



Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Relict Leopard Frog Monitoring and Management

2012 Annual Report



April 2013

Lower Colorado River Multi-Species Conservation Program Steering Committee Members

Federal Participant Group

Bureau of Reclamation
U.S. Fish and Wildlife Service
National Park Service
Bureau of Land Management
Bureau of Indian Affairs
Western Area Power Administration

Arizona Participant Group

Arizona Department of Water Resources
Arizona Electric Power Cooperative, Inc.
Arizona Game and Fish Department
Arizona Power Authority
Central Arizona Water Conservation District
Cibola Valley Irrigation and Drainage District
City of Bullhead City
City of Lake Havasu City
City of Mesa
City of Somerton
City of Yuma
Electrical District No. 3, Pinal County, Arizona
Golden Shores Water Conservation District
Mohave County Water Authority
Mohave Valley Irrigation and Drainage District
Mohave Water Conservation District
North Gila Valley Irrigation and Drainage District
Town of Fredonia
Town of Thatcher
Town of Wickenburg
Salt River Project Agricultural Improvement and Power District
Unit "B" Irrigation and Drainage District
Wellton-Mohawk Irrigation and Drainage District
Yuma County Water Users' Association
Yuma Irrigation District
Yuma Mesa Irrigation and Drainage District

Other Interested Parties Participant Group

QuadState County Government Coalition
Desert Wildlife Unlimited

California Participant Group

California Department of Fish and Game
City of Needles
Coachella Valley Water District
Colorado River Board of California
Bard Water District
Imperial Irrigation District
Los Angeles Department of Water and Power
Palo Verde Irrigation District
San Diego County Water Authority
Southern California Edison Company
Southern California Public Power Authority
The Metropolitan Water District of Southern California

Nevada Participant Group

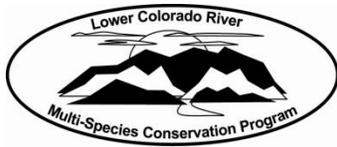
Colorado River Commission of Nevada
Nevada Department of Wildlife
Southern Nevada Water Authority
Colorado River Commission Power Users
Basic Water Company

Native American Participant Group

Hualapai Tribe
Colorado River Indian Tribes
Chemehuevi Indian Tribe

Conservation Participant Group

Ducks Unlimited
Lower Colorado River RC&D Area, Inc.
The Nature Conservancy



Lower Colorado River Multi-Species Conservation Program

Relict Leopard Frog Monitoring and Management

2012 Annual Report

Prepared by:

Jef R. Jaeger and Rebeca Rivera, School of Life Sciences,
University of Nevada, Las Vegas¹

¹ Under agreement with Lake Mead National Recreation Area, National Park Service,
and Nevada Department of Wildlife

Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada
<http://www.lcrmscp.gov>

April 2013

ACRONYMS AND ABBREVIATIONS

<i>Bd</i>	<i>Batrachochytrium dendrobatidis</i> (a pathogenic fungus)
BLM	Bureau of Land Management
CAS	conservation agreement and strategy
EPMT	Exotic Plant Management Team
LMNRA	Lake Mead National Recreation Area
NDOW	Nevada Department of Wildlife
NPS	National Park Service
PIT	passive integrated transponder
Reclamation	Bureau of Reclamation
RLFCT	Relict Leopard Frog Conservation Team
T ^A	ambient air temperature
UNLV	University of Nevada, Las Vegas
USFWS	U.S. Fish and Wildlife Service
VES	visual encounter survey

Symbols

°C	degrees Celsius
----	-----------------

CONTENTS

	Page
Executive Summary	ES-1
Introduction.....	1
Background	1
Goal and Objectives.....	2
Reporting Format	2
Methods.....	2
Site Surveys	3
Headstarting and Translocations.....	3
Other Activities.....	3
Study Areas.....	4
Results and Discussion	5
Monitoring of Natural Sites	6
Bighorn Sheep Spring, Nevada.....	6
Boy Scout Canyon Spring, Nevada	6
Dawn’s Canyon Spring, Nevada.....	7
Black Canyon Spring and Black Canyon Side Spring, Nevada.....	8
Salt Cedar Canyon Spring, Nevada	9
Upper and Lower Blue Point Springs, Nevada.....	9
Rogers Spring, Nevada	11
Monitoring of Experimental Translocation Sites.....	11
Goldstrike Canyon, Nevada	11
Grapevine Spring (Meadview), Arizona.....	12
Pupfish Refuge Spring, Nevada.....	13
Quail Spring, Nevada.....	14
Red Rock Spring, Nevada.....	14
Tassi Spring, Arizona.....	15
Perkins Pond, Nevada	16
Union Pass Spring, Arizona.....	17
New 2012 Translocation Site Surveys	18
Other Monitoring Actions.....	18
Gnatcatcher Spring.....	18
Chytridiomycosis Assessment	19
Headstarting and Translocations.....	19
Collections	19
Hatchery Issues	19
Translocations	20
Literature Cited	23

Tables

Table	Page
1	Summary of the maximum number of adult and juvenile frogs of <i>R. onca</i> seen during visual encounter surveys at sites in 2012, with results from 2011 presented for reference 5
2	Summary of <i>R. onca</i> observed at Bighorn Sheep Spring during visual encounter surveys conducted in 2012 6
3	Summary of <i>R. onca</i> observed at Boy Scout Canyon during visual encounter surveys conducted in 2012 7
4	Summary of <i>R. onca</i> observed at Dawn’s Canyon Spring during visual encounter surveys conducted in 2012 8
5	Summary of <i>R. onca</i> observed at Black Canyon Spring (main channel) and Black Canyon Side Spring during visual encounter surveys conducted in 2012 8
6	Summary of <i>R. onca</i> observed at Salt Cedar Canyon Spring during visual encounter surveys conducted in 2012 9
7	Summary of <i>R. onca</i> observed at Upper and Lower Blue Point Spring during visual encounter surveys conducted in 2012 10
8	Summary of <i>R. onca</i> observed at Rogers Spring during visual encounter surveys conducted in 2012 11
9	Summary of <i>R. onca</i> observed at Goldstrike Canyon during visual encounter surveys conducted in 2012 12
10	Summary of <i>R. onca</i> observed at Grapevine Spring during visual encounter surveys conducted in 2012 12
11	Summary of <i>R. onca</i> observed at Pupfish Refuge Spring during visual encounter surveys conducted in 2012 13
12	Summary of <i>R. onca</i> observed at Quail Spring during visual encounter surveys conducted in 2012 14
13	Summary of <i>R. onca</i> observed at Red Rock Spring during visual encounter surveys conducted in 2012 15
14	Summary of <i>R. onca</i> observed at Tassi Spring during visual encounter surveys conducted in 2012 16
15	Summary of <i>R. onca</i> observed at Perkins Pond during visual encounter surveys conducted in 2012 17
16	Summary of <i>R. onca</i> observed at Union Pass Spring during visual encounter surveys conducted in 2012 17
17	Summary of <i>R. onca</i> observed at new translocation sites during nocturnal visual encounter surveys conducted in 2012 18
18	Collection sites and dates collected of partial egg masses of <i>R. onca</i> for headstarting and translocation in 2012..... 19
19	Numbers of late-stage tadpoles and post-metamorphic frogs of <i>R. onca</i> raised from eggs collected in Black Canyon or Lower Blue Point Spring and released at sites in 2012..... 21

Figures

Figure		Page
1	Locations of sites containing natural populations of <i>R. onca</i> (in blue) and sites containing active experimental translocation sites (in green).....	4

EXECUTIVE SUMMARY

This report summarizes efforts under a project designed to implement monitoring 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*). The intent of the CAS is to increase both overall abundance as well as the number of separate populations of the species in a defined area of southern Nevada and northern 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 natural and experimental sites known to contain *R. onca*. To establish new populations and augment existing ones, egg masses were collected from native populations and reared in captive settings through development to advanced stage tadpoles or young frogs. These animals were then released at suitable sites following the objectives determined by the RLFCT. 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 the headstarting and translocation actions in 2012. Other conservation actions are also noted when appropriate.

- Spring and fall visual encounter surveys were completed at all natural and active experimental sites, with multiple surveys associated with a mark-recapture project conducted at several sites.
- The high count of 689 frogs from the surveys was higher than last year (see table 1), but the increase likely results from numerous, intensive surveys conducted at some sites this year in association with other projects.
- Overwintering, as well as breeding, was documented for the first time at Union Pass Spring.
- For the second year, no *R. onca* were observed to have overwintered at Perkins Pond.
- An experiment was completed at Perkins Pond that documented metamorphoses of tadpoles kept in containers within the pond.
- Three new experimental sites were initiated this spring: Bearpaw Poppy, Horse, and Lime Springs. The Bureau of Land Management led habitat improvement efforts at Bearpaw Poppy and Horse Springs prior to translocations.

**Relict Leopard Frog Monitoring and Management
2012 Annual Report**

- Partial egg masses were collected for headstarting from Lower Blue Point Spring and two sites in Black Canyon; an egg mass collected at Upper Blue Point Spring was not viable.
- In total, 761 animals from Black Canyon were released at Quail, Union Pass, and Lime Springs, with 1 mistakenly released at Perkins Pond. Animals from Lower Blue Point Spring included 945 released to Perkins Pond, Bearpaw Poppy Spring, Horse Spring, and to Lower Blue Point Spring, with 8 other juvenile frogs provided to the Las Vegas Springs Preserve for public display.
- Four small fish-free ponds were created at Upper Blue Point Spring along with small-scale vegetation reductions. Habitat maintenance efforts at Lower Blue Point Spring focused on rehabilitating the fish-free pond and small-scale vegetation reductions along the main stream channel. Following these efforts, egg masses and tadpoles were observed in modified areas at both the upper and lower sections.
- Small-scale maintenance of important breeding pools was conducted at Pupfish Refuge Spring, Quail Spring, and Boy Scout Canyon.
- As part of an associated project funded by the Nevada Department of Wildlife, sampling of *R. onca* for the causal agent of chytridiomycosis (*Batrachochytrium dendrobatidis*) was continued at several sites and again detected in *R. onca* at Lower Blue Point Spring.
- Mark-recapture surveys were conducted at Grapevine, Pupfish Refuge, Red Rock, Upper Blue Point, and Bighorn Sheep Springs this year as part of a U.S. Fish and Wildlife Service funded effort.

INTRODUCTION

Background

The relict leopard frog, *Rana onca* (= *Lithobates onca*), appears to be a regional endemic (Jaeger et al. 2001; 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. The species, however, has experienced a large reduction in geographic range and number of populations (Bradford et al. 2004). Although few populations were known to exist, taxonomic confusion once led to the declaration that *R. onca* was extinct (Jaeger et al. 2001). Natural populations of these frogs now occupy only a few spring sites within two general areas of southern Nevada within Lake Mead National Recreation Area (LMNRA). 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 *R. onca* 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 within the region. Despite the success of some conservation efforts, *R. onca* remain imperiled.

The information contained herein represents a summary of management, monitoring, and conservation actions implemented by the National Park Service (NPS) and Nevada Department of Wildlife (NDOW) toward meeting objectives outlined in the CAS. This document represents a final report for field efforts during 2012. 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 LMNRA and Jon Sjöberg at NDOW. Other actions conducted by cooperating agencies, such as the Bureau of Land Management (BLM) and the Bureau of Reclamation (Reclamation), are also summarized when appropriate.

Goal and Objectives

The main goal of the project was the conservation of existing *R. onca* 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 later-stage tadpoles or small 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 RLFCT prepared written protocols and techniques for conducting conservation actions for *R. onca*. 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. Also specified are the methods and timing for monitoring populations.

Site Surveys

In general, visual encounter surveys (VESs) were conducted at all natural and experimental sites known to contain *R. onca*. Surveys are conducted in early spring and again in fall. All frogs and egg masses observed are counted, but tadpole numbers represent estimates up to 300, after which a plus sign is added to indicate larger numbers. All field surveys were conducted by trained biologists with experience in amphibian monitoring. Diurnal surveys early in the year were used to document breeding activities (egg masses and tadpoles) during a prime breeding period. Nocturnal surveys during the spring and fall were used to better assess frog numbers (both adults and juveniles); 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, are determined during meetings of the RLFCT. Eggs were processed in a laboratory facility maintained by the LMNRA. Tadpoles were grown out at this facility as well as at the Willow Beach National Fish Hatchery maintained by the U.S. Fish and Wildlife Service (USFWS) and the Lake Mead State Hatchery maintained by NDOW. In general, eggs were collected in the wild from late January through March and released as late-stage tadpoles or juvenile frogs usually before the very hot temperatures began in June.

Other Activities

This report includes references to provisional mark-recapture results for population estimates at some targeted sites (Jef R. Jaeger, unpublished data). The mark-recapture efforts were conducted under a separate agreement and funding; provisional results are provided in discussion for context. Testing for the pathogenic fungus *Batrachochytrium dendrobatidis* (*Bd*), the causal agent of chytridiomycosis (Lips et al. 2006), was also conducted earlier in the season as part of a regional study mostly funded by NDOW; this report contains summary information of the results pertaining to the *R. onca* populations sampled. Although not a major component of this project, some habitat maintenance activities were performed or facilitated at important breeding pools, and these efforts are noted along with habitat activities conducted by collaborating entities.

STUDY AREAS

Eight natural sites containing *R. onca* were monitored during 2012. Sites are defined for monitoring purposes and recordkeeping, but do not necessarily represent separate demographic units. Natural sites occur in two general areas of southern Nevada, in Black Canyon below Hoover Dam, and in the Northshore Springs Complex along the edge of the Muddy Mountains. In addition, 11 experimental translocation sites in Nevada and northwestern Arizona were active in 2012 (figure 1).

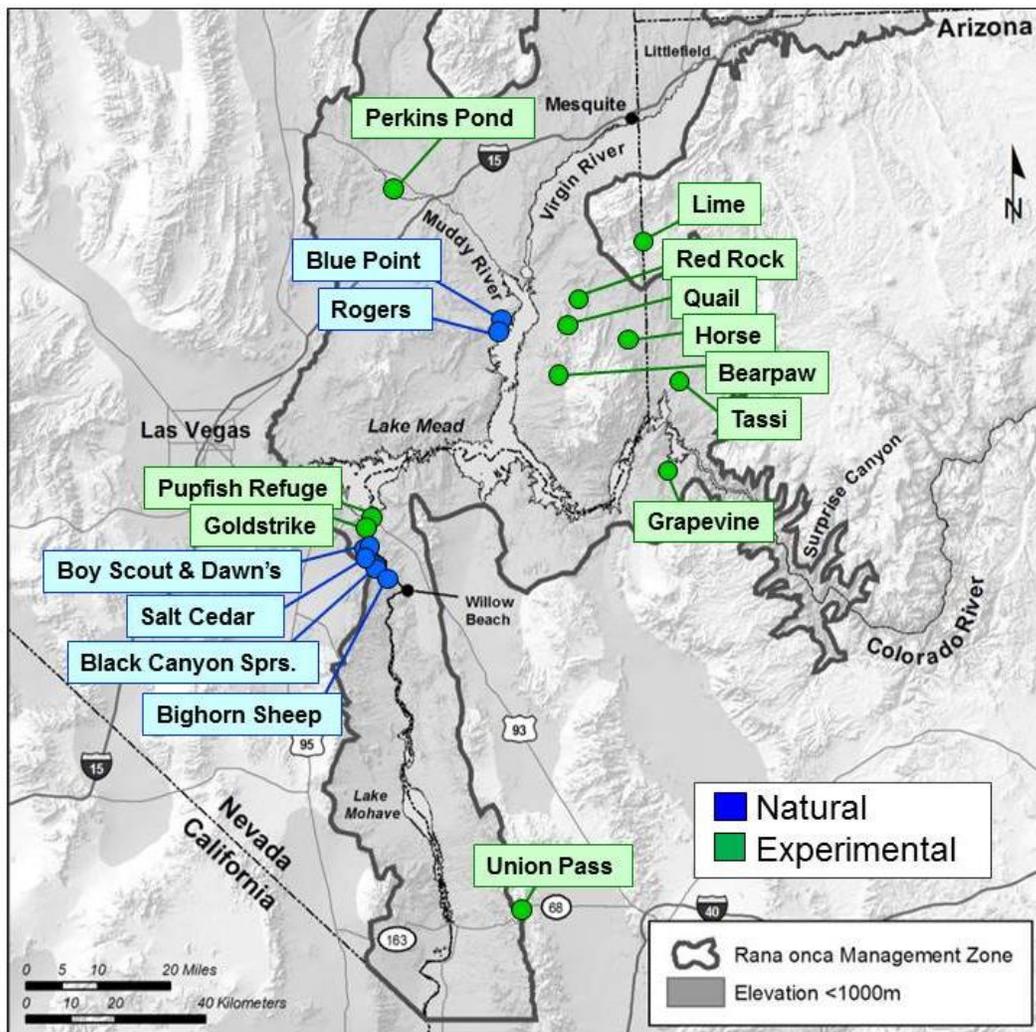


Figure 1.—Locations of sites containing natural populations of *R. onca* (in blue) and sites containing active experimental translocation sites (in green). The potential management zone for the species as identified in the CAS (RLFCT 2005) is indicated, although the area identified in western Grand Canyon may not be a viable region for translocations because of the documented presence of a closely related leopard frog species.

RESULTS AND DISCUSSION

The total maximum number of adult and juvenile frogs of *R. onca* seen during visual encounter surveys at sites represents a minimum count for the entire population. The highest seasonal count in 2012 was 689 frogs during the spring survey (table 1). This count represents a minimum estimate, as not all individuals are detected during the survey period.

Table 1.—Summary of the maximum number of adult and juvenile frogs of *R. onca* seen during visual encounter surveys at sites in 2012, with results from 2011 presented for reference

The count totals presented are high counts from surveys and include both adult and juvenile frogs. At some sites (indicated by asterisks), multiple mark-recapture surveys were conducted, and the number presented represents the highest count from these surveys. The seasonal totals represent minimum counts for the entire population.

Site type	Site	Spring 2011	Fall 2011	Spring 2012	Fall 2012
Natural	Bighorn Sheep Spring	18	16	11	71*
	Boy Scout Canyon	23	46	34	37
	Dawn's Canyon	8	5	6	4
	Black Canyon Springs	24	20	22	30
	Salt Cedar Canyon Spring	11	14	13	13
	Upper Blue Point Spring	31*	22*	26*	22*
	Lower Blue Point Spring	6	6	12	7
	Rogers Spring	6	3	14	11
Experimental	Bearpaw Poppy Spring	–	–	Intro.	11
	Goldstrike Canyon	15	12	30	15
	Grapevine Spring, Arizona	148	72	189*	94
	Horse Spring	–	–	Intro.	2
	Lime Spring	–	–	Intro.	6
	Pupfish Refuge Spring	31	25	47*	29
	Perkins Pond	0	2	0	4
	Quail Spring	164	96	114	121
	Red Rock Spring	19	16*	15*	10
	Tassi Spring	81	95	122	116
	Union Pass Spring	Intro.	–	34	37
Totals		585	450	689	640

Monitoring of Natural Sites

Bighorn Sheep Spring, Nevada

The low number of frogs seen during the spring (table 2) was consistent with the general trend in observed numbers at this site over the last couple of years following storm damage to the habitat in 2006. Vegetation recovery within the drainage may have also contributed to the low spring count by decreasing visibility. The creation of four artificial pools in July 2011 was predicted to increase recruitment because a large number of tadpoles were observed in the pools last fall. The counts this fall confirm recruitment, as many small adult and juvenile *R. onca* were observed. The artificial pools were washed out by rainstorms that occurred before the start of the fall surveys. One dead *R. onca* was found in an artificial pool during the spring nocturnal survey, and one sickly looking small adult with a damaged eye was seen during a fall nocturnal survey. During the egg mass survey, two egg masses were observed, and one recently hatched. About 3/4 of an egg mass was collected for headstarting (see table 18).

Table 2.—Summary of *R. onca* observed at Bighorn Sheep Spring during visual encounter surveys conducted in 2012

(Also provided is the ambient air temperature during the survey [T^A])

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Diurnal	01/30/2012	16.5	1	0	> 150 [^]	2
Nocturnal	05/03/2012	28.4	9	2*	> 300 [^]	0
Nocturnal	09/27/2012	28.6	48	23	0	0
Nocturnal	10/05/2012	27.7	37	29	0	0

* Metamorphic animals still with partial tails. [^] Many of these tadpoles were large, overwintered.

Mark-recapture surveys began at this site in the fall as part of a USFWS funded effort to estimate population size. Both mark-recapture surveys are reported herein as VESs. No preliminary population estimate is available at this time because of the limited number of surveys and complications from the large number of juvenile recruits.

Boy Scout Canyon Spring, Nevada

Observations at this site (table 3) indicate an increase in frog numbers related to recent breeding and recruitment along a small side channel located low in the system. During the spring, large tadpoles continued to be observed within the side channel and at the upper breeding pools. An egg mass was observed in the

**Relict Leopard Frog Monitoring and Management
2012 Annual Report**

Table 3.—Summary of *R. onca* observed at Boy Scout Canyon during visual encounter surveys conducted in 2012

(Also provided is the ambient air temperature during the survey [T^A])

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Diurnal	01/30/2012	16.6	8	0	0	1
Diurnal	02/10/2012	14.8	7	0	> 150*	3
Nocturnal	04/12/2012	23.0	30	4	> 50*	0
Nocturnal	10/16/2012	23.8	34	3 [^]	0	0
Diurnal	10/27/2012	23.4	16	0	0	0

* Some of these were large individuals. [^] Two of these were larger juveniles.

historical lower breeding pool during the early diurnal surveys, and while the eggs did hatch, no tadpoles were observed in this pool later that season. Only one adult frog was seen in the pool at that time, which was unusual.

A dead frog was again observed in a small thermal pool near where the main northern side stream enters the system. The water temperature in the pool was measured in the spring of 2011 at 56.6 degrees Celsius (°C) when a dead frog was also observed in this pool. These observations confirm suspicions of the potential lethality of some of the thermal waters in this system. Scouring from rains in the fall filled in this particular pool with gravel. The rains also piled debris into the upper breeding pools, which are in need of restoration.

A field trip this fall for members from Partners in Amphibian and Reptile Conservation was led by Jef Jaeger and Ross Haley. During the trip, remnants of a decomposing leopard frog were found in the water near the highest pools.

During the spring, about one-half of a small egg mass was collected for headstarting from the upper breeding pools (see table 18). Some minor habitat maintenance was performed at that time to reduce emergent and overhanging vegetation. Also, some vegetation was removed from the new breeding area at the base of the system to improve water flow and maintain water quality.

Dawn's Canyon Spring, Nevada

The number of frogs counted during the nocturnal surveys this year (table 4) is consistent with the numbers observed in recent years across the small area where surveys can be conducted at this site. An egg mass and some larger tadpoles were observed in the plunge pool at the base of a steep cliff (the common ending point of the survey area). During a spring survey, a juvenile frog was observed, indicating recruitment. During the fall, the site appeared scoured from rainstorms that occurred previous to the survey.

**Relict Leopard Frog Monitoring and Management
2012 Annual Report**

Table 4.—Summary of *R. onca* observed at Dawn’s Canyon Spring during visual encounter surveys conducted in 2012

(Also provided is the ambient air temperature during the survey [T^A])

Survey type	Date	T ^A (°C)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/24/2012	17.0	1	0	> 100	1
Nocturnal	05/03/2012	29.4	5	1	25	0
Nocturnal	10/16/2012	24.8	4	0	0	0

Black Canyon Spring and Black Canyon Side Spring, Nevada

These two areas represent components of the same system, although they are treated as separate sites for reporting. In general, the fast-flowing warm water along the main stream segment that is surveyed does not represent good habitat for *R. onca*, and the lack of observations during the spring nocturnal survey (table 5) was not surprising. During the fall survey, two adult *R. onca* were seen along the main channel; these frogs may have been pushed down from rains that occurred prior to the survey. In the Black Canyon Side Spring, all life stages were observed (table 5), and *R. onca* calls were heard during the spring survey.

Table 5.—Summary of *R. onca* observed at Black Canyon Spring (main channel) and Black Canyon Side Spring during visual encounter surveys conducted in 2012

(Also provided is the ambient air temperature during the survey [T^A])

Site	Survey type	Date	T ^A (°C)	Adult	Juvenile	Larvae	Egg masses
Main stream	Nocturnal	04/12/2012	22.0	0	0	0	0
	Nocturnal	10/19/2012	21.6	2	0	0	0
Side spring	Diurnal	01/31/2012	18.3	2	2	1*	0
	Diurnal	02/24/2012	20.5	1	0	> 100*	1
	Nocturnal	04/12/2012	22.4	19	3	23 [^]	0
	Nocturnal	10/19/2012	21.2	22	6 ^{^^}	0	0

* Includes one large, overwintered tadpole. [^] Includes some large tadpoles. ^{^^} Includes three larger juveniles.

Salt Cedar Canyon Spring, Nevada

The numbers of frogs observed this year (table 6) were consistent with counts last year, although well below the high counts in 2009 (as many as 47 frogs). Some areas of the spring are choked with vegetation. The tadpoles observed during the early surveys were all quite large and appeared to have overwintered. The juvenile frogs observed during the spring nocturnal survey were likely recruited from the overwintered tadpoles. During the fall survey, the majority of *R. onca* seen were small adults.

Table 6.—Summary of *R. onca* observed at Salt Cedar Canyon Spring during visual encounter surveys conducted in 2012

(Also provided is the ambient air temperature during the survey [T^A])

Survey type	Date	T ^A (°C)	Adult	Juvenile	Larvae	Egg masses
Diurnal	01/31/2012	16.8	6	0	9*	0
Diurnal	02/24/2012	23.6	2	0	2*	1
Nocturnal	04/12/2012	22.2	9	4	25 [^]	0
Nocturnal	10/19/2012	21.3	13	0	0	1

* Large, overwintered tadpoles. ^ Large tadpoles.

Upper and Lower Blue Point Springs, Nevada

Surveys at Upper Blue Point Spring were part of a long-term mark-recapture population estimation effort, and observations from these surveys are reported herein as VESs (table 7). Most of the frogs observed at Upper Blue Point Spring were individuals released to the site as part of augmentation efforts in 2008 and 2010. Two dead adult frogs were found during the spring surveys; however, seven previously unmarked frogs were captured and tagged this year. More encouraging was the observation of a few juveniles during the fall surveys. Calling by *R. onca* was heard on multiple surveys. A few Woodhouse's toads (*Bufo* [*Anaxyrus*] *woodhousii*) were seen along the upper stretch during the fall, which was unusual for this site.

Early in the spring, habitat efforts were conducted by members of the RLFCT led by NPS personnel (major effort on February 1, 2012). At Upper Blue Point Spring, 58.5 linear meters of vegetation were cut along the stream, and four small pools were created in areas adjacent to the stream channel. At Lower Blue Point Spring, 69 linear meters of vegetation were cut within the large fish-free pond and areas of the main stream nearby. The water pipe to the artificial pond was also cleared of debris to improve flow.

An egg mass was found at Upper Blue Point Spring within the main channel in an area where vegetation had been recently cut. Predatory fish (*Gambusia* sp.) were

**Relict Leopard Frog Monitoring and Management
2012 Annual Report**

Table 7.—Summary of *R. onca* observed at Upper and Lower Blue Point Spring during visual encounter surveys conducted in 2012

(Also provided is the ambient air temperature during the survey [T^A])

Site	Survey type	Date	T ^A (°C)	Adult	Juvenile	Larvae	Egg masses
Upper	Diurnal	02/07/2012	14.1	3	0	0	1
	Nocturnal	02/18/2012	14.0	19	0	0	0
	Nocturnal	03/04/2012	13.4	24	0	0	0
	Nocturnal	03/09/2012	07.4	26	0	0	0
	Nocturnal	04/06/2012	10.3	19	0	0	0
	Nocturnal	04/10/2012	25.0	21	0	0	0
	Nocturnal	04/16/2012	20.1	20	0	6	0
	Nocturnal	05/18/2012	26.3	20	0	1	0
	Nocturnal	09/17/2012	23.0	11	1	0	0
	Nocturnal	09/25/2012	20.9	11	0	0	0
	Nocturnal	10/02/2012	28.3	22	0	0	0
	Nocturnal	10/07/2012	19.0	16	0	0	0
	Nocturnal	10/14/2012	20.8	14	2	0	0
Nocturnal	11/4/2012	16.9	15	0	9*	0	
Lower	Diurnal	02/07/2012	15.4	1	0	0	2
	Nocturnal	02/21/2012	12.2	8	4	>50	0
	Nocturnal	03/07/2012	10.5	4	4	1	0
	Diurnal	05/19/2012	30.5	0	0	0	0
	Diurnal	06/30/2012	43.2	1	0	0	0
	Nocturnal	10/26/2012	14.8	7	0	0	0

* Species uncertainty.

observed nipping at the eggs. The eggs were collected for headstarting; however, they later proved to be unviable. Later in April, late-stage tadpoles were observed in shallow water along the main stream at another area where vegetation had been cut and the substrate disturbed. Adult frogs appear to favor two of the artificial pools, and in the fall, the lowest pool contained several small, unidentified tadpoles. Maintaining reasonable flows to the artificial pools has been difficult, and over time, *Gambusia* sp. have found their way into three of the pools.

At Lower Blue Point Spring, the number of frogs observed remains low (see table 7), but two egg masses were observed in the fish-free pond, and portions of these masses were collected for headstarting (see table 18). Small tadpoles were

later seen within shallow water at a site along the main channel where vegetation had been cut and the substrate disturbed. Unfortunately, large predator cichlid fish were also observed nearby. Calling by *R. onca* was heard during a nocturnal survey.

In the spring, vegetation was noted to be growing densely in areas where it had been cut earlier in the year. Also, the stream appeared to have become more channelized in areas where vegetation had been cut; in the future, vegetation reductions should probably be done in smaller patches (~ 5 linear meters) to reduce channelization. The water level within the fish-free pond decreased over time, and the pond was mostly choked with vegetation and dry by the fall survey. A single Woodhouse's toad was seen during the last release in June.

During the fall survey at Lower Blue Point Spring, frogs were captured, scanned, and measured; one was a recapture. While the recaptured frog appeared healthy, it had tested positive for *Batrachochytrium dendrobatidis* (*Bd*), the causal agent of chytridiomycosis, in the spring when *Bd* testing was conducted.

Rogers Spring, Nevada

Habitat conditions for *R. onca* at this site remain relatively poor, with dense vegetation covering the vast majority of the stream system. Observations of frogs (table 8) all occurred near the powerline road where some open habitat remains and where headstarted frogs have been released in the past. A juvenile frog observed in the spring may represent an animal recruited from tadpoles released at the site last year, but the tadpoles that were observed this spring may indicate recent breeding at the site. During the fall survey, it was noted that recent flooding appeared to have pushed down vegetation and created open areas of flowing water near the powerline road.

Table 8.—Summary of *R. onca* observed at Rogers Spring during visual encounter surveys conducted in 2012

(Also provided is the ambient air temperature during the survey [T^A])

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Nocturnal	03/16/2012	23.8	13	1	>50	0
Nocturnal	10/15/2012	23.6	11	0	0	0

Monitoring of Experimental Translocation Sites

Goldstrike Canyon, Nevada

The number of frogs seen during the spring (table 9) was higher than last year (see table 1) and more consistent with counts from earlier years. While evidence of breeding attempts have been consistently documented through recent years

**Relict Leopard Frog Monitoring and Management
2012 Annual Report**

Table 9.—Summary of *R. onca* observed at Goldstrike Canyon during visual encounter surveys conducted in 2012

(Also provided is the ambient air temperature during the survey [T^A])

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/26/2012	18.1	2	0	32*	1
Nocturnal	04/07/2012	19.5	29	1	> 200^	0
Nocturnal	10/29/2012	21.9	14	1	0	0

* Includes 20 large, overwintered tadpoles. ^ Includes 18 large, overwintered tadpoles.

(including overwintered tadpoles), the observation of a juvenile frog this spring provides the first confirmation of natural recruitment at this site since translocations ended in 2009. The fall survey count is consistent with last year's fall count, although many of the frogs appeared small (possibly young of the year). *R. onca* were heard calling during the early spring survey.

Grapevine Spring (Meadview), Arizona

This site was visited several times during the spring as part of the USFWS funded effort to use mark-recapture to estimate population size. VESs were conducted during the two earliest spring visits just ahead of the mark-recapture effort (table 10). Because of the amount of effort required for the mark-recapture, the survey teams did not always keep track of all frogs seen; thus, two of the surveys in May should not be considered VESs. Preliminary estimates indicated that there were about 352 adult frogs at this site, with 294 frogs passive integrated transponder (PIT) tagged; juveniles were not included in the estimate.

Table 10.—Summary of *R. onca* observed at Grapevine Spring during visual encounter surveys conducted in 2012

(Also provided is the ambient air temperature during the survey [T^A])

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Nocturnal	04/24/2012	26.6	90	9	> 1000^	13
Nocturnal	04/27/2012	23	99	10	> 300^^	16
Nocturnal*	05/02/2012	25.3	89	6	n.r.	n.r.
Nocturnal*	05/14/2012	28.0	129	3	n.r.	n.r.
Nocturnal	05/22/2012	33.7	179	10	10^^^	1
Nocturnal	10/17/2012	18.9	93	1	12	0

* Does not represent VES; instead, only includes animals actually handled for mark-recapture.

^ Includes 10 very large tadpoles. ^^ Includes 14 very large tadpoles. ^^ Includes 9 large tadpoles.

n.r. = Not recorded.

All life stages were observed during the spring, and calling by *R. onca* was heard on April 24, May 2, and May 22, while amplexus was observed on May 2. An increasing density of monkey flowers and other emergent vegetation was noted during the fall survey, and the observers noted that more frogs could easily be hiding within the vegetation.

Pupfish Refuge Spring, Nevada

This site was also surveyed several times during the spring as part of the USFWS funded mark-recapture effort. The number of frogs counted during these surveys varied and is reported here as VES results (table 11). About 75 adult frogs were estimated from a preliminary assessment of the mark-recapture data from spring efforts, with a minimum number of 66 frogs PIT tagged. A few juveniles were seen at that time and were not included in the estimate. All life stages of *R. onca* were observed again at this site, and calling by *R. onca* was heard during multiple surveys up through April 16.

Table 11.—Summary of *R. onca* observed at Pupfish Refuge Spring during visual encounter surveys conducted in 2012

(Also provided is the ambient air temperature during the survey [T^A])

Survey type	Date	T ^A (°C)	Adult	Juvenile	Larvae	Egg masses
Nocturnal	03/08/2012	18.9	45	2	> 500 [^]	1
Nocturnal	03/15/2012	27.1	42	2	> 500 [^]	1
Nocturnal	04/02/2012	20.7	25	0	> 500 [*]	1
Nocturnal	04/09/2012	30.5	35	0	> 500 [*]	2
Nocturnal	04/16/2012	26.5	24	0	> 300 [*]	0
Nocturnal	04/30/2012	33.4	21	1	> 300 [*]	0
Nocturnal	10/24/2012	21.1	24	5	> 30	4
Nocturnal	10/30/2012	20.0	20	4	> 550 ^{^^}	0

* Include a few large tadpoles. ^ Several large, overwintered tadpoles. ^^ Includes 50 older tadpoles.

During the last week of November, Reclamation continued habitat modification with help from the NPS Exotic Plant Management Team (EPMT). Efforts this year focused on retreatment of tamarisk using herbicide. Personnel from UNLV and NPS again spent time working along the Portal Road drainage ditch to remove cattails and clear debris from important breeding pools. Reclamation plans to plant more willow clippings at the site this year, but with fencing around each plant to deter bighorn sheep from eating the new leaves and killing the young trees.

Quail Spring, Nevada

Translocation to this small spring site began in 2008 and continued through this year, the last of the 5-year effort. The nocturnal count this spring (table 12) was much lower than last year (see table 1), but last year's count was conducted late in the season and may have included young animals emerging from the earlier releases of late-stage tadpoles. Large overwintering tadpoles were observed in the pond, and a note was made that indicated some of the frogs counted during the nocturnal survey may be young of the year.

Table 12.—Summary of *R. onca* observed at Quail Spring during visual encounter surveys conducted in 2012

(Also provided is the ambient air temperature during the survey [T^A])

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Diurnal	02/27/2012	16.0	20	0	> 30	10
Nocturnal	03/28/2012	17.2	114	0	> 323*	0
Diurnal	04/29/2012	28.2	1	0	0	0
Nocturnal	10/09/2012	20.3	117	4	17	0

* Includes 23 large, overwintered tadpoles.

BLM sponsored habitat maintenance efforts continued at this site earlier this year: eight people (including BLM and UNLV personnel from the RLFCT) worked for half a day pulling cattails from the main pond. This effort to retard vegetation encroachment was not crucial because there was plenty of evidence that cattle have been feeding on cattails along the edges of the pond. A similar observation was made during the fall survey.

Most of the egg masses observed (9 out of 10) were in the lower pond; this pond was densely choked with an algae mat, and large numbers of dragonfly nymphs (tadpole predators) have been observed in the pond over time. The egg mass in the upper pond had just hatched (February 27, 2012). It was noted that all frogs seen in the fall appeared healthy, and the abundance of insects at the spring is reassuring given the large number of frogs at this site. Calling by *R. onca* was heard during all surveys conducted this year.

Red Rock Spring, Nevada

Translocations to this site ended in 2010, and while evidence of breeding has been regularly documented, successful recruitment has not. Encouragingly, several overwintered tadpoles were observed earlier this year in an upper pool that maintains consistent water, and it seemed likely that these tadpoles would metamorphose. During the spring, adults were heard calling during multiple

surveys, and six egg masses were counted. While most of the eggs hatched, five of these masses were in pools that are often known to go dry during summer months, probably before the tadpoles can metamorphose.

This site was surveyed several times during the spring at night as part of the USFWS funded mark-recapture effort. The total counts from these surveys are reported here as VES results (table 13). The numbers counted have been relatively consistent in recent years and very similar to the range of counts reported from the surveys this spring (usually in the mid to low teens). The provisional estimate of adult frogs from mark-recapture this spring was about 19 frogs, which is consistent with the estimate made last fall. Twenty-two individuals were marked at this site overall.

Table 13.—Summary of *R. onca* observed at Red Rock Spring during visual encounter surveys conducted in 2012

(Also provided is the ambient air temperature during the survey [T^A])

Survey type	Date	T ^A (°C)	Adult	Juvenile	Larvae	Egg masses
Nocturnal	02/29/2012	15.6	1	0	0	0
Nocturnal	03/22/2012	15.2	13	0	0	6
Nocturnal	03/26/2012	10.8	15	0	4*	6
Nocturnal	03/30/2012	17.0	10	0	>1,000 [^]	0
Nocturnal	04/09/2012	18.6	13	0	> 200	0
Nocturnal	10/01/2012	20.8	10	0	47 ^{^^}	0
Nocturnal	11/01/2012	15.6	5	0	0	0

* Large, overwintered tadpoles. ^ Includes two large, overwintered tadpoles. ^^ Species uncertain.

During the fall, two surveys were conducted at the site (see table 13). A batch of small tadpoles was seen and recorded as *R. onca* (uncertain), but during the second survey, these tadpoles did not show much growth and had a darker mottled color (not the characteristics of *R. onca*). It was noted that the water in the upper pool was turbid, the flow had ceased, and cow dung surrounded the edges.

Tassi Spring, Arizona

The high number of *R. onca* frogs counted at this site during the spring was associated with expanded efforts to survey portions of the stream that flows down the main wash where dense vegetation limits access (table 14). The team worked through the densely covered drainage and documented frogs throughout the area surveyed. Translocation to this site ended in 2010, and while evidence of

**Relict Leopard Frog Monitoring and Management
2012 Annual Report**

Table 14.—Summary of *R. onca* observed at Tassi Spring during visual encounter surveys conducted in 2012

(Also provided is the ambient air temperature during the survey [T^A])

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Nocturnal	02/23/2012	19.8	46	0	> 310	18
Nocturnal	03/24/2012	22.4	113	9	> 500	1
Nocturnal	09/23/2012	26.3	49	2	0	0
Nocturnal	10/21/2012	23.0	115	1	5*	0

* Large tadpoles, one with hind legs.

reproduction (egg masses, tadpoles) has been observed on numerous occasions, natural recruitment was finally confirmed this year with the observation of juvenile frogs. Calling and amplexus were both noted during the later spring survey. Two fall surveys were conducted this season because of the low VES count in late September.

Perkins Pond, Nevada

Translocations of *R. onca* to this artificial pond began in 2010 and have continued this year (see table 19); however, overwintering animals have not been observed (table 15). Tadpoles were observed to metamorphose and grow to adult frogs in 2010, and two adult frogs were observed last year during the fall survey, indicating that growth and survival is possible at this site during the warm months. To address potential questions regarding water quality, late-stage tadpoles (Gosner stage 39–41) were released into two mesh-lined containers placed in the water near the bank. The experiment began on June 23 and ended on July 5. All tadpoles metamorphosed into healthy looking frogs. The experiment included six site visits, and three juvenile frogs were observed during one of these visits.

Several of the surveys in the spring were quite early because the effort focused on sampling chorus frogs (*Pseudacris* sp.) for *Bd* (see “Other Monitoring Actions” below), but even during the later survey after temperatures had warmed, no overwintering frogs were observed. During the fall survey, adult *R. onca* were observed and heard calling. A bullfrog was also heard calling either from the pond or just outside the exclusion fence in a marshy area formed by the overflow, but it could not be located.

**Relict Leopard Frog Monitoring and Management
2012 Annual Report**

Table 15.—Summary of *R. onca* observed at Perkins Pond during visual encounter surveys conducted in 2012

(Also provided is the ambient air temperature during the survey [T^A])

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Nocturnal	02/27/2012	12.5	0	0	0	0
Nocturnal	03/15/2012	10.6	0	0	0	0
Nocturnal	03/20/2012	11.3	0	0	0	0
Nocturnal	04/20/2012	23.8	0	0	0	0
Nocturnal	05/31/2012	24.2	0	2	0	0
Nocturnal	06/23/2012	33.2	0	0	0	0
Diurnal	07/26/2012	40.9	0	0	0	0
Nocturnal	09/19/2012	21.4	4	0	0	0

Union Pass Spring, Arizona

Translocations to this site began last year and continued this year (see table 19). Adult *R. onca* were observed during the spring survey (table 16), documenting overwinter survival. The high count of 34 frogs indicated that at least some of the tadpoles released last spring also metamorphosed and survived. Calling by *R. onca* was heard during the first two earlier surveys and an egg mass was recorded during the nocturnal fall survey, documenting breeding at the site. One small *R. onca* tadpole was later observed in the same general area. Also during the fall, an adult frog was observed in the stream well below the area where releases have occurred. Vegetation was noted to be growing dense at pools in the system where some vegetation reductions had occurred prior to frog and tadpole releases.

Table 16.—Summary of *R. onca* observed at Union Pass Spring during visual encounter surveys conducted in 2012

(Also provided is the ambient air temperature during the survey [T^A])

Survey type	Date	T^A (°C)	Adult	Juvenile	Larvae	Egg masses
Nocturnal	04/04/2012	19.0	11	0	0	0
Diurnal	05/04/2012	26.6	34	0	0	0
Diurnal	05/16/2012	34.4	21	2	0	0
Nocturnal	09/20/2012	25.1	29	8	0	1
Diurnal	09/28/2012	28.2	25	2	1	0

New 2012 Translocation Site Surveys

Nocturnal surveys during the fall were conducted at the newest translocation sites within the Gold Butte area (table 17). It was noted at Lime Spring that the upper portion of the stream only flows intermittently, whereas a consistent flow was present in June during the releases. At Bearpaw Poppy Spring, evidence indicated that burros had gotten into the enclosure built around the springhead. Besides the *R. onca* observed, there was a large number of Woodhouse's toads (94 adults and juveniles). All *R. onca* seen during the survey appeared healthy.

Table 17.—Summary of *R. onca* observed at new translocation sites during nocturnal visual encounter surveys conducted in 2012

(Also provided is the ambient air temperature during the survey [T^A])

Translocation site	Date	TA (°C)	Adult	Juvenile	Larvae	Egg masses
Lime Spring	09/29/2012	23.9	4	2	2	0
Bearpaw Poppy Spring	10/03/2012	28.9	11	0	0	0
Horse Spring	10/09/2012	21.1	2	0	0	0

At Horse Spring, only two adult frogs were observed. By the October survey, the water flow to the artificial pool created in late February was no longer reaching the pool. The water within the enclosure was shallow and stagnant and full of dragonfly larvae and water boatman (family Corixidae). Likely, stormflows had changed the water course, allowing it to continue downstream. Personnel from BLM used shovels to redirect the flow back to the artificial pool.

Other Monitoring Actions

Gnatcatcher Spring

A diurnal survey was conducted at this cold water site in November. The spring is located below the Northshore Road within the Lake Mead National Recreation Area between Blue Point and Rogers Springs. The spring is within a gully between steep slopes and is highly vegetated with emergent plants. There are also four closely situated cottonwood trees that can be seen from the road. Water can be heard near the cottonwoods, but the only open water (including a pool) was toward the lower half of the stream. Supposedly, *R. onca* were observed at this site sometime in the past by personnel working for NPS, but none were observed during the survey.

Chytridiomycosis Assessment

Testing for the pathogenic fungus *Bd* continued as part of a regional study mostly funded by NDOW. Herein, sampling and results directly relate to *R. onca* management are summarized. Eighty-six *R. onca* frogs were tested this year from Pupfish Refuge, Red Rock, Rogers, Upper Blue Point, and Lower Blue Point Springs. *Bd* was detected only at Lower Blue Point Spring. Chorus frogs appear to be regionally infected with *Bd*. One frog from the Muddy River tested positive with a high infection count, and frogs from Spring Mountain State Park in the southern Spring Range (an area identified as a potential future translocation site for *R. onca*) also tested positive at high prevalence.

Headstarting and Translocations

Collections

Portions of two egg masses were collected from two sites within the Black Canyon earlier this spring (table 18). In early February, portions of three egg masses were also collected from Blue Point Spring in areas where habitat restoration activities had been conducted just a few days earlier (see specifics above). The egg mass at Upper Blue Point Spring was collected from the main channel, but the eggs were unviable. The egg masses at Lower Blue Point Spring were found in the created fish-free pond where headstarted frogs had been released in 2008 and 2010–2012.

Table 18.—Collection sites and dates collected of partial egg masses of *R. onca* for headstarting and translocation in 2012

Area	Site	Date	Partial egg masses
Black Canyon	Bighorn Sheep Spring	01/30/2012	1 (small, 3/4 collected)
	Boy Scout Canyon Spring	02/10/2012	1 (small, 1/2 collected)
Northshore	Lower Blue Point Spring	02/07/2012	2 (majority collected)
	Upper Blue Point Spring	02/07/2012	1 (small, majority collected)*

* Eggs were not viable.

Hatchery Issues

Raceways at both the Lake Mead State Fish Hatchery and Willow Beach National Fish Hatchery were used again this year to grow out tadpoles. Feeding protocols followed those used in the NPS laboratory at Hilltop, and food was supplied from common stocks. Heaters were added to the Lake Mead Hatchery raceway this year to increase water temperatures to around 24 °C. Only Black Canyon animals

Relict Leopard Frog Monitoring and Management 2012 Annual Report

were raised at these facilities. Both systems produced healthy tadpoles and juvenile frogs, and no problems have occurred to date. A second raceway was added at the Lake Mead Hatchery for newly metamorphosed frogs.

Blue Point animals were raised at the NPS Hilltop facility along with a few Black Canyon animals. There was a problem in two tanks with eight tadpoles from Black Canyon (seven from Boy Scout and one from Bighorn Sheep) that tended to swim in circles, float upside down at the surface, and struggle to stay submerged. These animals were isolated in a separate tank, and all but one later lost their symptoms and metamorphosed into healthy frogs. These frogs were released into Union Pass Spring. The symptoms were not diagnosed, but it was once seen previously in a few tadpoles raised at the Willow Beach Hatchery.

There was also a mixup at the Hilltop facility when one juvenile frog from Black Canyon was moved to a tank holding Blue Point frogs. The mistake was immediately noted, but could not be corrected. The batch of 63 frogs (62 Blue Point and 1 Black Canyon) was later released to Perkins Pond. In general, there are existing protocols to minimize the potential for such errors. First, at Willow Beach Hatchery, only Black Canyon animals are raised. This is particularly important because this hatchery is in Black Canyon, and frogs from upstream sites have appeared here. At Lake Mead Hatchery, either Black Canyon or Blue Point animals can be raised, but only one stock at a time. At Hilltop, there is not enough space for separate growing rooms, but tanks are to be physically clustered by stock, and color codes have been added to the tanks (labeled using colored tape).

Translocations

This year, 1,715 animals (728 late-stage tadpoles and 987 juvenile frogs) were released to 6 experimental sites and 1 natural site, and 8 frogs were released to the Las Vegas Springs Preserve (table 19). Quail, Union Pass, and Lime Springs all received Black Canyon animals. Quail Spring was crowded with frogs, but the animals appeared healthy, and part of the translocation strategy is to establish genetic diversity. Releases to the site have been kept to a minimum in recent years, and only 70 juvenile frogs were released this year. This is the fifth and last year of releases to Quail Spring.

Translocations to Lime Spring began this year, even though the springhead is at high elevation and has a minimal flow. The site is occupied by a large number of chorus frogs, which may be vectors of disease. The large number of Black Canyon tadpoles reared this year, however, allowed for excess animals to be released at this experimental site. Perkins Pond, Bearpaw Poppy Spring, and Horse Spring, received Lower Blue Point Spring animals; although, as noted previously, a mixup did result in one Black Canyon frog going to Perkins Pond.

**Relict Leopard Frog Monitoring and Management
2012 Annual Report**

Table 19.—Numbers of late-stage tadpoles and post-metamorphic frogs of *R. onca* raised from eggs collected in Black Canyon or Lower Blue Point Spring and released at sites in 2012

Stocks	Translocation site	Date	Tadpoles	Frogs	Event totals
Black Canyon	Quail Spring	04/29/2012	–	70	70
	Union Pass Spring	05/04/2012	30	148	178
		05/16/2012	152	62	214
	Perkins Pond	04/20/2012	–	1	1
	Lime Spring	06/07/2012	217	67	284
		06/20/2012	14	1	15
	Cumulative totals		413	349	762
Blue Point	Bearpaw Poppy Spring	05/01/2012	–	175	175
		05/26/2012	–	184	184
	Horse Spring	05/17/2012	243	-	243
	Perkins Pond	04/20/2012	–	62	62
		05/31/2012	60	30	90
		06/23/2012	12	47	59
	Lower Blue Point	05/19/2012	–	122	122
		06/30/2012	–	10	10
	Las Vegas Springs Preserve	06/29/2012	–	8	8
	Cumulative totals		315	638	953
Column totals			728	987	1,715

Animals were also released back to Lower Blue Point to augment the low numbers observed at this site. The Las Vegas Springs Preserve received eight juvenile frogs from Lower Blue Point for use in display tanks.

At Bearpaw Poppy and Horse Springs, BLM led efforts to improve habitat prior to the releases. At Bearpaw Poppy Spring, emergent vegetation was cut from areas around the springhead and from the stream immediately below it. Two small pools were created – one near the springhead and another a few meters downstream. The pools were lined along the bottom with plastic liners to restrict regrowth of emergent vegetation. To stabilize the liners, holes were made through the material and rocks added to keep them submerged. A fence (approximately 6 meters x 6 meters) was constructed to keep feral burros from the springhead and from the lined area. At Horse Spring, habitat improvements included widening and deepening of an existing pool (approximately 5 meters x 5 meters) and covering the bottom of the pool with a pond liner to reduce vegetation growth. A fence was also placed on one side of the pool to restrict cattle and burros, and 10 willows were planted at the time of the release.

LITERATURE CITED

- Bradford, D.F., J.R. Jaeger, and R.D. Jennings. 2004. Population status and distribution of a decimated amphibian, the relict leopard frog (*R. onca*). *Southwestern Naturalist* 49:218–228.
- Jaeger, J.R., B.R. Riddle, R.D. Jennings, and D.F. Bradford. 2001. Rediscovering *R. onca*: Evidence for phylogenetically distinct leopard frogs from the border region of Nevada, Utah, and Arizona. *Copeia* 2001:339–354.
- Lips, K.R., F. Brem, R. Brenes, J.D. Reeve, R.A. Alford, J. Voyles, C. Carey, L. Livo, A.P. Pessier, and J.P. Collins. 2006. Emerging infectious disease and the loss of biodiversity in a Neotropical amphibian community. *PNAS* 103:3165–3170.
- Oláh-Hemmings, V., J.R. Jaeger, M.J. Sredl, M.A. Schlaepfer, R.D. Jennings, C.A. Drost, D.F. Bradford, and B.R. Riddle. 2010. Phylogeography of declining relict and lowland leopard frogs in the desert Southwest of North America. *Journal of Zoology* 280:343–354.
- Relict Leopard Frog Conservation Team (RLFCT). 2005. Conservation agreement and rangewide conservation assessment and strategy for the Relict Leopard Frog (*R. onca*). Unpublished document. Lake Mead National Recreation Area, Boulder City, Nevada. 164 p. Available at: www.fws.gov/nevada/es/documents/esa/Rana_onca_CAS_Final.pdf