2024 Annual Summary of Activities
Relict Leopard Frogs at the Springs Preserve

by

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The following report is the 2024 annual summary of activities under Landowner Cooperative Agreement LCA-R01 between the Las Vegas Valley Water District (LVVWD) and Nevada Department of Wildlife (NDOW) for relict leopard frogs (*Rana onca*) at the 73-ha (180-acre) Springs Preserve in Clark County, Nevada, USA. This Agreement was granted pursuant to the Programmatic Candidate Conservation Agreement with Assurances between the U.S. Fish and Wildlife Service (USFWS) and NDOW.

Executive Summary

Sixteen relict leopard frog (*Rana onca*) egg masses were documented in the North Fork refugium ponds; 14 in April and two others inferred based on two tadpole cohorts observed in September and October. No egg masses were observed in the Cienega. In August, a nocturnal survey of the Cienega documented 48 relict leopard frogs, only one of which was a juvenile. In October, 30 adults and 124 juveniles were captured during the annual mark-recapture survey of the refugium ponds. To increase public awareness about relict leopard frogs, educational content was provided through an internal weekly newsletter, in-person teacher training, posts on various social media platforms (i.e., Facebook, Instagram, LinkedIn, and YouTube), and content on the Springs Preserve website. Additionally, over 1,800 Springs Preserve guests participated in a drop-in activity specifically about the relict leopard frog.

North Fork Refugium Ponds

In 2024, the first relict leopard frog activity was observed in early March and active frogs continued to be observed into late October.

Egg mass surveys.–A total of 16 relict leopard frog (*Rana onca*) egg masses were observed directly or inferred in 2024. The refugium ponds were checked for egg masses at least five days per week. The first four egg masses were documented on March 26, 2024. Colleagues from University of Las Vegas, Nevada (UNLV) led the official annual egg mass survey on April 9, 2024, and documented 11 egg masses. In total, 14 egg masses were documented by May 14, 2024. The presence of two tadpole cohorts of noticeably different sizes during the fall mark-recapture surveys was indirect evidence that two additional egg masses were deposited in September and/or October 2024. The Springs Preserve did not receive any monsoonal rains in August or September 2024, so the two fall tadpole cohorts were not the result of rain-stimulated reproduction.

Tadpole translocations.–Per existing protocols, 2023 was the fifth and final year of tadpole supplementation of the refugium ponds. Thus, no laboratory-reared relict leopard frog tadpoles were added by UNLV to the refugium ponds in 2024. In addition, no tadpoles were translocated from the refugium ponds to the Cienega in 2024.

Mark-recapture Survey.–In total, 154 relict leopard frogs were captured during the 2024 refugium pond surveys conducted on September 23 and October 2, 2024 (**Table 1**). This is a 90% increase in the total number of frogs captured when compared to 2023. However, it is still lower than the total number of frogs captured during annual surveys conducted from 2019–2022. Most of the variability in frog numbers is attributed to annual recruitment, primarily the number of newly metamorphosed frogs. Recruitment success in the Springs Preserve refugium ponds appears to be dependent upon one or more of the following factors:

(1) avian (e.g., ducks, herons) and invertebrate (e.g., dragonfly larvae) predators
(2) cannibalistic adult frogs
(3) terrestrial predators, such as coyotes
(4) emigration; rain-assisted dispersal during years with monsoonal rains in August and/or September
(5) translocation of hundreds of tadpoles to establish the Cienega population
(6) supplementation via the release of ~ 100 UNLV lab-raised tadpoles or froglets for the 1st five years

Table 1. Summary of translocations, reproduction, and number of unique adult and juvenile relict leopard frogs captured from 2018–2024 in the Springs Preserve refugium ponds (excludes Cienega population). These numbers exclude recaptures.

YEAR	Number of Surveys	Juvenile Frogs Released	Tadpoles Released	*In Situ* Tadpole Cohorts	Adults Captured	Juveniles Captured	Total Captured
2018	1	100	0	0	4	0	4
2019	2	111	101	1	12	178	190
2020	2	0[a]	0[a]	2–3	40	244	284
2021	2	24	91	9[b]	66	161	227
2022	2	0	100	8[c]	40	142	182
2023	2	0	101	10	60	21	81
2024	2	0	0	16[d]	30	124	154

[a]No releases due to access restrictions associated with the Covid-19 pandemic.
[b]192 tadpoles were removed from the refugium ponds and translocated to the Springs Preserve Cienega.
[c]212 tadpoles were removed from the refugium ponds and translocated to the Springs Preserve Cienega.
[d]Presence of two tadpole size cohorts during surveys are indirect evidence of two fall egg masses.

Adults: There were 20 males and 10 females captured in 2024, for a male-biased sex ratio of 2:1 male:female. The 2024 adult population is estimated to be 36 adults (Chapman, 1951), which is a 64% decrease in the adult population estimate of 101 adults in 2023. This is perhaps not surprising given the low recruitment in 2023, when only 21 juveniles were captured (**Table 1**). Eight of the 30 adults (26.7%) captured in 2024 were recaptures of adults PIT tagged in 2023. However, this is only 8 of the 60 adults (13.3%) PIT tagged in 2023.

Juveniles: The 2024 juvenile population is estimated to be 206 juveniles (Chapman, 1951). We acknowledge that the juvenile population likely experienced some recruitment and mortality during the nine days between surveys. Interestingly, only 32.5% (n = 27) of the juveniles were recaptured during the second survey on October 2. Although newly metamorphosed frogs are relatively easy to capture initially, the relatively low recapture rate suggests they adopt avoidance behaviors after only a single capture.

Tadpoles: Four small (12 mm) tadpoles (Gosner Stage 23–25) were captured incidentally in the Upstream Pond on September 23, 2024. Six larger (~ 30 mm) tadpoles were captured incidentally in the Downstream Pond on October 2, 2024.

Mortality.–Several frog mortalities were documented and reported to NDOW in 2024.

- On February 27, 2024, a juvenile frog was found in a skimmer basket in an advanced state of decay. The frog appeared to have been deceased for some time, likely floated to the surface, and ended up in the skimmer. Cause of death: unknown.

- On June 26, 2024, a frog carcass comprised of skin and bones was found entangled in some vegetation. The frog was too decayed to even speculate on cause of death. Cause of death: unknown.
- On July 16, 2024, a frog was observed swimming in circles and then becoming motionless at the surface of the water. This occurred in the Upstream Pond next to an area where a continuous stream of Africanized bees (*Apis mellifera scutellate*) land at the pond's edge to gather water for the evaporative cooling of their hive. The 'swimming in circles' behavior was identical to our published observation of a frog swimming in circles and dying after being stung on the tongue by a bee (Bennett et al., 2020). Moreover, upon dissection, the frog's stomach contained two Africanized bees. Although circumstantial, the available data suggest that a bee sting was the most likely cause of death. Cause of death: Africanized bee sting.
- On July 31, 2024, a dead adult frog (SVL = 59 mm; Mass = 24 g) was recovered from the bottom of the Upstream Pond. The frog was observed upside down at the end of a Pahrump poolfish mark-recapture session. Upon recovery, the frog was found to have a slightly bloated, waterlogged, appearance and had a posterior abrasion/lesion. The abrasion, which was still bleeding, was consistent with a frog that may have accidentally been caught in a minnow trap set for the NDOW-led fish survey. Upon examination, the frog was not PIT tagged. The subsequent dissection did not reveal any Africanized bee remains. Africanized bees were actively foraging for water in the area, however, so a sting cannot be ruled out. Cause of death: Inconclusive, likely either anthropogenic drowning or bee sting.

Cienega

Egg mass surveys.–The Cienega was surveyed by UNLV, SNWA, and the Springs Preserve for relict leopard frog egg masses for the first time on April 9, 2024. No egg masses were documented.

Tadpole translocations.–No tadpoles were translocated from the refugium ponds to the Cienega in 2024. The second and last translocation of tadpoles from the refugium ponds to the Cienega was in July 2022.

Mark-recapture Survey.–In 2023, the visual encounter survey (VES) in the Cienega was moved to August, which resulted in the observation of 23 relict leopard frogs (**Table 2**). Given this success, Cienega surveys will henceforth take place in August. In 2024, we began mark-recapture surveys in the Cienega, rather than the simple VES conducted in 2021–2023. Although 48 frogs were observed on August 28, 2024, only 23 adults were captured and PIT tagged (**Table 2**).

Table 2. Summary of translocations, reproduction, and number of unique adult and juvenile relict leopard frogs captured or observed from 2021–2024 in the Springs Preserve Cienega population. These numbers exclude recaptures.

YEAR	Number of Surveys	Tadpoles Released	*In Situ* Tadpole Cohorts	Frogs Observed	Adults Captured	Juveniles Captured	Total Captured
2021	1	192	-	1	-	1	-
2022	1	212	-	0	-	-	-
2023	1	0	-	23	17	6	-
2024	2	0	0	48	23	1	24

Adults: Of the 23 adult frogs that were captured in August 2024 (**Table 2**), there were 11 males and 12 females, a sex ratio that does not differ significantly from 1:1. This unbiased sex ratio contrasts starkly with the aberrant 2:1

sex ratio at the north fork refugium ponds. No population estimate was calculated for the Cienega population due to an insufficient number of recaptures because of high winds.

Juveniles: The presence of a single juvenile frog with a snout-vent length < 45 mm is perplexing. There are several hypotheses that may explain the lack of juveniles: (1) a lack of reproduction, and thus recruitment, in the Cienega would seem the most obvious; (2) if there is a lack of reproduction within the Cienega itself, then perhaps the frogs in the Cienega are adult frogs colonizing the Cienega during rain-assisted dispersal from the refugium ponds; (3) if there is reproduction in the Cienega itself, then there may be a high predation rate on eggs, tadpoles, and/or newly metamorphosed frogs and thus only a few survive to adulthood; (4) there may be a lower probability of observing newly metamorphosed frogs vs adults in the dense emergent vegetation; and (5) given the number of frogs observed and the relatively larger wetland habitat, the lack of competition for resources resulted in an accelerated growth rate, as documented in 2018 in the refugium ponds.

Tadpoles: No tadpoles were observed in the Cienega in 2024.

Mortality.–No frog mortalities were documented in the Cienega in 2024.

Morphology

A comparative size-frequency histogram for both the Cienega and North Fork populations reveal interesting trends (**Fig. 1**). As previously discussed, there is a distinct lack of smaller, newly metamorphosed, juvenile frogs in the August Cienega sample, with none in the 26–40 mm SVL size classes. Second, the Cienega has several frogs in the two largest size classes covering 76-85 mm, which are conspicuously absent from the North Fork refugium ponds.

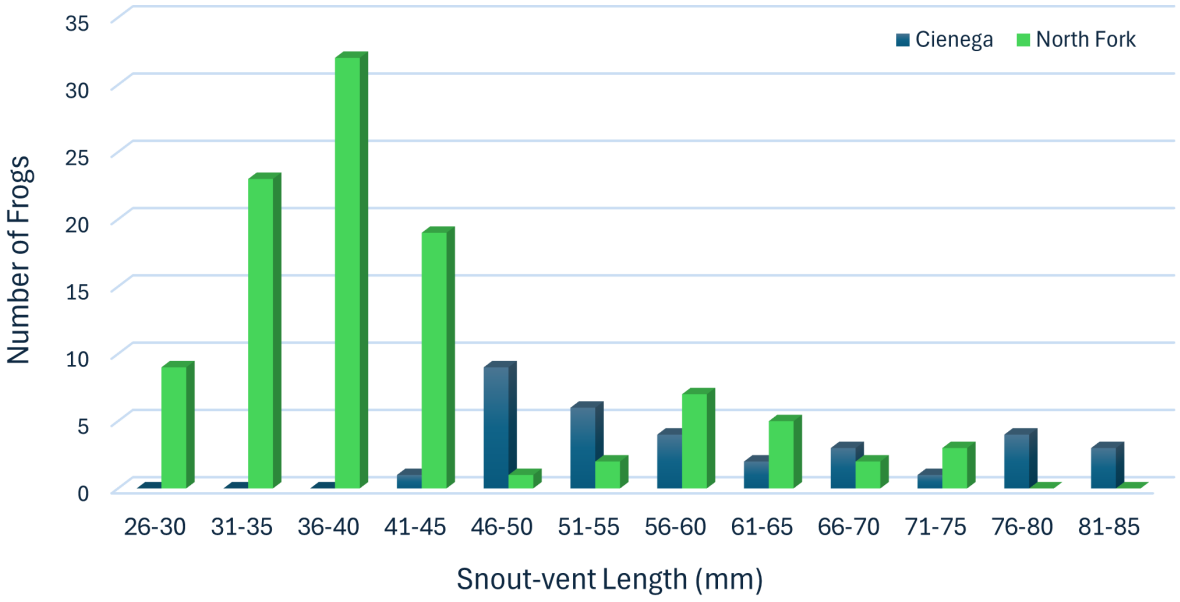

Fig. 1. Size-frequency histogram for snout-vent length (mm) for relict leopard frogs captured in 2024 in the Cienega and North Fork Refugium Ponds at the Springs Preserve, Las Vegas, Clark County, USA.

Education

Information about relict leopard frog is shared on the Springs Preserve's website. Guests visiting the ponds can read interpretive panels about the history of the relict leopard frog and some of the threats the species faces.

The Springs Preserve Conservation Education Division has made it a goal to educate guests about the natural history of the frog and about the re-wilding efforts that have been made to establish relict leopard frog populations at the Springs Preserve.

Much of the education programming is presented as a "drop-in" activity in our Origen Museum. This activity is a deep dive exploration of the species with a staff member, which includes: (1) an explanation of what an endemic species is; (2) why frogs are important environmental indicator species; (3) why we brought the relict leopard frogs to the Springs Preserve; and (4) what we are doing to restore and rewild our native habitats. In 2024, we had 1,837 drop-in interactions with guests specifically about the frogs.

The Springs Preserve also hosted a 'Teacher Training' in January 2024 attended by 29 elementary school educators with a total yearly outreach of 4,073 students, as well as 29 secondary school teachers with an outreach of 8,229 students. During this teacher training, educators were brought out to the refugia site at the Springs Preserve where they met with a biologist to learn more about the relict leopard frog. They were also provided with grade-specific lesson plans to bring to their classrooms, which align with Nevada academic content standards.

Other public education outreach efforts from Springs Preserve were presented in SNWA newsletters (**Appendix I**) and online through social media platforms (below). Note that many social media posts are provided in English and Spanish.

Title: Urban Almanac: Relict Leopard Frog
Publication: "Hey Las Vegas" daily newsletter
Date: January 30, 2024
Hyperlink: https://link.citycast.fm/view/63c9bc73d751aa0240955380kca2k.m2q/ce9706e0

Title: Leap Day
Publication: Facebook & Instagram
Date: February 29, 2024
Hyperlink: https://www.facebook.com/photo/?fbid=796497309180995&set=a.639234304907297

Title: Tree Trimming
Publication: Facebook & Instagram
Date: March 11, 2024
Hyperlink: https://www.facebook.com/photo?fbid=802956061868453&set=a.639234304907297

Title: National Wildlife Day
Publication: Facebook & Instagram
Date: September 4, 2024
Hyperlink: https://www.facebook.com/reel/363727936810747

Title: Beware of Zombie Frogs (Creepypasta illustrated using AI)
Publication: YouTube, LinkedIn
Date: September 30, 2024
Hyperlink: https://youtu.be/U1Kvww2Kjm8?si=jzaiOT5g0-MYNdvs

Title: Dead Pool: Never Give Up!
Publication: Facebook & Instagram
Date: October 7, 2024
Hyperlink: https://www.facebook.com/springspreserve/videos/2849765435330564

Title: Restoration efforts hit record numbers
Publication: Pipeline: The Las Vegas Valley Water District weekly newsletter
When: October 7, 2024
Hyperlink: Appendix I

Title: Some potential Predators at Relict Leopard Frog Refugium Pond
Publication: Facebook & Instagram
When: December 4, 2024
Hyperlink: https://www.instagram.com/reel/DDKq_nqsCPE/

Title: Ribbiting Progress
Publication: Facebook and Instagram
When: December 30, 2024
Hyperlink: https://www.facebook.com/springspreserve/posts/1000299832134074

Citations

Bennett, A.R., Rivera, R., Saumure, R.A., O'Toole, T. Jaeger, J.R. and Bean, P.R. 2020. *Rana onca* (Relict Leopard Frog). Diet and mortality. Herpetological Review 51:302–303.

Chapman, D.G. 1951. Some properties of the hypergeometric distribution with applications to zoological sample censuses. University of California Publications in Statistics 1(7):131–160.

Acknowledgments

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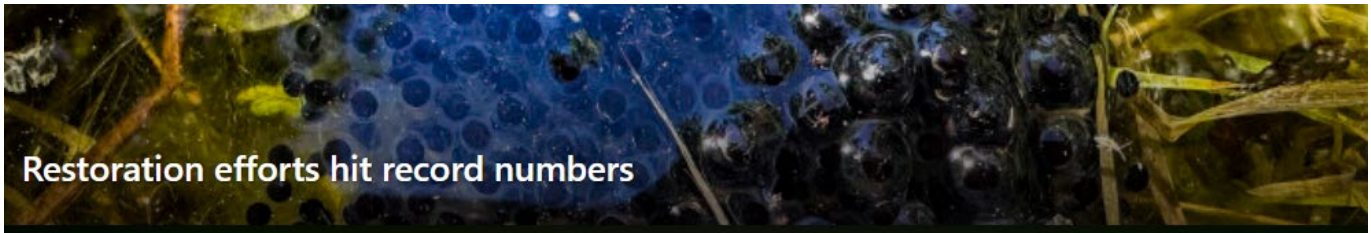
Appendix I



Restoration efforts hit record numbers

While the Springs Preserve is popularly known as a cultural destination, it is also a sanctuary for the federally endangered Pahrump poolfish and state-protected relict leopard frogs. Both species are making a comeback by leaps and bounds, thanks to preservation efforts by staff biologists working with the Nevada Department of Wildlife.

Pahrump poolfish numbers now total 757, based on counts of their populations in the Preserve's Upstream and Downstream ponds. After biologists started removing invasive macroalga (called "Stonewort") from the ponds in May 2022, the poolfish numbers jumped by more than 500 percent just a year later!

In addition, the number of relict leopard frogs documented in the Cienega doubled between 2023 and 2024. This year there were 15 relict leopard frog egg masses counted, which means healthy newly transformed frog numbers expected for this year's count.

By establishing a safe haven for both species at the Preserve, visitors can learn about the lives of the poolfish and relict leopard frogs who call Cottonwood Grove home. The Springs Preserve, in partnership with the Southern Nevada Water Authority, continues to work to protect native and endangered species and educate our community about our desert ecosystem.