



Monitoring Aquatic Amphibians and Invasive Species in the Mediterranean Coast Network, 2013 Project Report

Santa Monica Mountains National Recreation Area

Natural Resource Data Series NPS/MEDN/NRDS—2014/715



ON THE COVER

California newt (*Taricha torosa*)

Photograph by: National Park Service

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Introduction

Santa Monica Mountains National Recreation Area (SAMO) is adjacent to the second largest city in the United States. Ecosystem changes that result from urban development include the destruction and fragmentation of breeding habitat for aquatic amphibians, degradation of air and water quality, altered stream discharge regimes, and the introduction and spread of non-native invasive species. Urbanization of as little as 8 % of a watershed can have significant impacts on the distribution and abundance of native amphibian (Paul & Meyer 2001; Riley et al. 2005). A reduction in the distribution of native amphibians in the Santa Monica Mountains in association with increasing levels of urbanization and invasive species has been documented in the Santa Monica Mountains (Gamradt & Kats 1996; Goodsell & Kats 1999; Riley et al. 2005).

Native aquatic amphibian species in SAMO include California newts (*Taricha torosa*), Pacific treefrogs (*Pseudacris regilla*), California treefrogs (*P. cadaverina*), western toads (*Bufo boreas*), and red-legged frogs (*Rana draytonii*). Red-legged frogs, formerly common in a number of streams in the region (De Lisle et al. 1987), now occur only in one small population within the park. Non-native aquatic species within the SAMO include red swamp crayfish (*Procambarus clarkii*) native to the southeastern United States, bullfrogs (*R. catesbeiana*), and a number of fish species including bass (*Micropterus spp.*), bluegill (*Lepomis macrochirus*), and mosquitofish (*Gambusia affinis*).

Monitoring of aquatic amphibians in the Mediterranean Coast Inventory and Monitoring Network (Delaney et al. 2011) focuses on two metrics: occupancy (MacKenzie et al. 2003) and indices of abundance. Occupancy modeling provides a statistical framework for assessing changes in species occurrence while explicitly accounting for differences in detectability (MacKenzie et al. 2003, 2006). Information from repeated observations at sample units (streams) is used to estimate detectability and adjust occupancy rates for imperfect detection (failure to observe a species that is actually present).

The objectives of our long-term monitoring program are to 1) determine the status and long-term trends in abundance indices and percent area occupied by juvenile and adult aquatic amphibians in streams during the reproductive season, 2) determine the status and long-term trends in occupancy and abundance indices of non-native species, and 3) characterize the relationship between urbanization, non-native species and the occupancy and abundance indices of the focal native aquatic amphibians.

This report summarizes data collected during 2013, the 14th year of monitoring stream amphibians and invasive aquatic species in Santa Monica Mountains NRA. In this report, we present single-season occupancy and detectability estimates, naïve occupancy data, and abundance data.

Methods

A detailed description of methods for the long-term monitoring of aquatic amphibians in Santa Monica Mountains National Recreation Area can be found in Delaney et al. (2011a).

Sampling Design and Site Selection

In all, 58 unique locations have been identified for long-term monitoring (Figure 1). These sites include a mix of sites that have been monitored since 2000 (sentinel sites, N=22) and a suite of sites selected using generalized random tessellation stratified sampling (GRTS) (Stevens & Olsen 1999, 2003, 2004) that have been monitored on a rotating basis since 2006 (“R” sites, N=36). The “R” streams are visited following a serially rotating panel design. The 36 “R” sites are divided into 3 panels consisting of 12 monitoring sites (R1, R2, and R3). One panel is visited each year for three years. In the fourth year, R1 panel sites are revisited and so on. In 2013, sentinel sites and the R1 panel of stream sites (Figure 2) were surveyed by the National Park Service and collaborators.

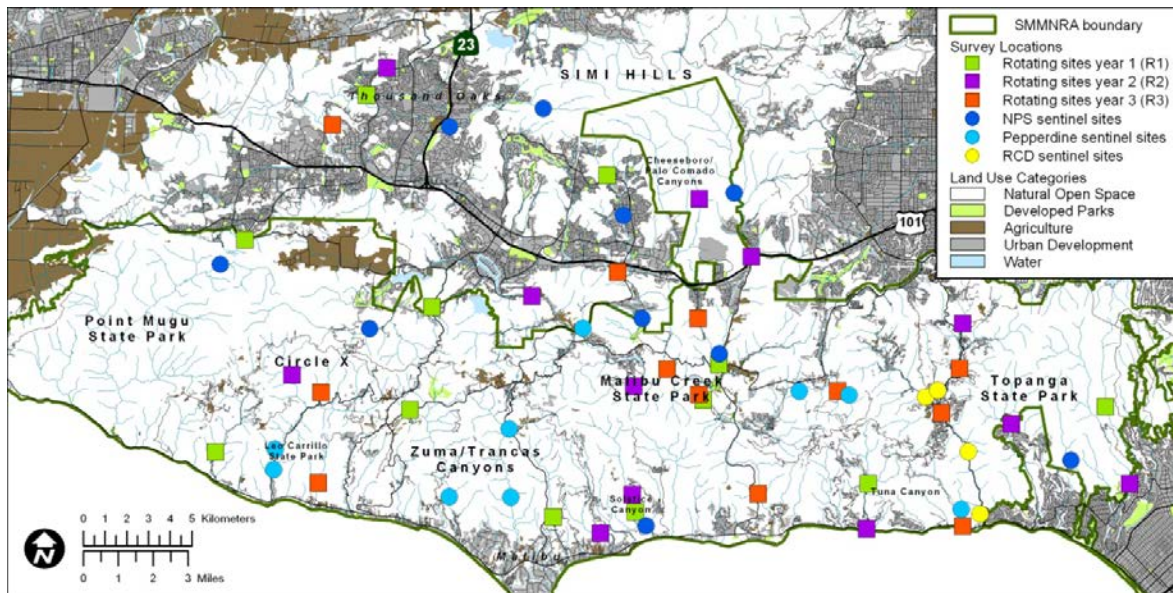


Figure 1. Study area and stream sites for all monitoring surveys.

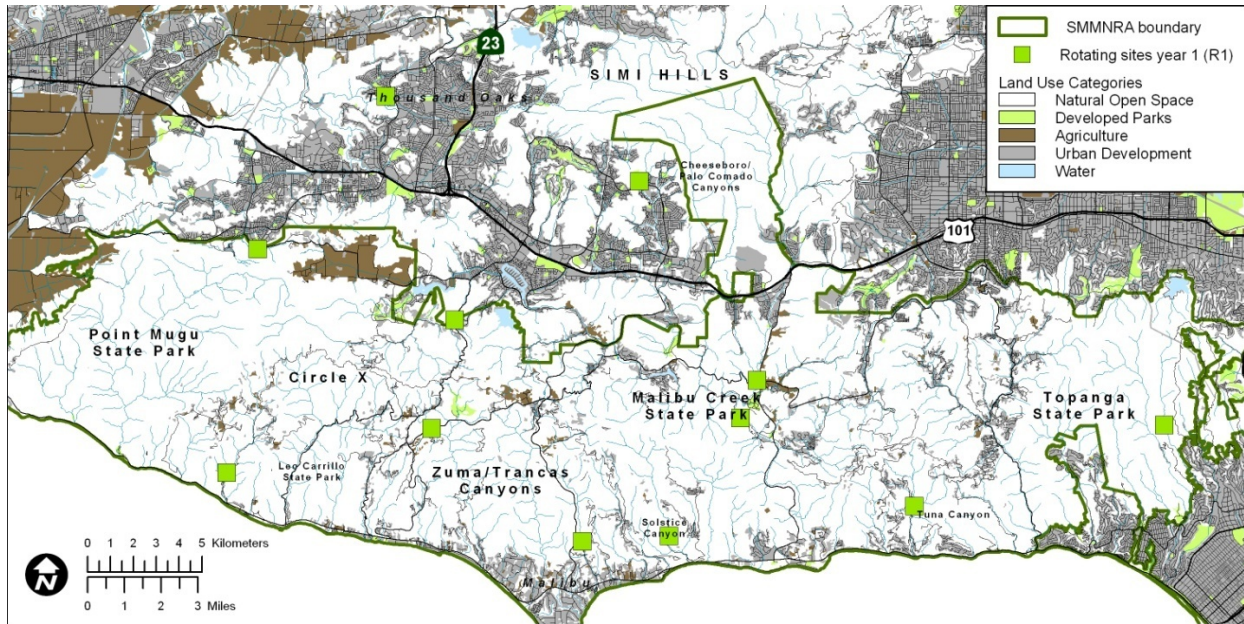


Figure 2. Rotating sites “R1” monitored by NPS in 2013.

Sampling Frequency and Replication

Sampling occurs from April to July to capture the breeding seasons of target amphibians. Each sampling location is visited twice in the season: once for an intensive sampling visit, when a full suite of biological and environmental data is collected, and another visit for observation of occupancy by target species (native amphibians and non-native fauna). Either survey type can be done first during the season. The timing of the sampling events are scheduled to coincide with species specific breeding seasons of the target amphibians, and is somewhat dependent upon year-to-year climate patterns. In very wet years the overall season for sampling may be longer than normal or drier years. Inland low elevation, low gradient streams are most likely to harbor the egg masses and/or larvae of Western toads and are sampled early in the season as these often dry up sooner than higher elevation high gradient streams. High gradient or coastal streams are most likely to harbor the larvae of California treefrogs and may be sampled later in the season.

Data Collection

There are two types of surveys done each year at each stream site; presence/absence (not detected) or occupancy sampling and intensive sampling. To confirm observations dip nets and aquascopes are used to find and capture larvae and adults and to verify species identification. Undersides of rocks, submerged logs and floating vegetation are searched for amphibian egg masses. Banks, exposed rocks and floating vegetation are also scanned for juvenile and adult amphibians.

- During occupancy sampling, a team of at least two surveyors begins at the designated starting point and travels upstream 250 meters (m) while recording the presence of any native amphibians or non-native target species.
- During intensive sampling, a team of at least two surveyors begins at the designated starting point, travels upstream for 250 m and collects physical and biological stream data as outlined below.

Physical Data

The field crew measures physical variables of each habitat along the length of the 250 m stream transect. Habitat is categorized into one of four types: pool (slow to non-moving bodies of water); riffle (quick shallow moving water); run (deeper slow moving water); and dry. Every change in habitat is considered a “stop” and is recorded as a number sequentially on the field data form. Length and depth of habitat are recorded for the stream segment between stops. Length (m) is measured using a 100m tape-measure, and depth (cm) is taken at the deepest point in the habitat segment using a meter stick. Habitat conditions (e.g. vegetation type, boulders, erosion) are recorded at each site.

Biological Data

For each target amphibian species, the following are determined and recorded at each stop:

- Abundance estimates using indices (<5, 5-20, 21-100, 101-500, >500) for larvae and juveniles; complete counts for adults and egg masses
- Age class counts (egg, larvae, juvenile, adult)

For each invasive species, the following are determined at each stop and recorded:

- Presence/absence of fish
- Presence/absence of crayfish
- Abundance estimates using indices (<5, 5-20, 21-100, 101-500, >500) of adult and juvenile crayfish

Data Verification, Validation, and Certification

Data were collected by park staff and interns and entered into the Aquatic Herpetofauna Database. Data were quality checked and verified for errors by program staff. Validation queries were run to highlight field values that were not consistent with expected results (i.e., out-of-range values). These values were double-checked against field datasheets and discrepancies were corrected as appropriate.

and/or noted in the database. All data collected in 2013 have been verified, validated, and certified to ensure they are error-free to the greatest extent possible.

Data Analysis

Naïve occupancy for 2013 was simply estimated from presence/absence data taken during the occupancy and intensive surveys conducted at each site. For analysis of occupancy, data from intensive surveys was collapsed to resemble the format of data from occupancy surveys. Single season occupancy estimates were made for each species using intercept-only, zero-inflated binomial mixture models. Occupancy and detection probabilities were estimated using maximum likelihood (MLE's) and numerical optimization. R code, adapted from Royle and Dorazio (2008; p. 117, Panel 3.8), was used to generate point estimates for occupancy and detection. Single season occupancy and detection did not include co-variates, therefore no model selection was needed.

Abundance data was used by calculating the number of stops in the stream that had the same abundance category. For example, we calculated the number of stops in a stream that had an abundance category of 21-100 divided by the total number of stops in a stream, resulting in a proportion of stops in a stream with an abundance category of 21-100. For Pacific treefrog tadpole abundance, we compared the proportion of stream stops in each category in streams with crayfish and without. Significance between crayfish and non-crayfish streams was tested with a non-parametric Wilcoxon signed-rank test using R.

Also, the average number of larvae per meter was calculated for streams with and without crayfish. This was calculated by taking the lowest number from our abundance categories (e.g. 5-20), adding the numbers together, and dividing by 250m (the length of stream surveyed).

Results and Discussion

Sites

Pepperdine staff surveyed seven stream sites and NPS staff surveyed 21 stream sites.

Pepperdine Sentinel, NPS Sentinel, and NPS Rotating (R1) stream survey data was used for this report for naïve occupancy and abundance analysis (see Table 1 and Figure 4).

Data from a second visit to Pepperdine's Sentinel sites was not available, so only NPS surveyed streams were used in the occupancy and detectability models (see Figure 3).

One stream was not surveyed because of dry conditions and was dropped from the analyses. This is the second year that this site was too dry to survey. The next time that R1 streams are surveyed, we will drop this site and it will be replaced with a new randomly-selected oversample site (from existing GRTS points).

NPS sentinel site "Big Sycamore Canyon" was not visited for the intensive survey because the site was severely altered due to a large wildfire. The Springs Fire occurred after our initial occupancy survey, therefore that data was included in our naïve occupancy data (see Table 1).

Biological Data

Naïve Occupancy

Pacific treefrogs had the widest distribution of all of the target amphibian species, and were present in 23 of 28 (85%) streams surveyed in 2013 (Table 1). California treefrogs were found in 9 (33%) and California newts were found in 11 (41%) of the 28 streams. The rarest species, western toads, were only found in 1 of the 28 (4%) streams surveyed. Invasive crayfish were present in 8 (30%) streams and invasive fish were present in 6 (22%). Bullfrogs were found at one site in 2013 (4%). Invasive New Zealand mudsnails were found in 13 (48%) of our sites.

Occupancy appeared to be related to the presence of non-native species in our stream surveys. California newts and California treefrogs were not present in streams that had invasive crayfish, fish, or bullfrogs (Table 1). Western toads can be locally abundant in the area, however, few of our streams fit the habitat requirements for toad breeding.

Table 1. Presence (1) or absence/not detected (0) of each target species at each Pepperdine and NPS stream site in 2013 (intensive and occupancy surveys combined). The following codes were used for each species: BUBO (Western toad), HYRE (Pacific treefrog), HYCA (California treefrog), TATO (California newt), CRAY (crayfish), FISH (any non-native fish species), RACA (bullfrog), and NZMS (New Zealand mudsnail); the number of streams where each species was present; and the percentage of streams [(number of streams with a species present/total number of streams surveyed)*100].

Stream Name	Stream Code	BUBO	HYCA	HYRE	TATO	CRAY	FISH	RACA	NZMS
Lower Arroyo Sequit	pepARRSEQL	0	1	1	1	0	0	0	0
Lower Cold Creek	pepCOLDCRKL	0	1	1	1	0	0	0	1
Upper Cold Creek	pepCOLDCRKU	0	1	1	1	0	0	0	0
Newton Canyon	pepNEWTON	0	1	1	1	0	0	0	
Trancas Canyon	pepTRANCAS	0	0	0	0	1	0	0	1
Tuna Canyon	pepTUNACYN	0	1	1	1	0	0	0	
Zuma Canyon	pepZUMACYN	0	1	0	0	0	0	0	1
Conejo Creek	R1_CONCRK	0	0	1	0	1	1	0	1
Eleanor	R1_ELEANOR	0	0	1	0	0	0	0	0
Las Flores	R1_LASFLORES	0	1	1	1	0	0	0	0
Liberty Canyon	R1_LIBCYN	0	0	1	0	1	1	0	1
Little Sycamore	R1_LITTLESYC	0	0	0	0	0	0	0	0
Malibu Creek	R1_MALICRK	0	0	1	0	1	1	1	1
Medea Creek	R1_MEDCRK	0	0	1	0	0	0	0	1
Ramirez Canyon	R1_RAMICYN	0	1	1	1	0	0	0	1
Solstice Canyon Upper	R1_SOLSCRK	0	1	1	1	0	0	0	0
Sullivan Canyon	R1_SULLCYN	0	0	1	0	0	0	0	0
Trancas West Fork	R1_WFTRANCAS	0	0	1	0	0	0	0	0
Big Sycamore Canyon	S_BIGSYC	0	0	0	0	0	0	0	0
Carlisle Canyon	S_CARLISLE	0	0	1	0	0	0	0	0
Lang Ranch (North)	S_LANRNCHN	0	0	1	1	0	0	0	0
Lang Ranch (Erbes)	S_LANRNCHS	0	0	0	0	1	0	0	1
Lower Las Virgenes	S_LLASVIR	0	0	1	0	1	1	0	1
Lower Medea Creek	S_LMEDCRK	0	0	1	0	1	1	0	1
Solstice Canyon	S_SOLSCRK	0	0	1	1	0	0	0	1
Temescal Canyon	S_TEMECYN	0	0	1	1	0	0	0	0
Upper Las Virgenes	S_ULASVIR	1	0	1	0	0	0	0	0
Upper Medea Creek	S_UMEDCRK	0	0	1	0	1	1	0	1
Total number of streams where present		1	9	23	11	8	6	1	13
Percentage of streams		4%	33%	85%	41%	30%	22%	4%	48%

Occupancy and Detectability

Western toads (BUBO) were only found at one site during 2013 (Table 1), and then only during one of the two surveys done. Because of this, the occupancy model could not estimate occupancy or detectability for the 2013 Western toad data. Estimated occupancy was very high for Pacific treefrogs (HYRE), and lower for the other two species. Detectability was very high for Pacific treefrogs (HYRE) and California newts (TATO), with a lower detectability for California treefrogs (HYCA) (Figure 3). Note that the occupancy and detectability analysis was done on NPS survey sites only (N=21). California treefrogs are cryptic species that can be hard to detect as adults, and breeding occurs in a shorter window of time than the other two native species. This may be the reason that detectability is lower in California treefrogs.

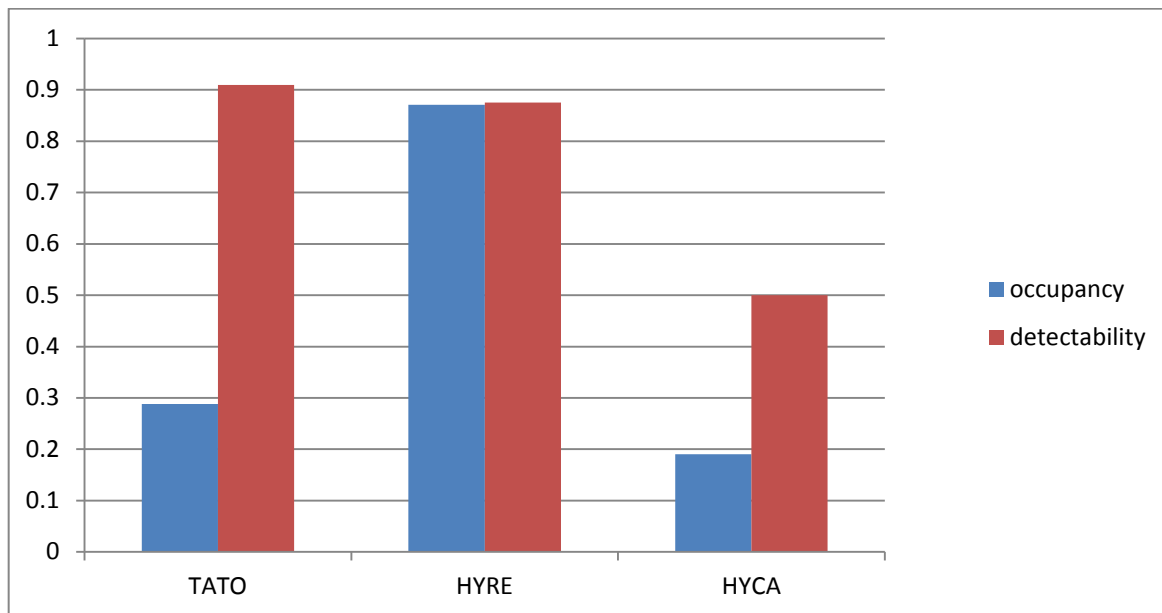


Figure 3. Single season (2013) estimate of occupancy and detectability for native amphibians in 21 streams. The following codes were used for each species: HYRE (Pacific treefrog), HYCA (California treefrog), and TATO (California newt).

Abundance

The average number of Pacific treefrog (HYRE) tadpoles was 0.43 per meter (N=19, SD=0.72) for streams without crayfish and 0.023 per meter (N=8, SD=0.032) for streams with crayfish. However, there was not a significant difference in the average number of Pacific treefrog larvae between streams with crayfish and streams without crayfish (Wilcoxon signed-rank test: $V = 5$, p -value = 0.078). Although the result is not significant, it is clear that there is almost a 20-fold increase in Pacific treefrog tadpole abundance in streams where crayfish have not been introduced.

Categorical abundance data was recorded at each stream “stop” during the intensive surveys. With these data, we examined how the presence of crayfish affected abundance of Pacific treefrog tadpoles. In streams with crayfish, there were more stops with zero Pacific treefrog tadpoles than in streams without crayfish, however, this difference was not significant. Also, streams without crayfish

had more stops with the 21-100 abundance index than streams without crayfish. These differences were not statistically significant.

Notable Detections

For the 5th year in a row, California red-legged frogs (*Rana draytonii*), a federally threatened species, were detected at the sentinel site, Upper Las Virgenes (S_ULASVIR). This detection was in the same stream reach that an adult California red-legged frog was found in 2009, 2010, 2011, and 2012 (Delaney et al. 2011; Delaney & Riley 2012a, 2012b, 2013). In 2013, three California red-legged frog egg masses were detected within the same stream but not within the survey site itself.

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