Anza-Borrego Desert State Park Amphibian Survey

Anza-Borrego Desert State Park, California
Final Report
2000

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California State Park Service
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200 Palm Canyon Drive
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Introduction

Wetlands are rare and fragile habitats in desert regions and are often isolated by xeric conditions. Consequently, amphibian communities utilizing these habitats may have been isolated from other populations for extended periods of time. These populations are often relatively small and subject to stochastic fluctuations in size due to unpredictable environmental conditions (Miller and Stebbins, 1964). Any negative impacts to these aquatic habitats may put these localized populations at risk of extirpation and effect the recruitment of these species by direct habitat reduction or reduction in habitat quality. For example, disturbances in the creek during the breeding cycle, such as vehicle, horse or foot traffic could adversely affect the resident amphibian population. Exotic species of fish, crayfish, and frogs can also create an adverse effect, as does exotic vegetation. To determine if management activities are adequately protecting these resources, monitoring aquatic sites for biotic and abiotic factors is required.

There are historic records for five native species of frogs and toads from Anza-Borrego State Park. One of these, the California red-legged frog (*Rana aurora draytonii*) is now protected by the endangered species act. One exotic amphibian species, the Bullfrog (*Rana catesbeiana*) is known from the park, at Lews spring. All of the amphibians are dependent on aquatic breeding sites for reproduction. Some species are able to breed in very small seeps and springs, but most prefer open pools associated with creeks.

During the 2000 field season we surveyed the wetlands associated with Coyote creek (including Tule, Alder, Sheep, and Cougar Canyon) in an attempt to track the recovery of the riparian zone following the closure of the off road vehicle track. We also surveyed Borrego Palm Canyon, Oroflamme Canyon and San Felipe Creek (including the cienega)

Methods

Surveys began fairly late in the season (5/15/00). Surveys consisted of two-person teams of field technicians familiar with the native and exotic amphibians of Southern California. Surveys usually began before noon and ended at dusk. Most sites were visited 3 times, usually involving two day visits and one night visit. During the breeding season, aural surveys for male advertisement calls were conducted. During a survey, the team would hike a stretch of streambed previously determined to retain some surface water. Any open pools or flowing stretches of the drainage were examined intensively for amphibian larvae and adults. In addition, audible calls that could be identified to species were also noted.

A suite of water quality variables including pH, conductivity, total dissolved solids, transparency, temperature, salinity and dissolved oxygen were measured during sample visits. The instruments used to record these variables were as follows: YSI 85 Handheld Dissolved Oxygen, Conductivity, Salinity and Temperature System, Oakton TDSTestr 10 for total dissolved solids, and Oakton pHTestr 2 for pH. Habitat variables including percent cover, vegetation type for streambed and bank, substrate type for streambed and bank, and general descriptions of water flow including stream width, depth and qualitative estimates of flow were also recorded for each site. In addition to collection of habitat and environmental variables, vertebrate and large macro-invertebrate species catalogs were recorded for each of the sites within the study area. Voucher specimens of species not considered threatened or sensitive were collected when they occurred at a study site.

Results:

We identified three distinct habitat types while conducting surveys in the park. The first type was associated with smaller watersheds and consisted of stream channels overgrown with vegetation and filled with sandy silt. Although surface water was present during the times we surveyed, the wetted areas at these sites often consisted of seeps or pools with very little flowing water. This habitat type also had very little exposed bedrock in the stream channel, corresponding to the thicker plant cover observed at these locations. Common plants at these locations included mulefat, catclaw and mesquite.

The second habitat type was associated with larger watersheds or confluences of several smaller drainages and consisted of exposed bedrock channels with vegetation restricted to the margins of the channel. The wetted areas at these sites consisted of larger pools and visible flow was commonly observed. Vegetation at these sites often consisted of larger trees and was more open than the first type. Common plants at these locations included California fan palms, sycamore and cottonwood as well as mulefat, catclaw and mesquite.

The third habitat type was associated with the floor of Coyote Canyon and was comprised of the three Willows sites. These sites were all extremely low gradient and densely vegetated. The vegetation at these sites retained a consistent pattern with a dense canopy of cottonwood and sycamore trees surrounded by catclaw and mesquite, which marked the beginning of the wetted portion. This canopy gradually thinned into willow and tules as the stream channel became more developed downstream. Open water at these sites consisted of stagnant pools and seeps within the dense canopy at the head of the seep, transitioning into well developed pools and flowing stream channels downstream.

Tule, Alder, and Oroflamme Canyon

Tule, Alder and Oroflamme Canyons were similar to each other, having smaller watersheds, and although steep, did not capture enough water to scour the drainage and form exposed bedrock channels. This reduced scouring resulted in much thicker riparian zones with dense underbrush. Although we found California tree-frogs (*Hyla cadaverina*) in these Canyons, we did not detect the red-spotted toad (*Bufo punctatus*) and therefore conclude that its habitat requirements are not met by these smaller order streams. Surface water at these locations was restricted to intermittent seeps and trickles or stagnant pools. A significant source of disturbance in the drainages at these sites was wild horse activity. The horses disturbed the drainage through direct physical disturbance (e.g. trampling) and through grazing and nitrogen input. Nitrogen level in these drainages has not yet been measured.

Sentenac Canyon (San Felipe creek)

Sentenac Canyon did not fall into an easily distinguishable category and was best defined as being a transition between the first and second habitat type discussed above. It was the only survey location where we observed introduced red swamp crayfish (*Procambrius clarkii*). We also detected unarmored threespine stickleback (*Gasterosteus aculeatus*), which although native to the region, are not native to this drainage. The ceinega at the top of the gorge was the most likely location for the persistence of ranid frogs, exotic or otherwise, however none were detected. The only native amphibian detected was the California tree frog, which persisted in pools without crayfish choked with chara (*Chara chara*), but was absent from pools with less vegetation. It is assumed that crayfish preyed on and extirpated tree frogs in these pools.

Sheep, Cougar, and Borrego Palm Canyon

Sheep and Cougar Canyons both had similar morphology and plant communities, which corresponded with larger watersheds than the first habitat type. These Canyons usually terminated in sandy washes that did not retain much surface water. We found California tree frogs and red-spotted toads at all three survey sites, but the red-spotted toads were always found in the lower reaches near or in the sandy washes. Borrego Palm Canyon was similar to both Sheep and Cougar in its overall composition but had larger palm groves than the other two locations. We found the Pacific tree-frog (*Hyla regilla*) at this survey location but did not detect it at the other two locations. As with the other sites, the red-spotted toads were restricted to the base of the Canyon where it began to open up and the tree-frog species were found further up in the Canyon.

Lower, Middle, and Upper Willows

All three Willows sites had a similar plant community and spring formation. The upstream boundary was demarked by willow but would rapidly transition into larger plants and a thicker canopy composed of cottonwood, sycamore and occasional

California fan palm with dense thickets of wild grape cat-claw and mesquite in the understory. Surface water was always found within these areas. Moving downstream, the canopy would thin and transition back into willow with tules and sedges forming dense lanes in the stream channel. Surface water would become more prevalent and transition from seeps and pools into a well-defined channel with measurable flow. Further downstream the channel would break away from the dense stands of tules and sedges to eventually disappear into the deep alluvium that formed the lower portions of each Willows site.

Lower Willows: Second Crossing

This was the wettest of the three springs on the floor of Coyote Canyon, and the only survey area impacted by off-road vehicle traffic. It kept the formation described above, but the stream channel was not as strongly defined as the other locations and appeared to braid during high flow. The road crossing formed a large pool and we observed California tree-frog tadpoles in the pool. We also observed Pacific tree-frog adults as well as heard them calling. During the 5/19 field survey we observed western toad (*Bufo boreas*) egg strings as well as red-spotted toad egg clusters. Red-spotted toad egg clusters were easily distinguishable from western toad eggs strings due to their grape cluster formation. The flowing stream channel outside the road crossing pool contained lower densities of tadpoles (~2 per meter^2) compared with the road crossing pool and nearby backwaters (~40 per meter^2). We collected one dead toebiter (*Abedus herberti*) after another vehicle had driven through the pool. We also observed a visitor's dog exploring the nearby backwaters and photographed its footprints in the pool.

Lower Willows: Third Crossing

At the third crossing tadpoles were restricted to the undercut banks on either side with few of them straying into the open channel. A dead California tree-frog tadpole being cannibalized by other tadpoles of the same species was collected from this location. We estimated tadpole density at ~10 per m^2 with ~40m^2 of habitat equaling ~400 tads at this location. All were California tree frogs and very large (30+mm). A shallow backwater just downstream of the road crossing was filled with very small (just hatched, 1cm total length) tads, most were California tree frogs, but ~1% were red-spotted toads. We estimated between 400-600 tads within this 1m^2 area. We observed a single western toad while at the site. We also heard red-spotted toad calls from the area.

Road Crossing Disturbance Measurements

At the Lower Willows site, in addition to regular surveys, we observed and measured the effects of automotive disturbance on the stream channel. We measured the effects of auto crossings on two large pools at the Lower Willows site using a Land Rover Discovery 4-wheel drive vehicle. The Land Rover was considered to be similar enough to other vehicles traversing this area as not to skew any observations made about its effects on the crossings. To support this, we observed a Ford Expedition (larger), a Dodge Durango (similar size) and a Suzuki Samurai (smaller) all make the crossing and produce similar effects. Each experimental disturbance was produced by driving the vehicle through the pool, completely out onto the opposite bank and then reversing and returning through with as little delay as possible at an average speed of 5 miles per hour. Transparency was used as an indirect measure of turbidity and was measured using a 5-centimeter sechi disk on a meter long pole. The general area was observed for approximately 2 hours prior to the disturbance in order for the observers to become familiar with the observable qualities of the stream channel to better gauge the disturbance. After observing two cars crossing the stream, we estimate immediate effects of the crossing to persist for ~5min before becoming un-observable. Silt was visibly transported more that 100m downstream in each observed crossing.

Measurement of turbidity at the road crossing pool created by automobile crossings at this location yielded the results in table #1. Just prior to conducting this disturbance and measurement, we observed a pair of red-spotted toads in amplexus and in the process of laying eggs (figure #1). We counted 20 separate egg clusters (figure #2) and then moved the pair downstream in order to proceed with the measurement. A significant amount of water was displaced by the car and the pair was washed downstream but quickly moved back into the pool and continued laying eggs.
After the disturbance, egg clusters were no longer visible although individual eggs were. The disturbed egg clusters formed rafts of eggs and were covered with a fine layer of sediment (figure #3). The Second Crossing appeared to experience more disturbance than the Third Crossing and had a more persistent layer of silt covering the substrate after disturbance. Turbidity measurements at the Second Crossing site yielded the results in table #2.

Middle Willows

Middle Willows possessed similar habitat to that of Lower Willows with the exception of the road crossing pools. Since being closed following the 1997 El Nino event, the stream channel shows little sign of the ORV track and it was difficult to determine where the track had been in most locations. We could not observe any geo-morphological or plant community differences that gave indications of the original location of the road. Areas outside the stream channel appeared to be the only surviving evidence of the roads existence. During night surveys we found red-spotted toad adults foraging in the under story of the upstream portion and during day surveys found red-spotted toad tadpoles in backwaters of the stream channel in the downstream portion. We also observed adults and tadpoles of both tree-frog species in the downstream portion.

Upper Willows

Upper Willows differed from the other two willows sites in that it experienced more disturbance from wild horses. Evidence of the presence of wild horses was present at all three willows locations and indeed at all Coyote Canyon field sites. However, Upper Willows appears to be the primary watering hole and was highly disturbed compared to all other sites. It possessed the typical canopy of oak and sycamore associated with the headwaters of the willows, but the lane of willow that followed the stream channel out of the canopy and downstream had been trampled and grazed to a point of complete exposure of the channel (i.e. no plant material/riparian zone). We found adult amphibians as well as evidence of reproduction in this area (Pacific and California tree-frogs and red-spotted toads) and it is unclear whether the presence of the horses is adversely affecting amphibian populations. Additionally, the issue of whether horse feces in the water may have adverse effects on the amphibian population through nutrient enrichment and deposition of nitrogen is unclear.

Discussion

There was a high degree of seasonality to the presence or absence of water and amphibian species at our survey locations within the park. Sites that possessed high flows one month were observed dry the next. Due to the late start of the field season (start date 5/15/00) we were unable to track seasonal variation at most sites. Expansion of the 2001 field season to include surveys during winter months when the park is receiving most of its precipitation is highly recommended. This expanded temporal period should allow us to detect all species at a given location.

We observed differences in habitat preference between species, with western and red-spotted toads being unable to utilize steep gradient drainages that didn't supply the flat, open pools they prefer for reproduction. There may also be adult habitat selection involved because adult toads of both species were only observed in relatively open areas like sandy benches and the un-vegetated under-story of cottonwood groves. It is important to note that the tree-frog species were not restricted by gradient and were found in both low and high gradient environments. They appeared more restricted by available sources of surface water. The California tree frog was the only species observed in the smaller, steeper reaches of most survey locations.

Although we observed adults and eggs of both toad species in the road crossing pools, we never saw tadpoles. We did observe toad tadpoles just below Lower Willows Third Crossing in a shallow backwater, and it is assumed that successful recruitment in the area as a whole is occurring. We also observed toad tadpoles at both Upper and Middle Willows, so reproduction is definitely not dependent on man-made pool formations. California tree-frog tadpoles were observed in abundance and apparently had no problems persisting in the face of disturbance by cars, as we observed only one mortality during ~20 road crossings. This is probably due to morphological differences between tree frog and toad tadpoles. The tree-frog tadpoles are very large and have well developed tails, enabling them to swim rapidly, while in contrast toad tadpoles posses rather small tails and do not attain as great a size, and hence do not swim as vigorously (pers. observation). This difference may allow tree-frog tadpoles to simply swim out of the way when cars pass through the pool. If indeed toad tadpoles are unable to persist in these pools due to disturbance by cars, then the pools are creating an attractive nuisance, because the adults seemed drawn to these areas and reproductive efforts by both species were observed. Habitat disturbance in Upper and Middle Willows was almost entirely caused by horses. Two years of isolation from motor vehicle traffic has allowed almost complete recovery from automotive disturbance in these areas.

Introduced Species in the Park

Two exotic aquatic species, the red swamp crayfish and the unarmored threespine stickleback were detected in Sentenac Canyon. The red swamp crayfish is an extremely destructive species and is capable of extirpating native species once it is introduced into a drainage (Gamradt, Kats and Anzalone, 1997). Its presence is probably due to the large pastureland above Sentenac Canyon. Any stock tanks above the Canyon that at one time had the crayfish introduced would allow the crayfish to colonize downstream easily. They may have also been incidentally introduced with the stickleback. However, there is little room for the crayfish to expand its range based on its current location. Human transport and introduction of the crayfish or any other common exotic species is of real concern to all aquatic habitats in the park. The presence of the threespine stickleback, a native to the area but not the drainage is due to purposeful introductions in the 1970's by California department of Fish & Game (CDFG). The stickleback is listed as endangered and the introduction was intended to establish a reserve stock. In this objective, CDFG succeeded, however, this may have resulted in the unintentional extirpation of red-legged frogs by introduction of viral pathogens that the frog is susceptible to. This possibility is currently being explored and samples of the stickleback have been sent to a fish health laboratory for analysis.

Acknowledgements

In closing we would like to acknowledge all those that made this work possible including the State Park Service for their generous support and Mark Jorgenson, who shared his unmatched knowledge of the park and its animals with us. Tim Hovey from Cal.Dept.Fish&Game also assisted in collection efforts. Finally, thanks to the many dedicated field workers of the USGS/BRD San Diego field station.

Literature Cited

Gamradt, S. C., L. B. Kats, C. B. Anzalone. 1997. Aggression by Non-Native Crayfish Deters Breeding in California Newts. Conservation Biology 11:793-796.

Miller, A. H., R. C. Stebbins. 1964. The Lives of Desert Animals in Joshua Tree National Monument. University of California Press pp. 20-24.

Appendix 1

Tables, Pictures and Maps

Table #1

Time in Seconds	Visibility in cm.
0	10
30	18
60	21
90	25
120	28
180	29
240	30
300	CLEAR

Table#2

Time in Seconds	Visibility in cm.
0	10
30	30
60	36
90	CLEAR
@420	No Suspended Silt

Figure #1

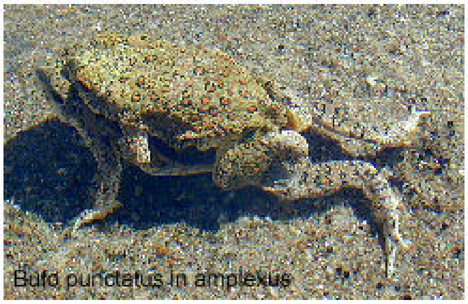


Figure #2

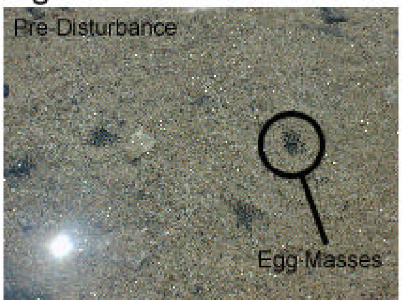
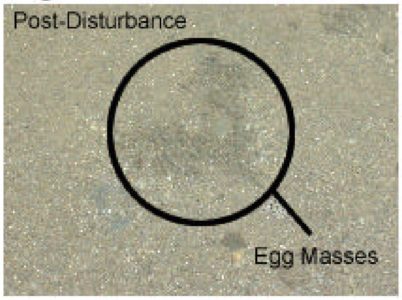
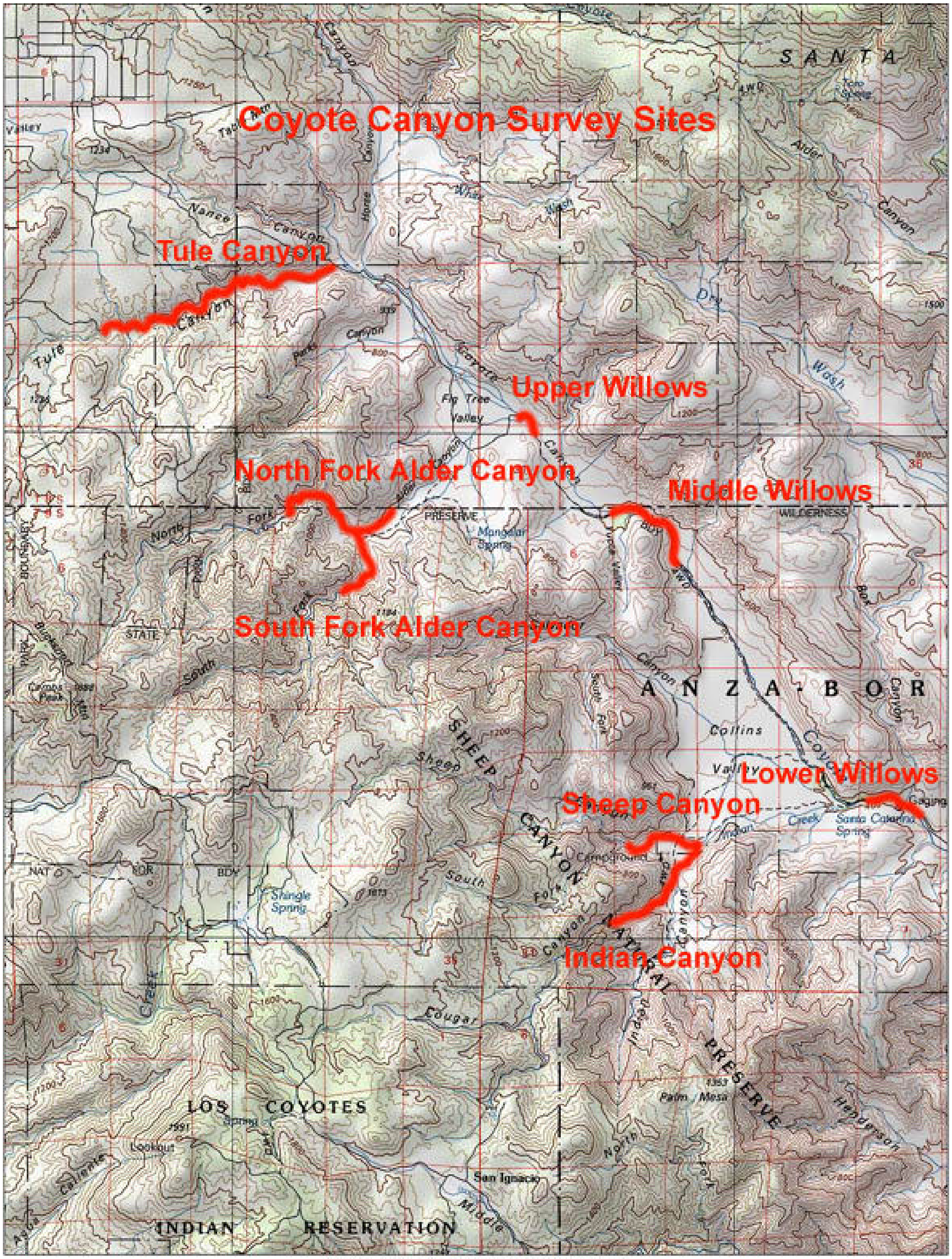


Figure #3



Map #1



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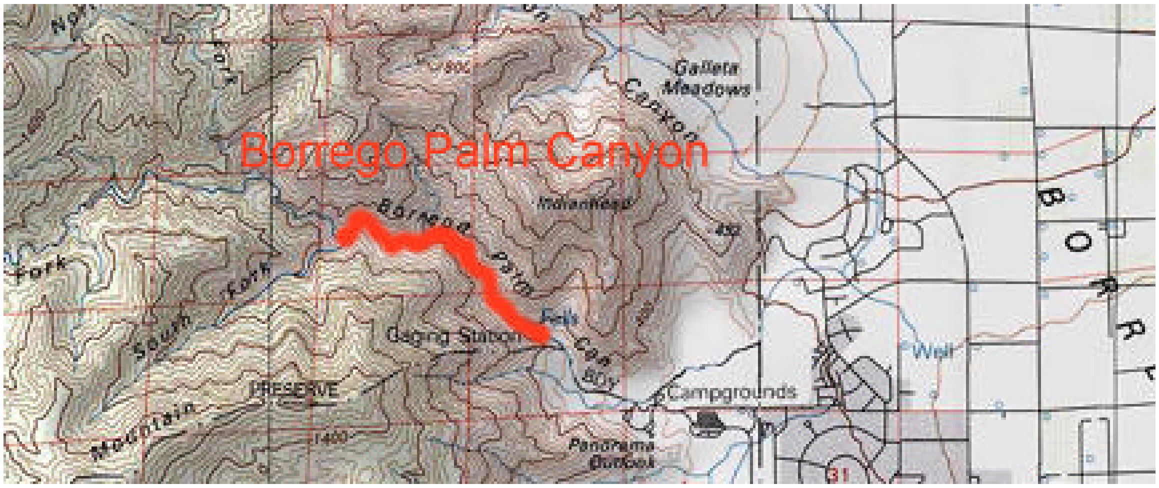
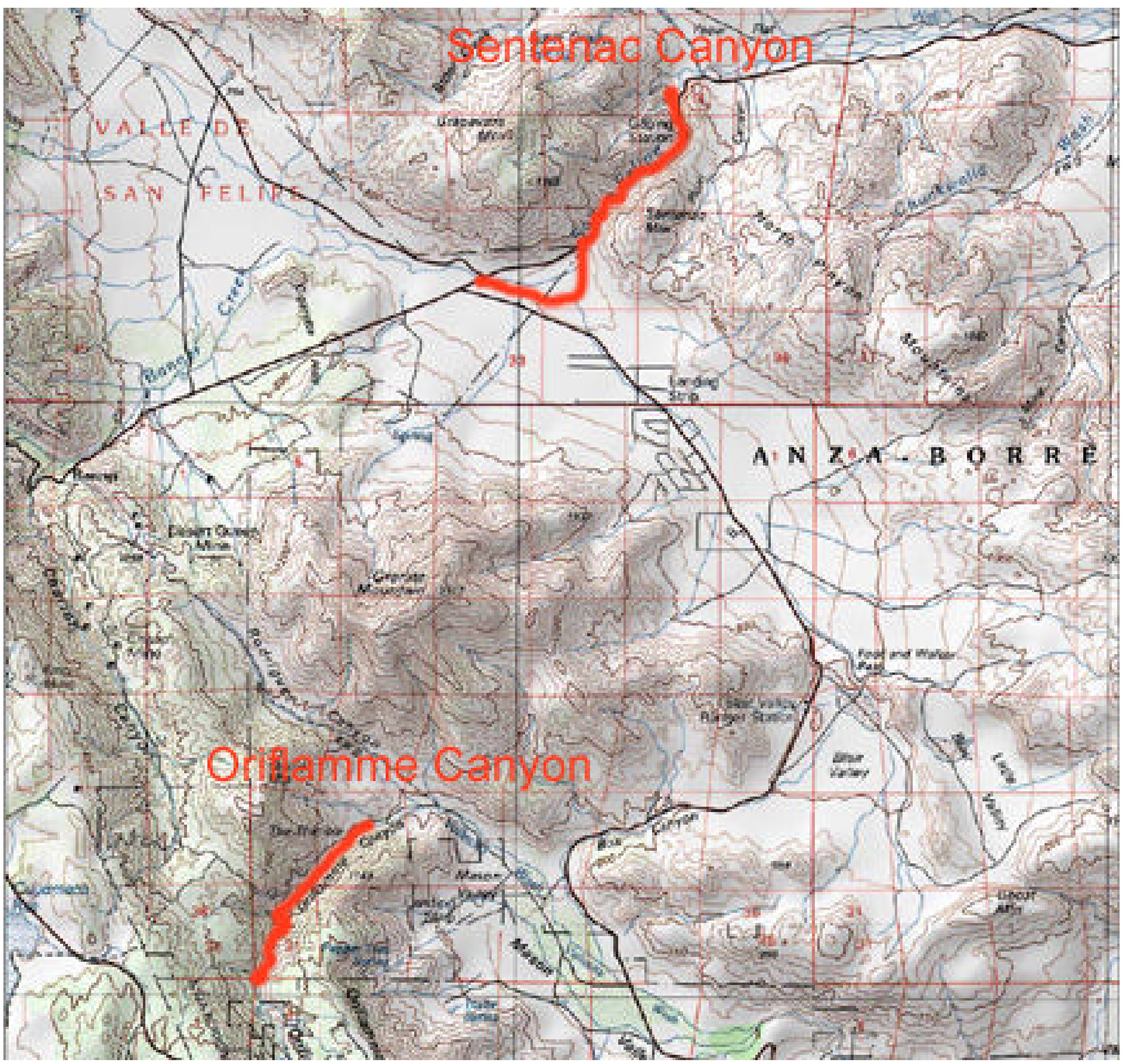
Map #2


Borrego Palm Canyon
Galleta
Meadows
Gaging Station
PRESERVE
Campgrounds
Panorama
Outlook

Map #3


Sentenac Canyon
VALLE DE
SAN FELIPE
A N Z A - B O R R E
Oriflamme Canyon

Appendix 2

Data Tables

Anza-Borrego Amphibian Observations by Survey Location

Location	Date	Latitude	Longitude	Hyre	Hyca	Bubo	Bupu	Prcl	Gaac
Lower Willows	5/18/00	33.37124	-116.42381	2	1,2	2	1		
Middle Willows	5/23/00	33.42450	-116.47858	2	1,2		1		
Upper Willows	5/23/00	33.44274	-116.50688	2	1,2		1,2		
San Felipe Creek at Hwy 78 xing	6/1/00	33.09821	-116.47205						1,2
San Felipe Creek / Sentenec cyn at cieniga	6/1/00	33.10477	-116.45196	1				1,2	1,2
Sentenac Cyn.	6/1/00	33.10343	-116.45303		1,2				
Alder Cyn. South Fork	5/30/00	33.41305	-116.54355		2				
Alder Cyn. North Fork	5/15/00	33.42761	-116.54923						
Oriflamme Cyn.	7/27/00	33.01269	-116.49842	1					
Tule Cyn.	5/30/00	33.46568	-116.57215	1,2	1,2				
Sheep Cyn.	5/17/00	33.37138	-116.49545	2	1,2				
Cougar Cyn.	5/18/00	33.34960	-116.49602		1,2		1		
Borrego Palm Cyn.	6/7/00	33.27995	-116.43333		1,2		1		

Legend			
Bupu	***Bufo punctatus***		**1 equals Eggs/Larvae**
Bubo	***Bufo boreas***		**2 equals Metamorph/Adult**
Hyre	***Hyla regilla***		
Hyca	***Hyla cadaverina***		
Prcl	***Procambrius clarkii***		
Gaac	***Gasterosteus aculeatus***		

Anza-Borrego Survey locations: Water Quality Variables

Location	Date	Water Temp	Transparency (cm)	Salinity	D.O.%	D.O.MG/L	T.D. Solids (ppm)	Conductivity	pH
Lower Willows, 2nd xing	5/18/00	24.7	na	0.4	91	7.5	525	815	8.4
Lower Willows, 2nd xing	8/31/00	23.7	na	0.4	78	6.6	590	849	8.4
Lower Willows 3rd xing, upstream of road xing	5/18/00	22.5	na	0.4	106	9.2	498	762	8.5
Lower Willows 3rd xing, at road xing	5/18/00	25.7	na	0.4	112	9.1	516	817	8.4
Lower Willows, 3rd xing	5/18/00	23.9	na	0.4	106	9.0	416	778	8.5
Lower Willows, 3rd xing, middle of road xing	5/18/00	22.5	na	0.4	105	9.0	505	761	8.4
Lower Willows, 2nd xing, at pool 100m upstream	5/19/00	21.6	na	0.4	120	10.7	530	775	8.5
Middle Willows, after constriction at blocked road xing	5/23/00	22.6	na	1.0	87	7.6	1530	1789	8.2
Upper Willows	5/23/00	23.8	na	0.8	86	7.3	103	1609	7.8
San Felipe Creek at Hwy 78 xing	6/1/00	20.9	na	0.4	87	8.2	577	836	8.4
San Felipe Creek / Sentenac cyn at cieniga	6/1/00	17.4	75	0.4	86	8.2	925	1288	8.4
Alder Cyn	5/15/00	20.2	na	1.1	88	8.0	na	1870	7.7
Oriflamme Cyn	7/27/00	21.3	na	0.6	78	6.8	800	1088	7.8
Borrego Palm Cyn, Ist palm oasis	8/31/00	22.3	na	0.6	55	4.5	825	1185	7.9
Borrego Palm Cyn, Ist palm oasis	6/7/00	21.3	na	0.6	40	3.6	704	1038	7.6
Borrego Palm Cyn, 2nd palm oasis	6/7/00	22.8	na	0.6	75	6.5	804	1196	7.9

Water Temperature (degrees celsius)
Transparency (centimeters)
Salinity (parts per thousand)
Dissolved Oxygen (percent saturation)
Dissolved Oxygen (milligrams per liter)
Total dissolved solids (parts per million)
Conductivity (microsiemens)
pH