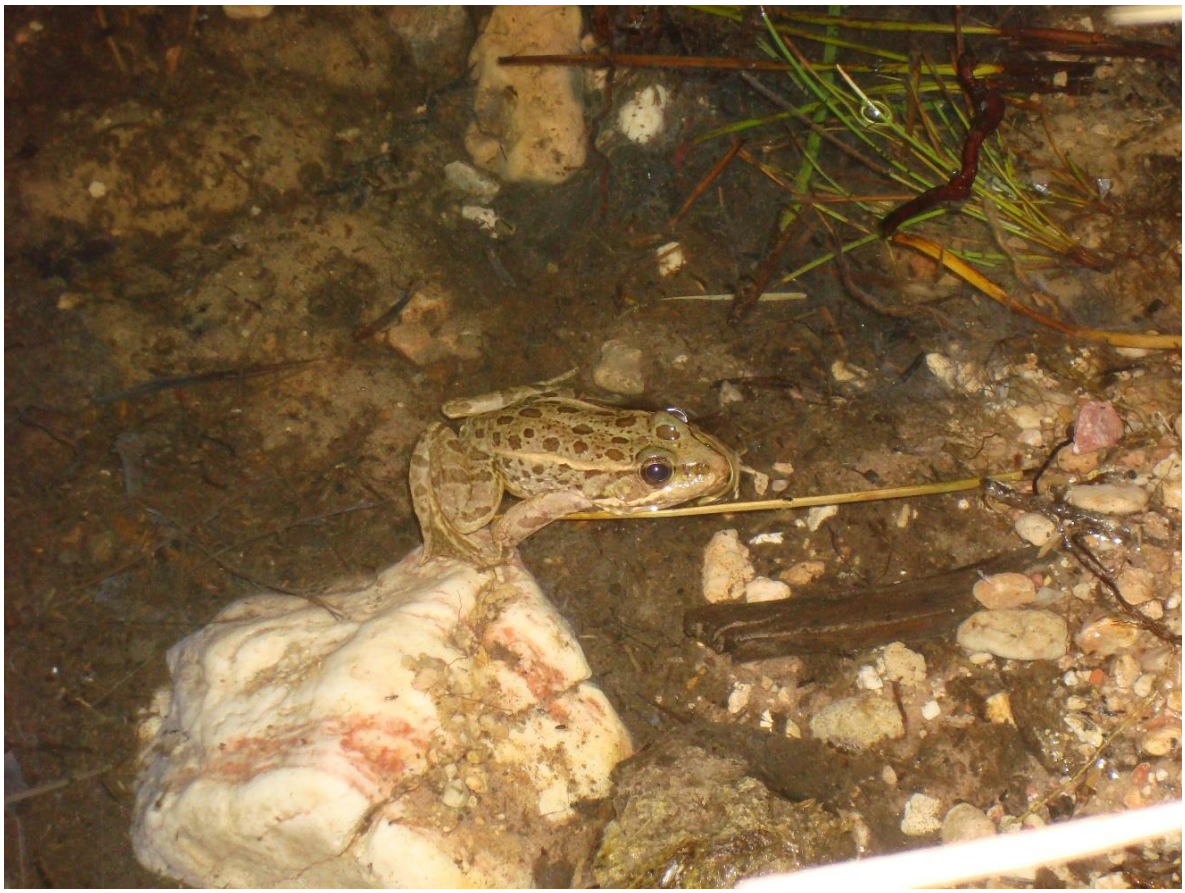
Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Relict Leopard Frog Monitoring and Management

2015 Annual Report



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May 2017

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Relict Leopard Frog Monitoring and Management

2015 Annual Report

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[1] Under an agreement with the Lake Mead National Recreation Area, National Park Service, and the Nevada Department of Wildlife.

Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
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ACRONYMS AND ABBREVIATIONS

Bd	*Batrachochytrium dendrobatidis* (a pathogenic fungus)
BLM	Bureau of Land Management
CAS	conservation agreement and strategy
Lake Mead NRA	Lake Mead National Recreation Area
m	meter(s)
n	sample size
NDOW	Nevada Department of Wildlife
NPS	National Park Service
PIT	passive integrated transponder
RLFCT	Relict Leopard Frog Conservation Team
T^A	ambient air temperature in degrees Celsius
UNLV	University of Nevada, Las Vegas

Symbols

°C	degrees Celsius
>	greater than
%	percent

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1 Locations of sites containing historical populations of relict leopard frogs (in blue) and sites containing active experimental translocation sites (in green); the latest site, Corn Creek (not shown) in the Desert National Wildlife Refuge, was established in 2015. 4

Attachments

Attachment

1 Site Assessments

EXECUTIVE SUMMARY

This report summarizes efforts under a project designed to implement monitoring, headstarting, and translocation actions described in the voluntary conservation agreement and strategy (CAS) (Relict Leopard Frog Conservation Team [RLFCT] 2005) for the relict leopard frog (*Rana onca = Lithobates onca*). The intent of the CAS is to manage these frogs through a cooperative interagency program to increase both overall numbers as well as number of populations of the species in a defined area of southern Nevada and northwestern Arizona. The methods implemented in this project are specified in a protocol and techniques manual included in the CAS. In general, visual encounter surveys were conducted at all historical and experimental sites known to contain relict leopard frogs. To establish new populations and augment existing ones, partial egg masses were collected from historical populations and reared in captive settings to late-stage tadpoles or juvenile frogs. These animals were then released at suitable sites according to objectives determined in the RLFCT conservation agreement and strategy. Assistance was provided to agency partners to identify potential translocation sites and to conduct associated conservation actions, including assisting with the coordination of the RLFCT meetings. The following information summarizes observations made during monitoring surveys and results from headstarting and translocation actions in 2015. Other conservation actions are also discussed when appropriate.

- Nocturnal surveys were completed at all historical and active experimental sites occupied by the relict leopard frog. This year, the fall count of adult and juvenile frogs was the highest ever recorded.

- Diurnal surveys were completed at all active sites except Lime Spring and Perkins Pond.

- Partial egg masses were collected for headstarting from sites within Black Canyon and the Northshore springs complex. Translocations totaled 113 Black Canyon animals released at Corn Creek, Lime Spring, and Union Pass Spring; 133 animals from Northshore released at Corn Creek, Bearpaw Poppy Springs, and Horse Spring; and 91 animals from Northshore released to Upper Blue Point and back to Lower Blue Point.

- Clark County is no longer supporting management of relict leopard frogs at Perkins Pond. The site was dry in mid-January, but the pond was filled again later in spring. No relict leopard frogs were observed during nocturnal surveys in late May and early October.

- Corn Creek, on the Desert National Wildlife Refuge, was initiated as an experimental site with the release of 109 juvenile frogs in May. Three of these frogs were observed during a nocturnal survey in October.

- Small-scale habitat maintenance for relict leopard frogs occurred at Bighorn Sheep, Blue Point, Boy Scout Canyon, Bearpaw Poppy, Horse, and Quail Springs.

- Field visits were conducted to assess Kaolin and Jackass Springs as translocation sites for relict leopard frogs. Both springs are managed by the Bureau of Land Management. Further habitat assessment of Kaolin Spring was recommended, as the site may have promise to support a population of relict leopard frogs, but Jackass Spring lacked sufficient habitat to support the species.

INTRODUCTION

Background

The relict leopard frog (*Rana onca = Lithobates onca*) appears to be a narrowly distributed endemic species (Oláh-Hemmings et al. 2010). The known historical range of the species includes springs and wetlands along the drainages of the Virgin, Muddy, and Colorado Rivers from the vicinity of Hurricane, Utah, to Black Canyon, below Lake Mead in Nevada and Arizona (Bradford et al. 2004). The species, however, has experienced a reduction in geographic range and number of populations, and taxonomic confusion once led to the declaration that these frogs now occupy only a few spring sites within two general areas of southern Nevada within the Lake Mead National Recreation Area (Lake Mead NRA). Translocation efforts have established new populations at additional sites (see below).

Conservation efforts for this species began in earnest in the early 1990s, as additional information on population dynamics and distribution was being gathered, including phylogenetic studies. The first interagency meeting focused on the relict leopard frog was held in 1999, and by 2001, a voluntary Relict Leopard Frog Conservation Team (RLFCT) was formed with members from numerous Federal and State agencies (RLFCT 2005). In 2002, the species was petitioned for listing under the Endangered Species Act. Listing was considered warranted but precluded because of conservation efforts by the RLFCT coordinated under a voluntary conservation agreement and strategy (CAS). Recent conservation efforts have focused on monitoring and maintaining existing populations and on attempts to establish experimental populations at additional sites. Despite the success of some conservation efforts, the relict leopard frog remains imperiled.

The information contained herein represents a summary of management, monitoring, and conservation actions implemented by the National Park Service (NPS) and the Nevada Department of Wildlife (NDOW) toward meeting objectives outlined in the CAS. This document represents a final report on field efforts during 2015. Major efforts under this project were performed under the task agreement by personnel at the School of Life Sciences, University of Nevada, Las Vegas (UNLV). Jef Jaeger, at UNLV, was the principle investigator in collaboration with Ross Haley at the Lake Mead NRA and Jon Sjöberg at the NDOW. Other actions conducted by cooperating agencies, such as the Bureau of Land Management (BLM), Bureau of Reclamation, U.S. Fish and Wildlife Service, Arizona Game and Fish Department, Clark County Desert Conservation Program, Lower Colorado River Multi-Species Conservation Program, and the NDOW are also summarized when appropriate.

Goal and Objectives

The main goal of the project was the conservation of existing relict leopard frog populations and establishment of new, experimental populations. The main field objectives were as follows:

1. Monitor existing natural populations to assess population persistence and identify potential changes in site conditions that may affect populations.

2. Monitor experimental populations to evaluate the success of translocations.

3. Identify management actions to improve or mitigate habitat conditions at existing sites to promote persistence of populations and implement small-scale actions or coordinate actions by crews under the guidance of land managers.

4. Manage a headstarting program to raise eggs collected from wild frogs to late-stage tadpoles or juvenile frogs for translocation to new sites or to augment existing sites.

5. Coordinate efforts to identify new sites for translocations and assist land managers with translocations to these new sites.

Reporting Format

The "Results and Discussion" section presented in this document follows a reporting format stipulated by the RLFCT. The format is intended to provide meaningful summaries of actions conducted at each site for seasonal reviews by team members.

METHODS

The methods implemented in this project are specified in the Relict Leopard Frog Protocol and Techniques Manual included in the CAS (RLFCT 2005). The protocols and techniques detail the various procedures used for collecting, rearing, transporting, and releasing frogs and tadpoles associated with headstarting and translocation. The methods and timing for monitoring populations are also specified.

Site Surveys

In general, visual encounter surveys were conducted at all historical and experimental sites known to contain the relict leopard frog. Surveys were conducted in early spring and again in autumn. All frogs and egg masses observed were counted, but tadpole numbers represent estimates up to 150 after which a greater-than symbol (>) is added to indicate larger numbers. All field surveys were conducted by trained biologists with experience in relict leopard frog monitoring and with specific knowledge of survey site characteristics. Diurnal surveys early in the year were used to document breeding activities (egg masses and tadpoles) during a prime breeding period. The diurnal surveys within the Gold Butte area early in the year were conducted in conjunction with site visits to assess potential habitat actions. Nocturnal surveys during spring and autumn were used to better assess numbers of adult frogs; these frogs are more readily observed at night using spotlights when they can be seen in less densely vegetated patches.

Headstarting and Translocations

Early spring diurnal surveys were also used to find and collect eggs for headstarting in the laboratory. The target goals for collection numbers and sites, as well as the targeted sites and actual numbers of late-stage tadpoles or juvenile frogs planned for release, were determined during meetings of the RLFCT. Eggs were processed in a laboratory facility maintained by the Lake Mead NRA. Tadpoles were grown out at this facility, as well as at the Willow Beach National Fish Hatchery and Lake Mead State Fish Hatchery. Eggs were collected in the wild during January and February and released as late-stage tadpoles or juvenile frogs from late April through June. Headstarted animals were also transferred to UNLV for use in research to determine the susceptibility of relict leopard frogs to a pathogenic fungus (*Batrachochytrium dendrobatidis; Bd*).

Other Activities

Site visits and assessments were also conducted at several springs to identify and evaluate new potential release sites. In general, identifying potential sites, along with compliance activities, depend largely on land and resource managers. The efforts conducted under this project (including reporting) were aimed at facilitating these actions. Some habitat maintenance activities were performed or facilitated at important breeding pools. These efforts are noted below along with habitat activities conducted by collaborating entities.

STUDY AREAS

Eight sites in southern Nevada containing historical populations of relict leopard frogs were monitored during 2015 (figure 1); sites were defined for monitoring purposes and recordkeeping but do not necessarily represent separate demographic units. The historical sites occur in two general areas: in Black Canyon below Hoover Dam and in the Northshore springs complex along the edge of the Muddy Mountains. In addition, 12 active, experimental translocation sites in southern Nevada and northwestern Arizona were surveyed in 2015 (figure 1), and two sites were assessed for potential translocations (see below).

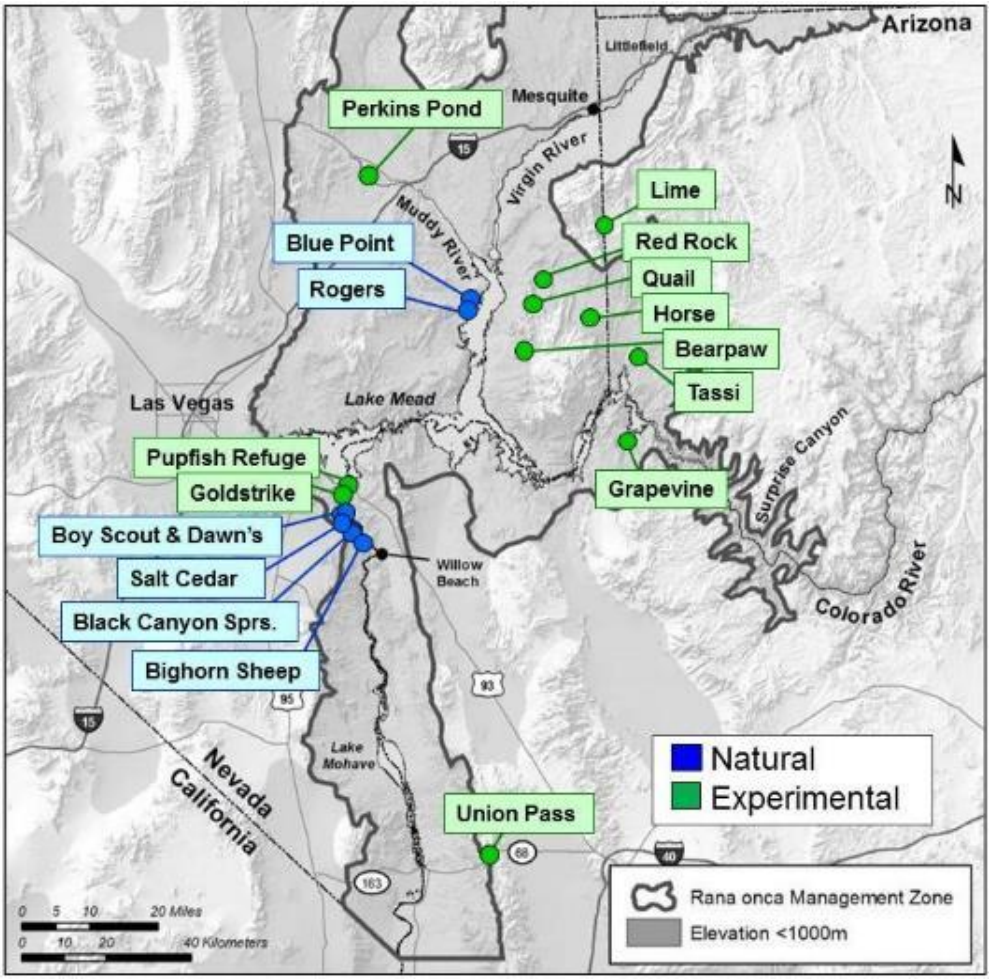

Figure 1.—Locations of sites containing historical populations of relict leopard frogs (in blue) and sites containing active experimental translocation sites (in green); the latest site, Corn Creek (not shown) in the Desert National Wildlife Refuge, was established in 2015.
The potential management zone for the species as identified in the CAS (RLFCT 2005) is indicated, although the area identified in the western Grand Canyon will not be targeted for translocations because of the documented presence of a closely related leopard frog species.

RESULTS AND DISCUSSION

The total number of adult and juvenile relict leopard frogs seen during visual encounter surveys at sites represents a minimum count for the entire species, as not all individuals were detected during the surveys. The count in spring 2015 was 827 frogs, and the count in autumn was 877 adult frogs (table 1). This year, the fall count of adult and juvenile frogs was the highest ever recorded since systematic monitoring was initiated in 2004.)

Table 1.—Summary of the maximum number of adult and juvenile relict leopard frogs seen during visual encounter surveys at sites in 2015, with results from 2014 presented for reference

(The count totals at each spring are the highest number of relict leopard frog detections from a single season, and the seasonal totals represent minimum numbers for the entire population.)

Site type	Site	Spring 2014	Autumn 2014	Spring 2015	Autumn 2015
Natural	Bighorn Sheep Spring	54	11	37	15
	Boy Scout Canyon	36	27	19	21
	Dawn's Canyon	5	6	4	1
	Black Canyon Springs	25	49	44	31
	Salt Cedar Canyon Spring	12	48	64	53
	Upper Blue Point Spring	13	14	14	5
	Lower Blue Point Spring	11	17	14	10
	Rogers Spring	3	14	11	4
Experimental	Bearpaw Poppy Spring	51	60	51	22
	Corn Creek	–	–	Initiated	3
	Goldstrike Canyon	26	12	19	13
	Grapevine Spring, Arizona	116	150	159	154
	Horse Spring	24	51	37	24
	Lime Spring	15	7	7	10
	Pupfish Refuge Spring	39	26	30	22
	Perkins Pond	1	0	0	0
	Quail Spring	164	76	122	105
	Red Rock Spring	6	20	13	3
	Tassi Spring	107	50	45	89
	Union Pass Spring	135	204	137	292
	Totals	**843**	**842**	**827**	**877**

Monitoring of Natural Sites

Bighorn Sheep Spring, Nevada

High-counts at this site show wide variance in recent years (see table 1), and the counts this year showed a more than two-fold difference between the seasons (table 2). Flooding occurred at this site prior to the 2014 fall survey, causing a moderate level of habitat disturbance (reported previously); since then, there appears to be less surface water and few substantial pools. Some habitat still exists where development appears possible given the four smaller adults observed in April. In June, minor habitat maintenance (moving rocks and cobble to improve pooling in areas of streams that contained relict leopard frog tadpoles) was conducted, but no tadpoles or small adults were observed in October.

Table 2.—Summary of relict leopard frogs observed at Bighorn Sheep Spring during visual encounter surveys conducted in 2015
(Also provided is the ambient air temperature during the survey [TA] in degrees Celsius [°C])

Survey type	Date	T^A] (ºC)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/15/2015	16.6	0	0	133	1
Nocturnal	04/19/2015	27.5	37	0	93*	0
Nocturnal	10/12/2015	27.4	15	0	0	0

* Observed 21 large tadpoles.

Again this year, part of an egg mass was collected for headstarting (see table 21), and partial egg masses have been collected most years despite the limited population at this site. Most of the egg masses have been observed in pools that cannot sustain large numbers of tadpoles. Collection of some of the eggs has been thought to have no substantial negative impact and may actually improve survivorship of remaining tadpoles by reducing competition.

Boy Scout Canyon Spring, Nevada

The counts this year were slightly lower than last year (see table 1), which appears to be a result of the desiccation of a breeding pool that had formed several years ago low in this system. Adult and juvenile frogs were often seen in or near this pool, but this year few frogs were observed over the entire lower segment of the stream, with the majority of frogs observed at known breeding pools higher in the system. Tadpoles from at least four different cohorts and an egg mass were observed in the upper breeding pools (“Jef’s pools”) this spring (table 3); part of the egg mass was collected for headstarting (see table 21). During the diurnal survey in early February, calling from relict leopard frogs was heard. At that time, habitat maintenance was conducted at upper breeding pools by RLFCT members from the Desert Conservation Program, NDOW, and

Table 3.—Summary of relict leopard frogs observed at Boy Scout Canyon during visual encounter surveys conducted in 2015
(Also provided is the ambient air temperature during the survey [TA] in degrees Celsius [°C])

Survey type	Date	T^A (ºC)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/06/2015	18.0	2	0	0	1
Nocturnal	04/09/2015	23.0	19	0	79*	0
Nocturnal	10/14/2015	32.0	21	0	18^	0

* Observed three large tadpoles.
^ Large tadpoles.

UNLV. Minor flooding in fall did not improve conditions at breeding pools, and removal of emergent vegetation should be conducted at important sites.

Dawn's Canyon Spring, Nevada

Only small numbers of frogs have ever been observed at this site, so the low counts this year are not exceptional (table 4); a count of a single frog has been recorded in the past. In early spring, newly hatched relict leopard frog tadpoles were documented at the "plunge pool," but none of these tadpoles were evident 2 months later (table 4).

Table 4.—Summary of relict leopard frogs observed at Dawn's Canyon Spring during visual encounter surveys conducted in 2015
(Also provided is the ambient air temperature during the survey [TA] in degrees Celsius [°C])

Survey type	Date	T^A (ºC)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/06/2015	18.1	0	0	9	0
Nocturnal	04/09/2015	22.5	4	0	0	0
Nocturnal	10/14/2015	31.5	1	0	0	0

Black Canyon Spring and Black Canyon Side Spring, Nevada

As in the past, the majority of frogs were encountered at the Side Spring, and only a few seen along the main stream (table 5). At the Side Spring, all life stages were observed during spring, and calling was noted in February. The high-counts this year were in the range of last year's high-counts (see table 1). The survey in fall 2014 followed flooding at the Side Spring that had reduced vegetation around many of the pools (previously reported), and the recent increases in the counts were probably associated with better detectability.

Table 5.—Summary of relict leopard frogs observed at Black Canyon Spring (main stream) and Black Canyon Side Spring during visual encounter surveys conducted in 2015.
(Also provided is the ambient air temperature during the survey [TA] in degrees Celsius [°C])

Site	Survey type	Date	T^A (ºC)	Adult	Juvenile	Larvae	Egg masses
Main stream	Diurnal	02/08/2015	24.6	0	0	0	0
	Nocturnal	04/09/2015	19.0	3	0	0	0
	Nocturnal	10/14/2015	28.0	3	0	0	0
Side spring	Diurnal	02/08/2015	16.9	3	0	543*	1
	Nocturnal	04/09/2015	19.1	27	14	34^	0
	Nocturnal	10/14/2015	26.5	28	0	12^^	0

* Observed three overwintering tadpoles.
^ Observed four large tadpoles.
^^ Large tadpoles.

Vegetation, mainly cattail (*Typha* sp.) and saltcedar (*Tamarisk* sp.), has noticeably increased since the spring surveys, but pools remain open. The main stream remains predominately open but lacks good breeding habitat.

Salt Cedar Canyon Spring, Nevada

Flooding in fall 2014 (reported previously) appears to have increased detectability of relict leopard frogs at this site, and the counts of frogs since then have been markedly high. The high-count of frogs this spring (table 6) was the highest ever recorded for the site. The flooding, however, also appears to have improved recruitment given the large numbers of juveniles observed this spring. Juveniles were again observed during fall, and these animals likely came from tadpoles recorded in April. Although, not all life stages of relict leopard frogs were observed, different cohorts of tadpoles were noted, indicating egg masses were laid earlier in the year. During the fall visit, vegetation had noticeably rebounded. Also during that visit, an adult relict leopard frog was observed at the confluence of this system and the Colorado River.

Table 6.—Summary of relict leopard frogs observed at Salt Cedar Canyon Spring during visual encounter surveys conducted in 2015
(Also provided is the ambient air temperature during the survey [TA] in degrees Celsius [°C])

Survey type	Date	T^A (ºC)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/08/2015	23.5	4	2	7*	0
Nocturnal	04/09/2015	18.6	41	23	46^	0
Nocturnal	10/14/2015	27.4	44	9	0	0

* Observed one overwintering tadpole.
^ Mostly large tadpoles.

Upper and Lower Blue Point Springs, Nevada

This extensive system is treated as two separate sites for reporting. At Upper Blue Point Spring, the high-counts have been declining in recent years, and the counts this fall were particularly low (table 7). This decline is in spite of releases of headstarted animals at this site over time; most recently, 71 juveniles and larvae were released in June (see table 22). The juveniles observed during the nocturnal surveys this year were very probably animals released earlier.

Table 7.—Summary of relict leopard frogs observed at Upper and Lower Blue Point Springs during visual encounter surveys conducted in 2015
(Also provided is the ambient air temperature during the survey [TA] in degrees Celsius [°C])

Site	Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Upper	Diurnal	01/28/2015	15.5	0	0	0	0
	Diurnal	06/09/2015	30.9	0	0	0	0
	Nocturnal	04/13/2015	25.5	13	1	0	0
	Nocturnal	10/22/2015	23.0	3	1	0	0
	Nocturnal	11/01/2015	19.5	2	0	0	0
	Nocturnal	11/08/2015	16.9	5	0	0	0
Lower	Diurnal	01/28/2015	21.5	2	0	213*	3
	Diurnal	06/09/2015	31.7	0	0	0	0
	Nocturnal	04/13/2015	26.1	12	2	0	0
	Nocturnal	10/22/2015	14.3	10	0	0	0

* Observed 13 that were a different cohort; the remainder were hatchlings.

Emergent vegetation was reduced along some sections of the stream last fall (previously reported). These sections remained relatively open in spring but were mostly overgrown by the fall. Very little open habitat remains along the stream, and invasive young palm trees and sawgrass (*Cladium* sp.) have now established along a stretch of the stream. The water level above the historical dam continues to decrease as the dam erodes, and all but one of the artificial ponds previously dug in this area a few years ago are now dry. Management actions are needed to maintain favorable habitat for relict leopard frogs along this stretch of stream.

Frog counts at Lower Blue Point Spring have commonly been low in recent years, and the number of frogs counted this year was no exception (see table 1). This is despite the multiple years of augmentation. Juveniles observed during the nocturnal survey in April (see table 7) probably represent slow-growing animals from last year's releases, but natural recruitment cannot be ruled out; given the warm waters at this site, it is possible that the juveniles were from egg masses

seen in the fish-free pond in late January. No tadpoles, however, were observed in April, but detectability appears low given the high density of algae growth in the pond. All life stages of relict leopard frogs were again observed at this site, and calling was heard during the January survey. Two partial egg masses were collected from the fish-free pond for headstarting (see table 21).

During the diurnal survey in January, two dead adult relict leopard frogs were observed. One was found desiccated not far from the intake pipe for the fish-free pond, and the other was found within the fish-free pond (fully intact). No physical trauma or other markings were obvious. The amphibian chytrid fungus has been previously documented during early spring periods at this site, and there is concern that these deaths may be related to the pathogen. All other frogs observed appeared healthy.

Dense vegetation continues to cover the majority of this system, with very few areas of open habitat. Channelization of the stream continues to reduce bank habitat and surface water. Last fall (2014), emergent vegetation was reduced along small sections of the stream and around the intake pipe to the fish-free pond (previously reported), and these sites remained somewhat open this year. Sedimentation around the water intake pipe to the fish-free pond remains a problem, although water was flowing into the pond during all site visits.

Rogers Spring, Nevada

Low numbers of frogs continue to be observed at this site (table 8) despite augmentations in 2008, 2011, and 2014 that included the release of 111 frogs and tadpoles. This system is covered in dense vegetation, predominately sawgrass, and while this vegetation certainly limits detectability, it also creates unfavorable conditions for relict leopard frogs. Over the last several years, all frogs have been observed only in small pockets of open surface water habitat scattered around the dirt road along the power line. The egg mass observed in January was found in a pool formed by tire ruts in the road. It appeared to be a relict leopard frog, but it had been disturbed and broken up, probably by a passing vehicle. A spent egg mass was observed in the same pool in November.

Table 8.—Summary of relict leopard frogs observed at Rogers Spring during visual encounter surveys conducted in 2015
(Also provided is the ambient air temperature during the survey [T^A] in degrees Celsius [°C])

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Diurnal	01/28/2015	11.7	0	0	0	1*
Nocturnal	04/21/2015	19.5	11	0	0	0
Nocturnal	11/01/2015	15.9	4	0	4^	0

* Uncertain of the species.
^ Hatchlings on spent egg mass.

Monitoring of Experimental Sites – Black Canyon

Goldstrike Canyon, Nevada

The most recent augmentation at this site occurred in 2013 (111 animals), but the release of so many animals did not appear to have significantly affected the numbers of frogs subsequently encountered. All life stages of relict leopard frogs were observed in spring, including an overwintering tadpole (table 9). The juveniles documented in April were likely young-of-year frogs. These juveniles were located near pools where tadpoles were observed during the diurnal survey; natural recruitment at this experimental site was previously confirmed in 2012.

Table 9.—Summary of relict leopard frogs observed at Goldstrike Canyon during visual encounter surveys conducted in 2015
(Also provided is the ambient air temperature during the survey [TA] in degrees Celsius [°C])

Survey type	Date	T^A (ºC)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/06/2015	16.2	1	0	5*	2
Nocturnal	04/17/2015	23.9	17	2	4^	0
Nocturnal	10/12/2015	27.3	13	0	8^	0

* Observed one overwintering tadpole.
^ Large tadpoles.

Pupfish Refuge Spring, Nevada

The counts of relict leopard frogs this year (table 10) were consistent with numbers commonly observed at this site since augmentations ended in 2008. In fall, multiple surveys were conducted to obtain data on previously passive integrated transponder (PIT) tagged relict leopard frogs; the tagging of individuals was associated with a separate project to estimate the population size in 2012 (reported previously). Only one PIT-tagged frog was encountered this fall.

Table 10.—Summary of relict leopard frogs observed at Pupfish Refuge Spring during visual encounter surveys conducted in 2015
(Also provided is the ambient air temperature during the survey [TA] in degrees Celsius [°C])

Survey type	Date	T^A (ºC)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/05/2015	14.6	1	0	3002*	1
Nocturnal	04/04/2015	25.8	27	3	160^	0
Nocturnal	10/21/2015	24.1	8	2	10^^	0
Nocturnal	10/27/2015	23.8	18	4	2^^^	0
Nocturnal	11/03/2015	19.2	8	0	4^^^	0

* From seven spent egg masses.
^ Fourteen were large tadpoles, but 106 were small tadpoles, and the species identification was uncertain.
^^ Observed six large tadpoles.
^^^ Observed only large tadpoles.

All life stages of relict leopard frogs were observed again this year, with the majority of tadpoles and egg masses observed in the breeding pools along the Portal Road drainage ditch. Few frogs continue to be observed below Portal Road, as vegetation along that stretch of stream has become dense. Calling from relict leopard frogs was noted in February

Following extensive saltcedar removal a couple years ago (previously reported), dense native vegetation has come to dominate the majority of the stream, with the exception of the waterfall pools. Planted mesquite trees (*Prosopis* sp.) below Portal Road have become large, and lower branches should be removed and the understory vegetation opened. Aggressive maintenance to remove vegetation along the drainage ditch is also recommended.

Bearpaw Poppy Spring, Nevada

The frog count in spring was consistent with counts last year (see table 1). Soil moisture from rains before the fall survey and high relative humidity (50.8%) at the time of the survey allowed frogs to disperse widely and likely resulted in the low count during fall; many of the frogs were observed away from the main stream. The egg masses observed this season (table 11) were the first documented evidence of attempted breeding at this site. One of the egg masses was found desiccated on the streambank, likely stranded by a decrease in water level, which appears to occur quickly at this site. Natural recruitment cannot yet be confirmed at this site, and the juvenile frogs observed in spring were likely from tadpoles released the previous year. Augmentation continued this year (see table 22), but only a small number of animals were released to avoid overcrowding. Calling by relict leopard frogs was noted during the spring nocturnal survey.

Table 11.—Summary of relict leopard frogs observed at Bear Poppy Spring during visual encounter surveys conducted in 2015
(Also provided is the ambient air temperature during the survey [TA] in degrees Celsius [°C])

Survey type	Date	T^A (ºC)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/11/2015	29.1	2	0	0	1
Diurnal	05/23/2015	29.2	6	0	0	0
Nocturnal	03/24/2015	20.8	47	4	0	3*
Nocturnal	10/08/2015	26.2	22	0	1^	0

* Observed one desiccated egg mass.
^ Observed a large tadpole.

Habitat at this site remained relatively open in segments along this system, and burro activity was noticeable during all visits; however, pools associated with

breeding habitat remain limited. Efforts to improve breeding habitat were conducted on March 24 by personnel from the Great Basin Institute, the Nevada Conservation Corps, and UNLV to re-establish a pool previously constructed along the main stream channel in 2012 and to create a new pool (approximately 2 x 1.5 x 0.2 meters [m]) off the current water course. Cattails were removed from both pools, and plastic liners were added to retard growth. Sandbags were used to hold down the liners and to create diversions intended to redirect sediment during a flood. Sandbags were also added to a third pool previously created in 2012; some cattails had been removed at this pool earlier in March by Great Basin Institute personnel. These pools were predominately intact in fall.

Horse Spring, Nevada

Initial translocations to this site began in 2012 and have continued through this year (see table 22). A large number of egg masses were observed in February (table 12), indicating breeding activity, and relict leopard frogs were heard calling during site visits in spring. The juvenile frogs observed this year were possibly from tadpoles released last year and did not represent natural recruitment. Cattails and reed canary grass (*Phalaris* sp.) have grown dense in the pond, affecting detectability of relict leopard frogs, although by fall, the density of vegetation was conspicuously less because of cattle grazing and heavy rains. The lower number of frogs counted in fall may have been associated with wet soils following rains prior to the survey.

Table 12.—Summary of relict leopard frogs observed at Horse Spring during visual encounter surveys conducted in 2015
(Also provided is the ambient air temperature during the survey [TA] in degrees Celsius [°C])

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/10/2015	20.9	2	2	41*	28
Diurnal	04/26/2015	17.2	15	1^	0	0
Nocturnal	03/25/2015	11.3	32	5	47**	0
Nocturnal	10/09/2015	22.6	20	4	18^^	0

* Observed 10 overwintering tadpoles.
** Large tadpoles, but species identity is uncertain on the remainder.
^ Metamorph.
^^ Large tadpoles.

Minor habitat maintenance was conducted at this site this year. Prior to the nocturnal survey in April, personnel from the Great Basin Institute and UNLV re-established waterflow to a lower artificial pool and removed patches of reed canary grass and stonewort algae (*Chara* sp.) from the main pool. Later in April,

personnel from UNLV conducted further minor work on the channel leading to the lower pool. Redirection of waterflow to the lower artificial pool does not appear to be stable, and the pool was dry again in October.

Lime Spring, Nevada

This site was established in 2012, and releases have continued through this year (see table 22). The site, however, has only limited permanent habitat, and few frogs have been observed during surveys. In May, calling by relict leopard frogs was heard, and hatchling tadpoles were observed (table 13) around a spent egg mass in a shallow pool where seven frogs were observed last fall. The observation of the hatchlings represents the first documented breeding attempt at this site, but by September no tadpoles were observed, and the pool that previously contained the hatchlings was dry. The juvenile frog observed in September likely represented an animal from the most recent release in May.

Table 13.—Summary of relict leopard frogs observed at Lime Spring during visual encounter surveys conducted in 2015
(Also provided is the ambient air temperature during the survey [TA] in degrees Celsius [°C])

Survey type	Date	T^A (ºC)	Adult	Juvenile	Larvae	Egg masses
Nocturnal	05/20/2015	14.1	7	0	700*	0
Nocturnal	09/23/2015	20.6	9	1	0	0

* All hatchlings from spent egg masses.

As was speculated during the initial site assessment before translocations began, the amount of surface water in this system is highly variable across seasons. This spring, surface water was intermittent starting upstream of the old cattle trough. At that time, the only deep pool was near the cattle trough, but this pool often goes dry, as was observed again during the fall visit. By fall, surface water flowed intermittently over only approximately 27 linear meters.

Quail Spring, Nevada

The nocturnal surveys this year resulted in a count well over 100 frogs (table 14), which is common for this site. All life stages of relict leopard frogs were observed this year, with large tadpoles observed early in the season, likely reflected by the juveniles observed in fall. Over the years, most egg masses and tadpoles have been observed in the main pool, but in March, a spent egg mass surrounded by hatchling tadpoles was observed at the lower pool; this pool had been constructed several years earlier.

Table 14.—Summary of relict leopard frogs observed at Quail Spring during visual encounter surveys conducted in 2015
(Also provided is the ambient air temperature during the survey [TA] in degrees Celsius [°C])

Survey type	Date	T^A (ºC)	Adult	Juvenile	Larvae	Egg masses
Diurnal	2/10/2015	22.7	6	0	8*	4
Nocturnal	03/25/2015	19.0	120	2	70^	0
Nocturnal	10/09/2015	23.5	94	11	16^^	0

* Observed one overwintering tadpole.
^ Observed 31 large tadpoles and 39 hatchlings.
^^ Large tadpoles.

Calling by relict leopard frogs was noted during all site visits, and amplexus was observed in fall. In February near the main pool, a dead adult relict leopard frog was observed with one leg missing, likely a predation event. As has been commonly noted, cattle activity appears to have limited the density of cattails located in the main pool. In February, a dense mat of stonewort algae encompassed about one-half of the main pool. In March, prior to the survey, personnel removed approximately 30% of the algae mat from the pond.

Red Rock Spring, Nevada

The counts this year remained low (see table 1) despite the release of 193 excess animals from the headstarting program in 2013 and 2014. Overwintering and breeding at the site has occurred, but recruitment has not been documented, although late-stage tadpoles were once observed. The juvenile and smaller adults observed this year (table 15) were likely from the releases last year. In February, water was observed flowing into the "mud pools," and later in March, larvae associated with a spent egg mass were observed in the main mud pool. Larvae from a spent egg mass were also observed in the waterfall pool, and a younger egg mass was found further downstream. No tadpoles were observed later in October, and the main mud pool was dry, as was observed last year. Cattle and burro activity remained evident during all surveys.

Table 15.—Summary of relict leopard frogs observed at Red Rock Spring during visual encounter surveys conducted in 2015
(Also provided is the ambient air temperature during the survey [TA] in degrees Celsius [°C])

Survey type	Date	T^A (ºC)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/11/2015	23.6	0	0	0	0
Nocturnal	03/23/2015	15.8	12	1	1,000*	1
Nocturnal	10/25/2015	19.8	3	0	0	0

* Hatchlings from two spent egg masses.

Tassi Spring, Arizona

Relatively low numbers of frogs were counted at this site this year (see table 1), but the spring survey was conducted quite late in the season, which may have affected detectability. Over recent years, detectability at this site in fall has been highly variable, and what causes this variability is not understood. The count this fall included a large number of juvenile frogs (36% of frogs observed) (table 16). These juveniles likely metamorphosed from the large tadpoles observed in May. Large numbers of tadpoles of various sizes were observed throughout the lower stream (within the wash) along with what appeared to be four spent egg masses observed earlier this year. Calling by relict leopard frogs was heard in February.

Table 16.—Summary of relict leopard frogs observed at Tassi Spring during visual encounter surveys conducted in 2015
(Also provided is the ambient air temperature during the survey [TA] in degrees Celsius [°C])

Survey type	Date	T^A (ºC)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/19/2015	26.2	6	0	3,146*	0
Nocturnal	05/03/2015	22.2	45	0	120^	0
Nocturnal	09/20/2015	23.1	57	32	0	0

* Approximately 700 larvae, but species identification uncertain; others are larger and included 18 overwintering.
^ Large tadpoles.

Vegetation has grown quite dense along the upper historical ditch, lowering detectability of frogs along this stretch. Maintenance of the ditch by NPS has been delayed because of concerns by Federal agencies with access to the Gold Butte area. Control action for Scotch thistle (*Onopordum acanthium*), cattails, and mesquite along the ditch are needed. The lower stretch of the stream within the wash experienced flooding last year (reported previously), and this stretch remains relatively easy to survey.

Monitoring of Experimental Sites – Other Sites

Perkins Pond, Nevada

Translocations to this site ended last year following 5 years of efforts; 1,819 relict leopard frogs and tadpoles had been released to the site. Observations of adult frogs and calling males over the years indicated some level of success, but very few overwintering animals were ever observed. Speculation on the limited observation of relict leopard frogs included low detectability, but a more plausible explanation was low survivorship. Likely stressors included predation from aquatic birds, fluctuations in water levels that could have affected predation rates and overwinter survival, and the presence of *Bd*.

As was reported previously, the water infrastructure to the pond was severely damaged by storms last year, and the pond was dry in early 2015. Shortly thereafter, Marci Henson representing Clark County (owner of the pond) announced that the county was no longer supporting the site for relict leopard frogs.

The pond was refilled later in the spring, and nocturnal surveys were conducted at the site in May and October using broadcasts of recorded relict leopard frog calls. No relict leopard frogs were detected (table 17). In fall, the water level was well below the measuring stick (located within the pond), and surveyors were able to wade and scan the inner portion of the pond; only a few treefrogs (*Pseudacris hypochondriaca*) were observed.

Table 17.—Summary of relict leopard frogs observed at Perkins Pond during visual encounter surveys conducted in 2015
(Also provided is the ambient air temperature during the survey [TA] in degrees Celsius [°C])

Survey type	Date	T^A (˚C)	Adult	Juvenile	Larvae	Egg masses
Nocturnal	05/30/2015	21.5	0	0	0	0
Nocturnal	10/01/2015	25.7	0	0	0	0

Grapevine Spring (Meadview Area), Arizona

This site currently holds one of the largest populations of relict leopard frogs (see table 1), and all life stages have been commonly observed during spring surveys since translocation ended in 2009. This year was no exception (table 18), and calling was heard during both surveys in spring. Some flooding occurred last year (previously reported), and while regrowth of vegetation has been robust, much of the stream remains open, and detectability is probably relatively high. In September, waterflow was unusually intermittent along lower parts of the drainage. A dead frog was also observed at this time, but the cause of death was unknown.

Table 18.—Summary of relict leopard frogs observed at Grapevine Spring during visual encounter surveys conducted in 2015
(Also provided is the ambient air temperature during the survey [TA] in degrees Celsius [°C])

Survey type	Date	T^A (ºC)	Adult	Juvenile	Larvae	Egg masses
Diurnal	03/08/2015	20.0	31	1	22*	7^
Nocturnal	04/30/2015	26.0	158	1	132^^	0
Nocturnal	09/26/2015	31.2	150	4	17^^^	0

* Large tadpoles, several overwintered.
^ Two egg masses just hatched.
^^ Observed about 100 hatchlings.
^^^ Observed only large tadpoles.

Union Pass Spring, Black Mountains, Arizona

The population of relict leopard frogs at this site rivals that at Grapevine Spring (see table 1), and the high-count this fall was the highest recorded at this site. Translocations occurred again this year, making this the final year for scheduled releases, but only 34 juvenile frogs were released because animals were diverted to Corn Creek (see table 22). Many egg masses were observed throughout this system during the diurnal survey. During both spring surveys, overwintering tadpoles and calling by adult males were noted (table 19). Although natural recruitment is likely occurring at this site, it has not yet been confirmed because of the continued releases. A dead adult relict leopard frog was observed in February; this animal showed no obvious physical trauma.

Table 19.—Summary of relict leopard frogs observed at Union Pass Spring during visual encounter surveys conducted in 2015
(Also provided is the ambient air temperature during the survey [TA] in degrees Celsius [°C])

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/22/2015	10.0	24	2	1,507*	37
Nocturnal	04/28/2015	16.7	135	2	23^	1
Nocturnal	09/30/2015	19.7	258	34	123^^	0

***** Observed six overwintered; all others were hatchlings from seven spent egg masses.
^ Observed 10 large tadpoles.
^^ Observed 12 large tadpoles.

Corn Creek, Nevada

On March 10, personnel from NDOW and UNLV conducted a survey at this site to assess Woodhouse's toad (*Anaxyrus woodhousii*) activity prior to sampling to detect the presence of *Bd*. Three bullfrogs (*Rana catesbeiana = Lithobates catesbeianus*) observed during the survey were removed by NDOW personnel. On March 12, nondestructive samples (swabs) for *Bd* were taken of 62 adult Woodhouse's toads. Testing confirmed the presence of *Bd* but at low prevalence and low infection intensity.

Translocation of relict leopard frogs to Corn Creek was authorized by the U.S. Fish and Wildlife Service and NDOW early in the year. At the RLFCT meeting in December 2014, it was decided that Corn Creek would receive animals from both Black Canyon and Northshore to allow flexibility for the headstarting program and to experiment with increased genetic diversity at an isolated site. In May, 109 juvenile frogs representing headstarted animals from both Black Canyon and Northshore were released over two events (see table 22). As was reported previously, Corn Creek contains bullfrogs, crayfish (*Procambarus* sp.),

small carnivorous fishes, as well as large Woodhouse's toads. Releases were made along a fast-moving segment of stream below the cement retention pond, where these predators appeared to be less common.

During the survey in October, three of the newly released relict leopard frogs were observed (table 20). These small adult frogs appeared healthy and were seen in dense grass along stretches of stream where releases occurred last spring. Prior to the fall survey, recent rains left the soil wet, which usually results in low counts, as relict leopard frogs may not be concentrated along the stream and thus harder to find. Of interest, there appeared to be a higher density of crayfish in the stream segments where relict leopard frogs were released compared to last spring.

Table 20.—Summary of relict leopard frogs observed at Corn Creek during visual encounter surveys conducted in 201
(Also provided is the ambient air temperature during the survey [TA] in degrees Celsius [°C])

Survey type	Date	T^A (˚C)	Adult	Juvenile	Larvae	Egg masses
Nocturnal	10/07/2015	19.5	3	0	0	0

Other Monitoring Actions

Site Assessments

Two spring sites, Kaolin and Jackass Springs, were assessed this year as potential translocation sites for relict leopard frogs. Kaolin Spring is located on BLM land near Overton, Nevada, within the vicinity of the J.R. Simplot Company silica mining facility. Jackass Spring is also on BLM land just south of the Moapa Valley National Wildlife Refuge, Nevada. Site assessments reports are provided at the end of this report; below are brief summaries.

On September 7, personnel from UNLV conducted a survey at Kaolin Spring on the suggestion of BLM personnel who visited the site previously in May. The plan was to assess summer habitat conditions, but summer rains had occurred in August prior to the site visit. Potential habitat for relict leopard frogs at the site was limited, but there were several large pools, some within rock formations, and a segment of stream with aquatic vegetation that could possibly support a small population. In December, personnel from BLM and UNLV visited the site to evaluate potential actions that could enhance habitat conditions for relict leopard frogs, although none could be identified at that time. Further assessments of the nature of surface water retention at the site, including an attempt to access the tinajas (large pools in bedrock), and the potential impact of scouring floods is warranted.

Jackass Spring was visited in December by personnel from BLM and UNLV, and other site visits by BLM personnel occurred earlier in May and June. The spring is above a perched aquifer, and BLM personnel stated that the surface water appeared stable between visits this year. In December, the stream flowed intermittently for approximately 90 m, with less than 50 m of aquatic habitat and very little emergent vegetation. Conditions at this site appear unlikely to support a population of relict leopard frogs. No further assessment of this site is planned.

Headstarting and Translocations

Collections

In total, four partial egg masses were collected for the headstarting program – two from the Black Canyon area and the others from Lower Blue Point. All egg masses collected contained viable eggs, and tadpoles were initially reared at the NPS facility. Small numbers of tadpoles were later moved for development to the Willow Beach National Fish Hatchery (60 Black Canyon tadpoles) and the Lake Mead State Fish Hatchery (Lower Blue Point tadpoles from 1 egg mass) (table 21).

Table 21.—Collection sites and dates collected of partial egg masses of relict leopard frogs for headstarting and translocation in 2015

Area	Site	Date	Partial egg masses
Black Canyon	Bighorn Sheep Spring	02/01/2015	1 (small, 1/4 collected)
	Boy Scout Spring	02/06/2015	1 (small, 1/4 collected)
Northshore	Lower Blue Point Spring	01/28/2015	1 (small, 3/4 collected)
	Lower Blue Point Spring	01/28/2015	1 (small, 1/2 collected)

Translocations

To date, a total of 246 animals (65 late-stage tadpoles and 181 juvenile frogs) were released to 5 experimental sites (table 22). Sites that received Black Canyon animals included Corn Creek and Lime and Union Pass Springs. Sites that received Lower Blue Point animals were Corn Creek and Bearpaw Poppy and Horse Springs. Lower Blue Point animals were also released to Upper Blue Point and returned to Lower Blue Point.

Hatchery Issues

A power outlet at the NPS Lake Mead Hilltop Laboratory failed in early March, cutting power to four tanks (both filters and heaters) for a period less than 24 hours. These tanks, however, housed large numbers of tadpoles at high

Table 22.—Numbers of late-stage tadpoles and post-metamorphic frogs raised from eggs collected in Black Canyon or the Northshore springs complex and released at sites in 2015
(The years when experimental sites first received translocations are indicated parenthetically after the site name.)

Stocks	Translocation site	Initiated	Date	Tadpoles	Frogs	Event totals
Black Canyon	Corn Creek	2015	05/06/2015	0	52	52
			05/31/2015	0	4	4
	Lime Spring	2012	05/20/2015	5	18	23
	Union Pass Spring	2011	04/28/2015	0	34	34
			Cumulative subtotal	**5**	**108**	**113**
Lower Blue Point	Corn Creek	2015	05/06/2015	0	27	27
			05/31/2015	0	26	26
	Bearpaw Poppy Spring	2012	05/23/2015	30	20	50
	Horse Spring	2012	04/26/2015	30	0	30
	Lower Blue Point Spring		06/09/2015	0	20	20
	Upper Blue Point Spring		06/09/2015	44	27	71
			Cumulative subtotal	**104**	**120**	**224**
			Column totals	**109**	**228**	**337**

densities. A total of 14 tadpoles died across the tanks, which represented a small proportion of the animals in each tank. Other tadpoles in these tanks appeared stressed, but they all quickly recovered following remediation

Physical deformities of tadpoles were observed in a few animals at both the NPS Lake Mead Hilltop Laboratory (n = 8) and Willow Beach National Fish Hatchery (n = 5). These deformities included straight legs at Willow Beach National Fish Hatchery and kinked tails or potentially shortened femurs at Hilltop – conditions that have been observed in the past. Previous assessments determined that these deformities were most likely associated with dietary issues and not diseases. An assessment of feeding material noted a change in the style of alfalfa pellets (rabbit food) and the use of non-organic endive lettuce; the remainders of these foods were discarded. Changes in the feeding protocol, with higher amounts of commercial algae wafers used and less egg white, were also noted.

Soon after the deformities were observed (on April 22), all tadpoles from the Willow Beach National Fish Hatchery were returned to the NPS facility for closer monitoring. All animals showing deformities were isolated from other animals. Once feeding protocols were modified, tadpoles with kinked tails (all raised at Hilltop) eventually metamorphosed into frogs with no obvious health issues.

These frogs were later released to Union Pass. Tadpoles with straight legs from the Willow Beach National Fish Hatchery or shorter femurs from NPS Lake Mead Hilltop Laboratory, however, developed into frogs with leg problems. These frogs were eventually euthanized.

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ATTACHMENT 1

Site Assessments

Amphibian Site Assessment: Kaolin Spring, Kaolin Spring Wash, Clark County, Nevada

Surveyors and Report Authors: Jef Jaeger and Rebeca Rivera, University of Nevada, Las Vegas (UNLV)

Date and Time of Survey: September 7, 2015; 09:38–10:38 (diurnal)

Environment Conditions (recorded at end of survey):

- Water temperature lowest main pool: 25.6 degrees Celsius (°C)
- Ambient air temperature: 32.3°C
- Relative humidity: 35.2%
- Cloud cover: 0–20%

OBJECTIVE

The survey was intended to assess summer conditions at Kaolin Spring in terms of its use as a potential experimental translocation site for the relict leopard frog (*Rana onca = Lithobates onca*). A previous survey was conducted by personnel, Mark Slaughter and Boris Poff, from the Bureau of Land Management (BLM) on May 14, 2015.

DETAILS

Kaolin Spring is located on BLM land and emerges at a rock formation that crosses Kaolin Spring Wash. Along one side of the spring runs a dirt road and water pipes associated with the J.R. Simplot Company silica mine facility. Mining activity appears to occur above the site, but this was not assessed. Further down the wash, below the spring site, were large hills of mine tailings.

The site was easily accessible by vehicle on a dirt road along a power line leading directly to Kaolin Spring Wash to within about 100 meters (m) of the spring. During the survey, water continuously flowed within the narrow canyon into the wash for approximately 260 m, (downstream end point, 727121, 4041067, Zone 11S, NAD83; figure 1). This appears to be about 70 m further downstream than the ending point recorded by BLM personnel in May (727088, 4041008). Much of the wash appeared moist from rains in August, with the last rain event on August 25.

Where the canyon narrows (726993, 4040954; figures 2 and 3) there were several successive pools mostly shaded by the canyon walls. Two or three of these pools were deep tinajas (depressions in bedrock) surrounded by steep bedrock walls

(located between: 726948, 4040949 and 726919, 4040935; figure 4). The lotic width of this system was mostly between 3–5 m, with an average water depth of about 0.25 m. The most accessible pool (lowest main pool) was about 8 m long x 8 m wide x 3 m deep. The flow rate was not substantial but consisted of a steady stream of several to many liters per minute (figure 5).

Vegetation associated with aquatic habitat was minimal. The riparian width was about 3–5 m. Tree species included willow (*Salix* sp.), cottonwood (*Populus fremontii*), and saltcedar (*Tamarix* sp.), although canopy cover was minimal. Emergent vegetation included cattail (*Typha* sp.) and common reed (*Phragmites* sp.) and at the perimeter arrowweed (*Pluchea sericea*), saltgrass (*Distichlis spicata*), and *Baccharis* sp. The site experiences scouring floods, which appears to limit vegetation density. Open surface water was dominated by planktonic algae. Tadpoles (n = 77) and juveniles (n = 3) of the red-spotted toad (*Bufo punctatus* = *Anaxyrus punctatus*) were observed. Aquatic macroinvertebrate predators included dragonflies, damselflies, and beetles. Also observed were numerous tracks from coyotes (*Canis latrans*) near the water (see figure 1).

CONCLUSION

During the survey, habitat conditions appeared adequate to support a small population of relict leopard frogs; however, additional assessments of conditions at this site are warranted before any decision is made regarding its suitability for potential introduction of relict leopard frogs. Permanence of surface water is questionable, and the tinajas need to be accessed and evaluated (access may require ropes and technical climbing). Scouring floods at this site also appear to be an issue, and such floods may recurrently diminish the population greatly.

Figure 1.—View of Kaolin Spring Wash, Clark County, Nevada, looking upstream of the end point of surface water.
Coyote tracks are noticeable.

Figure 2.—An upstream view of Kaolin Spring where the canyon narrows.

Figure 3.—Looking downstream at Kaolin Spring Wash from the same position as in figure 1.
A large iron structure associated with previous mining is on the right. Willows dominate the vegetation, with small cottonwood trees in the background; algae dominate the stream.

Figure 4.—Two or three successive, large tinajas (bedrock pools) at Kaolin Spring, located upstream where water emerges.

Figure 5.—Easily accessible pool (lowest main pool) at Kaolin Spring.
The first tinaja (see figure 4) is located directly behind the bedrock wall. Water from that tinaja can be seen seeping into the pool.

Amphibian Site Assessment: Jackass Spring, south of Moapa Valley National Wildlife Refuge, Clark County, Nevada; also referenced as Grapevine Spring on U.S. Geological Survey topographic maps

Report Author: Rebeca Rivera; UNLV

Surveyors: Rebeca Rivera (UNLV); Mark Slaughter, Melanie Cota, Boris Poff, and Jonathan Smith, BLM

Date and Time of Survey: December 1, 2015; 14:00–14:28 (diurnal)

Environment Conditions (recorded at end of survey):

- Water temperature at highest pool: 8.1 °C
- Ambient air temperature: 18.3 °C
- Relative humidity: 16.4%
- Cloud cover: 0–20%

OBJECTIVE

A survey was conducted at Jackass Spring to assess whether the conditions could possibly support a translocated population of the relict leopard frog. A previous site visit was conducted by Mark Slaughter and Boris Poff on May 14, 2015. Boris Poff also conducted a Proper Function Condition assessment at the site on June 4, 2015.

DETAILS

Jackass Spring is on BLM land and located in a wide gully south of the Moapa Valley National Wildlife Refuge. A dirt road leads directly to the spring. Along the north side of the gully is a trench where the stream resides. The headwater seepage (at 704814, 4062813, Zone 11S, NAD83; figure 6) produces little water, and discharge was measured at 0.01 liters per minute in June. Surface flow is intermittent for about 90 m (downstream end point, 704906, 4062804), with aquatic habitat of no more than 50 m. Few pools were observed, with the largest pool (figure 7) having dimensions of about 4 x 3 x ½ m (water temperature = 9.8 °C). The width of the stream averaged about 2 m, with an average water depth of about 0.4 m. Surveyors present during earlier visits noted that the amount of surface water was similar to that observed during previous visits.

The spring is associated with a perched aquifer, which allows for a wide riparian width of 21–50 m (figure 8). Tree species along the perimeter of the spring included cottonwood, screwbean mesquite (*Prosopis pubescens*), honey mesquite

(*Prosopis glandulosa*), and catclaw acacia (*Acacia greggii*) as well as palm trees. Three of the cottonwood trees are quite large, and cottonwood saplings were common within the trench. Other vegetation included canyon grape (*Vitis arizonica*) and common reed, a small patch of sedge (probably *Eleocharis* sp.), and cattail. There is evidence of occasional scouring in the trench (figure 7), which limits the growth of vegetation within the stream. No anurans were observed at this time.

CONCLUSION

The overall consensus of the field crew was that the site did not have sufficient habitat to support a population of relict leopard frogs. Minimal surface water and limited emergent vegetation was of concern. Further site assessments are not planned.

Figure 6.—Largest pool (4 x 3 x ½ m) at Jackass Spring looking upstream.
Vegetation includes cottonwood saplings, canyon grape, cattail, and a young palm tree.

Figure 7.—View of the gully with a wide riparian zone at Jackass Spring.
The trench at the bottom of the photo is where the stream lies.

Figure 8.—A downstream view of surface water about 20 m below the Jackass Spring springhead.