

Relict Leopard Frog Monitoring, Management, and Research 2006 Activity Report

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Primary Authors:

Jef R. Jaeger and Dana L. Drake
Public Lands Institute, University of Nevada, Las Vegas

EXECUTIVE SUMMARY

This report summarizes activities for the conservation of the Relict Leopard Frog (*Rana onca*) conducted under task agreements awarded by the National Park Service, Lake Mead National Recreation Area, to the Public Lands Institute at the University of Nevada, Las Vegas. The period summarized in this report partially spans two such task agreements, with this report compiled under a task agreement begun on September 30, 2006. Monitoring, management, and research activities for the Relict Leopard Frog are overseen by the Relict Leopard Frog Conservation Team (RLFCT) and specified within the Relict Leopard Frog Conservation Assessment and Strategy (CAS). The CAS describes the development of annual work plans and insures the assessment of annual monitoring and management actions. An associated document specifies management and monitoring protocols. The following information summarizes major activities and products accomplished during 2006 towards the successful completion of deliverables in the statements of work for the associated task agreements.

- As part of the translocation program, 6 egg masses were removed from a wild population for head-starting, resulting in 230 frogs and 1787 tadpoles used to augment 4 existing sites and to start 2 new sites (meeting specified objectives).
- Sugarloaf Spring, a previous translocation site, was not augmented this year because of an unexpected lack of water during the summer.
- Diurnal visual encounter surveys were conducted at all established natural and experimental sites during the spring to assess breeding success (meeting specified objectives).
- Nocturnal visual encounter surveys were conducted at all established natural and experimental sites during both the spring and fall to assess population status (meeting specified objectives)
- Additional diurnal and nocturnal surveys were conducted in the fall and winter as initiated research to better determine breeding activities and to describe oviposition sites.
- The main findings of concern results from major storm and flooding events in mid-October that caused massive debris flows and scouring at most sites within Black Canyon and substantially damaged habitat at Bighorn Sheep Spring (historically, the most productive population). Other

sites also were greatly modified by the scouring events, but habitat for leopard frogs at Salt Cedar Spring may have actually been improved.

- Vegetation management was conducted to decrease tamarisk cover along the stream at the Pupfish Refuge Spring.
- The Relict Leopard Frog Conservation Team met on June 12, 2006 and on November 29, 2006 with associated meeting minutes generated. The 2005 RLFCT annual report was compiled and accepted by the team.

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Background

The Relict Leopard Frog (*Rana onca*) occurs naturally at only seven sites clustered in two general areas within the boundaries of Lake Mead National Recreation Area (LMNRA). The total number of adult frogs in the wild was roughly estimated at 1,100 in 2001 (Bradford et al. 2004). Early descriptions of the species range, as presented in the literature, were confused by taxonomic uncertainties regarding regional leopard frog populations, but this frog appears to be a regional endemic, historically occurring along the Virgin and Muddy River drainages and adjacent portions of the Colorado River (Bradford et al. 2004). The causal factors associated with the decline of the Relict Leopard Frog are not entirely clear, but implicated factors included agriculture and water development, and the introduction of exotic predators and competitors (e.g., American bullfrog, red swamp crayfish, and various fishes; Jennings and Hayes 1994). More recent population losses at two sites appear to have had causal factors associated with habitat changes resulting from reductions in habitat disturbance leading to increases in emergent native vegetation (Bradford et al. 2004).

Monitoring, management, and research activities for the Relict Leopard Frog are overseen by the Relict Leopard Frog Conservation Team (RLFCT; chaired by Mr. Ross Haley, Wildlife Branch Chief, LMNRA) and specified within the Relict Leopard Frog Conservation Assessment and Strategy (CAS 2005). The CAS complies with the U.S. Fish and Wildlife Service (USFWS) Policy for the Evaluation of Conservation Efforts (PECE), and the final document has signatures from several federal and state agencies. The CAS describes the development of annual work plans and insures the assessment of annual monitoring and management actions. A Protocols and Techniques Manual that outlines acceptable procedures for use in monitoring and management was prepared as a companion document to the CAS.

Research personnel from the Public Lands Institute (PLI), University of Nevada Las Vegas (UNLV) have primary responsibility for implementing monitoring, management, and research actions for this species on federal lands as stipulated under task agreement awarded by the NPS. These continuing efforts have been covered under several such task agreements, and earlier efforts in 2004-2005 were presented in a final report completed by PLI (Velez 2006) and provided to the NPS for submission to the Clark County Multiple Species Habitat Conservation Plan (MSHCP; the format of this report was stipulated by the County). Reports on conservation efforts have been systematically presented to the RLFCT and variously reported in the minutes and team reports. In addition, efforts towards successfully meeting task agreement deliverables for the first three quarters of 2006 were summarized in a final close-out report for the task agreement ending on September 30, 2006 (PLI 2006). All data associated with survey and translocation efforts have been entered into a database (Access database) or spread sheets (Microsoft) maintained by the NPS at LMNRA.

As noted above, the information reported herein summarizes major activities and products accomplished during 2006 towards successfully meeting the deliverables in the statements of work for the associated task agreements and the conservation of the Relict Leopard Frog.

Task Agreement Objectives

The general objectives for 2006 are outlined below:

1. Conduct a translocation program for the Relict Leopard Frog to establish experimental populations at suitable locations.
2. Monitor existing experimental populations to determine translocation success.
3. Monitor populations at natural sites to evaluate population status and identify potential emerging threats to populations or habitats.
4. Conduct small-scale habitat management activities as needed to improve habitat conditions.
5. Coordinate and monitor activities by teams working on large-scale exotic vegetation management and on experimental efforts to improve habitat conditions at natural and experimental sites.
6. Assist with research efforts conducted by other researchers.
7. Assist with planning efforts through active coordination of the Relict Leopard Frog Conservation Team.

Translocation Efforts

Management actions include the continuation of a head-starting and translocation program aimed at establishing populations of Relict Leopard Frogs within the potential management zone for this species (CAS 2005). These activities include the maintenance and operation of the head-starting (rearing) facility at LMNRA (Hill Top facility, Boulder City) and coordination of a facility at the USFWS Willow Beach National Fish Hatchery. In general, eggs have been collected from an appropriate wild population in early spring for rearing in these laboratories. Once tadpoles near metamorphosis or shortly after metamorphosis, animals have been released to either augment existing translocation populations or to establish additional populations as determined by surveys and stipulated in the adaptive RLFCT annual work plan.

In January 2006, in support of the translocation effort, six egg masses were collected from Bighorn Sheep Spring and transferred to the head-starting facilities. These collections resulted in a total of 230 frogs and 1787 large tadpoles released to translocation sites (Table 1). In addition, 10 adult frogs were retained in captivity at the USFWS facility.

Table 1. Number of frogs and tadpoles released in 2006 and total number released since 2003 by site.

Site Name	Animals Release in 2006	Total Animals Released
Goldstrike Canyon, NV	527 tadpoles	1,739 total since 2004
Grapevine Spring, AZ	660 tadpoles	2,195 total since 2004
Lower Grapevine Spring, NV	600 tadpoles	600 total since 2006
Pupfish Refuge Spring, NV	21 frogs	427 since 2003
Red Rock Spring, NV	34 frogs	233 total since 2005
Sugarloaf Spring, AZ	0	372 total since 2003
Tassi Spring, AZ	175 frogs	175 total since 2006
Totals	230 frogs, 1787 tadpoles	5741 animals since 2003

Translocation efforts suffered minor difficulties in late June 2006, following the discovery of bloating (fluid accumulation under the skin) in several newly metamorphosed individuals. Because this condition was symptomatic of several bacterial or viral diseases, releases were postponed while samples were sent to Dr. David Green at the National Wildlife Health Center, Madison, Wisconsin, for diagnosis. This delay resulted in subsequent overcrowding as tadpoles metamorphosed into juvenile frogs and the crowded conditions resulted in the loss of some newly metamorphosed frogs. Test results were not returned until mid-August; all bacterial and viral tests results were negative. Under microscope inspection, necropsy analysis showed large crystals in the kidneys blocking fluid passage, hence the fluid accumulation. The diagnosis was a kidney disease called oxalate nephrosis probably resulting from exposure to ethylene glycol, a naturally occurring chemical in spinach (the primary food for tadpoles in the lab). The feeding regime followed accepted protocols (under the CAS) and was not different from that used successfully in previous years; however, levels of this chemical can vary in spinach. Nutritional/husbandry will be modified to limit the potential for this problem by mixing the diet with tadpole kibble and food-types high in alfalfa (e.g., rabbit pellets) to reduce ethylene glycol levels in the diet.

Two new translocation sites were added this year, Lower Grapevine Spring, Nevada, and Tassi Spring, Arizona, meeting annual objectives. Augmentation of the Relict Leopard Frog populations at Sugarloaf Spring was terminated this year, as no flowing water was observed during a summer site visit. Some areas within the Sugarloaf Spring system retained moist soil under dense emergent vegetation, which prompted a nocturnal survey of the site in the fall, but no Relict Leopard Frogs were observed during that survey.

Suitable translocation sites are few, and activities to identify and permit new sites for translocations must be conducted with the goal of establishing two additional experimental translocation sites each year. Evaluations of eight sites for potential experimental translocations were conducted by PLI staff and state or federal collaborators during 2006 (Appendix 1). Evaluations were made at: Bridge Canyon, Lower Grapevine Spring (NV), Lake Mead Hatchery overflow, South Pipe Spring, Cottonwood Spring, Rainbow/Bootleg Spring, Burro Spring-Spring Canyon, and Salt Spring. An attempt was made to find another recommended site, Lave Spring (on BLM lands), but this spring could not be located, and Gerry Hickman (BLM) was tasked with follow-up to contact the BLM botanist that reported the site. Of the sites visited, only Lower Grapevine Spring and the Rainbow/Bootleg were considered to have reasonable potential for successful translocations. At the latter site, the recommendation was that the dense stands of *Eleocharis* that cover the spring should be reduced before releases. At Lower Grapevine Spring there was concern expressed about whether the flow was sufficient to maintain surface water during dry summers, but the RLFCT decided to move forward with an experimental translocation this year.

In addition to the evaluation visits, an unsubstantiated report of a bullfrog sighting at Tassi Spring (a new 2006 translocation site in the Parashant National Monument) resulted in a follow-up nocturnal visual encounter survey to evaluate the presence of this invasive species prior to scheduled releases. A follow-up investigation on the report of the bullfrog sighting found that the report was based on comments that someone saw/heard "something leap into the water". No bullfrogs were observed during the site visit.

Monitoring

Monitoring of existing populations has three general objectives: (1) assess the status of natural populations; (2) assess status of experimental populations to determine translocation success; (3) observe habitat conditions at both natural and experimental sites to identify potential emerging threats to populations. Existing populations were monitored in 2006 by visual encounter surveys

(VES; Crump and Scott 1994). At least once during the prime breeding season (early spring), a diurnal VES was conducted at each site to assess breeding activities (presence of egg masses and/or tadpoles). During these visits, habitat conditions at sites were observed to identify potential emerging threats to populations. Additional diurnal visits to some sites were conducted to assess fall breeding activities as part of research initiated to document breeding timing and oviposition sites. Nocturnal VES were conducted at each site during the spring and again in fall. Because sites are predominately linear spring systems, VES were conducted as single counts of all frogs seen at a site by at least one professional observer, but in most cases more than one observer took part with observations coordinated to avoid double-counting. Nocturnal VES were conducted using high-intensity spot/flood lights. Results of VES are summarized below (Tables 2 and 3; Appendix 2).

The main findings of concern results from major storm and flooding events in mid-October (October 13-14, 2006) that caused massive debris flows at most sites within Black Canyon. Bighorn Sheep Spring suffered extensive habitat damage with much of the vegetation stripped from the channel and most of the bedrock pools where frogs were previously observed filled in with gravel and sand. No tadpoles were seen in surveys conducted shortly after the event and adult frog numbers were greatly reduced compared to previous surveys (Table 2).

Table 2. Results of visual encounter surveys for Relict Leopard Frogs at natural sites conducted during 2006.

Site Name	Survey Date	Time	Adults	Juveniles	Tadpoles	Egg Masses
Bighorn Sheep Spring	1/7/2006	Diurnal	8	0	320	20
	2/9/2006	Diurnal	1	0	300	2
	11/29/2006*	Diurnal	0	0	26	0
	4/5/2006	Nocturnal	160	7	107	2
	10/25/2006*	Nocturnal	52	6	0	0
Boy Scout Canyon	2/9/2006	Diurnal	3	0	0	1
	4/9/2006	Nocturnal	18	0	0	2
	10/25/2006*	Nocturnal	9	0	0	0
"Dawn's Canyon"	2/9/2006	Diurnal	1	0	100	0
	4/9/2006	Nocturnal	5	0	10	1
	11/06/2006*	Nocturnal	5	1	0	0
Salt Cedar Spring	2/10/2006	Diurnal	0	0	58	0
	11/29/2006*	Diurnal	1	0	9	0
	4/9/2006	Nocturnal	10	1	10	0
	11/06/2006*	Nocturnal	10	0	0	0
Black Canyon Spring	11/29/2006*	Diurnal	0	0	0	0
	11/06/2006*	Nocturnal	10	1	0	0
Blue Point Spring	2/21/2006	Diurnal	0	0	0	0
	2/27/2006	Diurnal	3	0	0	0
	4/25/2006	Nocturnal	15	0	0	0
	10/20/2006	Nocturnal	3	2	0	0
	11/09/2006	Nocturnal	2	0	0	0
	11/16/2006	Nocturnal	0	0	0	0
Rogers Spring	2/27/2006	Diurnal	0	0	0	0
	4/6/2006	Nocturnal	0	0	0	0
	6/28/2006	Nocturnal	4	0	0	0
	10/22/2006	Nocturnal	1	0	0	0

* Surveys conducted after major flooding event 13-14 October, and associated habitat changes.

Salt Cedar Spring and the associated main canyon drainage – now called “Black Canyon Spring” (formerly called Salt Cedar Canyon) – had almost all vegetation stripped from the channels. These major changes in vegetation density allowed more extensive surveys of the entire Salt Cedar Spring than on previous visits, and allowed the first surveys of much of the main drainage (Black Canyon Spring) which could not be previously surveyed (Table 2). Both these sites contained mesquite trees and tamarisk thickets that were mostly removed by scouring. Conditions for frogs at Salt Cedar Spring appear to have been improved by the scouring event that uncovered numerous bedrock pools from under previously dense vegetation and debris. Crayfish from the Colorado River had previously reached tadpole sites along Salt Cedar Spring, but the scouring event appears to have removed the crayfish from upper reaches of the stream. Crayfish still occur at the base of the stream, but are separated from the upper reaches by a debris dam and many meters of gravel without surface flow. Habitat changes at Boy Scout Canyon appeared less substantial, but a cool water side pool noted as a major breeding area in this system was destroyed.

The experimental Relict Leopard Frog translocation sites within Black Canyon appeared to have been less impacted by the flooding events, although frog numbers in Goldstrike Canyon may have been reduced (Table 3). Substantial flooding was evident at Pupfish Refuge with damage to pools upstream of the refuge. The uppermost stream dam was partially blown out and the pool itself mostly filled with sediment. The pool below that was also partly filled with sediment. Water was actively flowing alongside the washed-out road down to the river, but numerous adult frogs were observed throughout the system including along the road ditch. A Relict Leopard Frog tadpole was verified from a relatively large pool in the road ditch. This pool was later found to contain several egg masses and new tadpoles (on November 1), but the Bureau of Reclamation had the road rebuilt and improved a short time later and the side pool was destroyed.

As noted above, another important finding from monitoring efforts was the loss of surface flows at Sugarloaf Spring during the summer of 2006; no Relict Leopard Frogs have been seen at this site since that time. This site, however, was also substantially impacted by October flooding. Similarly, surface water at Red Rock Spring was also noted to be minimal in late summer. The large pool at the base of the waterfall at Red Rock Spring was dry, but there were some small pools of water and sheet flows near the marshy spring heads above the water fall. Surface flows had improved by the fall survey and adult survival was documented (Table 3).

Also of concern during 2006 was the lack of frog observations during nocturnal VES at Rogers Spring. Although surveys of this site consistently returned few individuals, this was the first survey during which no individuals were observed. Both Rogers and lower Blue Point Springs are extensively vegetated with emergent plants, and portions of the streams consist of interweaving channels of which some reaches are underground. PLI personnel with assistance from NPS GIS specialists completed generalized habitat maps for Rogers and Blue Point Springs. These maps, and associated GPS coordinates, were created to assist with nocturnal VES efforts with the idea that they would help insure that surveyors reach all habitats considered to be of relatively good or moderate condition within these extensive systems. The maps were submitted to the Clark County MSHCP by NPS personnel as deliverables associated with project funding. Following the initial spring survey, the map of Rogers Spring was used to guide a subsequent nocturnal search of relatively good and intermediate habitat by several personnel during which four adult frogs were observed.

Table 3. Results of visual encounter surveys for Relict Leopard Frogs at experimental sites conducted during 2006.

Site Name	Survey Date	Time	Adults	Juveniles	Tadpoles	Egg Masses
Goldstrike Canyon (tadpole release site)	2/10/2006	Diurnal	1	0	300	1
	5/24/2006	Diurnal	0	0	25	0
	8/28/2006	Diurnal	1	0	0	0
	4/19/2006	Nocturnal	30	0	50	3
	11/06/2006*	Nocturnal	6	0	0	0
Sugarloaf Spring (adult release site)	2/7/2006	Diurnal	0	1	0	3
	4/18/2006	Nocturnal	24	9	20	3
	10/24/2006*	Nocturnal	0	0	0	0
Pupfish Refuge Spring (adult release site)	2/6/2006	Diurnal	7	0	7	9
	11/01/2006*	Diurnal	20	0	0	4
	11/20/2006*	Diurnal	5	0	150	4
	11/28/06	Diurnal	1	0	500+	0
	3/27/2006	Nocturnal	48	0	5	7
	8/9/2006	Nocturnal	21	0	0	0
	10/19/2006*	Nocturnal	40	0	0	0
Grapevine Spring, AZ (tadpole release site)	2/15/2006	Diurnal	3	0	0	0
	8/12/06	Diurnal	21	0	28	0
	4/12/2006	Nocturnal	22	0	2	17
	10/27/2006	Nocturnal	5	1	28	0
Lower Grapevine Spring, NV (new site; tadpole release)	11/02/2006	Nocturnal	9	0	0	0
Red Rock Spring (adult release site)	2/25/2006	Diurnal	0	0	0	0
	8/24/06	Diurnal	3	0	0	0
	4/11/2006	Nocturnal	18	0	0	0
	11/01/2006	Nocturnal	7	0	0	0

* Surveys conducted after major flooding event in the Black Canyon, 13-14 October.

Habitat Management Actions

Management actions include small-scale activities (e.g., exotic vegetation reduction, pool maintenance) as needed to improve habitat conditions at sites for Relict Leopard Frogs, as well as providing coordination of exotic vegetation control activities by the Exotic Plant Management Team (EPMT) at Relict Leopard Frog sites. Two PLI personnel provided oversight and direction to a Nevada Conservation Corps crew of ten individuals in the reduction of non-native tamarisk from the Pupfish Refuge area on November 1, 2006. The objective was to reduce tamarisk along the main stream (below the road) to produce more open pool habitat for Relict Leopard Frogs and to create a pathway for more effective surveys. A pair of side pools was created during the vegetation reduction project which were used in the fall as oviposition sites by Relict Leopard Frogs. Late stage tadpoles were subsequently observed in these pools.

A meeting was conducted with EPMT leader Curt Deuser (NPS) in effort to coordinate tamarisk control at Bighorn Sheep, Salt Cedar, and Black Canyon springs following the major flooding events in October. Selection and use of herbicides and chainsaw bar oil were discussed along with a requirement for a biologist to flag tadpole sites prior to arrival of crews so that damage to these sites could be avoided.

As part of actions to monitor habitats at active sites, the NPS requested the establishment of photo points at each of the sites. This request followed the major flooding and scouring events at sites in Black Canyon during mid-October. During the fall of 2006, the establishment of photo sites was begun while sites were visited during the day. Photos were taken at obvious locations through each system. The plan is to take photos that are representative of conditions at each location to monitor change in the system through time.

RLFCT Activities

Under the task agreements, a research assistant, will coordinate and assist the RLFCT to ensure semi-annual meetings (fall and spring) and will help develop, compile and write the annual work plan, annual report (due at the end of each year), and other documents as specified by the CAS (2005) and team. Meetings of the RLFCT were held at NPS facilities in Boulder City, NV, on June 12, 2006 and November 27, 2006. Associated minutes were developed and distributed. The 2005 annual report was compiled and accepted by the team and a 2006 annual work plan was compiled. Information on these documents is available through the RLFCT.

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Appendix 1. Summary of Sites Evaluated for Translocation

Evaluations were made at: Lower Grapevine Spring (NV), Cottonwood Spring, Rainbow/Bootleg Spring, Burro Spring-Spring Canyon, and Salt Spring.

Bridge Canyon – LMNRA. Visited on February 24, 2006. Condition: Not recommended for Relict Leopard Frog translocation. No permanent riparian vegetation and appear to dry up at times. 2950 feet elevation, 12°C water.

Cottonwood Spring – LMNRA. Visited on June 16, 2006. Condition: Not recommended for Relict Leopard Frog translocation. Limited riparian vegetation for habitat and water appears ephemeral.

Lake Mead Fish Hatchery outflow – Nevada Department of Wildlife facility in LMNRA. Visited site January 19, 2006. Condition: Very fast flowing, cool water (14.5°C). Narrow deep cut channel, lots of vegetation, trout seen in stream. Not promising for leopard frog habitat unless serious manipulation occurs. Outdoor raceways, or empty ponds, within the hatchery proper could have potential for a refuge.

South Pipe Spring – LMNRA. Visited on February 24, 2006. Condition: Not recommended for Relict Leopard Frog translocation at this time. Approximately 75m (paced) of emergent vegetation from spring head with only a few pools where water may be permanent. Site probably too small. Water at 18°C and flowing about 180m down wash at time of visit.

Salt Spring – Visited May 8, 2006. Condition: Not recommended for translation of Relict Leopard Frogs. No deep pools and only limited water flow during the site visit. Site dominated by *Phragmites*, *Baccharis*, and Tamarisk.

Burro Spring, Spring Canyon – LMNRA. Visited site May 8, 2006. Condition: Not considered a positive site for translocation of Relict Leopard Frogs at this time. Site dominated by *Phragmites*, *Baccharis*, Mesquite, Arrowweed, Tamarisk. Site gets choked in canyon by tamarisk, too dense to even bushwack through. Site may have potential for frogs (good flow, 25°C water, lots of bank vegetation) but vegetation reductions would be required for evaluation. Vegetation manipulations would be required to open up the site prior to any translocation attempt.

Rainbow/Bootleg Spring – Red Rock Wilderness. Site visited on June 27, 2006. Condition: Not considered a positive site for translocation of Relict Leopard Frogs at this time. Vegetation manipulations would be required to open up the site prior to any translocation attempt, as site is crowded with *Eleocharis*. Water is shallow. 1598 feet elevation.

Appendix 2. Specific Summaries of Existing Sites

Natural Populations – Black Canyon

Bighorn Sheep Spring – This thermal spring is presently the only source of egg masses for the translocation component of the Relict Leopard Frog conservation efforts. This site was visited 5 times in 2006. Counts of adult frogs observed during nocturnal VES ranged from 52-160 (Table 2) with the lower number following the massive flooding and scouring events in mid-October (discussed in detail in main text). Between 2003-5 (Velez 2006), counts ranged from 198-373 frogs, which are lower numbers than those reported between 1997 and 2001 (Bradford et al. 2004). Red-spotted Toads (*Bufo punctatus*) were present at this site during surveys. Six partial and 2 whole Relict Leopard Frog egg masses were collected from this site for the headstarting/translocation program on January 17, 2006. Photo points were established at this site on November 29, 2006.

Boy Scout Spring – This thermal spring was visited 3 times in 2006. Nocturnal VES resulted in counts of 18 and 9 adult frogs in the spring and fall respectively, and evidence of breeding (Table 2). These survey numbers were consistent with results from earlier surveys at this site (Bradford et al. 2004; Velez 2006). Flooding events in mid-October destroyed a cold water side pool that was known as a breeding site. Red-spotted toads occur in large numbers at this site.

“Dawn’s Canyon” Spring – This unofficially named spring is located just north of Boy Scout Spring on the bank of the Colorado River. Relict Leopard Frogs and tadpoles were discovered at this site in August 2005. Three visits were made to this site in 2006. Adult Relict Leopard Frogs were observed during both nocturnal and diurnal surveys, with evidence of reproduction at the site (Table 2). This site, and the frog habitat therein, was not nearly as affected by the flood event in mid-October as were the larger sites further downstream in the Black Canyon.

Salt Cedar Spring – This thermal spring was opened up and potential frog habitat made much more accessible to observers as a result of the mid-October storms that scoured vegetation and accumulated debris out of the canyon. This spring was visited 4 times in 2006, with 10 frogs seen in each nocturnal spring and fall survey (Table 2), almost matching the largest number of frogs observed during surveys in 2003-2005 (Valez 2006). This is the only known site in which crayfish and Relict Leopard Frogs co-occur, although most of the area at this site in which the frogs have been observed is free of crayfish, and no egg masses or tadpoles have been seen co-occurring in the same pools with crayfish (see comments on crayfish in main text). Photo points were established at this site on November 29, 2006.

Black Canyon Spring – This thermal spring and its side channel was able to be surveyed this year as a result of the extensive scouring and vegetation removal caused by the storms in mid-October. The channel consists of a shallow, flowing hot main stream with a few cooler side pools. A total of 10 Relict Leopard Frogs were observed during a nocturnal VES (Table 2), but none were seen during a diurnal visit. Photo points were established at this site on November 29, 2006. Multiple source springs feed this stream, but are located above a water fall and are difficult to reach. Surveys ought to be conducted of these spring sites and the upper reaches of the canyon.

Natural Populations – Northshore springs complex

Blue Point Spring – Six VES were conducted at this site in 2006. Results from nocturnal surveys, summarized including the upper and lower portions of this spring, ranged from 0-15 adult Relict Leopard Frogs observed. No egg masses or tadpoles were observed at this site this year. Both Woodhouse’s (*Bufo woodhousii*) and Red-spotted Toads occur at this site but in very low numbers.

This thermal spring contains many non-native fishes. Reduction of grazers in the system appears to have resulted in dense vegetation growth in stream-side areas once inhabited by frogs. There are plans to conduct experimental reductions of plants to improve frog habitat in the upper portion of this spring.

Rogers Spring – This spring system is extensively covered by dense stands of emergent vegetation, which make thorough surveys of this site impossible. This site was visited 4 times in 2006, with only a single adult frog observed during the regular fall survey and 4 adults observed on a targeted survey of the site in late June. No egg masses or tadpoles were documented (Table 2). There are concerns by the RLFCT about the status of this natural population, and plans have been initiated to conduct experimental reductions of plants to improve frog habitat in portions of this spring.

Experimental Populations

Goldstrike Canyon – This thermal spring site was evaluated and approved by the RLFCT for frog translocations in 2003. A total of 527 tadpoles were released at this site in 2006. This site was visited 5 times in 2006. During the spring survey 30 adult Relict Leopard Frogs were observed but in the fall survey, after the mid-October flooding events, only 6 adult frogs were seen. Breeding was documented in the spring surveys (Table 3). The presence of Red-spotted Toads was noted.

Grapevine Spring, AZ – This spring site was evaluated and approved by the RLFCT for translocations in 2003. A total of 660 tadpoles were released in 2006. This non-thermal spring has much colder water temperatures than other sites with Relict Leopard Frogs, but vegetation is plentiful with good open pool habitat. The site was visited 3 times in 2006. VES, however, were challenging at this site because the abundant, open vegetation structure allows for numerous hiding places for active frogs, nevertheless, adults were observed at this site during each survey. Numerous egg masses were documented in the spring survey (Table 3). Both Red-spotted Toads and Canyon Treefrogs (*Hyla arenicolor*) were observed at this site.

Lower Grapevine Spring, NV – This cool spring site was evaluated for frog translocations in 2005 and revisited again January 3 and February 24, 2006. Tamarisk removal was conducted by the NPS Exotic Plant Management Team at the site January 2-7, 2006. 600 tadpoles were released at this site March 3, 2006. Nine Relict Leopard Frogs were observed during a nocturnal VES conducted November 2, 2006.

Pupfish Refuge Spring – This thermal spring site was evaluated and approved by the RLFCT for frog translocations in 2003. A total of 21 frogs were released at this site in 2006, and the site was visited 6 times. This site does not appear to have had major habitat modification occur as a result of the mid-October storms. VES results for adult frogs ranged between 21 and 48 observations (Table 3), and breeding was documented in 2006. Red-spotted Toads occur at this site.

In an effort to improve habitat for Relict Leopard Frogs at this site, sections of the outflow stream were cleared of vegetative overgrowth (predominantly tamarisk) by a Nevada Conservation Corps group under the supervision of PLI personnel (see comments in main text).

Red Rock Spring – This spring was deemed suitable for Relict Leopard Frog introductions in 2004 by the RLFCT. A total of 34 post-metamorphic frogs were released in 2006 at this site, supplementing the previous years' introduced population. Nocturnal VES resulted in the observation of 18 and 7 adult Relict Leopard Frogs during the spring and fall surveys respectively (Table 2), although no signs of reproduction were detected. Other amphibians observed at this site were Red-spotted Toads and Woodhouse's Toads.

Sugarloaf Spring – The NPS attempted to establish a population of Relict Leopard Frogs at Sugarloaf Spring in 2002. This thermally influenced spring was visited 17 times between 2003 and 2005, and 3 times in 2006. The amount of water has varied at this site during the past 4 years, and ultimately the lack of persistent water in the summer of 2006 resulted in the decision by the RLFCT to cease translocations to this site. This site was visited 3 times in 2006 (Table 2), once with the intention of releasing post-metamorphic frogs, only to discover the lack of water at the site. No signs of Relict Leopard Frogs were apparent during the fall survey. Red-spotted Toads occur at this site in large numbers when water is present.