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Understanding the Demographics of Arroyo Toad (*Bufo californicus*) Reproduction to Develop Management Strategies.

Research Proposal

Prepared for:

California Department of Fish and Game
Tim Hovey

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
WESTERN ECOLOGICAL RESEARCH CENTER

Understanding the demographics of Arroyo Toad (*Bufo californicus*) reproduction to develop management strategies.

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BACKGROUND

We recently (August 27, 2002) conducted a scientific review workshop assessing how to monitor arroyo toad breeding population trends at MCB Camp Pendleton. Part of the workshop background included developing a conceptual model of the arroyo toad life history.

While commenting on the conceptual model and making recommendations regarding the monitoring protocol, the workshop participants identified several areas for research that would improve understanding to assist with management of the arroyo toad, e.g. improving understanding of the relationships between toads and potential stressors, habitat, and response to potential management action as well as understanding of toad phenology and demographics, especially longevity. It has been suggested that arroyo toads are relatively short-lived species (4-5 years) compared to many toads that live longer (>10 years). Because management and monitoring scenarios are very different under these two demographic strategies it is important to verify the longevity of arroyo toads.

Toad longevity should be fairly easy to assess and with a couple different options. An estimate of longevity could be made by capturing previously tagged toads if the original tab numbers from Holland *et al.* (2001) could be located. This would result in a minimum age for these animals. This could be accomplished more accurately by marking metamorphs and recapturing them annually. This technique would require a long-term study and recapture rates are low.

Therefore, we propose to employ skeletochronology. This technique involves the aging of individuals using samples of bones, in this case toes. This technique allows more flexibility than with only pit-tagging. First, you are not limited to sites where toads have been previously marked, and second, you can identify the demographics of the population in one to few years as opposed to only following a single cohort or staggering pit-tagging efforts for many years. Thus, one can investigate the breeding site demographics of any population where adequate samples can be collected. This technique might be very useful for understanding the demographics of arroyo toads within the MSCP Reserve in San Diego.

SPECIFIC QUESTIONS

How long do arroyo toads live? When skeletochronology is to be used, it is extremely valuable to validate the technique by having known-age animals to age in a blind experiment. This could be done by marking new metamorphs, or by aging an animal the first year with a toe clip, then recapturing that animal in the next few years and re-aging—in that way, at least you can say that in (for example) 2005 it is two years older than in 2003.

Are there gradients in the demographics across populations in the reserve? If recruitment is linked to water availability, different populations could require different

management scenarios. By sampling a gradient of sites we can test whether the age structure matches.

Are El Nino events driving the age structure of this species locally? If we find tight cohorts of similarly aged individuals then we can test whether the age structure lines up with these climatic events. It might be that these events drive the recruitment of this species and the only variability in age structure of the populations is the time lag between events.

TECHNIQUES

While we could sample sites where animals have been pit-tagged by other investigators for a known period of time, the number of these sites is low (Camp Pendleton, Rincon Indian Reservation, Sloan Quarry), and the chance of getting enough toads for assessment might also be low as recapture rate across years is low for this species. Also, access to the original pit-tag information may be limited but this could be investigated. Therefore, we have selected skeletochronology as the technique to verify arroyo toad longevity. This method requires the sampling of a toe for each individual. Multiple populations could be studied in one year to determine their age class structure. A subset of sites will be revisited on the second year to resample a subset of individuals to re-age them as a control. The study design for skeletochronology would be hierarchical and focus on the MSCP land. Both large and small populations would be sampled to determine if there are differences.

WORK PLAN

<u>Winter/spring of 2003</u>

Proposed sample arroyo toad breeding sites for adults:

Target sites

Large populations: Marron Valley, San Pasqual Valley
(30 males, 20 females minimums) + upland individuals

Small populations: San Vicente/Kimball Valley, Boden Canyon, Sweetwater River
(10 males, 5 females minimums) + upland individuals

<u>Summer/fall of 2003</u>

Analyze the skeletochronology field samples

<u>Winter of 2003</u>

Data reduction and preliminary work-up

Winter/spring of 2004

Resample a subset of sites and individuals to determine validation of technique.

Summer of 2004

Analyze new field samples.

Winter of 2004

Complete analysis and submit report and manuscript.

POSSIBLE RESULTS AND APPLICATIONS FOR MANAGEMENT

This study will provide an understanding of the demographics of breeding toad populations and provide the initial estimate of arroyo toad longevity. In addition, it may provide the basis for identifying the minimum and maximum breeding age for the arroyo toad. In addition, these results may also show that the El Nino climatic events that drive much of the hydrology of southern California could be a major factor in the age structure of this species.

The management scenarios recommended may be very different dependant on the longevity results of this study. For instance, if the species is found to be long lived with a short time to breeding age then management might be focused toward ensuring that some level of recruitment takes place every few years. Alternatively, if the species is found to be short lived with an age structure driven by El Nino events, management should be focused toward ensuring that each El Nino event results in successful recruitment.

LITERATURE CITED AND ADDITIONAL REFERENCES

Bastien, H. and R. Leclair. 1992. Aging wood frogs (*Rana sylvatica*) by skeletochronology. Journal of Herpetology 26:222-225.

Holland, D.C., N.R. Sisk, and R.H. Goodman. 2001. Linear Transect Censusing of the Arroyo Toad (*Bufo californicus*) from 1996-2000 on MCB Camp Pendleton, San Diego County, California.

Trenham, P.C., Shaffer, H.B., Koenig, W.D. and M.R. Stromberg. 2000. Life history and demographic variation in the California tiger salamander (*Ambystoma californiense*). Copeia 2000:365-377.

BUDGET

Understanding Demographics of Arroyo Toads

	Estimated Cost	U.S.G.S. Match
Principle Investigator		$2,000.00
Surveyors	$19,800.00	
Travel		
Vehicles		$1,500.00
Additional Supplies and Materials		
Batteries, Lights, Film, Nets, etc.		$1,150.00
Data Management and Analysis /Lab Support	$8,776.00	
Report production		
Writing	$1,100.00	
Spatial Data Development	$264.00	
Metadata Development	$528.00	
Printing Costs		$1,500.00
Subtotal Annual Costs	$30,468.00	$6,150.00
Indirect Cost Center 19%	$5,788.92	$1,168.50
Indirect Cost Headquarters 11%	$3,988.26	$805.04
Total	$40,245.18	$8,123.54