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Chiricahua Leopard Frog Management in Southern Arizona

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Introduction

The Chiricahua leopard frog (*Lithobates chiricahuensis*, hereafter referred to as "CLF") is a native frog in southern Arizona. The CLF range spans through central Arizona and south into the Altar Valley where it extends into Sonora, Mexico and east to the southwestern portion of New Mexico (1). This federally threatened species once existed in many cienegas, pools, lakes, streams, and reservoirs across southern and central Arizona. By 2011, CLF had disappeared from more than 80% of their historical locations in the U.S. (2). Their habitat is now largely limited to stock tanks, springs, and streams that are protected by local management and landowners from water loss and non-native predators such as bullfrogs. Solutions to these threats require creating and improving ideal habitat. Management approaches can be developed by investigating the factors that contribute to suitable habitat and understanding how threats to the species can be addressed.

Although other native frogs have suffered extensive population losses, the CLF is the only southwestern ranid listed in the U.S. Threatened and Endangered Species List (3). Landowners and managers would like to find practical solutions that improve water infrastructure and enhance frog habitat while complementing other land management practices and needs. We explored past management actions and how they support CLF populations. We describe the challenges that may be encountered during project planning and implementation when deploying habitat enhancement projects. The aim of this review was to identify best management practices to enhance and connect existing CLF populations and establish new populations.

Methods

A review of scientific literature about CLF life history, habitat, and recovery efforts in the Southwest was conducted. Using Google Scholar, ISI Web of Science and Google we searched terms; *Lithobates chiricahuensis, Rana chiricahuensis*, Chiricahua Leopard Frog. We then explored the literature for details of species habitat, explanations of declining numbers, reintroduction and restoration efforts, and management outcomes. We found a total of 21 papers relevant to our review: seventeen peer-reviewed publications and four government reports. Ten of these papers are cited in this publication. We supplemented the literature review with a compilation of up-to-date information gathered directly from individuals living and working in CLF areas where various habitat enhancement efforts have occurred. We spoke with 12 key individuals about successes, challenges, and opportunities related to enhancing CLF populations.

Results and Discussion

CLFs (Image 1) are most active early in the morning during the warm season. As ambient air temperature rises, and water becomes warmer, nocturnal activity is more common. CLF movements from aquatic to terrestrial habitats are typically triggered by rain (1). During the monsoon season CLFs can be observed moving further up the banks of water features as humidity levels increase and disperse after the rain stops. CLFs will often end up following drainages during rain events but can sometimes be led outside of drainage areas with the rain. Frogs seem to disperse in all directions with an astonishing ability to detect bodies of water. The most important factor in dispersal is proximity to other water sources; there have been documented dispersals of 12 miles, sometimes within a few days.

Major challenges to the CLF

Bullfrogs

A prerequisite for the health of any CLF population is the absence of American bullfrogs (*Lithobates catesbeianus*). Many

CLF recovery efforts have failed due to bullfrog invasion. The introduction of bullfrogs, from the 1920s through 1980s, has led to near extinction of the CLF in natural systems and is probably the most important factor in species decline (5,8). Bullfrog presence in or near CLF habitat should be monitored and controlled frequently. It is recommended not to introduce CLFs near any existing or anticipated future bullfrog populations.

Bullfrogs can quickly travel similarly large distances as CLFs and have been seen crossing multiple drainages using unpredictable dispersal corridors. One female can lay over 1000 eggs, potentially undoing years of removal work - so monitoring bullfrog movement before, during, and after eradication efforts is necessary. It is well-known that fences do not keep bullfrogs out of CLF habitat. Early detection and immediate communication when bullfrogs are seen in the area is critical for keeping bullfrog eradication costs low. According to interview participants, planning long-term funding, and landowner buy-in are the most important aspects for controlling bullfrog populations.

Drought

CLFs, like all aquatic native frogs, require semi-permanent or permanent water (9). Thus, vulnerability to drought is another consideration for CLF habitats because populations can collapse quickly without nearby water sources. While some ponds might have limited carrying capacity, even small bodies of water with consistent moisture can be valuable to CLF populations. Increasing the permanence of water in any capacity is considered a potential dispersal corridor. Since the exact traveling distances of CLF are not known, researchers suggest, where possible, that CLF habitats be within 5 miles of one other to give populations a chance to move to a better location.

Isolation

Many CLF sites are threatened by fragmentation and isolation associated with habitat loss and degradation (7). Isolation of CLF habitat exacerbates all other vulnerability factors because the frogs may depend exclusively on a single area and have no additional options if the area becomes uninhabitable. Smaller CLF sites are often vulnerable to population extinction due to low numbers and because they are not linked by usable corridors to other sites (6). Researchers stated that it is usually best to focus on the meta-population level rather than building up population at a specific site. Sites that are linked by usable corridors to other sites can save populations during drought and ensures population resilience if a specific site experiences a die-off event.

Although large habitats with greater complexity of vegetation, soils/substrate, and air and water temperatures would seem to better support CLF populations than simple habitats, such complex habitats also support CLF predators (6). Large water bodies and complex habitats managed by USFWS have been unsuccessful at enhancing CLF numbers. Simple habitats such as dirt tanks, that primarily support livestock and that are closely connected to similar sites, are recommended.

Fungus

Chytrid fungus, *Batrachochytrium dendrobatidis*, is commonly known as a winter phenomenon that causes localized die-off in CLF populations (4). Some frog populations can persist with the disease, especially at warmer and lower elevation sites, although it is unknown why (10). Cooler water temperatures seem to result in both higher occurrence of chytrid fungus and CLF mortality; the relationship between these variables has not been explained.

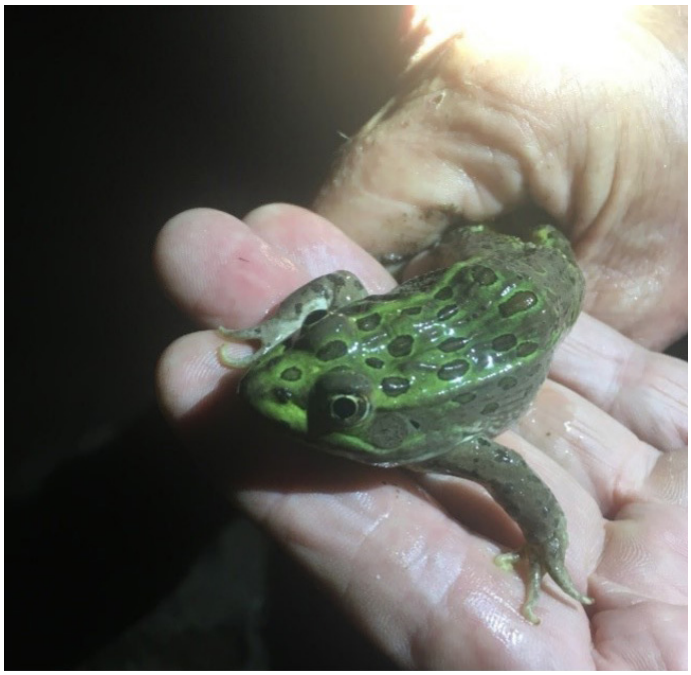

Image 1: CLF photographed during an evening survey in September 2020. Photo credit: Whitney Noel.

Recommendations for CLF habitat projects

Water Depth

The recommended depth of water depends on the size of the water source as well as the ability to control water levels. At sites with controllable water levels, water depth from 18 inches to three feet is recommended. Adult frogs use the shoreline of a habitat and usually won't occupy an area deeper than three feet, but their predators and competitors do. Low water levels are acceptable, if monitored, as CLF have been known to survive in 18 inches of water in the driest months. Frogs grow faster in warm water, so shallow habitats can be beneficial. Shallower habitat can

also prevent the colonization of invasive cattails. While recommendations about depth are primarily based on the benefits of shallow habitat, researchers acknowledge that without a controllable water source, tanks should have a minimum of ten feet of water at their deepest point to mitigate the risk of drying during droughts or mechanical issues that may go unnoticed.

Sealing Water Tanks

The main purpose of sealing a water tank is to prevent water loss. Depending on the method, sealants can also help prevent plant and tree encroachment. Options range from low-cost cattle trampling to installing liners, which have greatly improved over the years. Areas of high clay soil content provide a good sealant for habitat creation; the clay soils can be dug up and compacted while the site is being built. Compaction is usually necessary, and it can be done mechanically with a "sheep's foot" roller, and it is helpful to allow cattle to trample the pond as it's filling. Tank rehabilitation involves deepening, sealing, and cleaning out inflow infrastructure. Bentonite can be used to seal tanks by hardening soil, so water drains out more slowly.

Vegetation Management

Vegetation on shorelines and at the bottom of depths of ponds and tanks may positively or negatively affect CLFs. Submerged vegetation can help protect CLF larvae and tadpoles from predators and vegetation on shorelines can provide cover for adults. However, certain aquatic plants can be very problematic to a CLF habitat. Primarily, cattails, bulrush and giant rush are aggressive plants that can take over a pond within a few years and leave no open water for CLFs. Bulrush and giant rush are very difficult to thin or remove once established because they have tough roots and heavy biomass. Large trees near the waterline utilize high volumes of water, and their roots grow into the pond.

CLF Introduction/Translocation

Translocation of CLFs to new habitat is usually regulated by the U.S. Fish and Wildlife Service (USFWS) and the Arizona Game and Fish Department (AZGFD), with the assistance and cooperation of local recovery groups. For reintroductions, frogs of multiple life stages may be used, including eggs, tadpoles, and adults. Eggs are at risk of predation by aquatic insects, so using tadpoles and frogs is preferable.

In Arizona, there is an agreed upon standard protocol for surveying CLF populations as well as a centralized database for tracking population status. The USFWS, U.S. Geological Survey, and AZGFD cooperate to manage the data itself, manage data access, and to certify surveyors. While some CLF populations have been monitored for many years, some populations are inconsistently monitored due to the lack of sustained funding for monitoring.

AZGFD and USFWS have highlighted the importance of adhering to the complex guidelines for CLF recovery projects. In addition, monitoring data can be added to the statewide CLF database. Coordination with these agencies is required if CLF are being translocated.

Conclusions

While many challenges exist, there are individuals and agencies that aid in the CLF's continued survival. Collaboration with different partners to source long-term funding will be needed for habitat maintenance and monitoring as well as responses to current and unexpected challenges. Proactive management is important to the success of CLF populations which can be seen when project monitoring and maintenance is conducted consistently. Maintaining a core population (composed of multiple small populations) can be very beneficial because it allows frogs to disperse to multiple locations.

Landowners of CLF habitats have been supportive of projects occurring on their land, and have been in open communication as projects progress. There are always challenges to creating realistic monitoring and maintenance goals when planning new projects. Some landowners will require permits and other permissions for a project to begin. Creating habitats with a minimum amount of work that, after completion, can be revisited for monitoring 1-3 times a year and can go without maintenance for many years are ideal.

A major value of the CLF is the potential to benefit livestock and other wildlife through the creation of perennial water sources. While impacts and interactions between ranchers and CLF habitat found in year-round dirt tanks can be difficult at times, it has been shown that, with support from multiple agencies, there is potential for cattle and CLF to co-exist. These partners include USFWS, Partners for USFWS, AZGFD, USFS, National Fish and Wildlife Foundation, and Bureau of Land Management.

There are also economic opportunities related to having permanent waters that support CLF populations. Water attracts a diversity of species, and water sources have the potential to become destinations for birders and other wildlife watchers who may be willing to pay for access to those features.

Strong support from researchers, past management, and landowners have paved the way for the active management taking place today. Documentation, collaboration, and outreach play a key role in Chiricahua leopard frog persistence in the Southwest.

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