768770	-116.207803	3958591	571607
AMARGOSA	10950	NV	24.0	135	SAMPLED	35.768561	-116.208221	3958568	571569
AMARGOSA	11000	NV	24.0	160	SAMPLED	35.768538	-116.208734	3958565	571523
AMARGOSA	11050	NV	25.0	215	SAMPLED	35.768846	-116.209114	3958599	571488
AMARGOSA	11100	NV	25.0	115	SAMPLED	35.769035	-116.209543	3958619	571449
AMARGOSA	11150	NV	24.0	185	SAMPLED	35.768942	-116.210037	3958609	571405
AMARGOSA	11200	NV	26.0	175	SAMPLED	35.769013	-116.210624	3958616	571352
AMARGOSA	11250	NV	26.0	255	SAMPLED	35.768938	-116.211105	3958607	571308
AMARGOSA	11300	NV	25.0	145	SAMPLED	35.768896	-116.211640	3958602	571260
AMARGOSA	11350	NV	25.0	220	SAMPLED	35.768646	-116.212085	3958574	571220
AMARGOSA	11400	NV	26.0	195	SAMPLED	35.768342	-116.212430	3958540	571189
AMARGOSA	11450	NV	25.0	280	SAMPLED	35.767912	-116.212504	3958493	571183
AMARGOSA	11500	NV	24.0	155	SAMPLED	35.767501	-116.212289	3958447	571203
AMARGOSA	11550	NV	24.0	195	SAMPLED	35.767118	-116.212417	3958405	571191
AMARGOSA	11600	NV	24.0	355	SAMPLED	35.766862	-116.213071	3958376	571132
AMARGOSA	11650	NV	23.0	155	SAMPLED	35.766441	-116.213259	3958329	571116
AMARGOSA	11700	NV	22.0	240	SAMPLED	35.766063	-116.213448	3958287	571099
AMARGOSA	11750	NV	23.0	165	SAMPLED	35.765780	-116.213853	3958255	571063
AMARGOSA	11800	NV	22.0	515	SAMPLED	35.765411	-116.213971	3958214	571052
AMARGOSA	11850	NV	22.5	250	SAMPLED	35.765107	-116.214523	3958180	571003
AMARGOSA	11900	NV	22.0	180	SAMPLED	35.764949	-116.215039	3958162	570956
AMARGOSA	11950	NV	21.0	152	SAMPLED	35.764796	-116.215558	3958145	570909
AMARGOSA	12000	NV	21.0	200	SAMPLED	35.764576	-116.216040	3958120	570866
AMARGOSA	12050	NV	20.0	295	SAMPLED	35.764311	-116.216450	3958090	570829
AMARGOSA	12100	NV	20.0	300	SAMPLED	35.764276	-116.217027	3958086	570777
AMARGOSA	12150	NV	22.0	182	SAMPLED	35.763926	-116.217381	3958047	570745
AMARGOSA	12200	NV	N/A	N/A	SAMPLED	35.763633	-116.217854	3958014	570703
AMARGOSA	12250	NV	N/A	N/A	SAMPLED	35.763430	-116.218272	3957991	570665
AMARGOSA	12300	N/A	N/A	N/A	DRY	35.763229	-116.218816	3957969	570616
AMARGOSA	12350	N/A	N/A	N/A	DRY	35.762872	-116.219154	3957929	570586
AMARGOSA	12400	N/A	N/A	N/A	DRY	35.762520	-116.219493	3957889	570556
AMARGOSA	12450	N/A	N/A	N/A	DRY	35.762081	-116.219602	3957841	570546
AMARGOSA	12500	N/A	N/A	N/A	DRY	35.761666	-116.219814	3957795	570528
AMARGOSA	12550	N/A	N/A	N/A	DRY	35.761219	-116.219848	3957745	570525
AMARGOSA	12600	N/A	N/A	N/A	DRY	35.760810	-116.219626	3957700	570545
AMARGOSA	12650	N/A	N/A	N/A	DRY	35.760413	-116.219366	3957656	570569
AMARGOSA	12700	N/A	N/A	N/A	DRY	35.760109	-116.218963	3957622	570606
AMARGOSA	12750	N/A	N/A	N/A	DRY	35.760039	-116.218453	3957615	570652
AMARGOSA	12800	N/A	N/A	N/A	DRY	35.759794	-116.218073	3957588	570687
AMARGOSA	12850	N/A	N/A	N/A	DRY	35.759388	-116.217847	3957543	570707
AMARGOSA	12900	N/A	N/A	N/A	DRY	35.758944	-116.217781	3957494	570714
AMARGOSA	12950	N/A	N/A	N/A	DRY	35.758498	-116.217811	3957445	570711
AMARGOSA	13000	N/A	N/A	N/A	DRY	35.758187	-116.218188	3957410	570678
AMARGOSA	13050	N/A	N/A	N/A	DRY	35.757884	-116.218595	3957376	570641
AMARGOSA	13100	N/A	N/A	N/A	DRY	35.757534	-116.218942	3957337	570610
AMARGOSA	13150	N/A	N/A	N/A	DRY	35.757144	-116.219218	3957293	570585
AMARGOSA	13200	N/A	N/A	N/A	DRY	35.756764	-116.219294	3957251	570579
AMARGOSA	13250	N/A	N/A	N/A	DRY	35.756511	-116.219726	3957223	570540
AMARGOSA	13300	N/A	N/A	N/A	DRY	35.756147	-116.219974	3957182	570518
AMARGOSA	13350	N/A	N/A	N/A	DRY	35.755797	-116.220301	3957143	570489
AMARGOSA	13400	N/A	N/A	N/A	DRY	35.755373	-116.220441	3957096	570476
AMARGOSA	13450	N/A	N/A	N/A	DRY	35.754939	-116.220299	3957048	570490

Table A1. Geographic location, distance, habitat, temperature, and depth (if available) of the 405 established stations in the summer 2010 survey of the Amargosa River Canyon and Willow Creek, California, USA.—Continued

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Stream	Stream Distance(m) Sampling Station ID	Riparian Habitat	Temperature (°C)	Depth (mm)	Status	Latitude	Longitude	Northing	Easting
AMARGOSA	13500	N/A	N/A	N/A	DRY	35.754512	-116.220121	3957001	570506
AMARGOSA	13550	N/A	N/A	N/A	DRY	35.754077	-116.220026	3956953	570515
AMARGOSA	13600	N/A	N/A	N/A	DRY	35.753675	-116.219852	3956908	570531
AMARGOSA	13650	N/A	N/A	N/A	DRY	35.753233	-116.219744	3956859	570541
AMARGOSA	13700	N/A	N/A	N/A	DRY	35.752789	-116.219656	3956810	570550
AMARGOSA	13750	N/A	N/A	N/A	DRY	35.752354	-116.219511	3956762	570563
AMARGOSA	13800	N/A	N/A	N/A	DRY	35.751943	-116.219286	3956716	570584
AMARGOSA	13850	N/A	N/A	N/A	DRY	35.751516	-116.219110	3956669	570600
AMARGOSA	13900	N/A	N/A	N/A	DRY	35.751067	-116.219104	3956619	570601
AMARGOSA	13950	N/A	N/A	N/A	DRY	35.750619	-116.219139	3956570	570598
AMARGOSA	14000	N/A	N/A	N/A	DRY	35.750233	-116.219408	3956527	570574
AMARGOSA	14050	N/A	N/A	N/A	DRY	35.750055	-116.219913	3956507	570529
AMARGOSA	14100	N/A	N/A	N/A	DRY	35.749857	-116.220409	3956484	570484
AMARGOSA	14150	N/A	N/A	N/A	DRY	35.749666	-116.220909	3956463	570439
AMARGOSA	14200	N/A	N/A	N/A	DRY	35.749331	-116.221264	3956425	570407
AMARGOSA	14250	N/A	N/A	N/A	DRY	35.748933	-116.221523	3956381	570384
AMARGOSA	14300	N/A	N/A	N/A	DRY	35.748497	-116.221647	3956333	570373
AMARGOSA	14350	N/A	N/A	N/A	DRY	35.748054	-116.221749	3956283	570365
AMARGOSA	14400	N/A	N/A	N/A	DRY	35.747612	-116.221851	3956234	570356
AMARGOSA	14450	N/A	N/A	N/A	DRY	35.747162	-116.221884	3956184	570353
AMARGOSA	14500	N/A	N/A	N/A	DRY	35.746715	-116.221955	3956135	570347
AMARGOSA	14550	N/A	N/A	N/A	DRY	35.746294	-116.222147	3956088	570330
AMARGOSA	14600	N/A	N/A	N/A	DRY	35.745926	-116.222465	3956047	570302
AMARGOSA	14650	N/A	N/A	N/A	DRY	35.745528	-116.222723	3956003	570279
AMARGOSA	14700	N/A	N/A	N/A	DRY	35.745145	-116.223010	3955960	570253
AMARGOSA	14750	N/A	N/A	N/A	DRY	35.744803	-116.223371	3955922	570221
AMARGOSA	14800	N/A	N/A	N/A	DRY	35.744471	-116.223744	3955885	570187
AMARGOSA	14850	N/A	N/A	N/A	DRY	35.744054	-116.223941	3955838	570170
AMARGOSA	14900	N/A	N/A	N/A	DRY	35.743613	-116.224057	3955789	570160
AMARGOSA	14950	N/A	N/A	N/A	DRY	35.743164	-116.224090	3955739	570157
AMARGOSA	15000	N/A	N/A	N/A	DRY	35.742742	-116.223928	3955693	570172
AMARGOSA	15050	N/A	N/A	N/A	DRY	35.742345	-116.223679	3955649	570195
AMARGOSA	15100	N/A	N/A	N/A	DRY	35.741912	-116.223529	3955601	570209
AMARGOSA	15150	N/A	N/A	N/A	DRY	35.741513	-116.223272	3955557	570233
AMARGOSA	15200	N/A	N/A	N/A	DRY	35.741111	-116.223023	3955512	570255
AMARGOSA	15250	N/A	N/A	N/A	DRY	35.740703	-116.222787	3955467	570277
AMARGOSA	15300	N/A	N/A	N/A	DRY	35.740287	-116.222574	3955421	570297
AMARGOSA	15350	N/A	N/A	N/A	DRY	35.739851	-116.222438	3955373	570309
AMARGOSA	15400	N/A	N/A	N/A	DRY	35.739411	-116.222320	3955324	570321
AMARGOSA	15450	N/A	N/A	N/A	DRY	35.738972	-116.222213	3955276	570331
AMARGOSA	15500	N/A	N/A	N/A	DRY	35.738522	-116.222244	3955226	570328
AMARGOSA	15550	N/A	N/A	N/A	DRY	35.738072	-116.222263	3955176	570327
AMARGOSA	15600	N/A	N/A	N/A	DRY	35.737645	-116.222091	3955129	570343
AMARGOSA	15650	N/A	N/A	N/A	DRY	35.737209	-116.221960	3955080	570355
AMARGOSA	15700	N/A	N/A	N/A	DRY	35.736773	-116.221821	3955032	570368
AMARGOSA	15750	N/A	N/A	N/A	DRY	35.736327	-116.221817	3954983	570369
AMARGOSA	15800	N/A	N/A	N/A	DRY	35.735879	-116.221848	3954933	570366
AMARGOSA	15850	N/A	N/A	N/A	DRY	35.735433	-116.221769	3954884	570374
AMARGOSA	15900	N/A	N/A	N/A	DRY	35.734994	-116.221645	3954835	570385
AMARGOSA	15950	N/A	N/A	N/A	DRY	35.734558	-116.221503	3954787	570399
AMARGOSA	16000	N/A	N/A	N/A	DRY	35.734121	-116.221370	3954738	570411
AMARGOSA	16050	N/A	N/A	N/A	DRY	35.733705	-116.221156	3954692	570431
AMARGOSA	16100	N/A	N/A	N/A	DRY	35.733298	-116.220920	3954647	570453
AMARGOSA	16150	N/A	N/A	N/A	DRY	35.732862	-116.220780	3954599	570466

Table A1. Geographic location, distance, habitat, temperature, and depth (if available) of the 405 established stations in the summer 2010 survey of the Amargosa River Canyon and Willow Creek, California, USA.—Continued

[NV = native, CCR = cattail/rush, SC = saltcedar. Latitude and longitude are decimal degree NAD 83; UTM's are Zone 11, NAD 83]

Stream	Stream Distance(m) Sampling Station ID	Riparian Habitat	Temperature (°C)	Depth (mm)	Status	Latitude	Longitude	Northing	Easting
AMARGOSA	16200	N/A	N/A	N/A	DRY	35.732424	-116.220654	3954551	570477
AMARGOSA	16250	N/A	N/A	N/A	DRY	35.731977	-116.220581	3954501	570484
AMARGOSA	16300	N/A	N/A	N/A	DRY	35.731549	-116.220412	3954454	570500
AMARGOSA	16350	N/A	N/A	N/A	DRY	35.731109	-116.220460	3954405	570496
AMARGOSA	16400	N/A	N/A	N/A	DRY	35.730704	-116.220701	3954360	570475
AMARGOSA	16450	N/A	N/A	N/A	DRY	35.730325	-116.221000	3954318	570448
AMARGOSA	16500	N/A	N/A	N/A	DRY	35.729944	-116.221296	3954275	570421
AMARGOSA	16550	N/A	N/A	N/A	DRY	35.729576	-116.221614	3954234	570393
AMARGOSA	16600	N/A	N/A	N/A	DRY	35.729171	-116.221857	3954189	570371
AMARGOSA	16650	N/A	N/A	N/A	DRY	35.728771	-116.222111	3954144	570349
AMARGOSA	16700	N/A	N/A	N/A	DRY	35.728364	-116.222349	3954099	570328
AMARGOSA	16750	N/A	N/A	N/A	DRY	35.727927	-116.222482	3954051	570316
WILLOW	00000	N/A	N/A	N/A	DRY	35.805809	-116.180363	3962720	574053
WILLOW	00050	N/A	N/A	N/A	DRY	35.805940	-116.180892	3962734	574005
WILLOW	00100	N/A	N/A	N/A	DRY	35.805990	-116.181441	3962739	573955
WILLOW	00150	N/A	N/A	N/A	DRY	35.805973	-116.181992	3962737	573906
WILLOW	00200	N/A	N/A	N/A	DRY	35.805837	-116.182519	3962721	573858
WILLOW	00250	N/A	N/A	20	DRY	35.805638	-116.183016	3962699	573813
WILLOW	00300	N/A	23.0	360	SAMPLED	35.805437	-116.183511	3962676	573769
WILLOW	00350	N/A	N/A	N/A	DRY	35.805237	-116.184007	3962654	573724
WILLOW	00400	N/A	N/A	N/A	DRY	35.805068	-116.184518	3962634	573678
WILLOW	00450	N/A	N/A	N/A	DRY	35.805003	-116.185065	3962627	573629
WILLOW	00500	N/A	N/A	N/A	DRY	35.805031	-116.185616	3962629	573579
WILLOW	00550	N/A	N/A	N/A	DRY	35.805068	-116.186167	3962633	573529
WILLOW	00600	N/A	N/A	N/A	DRY	35.805056	-116.186719	3962631	573479
WILLOW	00650	N/A	N/A	N/A	DRY	35.805014	-116.187270	3962626	573430
WILLOW	00700	N/A	N/A	N/A	DRY	35.804998	-116.187823	3962624	573380
WILLOW	00750	N/A	N/A	N/A	DRY	35.804928	-116.188369	3962616	573330
WILLOW	00800	N/A	N/A	N/A	DRY	35.804878	-116.188919	3962610	573281
WILLOW	00850	N/A	N/A	N/A	DRY	35.804745	-116.189446	3962595	573233
WILLOW	00900	N/A	N/A	N/A	DRY	35.804570	-116.189956	3962575	573187
WILLOW	00950	N/A	N/A	N/A	DRY	35.804347	-116.190436	3962550	573144
WILLOW	01000	N/A	N/A	N/A	DRY	35.804102	-116.190901	3962522	573102
WILLOW	01050	N/A	N/A	N/A	DRY	35.803906	-116.191397	3962500	573058
WILLOW	01100	N/A	N/A	N/A	DRY	35.803715	-116.191897	3962479	573013
WILLOW	01150	N/A	N/A	N/A	DRY	35.803468	-116.192359	3962451	572971
WILLOW	01200	N/A	N/A	N/A	DRY	35.803124	-116.192715	3962413	572939
WILLOW	01250	N/A	N/A	N/A	DRY	35.802758	-116.193037	3962372	572911
WILLOW	01300	N/A	N/A	N/A	DRY	35.802392	-116.193359	3962331	572882
WILLOW	01350	N/A	N/A	N/A	DRY	35.801992	-116.193612	3962286	572859
WILLOW	01400	N/A	N/A	N/A	DRY	35.801603	-116.193891	3962243	572835
WILLOW	01450	N/A	23.0	66	SAMPLED	35.801213	-116.194167	3962200	572810
WILLOW	01500	N/A	23.0	270	SAMPLED	35.800828	-116.194456	3962157	572784
WILLOW	01550	N/A	22.0	88	SAMPLED	35.800428	-116.194706	3962112	572762
WILLOW	01600	N/A	22.0	155	SAMPLED	35.799991	-116.194843	3962064	572750
WILLOW	01650	N/A	23.0	65	SAMPLED	35.799558	-116.194994	3962015	572737
WILLOW	01700	N/A	24.0	100	SAMPLED	35.799006	-116.194934	3961954	572743
WILLOW	01750	N/A	N/A	N/A	INACCESSIBLE	35.798718	-116.195379	3961922	572703
WILLOW	01800	N/A	N/A	N/A	INACCESSIBLE	35.798278	-116.195279	3961873	572712
WILLOW	01850	N/A	N/A	N/A	INACCESSIBLE	35.797832	-116.195215	3961824	572718
WILLOW	01900	N/A	N/A	N/A	INACCESSIBLE	35.797399	-116.195344	3961776	572707
WILLOW	01950	N/A	N/A	N/A	INACCESSIBLE	35.797027	-116.195655	3961734	572679
WILLOW	02000	N/A	N/A	N/A	INACCESSIBLE	35.796726	-116.196063	3961701	572643
WILLOW	02050	N/A	N/A	N/A	INACCESSIBLE	35.796481	-116.196527	3961673	572601

Table A1. Geographic location, distance, habitat, temperature, and depth (if available) of the 405 established stations in the summer 2010 survey of the Amargosa River Canyon and Willow Creek, California, USA.—Continued

[NV = native, CCR = cattail/rush, SC = saltcedar. Latitude and longitude are decimal degree NAD 83; UTM's are Zone 11, NAD 83. N/A, not applicable]

Stream	Stream Distance(m) Sampling Station ID	Riparian Habitat	Temperature (°C)	Depth (mm)	Status	Latitude	Longitude	Northing	Easting
WILLOW	02100	N/A	22.0	25	SAMPLED	35.796229	-116.196986	3961645	572560
WILLOW	02150	N/A	N/A	N/A	INACCESSIBLE	35.795973	-116.197440	3961616	572519
WILLOW	02200	N/A	23.0	30	SAMPLED	35.795566	-116.197745	3961571	572492
WILLOW	02250	N/A	N/A	N/A	DRY	35.795422	-116.198316	3961554	572440
WILLOW	02300	N/A	23.0	30	SAMPLED	35.795059	-116.198636	3961514	572412
WILLOW	02350	N/A	23.0	30	SAMPLED	35.794618	-116.198718	3961465	572405
WILLOW	02400	N/A	N/A	N/A	DRY	35.794169	-116.198662	3961415	572410
WILLOW	02450	N/A	23.0	30	SAMPLED	35.793721	-116.198610	3961365	572415
WILLOW	02500	N/A	23.0	30	SAMPLED	35.793271	-116.198622	3961315	572415
WILLOW	02550	N/A	23.0	30	SAMPLED	35.792831	-116.198741	3961267	572404
WILLOW	02600	N/A	23.0	35	SAMPLED	35.792415	-116.198949	3961220	572386
WILLOW	02650	N/A	N/A	N/A	DRY	35.792090	-116.199328	3961184	572352
WILLOW	02700	N/A	N/A	N/A	DRY	35.791777	-116.199722	3961149	572317
WILLOW	02750	N/A	N/A	N/A	DRY	35.791346	-116.199717	3961101	572317
WILLOW	02800	N/A	N/A	N/A	DRY	35.790905	-116.199651	3961052	572324
WILLOW	02850	N/A	N/A	N/A	DRY	35.790467	-116.199783	3961004	572312
WILLOW	02900	N/A	N/A	N/A	DRY	35.790022	-116.199867	3960954	572305
WILLOW	02950	N/A	N/A	N/A	DRY	35.789588	-116.200016	3960906	572292
WILLOW	03000	N/A	N/A	N/A	DRY	35.789169	-116.200220	3960859	572274
WILLOW	03050	N/A	N/A	N/A	DRY	35.788729	-116.200303	3960810	572267
WILLOW	03100	N/A	N/A	N/A	DRY	35.788285	-116.200210	3960761	572276
WILLOW	03150	N/A	N/A	N/A	DRY	35.787838	-116.200255	3960712	572272
WILLOW	03200	N/A	N/A	N/A	DRY	35.787487	-116.200581	3960672	572243
WILLOW	03250	N/A	N/A	N/A	DRY	35.787182	-116.200988	3960638	572206
WILLOW	03300	N/A	N/A	N/A	DRY	35.786855	-116.201368	3960602	572172
WILLOW	03350	N/A	N/A	N/A	DRY	35.786471	-116.201657	3960559	572147
WILLOW	03400	N/A	N/A	N/A	DRY	35.786127	-116.202010	3960521	572115
WILLOW	03450	N/A	N/A	N/A	DRY	35.785777	-116.202354	3960481	572084

Table A2. Trapping and species capture summary table for the 405 established stations of the summer 2010 survey of the Amargosa River Canyon and Willow Creek, California.

	Amargosa River Canyon	Willow Creek	Total
Potential Stations	335	70	405
Sampled Stations	238	15	253
Dry Stations	94	47	141
Inaccessible Stations	3	8	11
Traps with Native Fishes	225	4	229
Traps with Pupfish	194	0	194
Total Pupfish Caught	8,558	0	8,558
Traps with Speckled Dace	206	4	210
Total Speckled Dace Caught	3,429	43	3,472
Traps with Invasive Species	153	7	160
Traps with Mosquitofish	110	0	110
Total Mosquitofish Caught	1,095	0	1,095
Traps with Crayfish	76	7	83
Total Crayfish Caught	195	43	238

Table A3. Water-quality measurements taken during the summer 2010 survey of the Amargosa River Canyon and Willow Creek, California.

[km, kilometer; °C, degrees Celsius; mg/L, milligrams per liter; µS/cm; microseimens per centimeter]

Stream	Distance downstream (km)	Temperature (°C)	LDO (mg/L)	Conductivity (µS/cm)	pH
Amargosa	0.00	24.3	7.8	4,645	8.2
Amargosa	1.60	24.5	6.4	2,044	7.9
Amargosa	6.95	24.8	8.6	2,381	8.3
Amargosa	8.25	23.4	6.2	5,318	8.1
Amargosa	12.20	25.4	4.2	4,840	8.1
Willow	1.45	28.7	7.1	1,050	7.6
Willow	2.10	27.7	8.6	1,082	8.3
Willow	2.60	25.2	12.1	1,027	8.4

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