# Global Re-introduction Perspectives: 2011

## More case studies from around the globe

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# Houston toad population supplementation in Texas, USA

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## Introduction

The Houston toad (*Bufo* [*Anaxyrus*] *houstonensis,* Saunders, 1953) is endemic to the forested, deep sandy soils of east-central Texas, USA. It was the first amphibian placed on the United States List of Threatened and Endangered Species in 1970, and is also listed as Endangered by the IUCN and the state of Texas. Since the 'Endangered' listing of the Houston toad, its populations have continued to decline across its range. This is largely synchronous with a reduction in habitat quantity, through conversion of forest to agriculture and urban development, and quality, due to fire suppression and fragmentation. Precipitous declines have been observed concomitantly with prolonged droughts (Brown & Mesrobian, 2005). There are two parcels of state owned property; the 2,400 ha Bastrop State Park and a separate 178 ha tract (Welsh Tract), both in Bastrop County, Texas. All other tracts are privately owned and only with the collaboration of landowners do these tracts provide habitat restoration and stewardship efforts for the species in the wild. The Welsh Tract, owned and administered by Bastrop County is the only tract managed primarily for toad recovery. Other conservation or stewardship tracts have other primary objectives and incorporate Houston toad stewardship alongside those goals.

## Goals

- Goal 1: To increase juvenile survivorship above 1% on critical recovery sites, thereby decreasing the likelihood of extinction within the next decade.
- Goal 2: To facilitate natural recolonization of restored habitat by increasing population sizes.
- Goal 3: To establish a captive assurance colony of genetically representative Houston

Houston toad showing vocal sac

toads to supply individuals for re-introductions in the event of extinction in the wild.

## Success Indicators

- Indicator 1: Increase in sub-population size (mean over 5 years) to 5,000 adult females for habitat fragments where head-starting has occurred.
- Indicator 2: Increase the number of robust sub-populations to at least two.
- Indicator 3: Achieve a sustainable captive assurance colony containing genetic diversity representative of the remnant wild populations.

## Project Summary

**Feasibility:** A Population Viability Analysis (PVA) conducted by Hatfield *et al.* (2004) determined the Houston toad would likely go extinct within a decade if juvenile survivorship was below 1% and there was only one subpopulation. Field data suggested juvenile survivorship was 0.03% (Grueter, 2004), much lower than originally assumed, and that there might indeed be only one viable subpopulation. A subsequent model-based estimate concluded juvenile survivorship to be 0.75% - 1.5% (Swannack *et al.*, 2009), but again it appears that only one robust subpopulation exists. Thus, it was proposed by one of the authors to the United States Fish and Wildlife Service that without active stewardship the Houston toad would be extinct in the near future. We believe future recovery efforts should address pertinent biological weaknesses identified by the PVA, and focus on head-starting (to improve juvenile survivorship), habitat restoration (to increase the viability of additional subpopulations), and creation of a captive assurance colony. This would not be the first time Houston toads were collected for *ex situ* conservation purposes. In the 1980s nearly 500,000 eggs, tadpoles, toadlets and adult Houston toads were captive propagated and translocated to the Attwater Prairie Chicken National Wildlife Refuge in the hopes of creating a second population in a protected area. This previous Houston toad *ex situ* conservation program provided relevant experience and information for the current work. The 1980s effort has been largely viewed as a failure (Dodd & Seigel, 1991), yet recently generated genetic data from the dissertation work of McHenry (2010) revealed evidence that supports the potential long-term success of those early efforts. Significant pre-existing data from annual surveys, mark-recapture, and habitat restoration efforts were available for the Bastrop County sites, which enabled us to test the efficacy of supplementation at various life stages. With this backdrop, the most recent population supplementation project was initially focused on the robust Bastrop County sub-population, as well as the much less robust, but critically important, sub-population in Austin County, Texas.

**Implementation:** In the spring of 2007, the first Houston toad eggs were transported to the Houston Zoo for head-starting. For the head-starting efforts, egg strands or partial egg strands, are collected and transported to the zoo's "amphibian conservation quarantine" facility. The eggs are acclimated to captive water conditions and are introduced to the tadpole rearing aquarium rack system. As larvae approach Gosner stage 42 they are transferred to "emergence tanks", which are miniature ponds with a high temperature ($32^{o}$ C - $35^{o}$ C) basking spot. Upon complete absorption of the tail the toadlets are then transferred to fully

Army of Houston toads ready for release

terrestrial enclosures. They are fed a series of gradually larger prey items (springtails, fruit flies, bean beetles, domestic crickets, wax worms, and mealworms) until achieving the scheduled release size. Actual releases are timed to coincide with rain events whenever possible. In 2010, larvae between Gosner stage 38 and 40 were released in an effort to determine if larvae releases would be as effective as toadlet releases (i.e., have the same,  less, or more effects on juvenile survivorship). Pre-release protocols mandate a clear fecal parasite history (no parasites for at least 2 consecutive screenings), healthy and normal histopathology results from deceased or screened individuals from the group, and a negative amphibian chytrid qPCR test. The toadlets are released at or just after sunset into the forest surrounding the same pond from which the eggs were collected. For late stage larvae, releases are performed in the early afternoon. In 2007, 500 Houston toads were released, with an impressive 33.5% of juveniles surviving in captivity. In 2009 and 2010, 4,194 and 14,728 Houston toads were released, respectively, with captive survivorship increasing to 50 - 55%. Both 2008 and 2011 were exceptional drought years during which Houston toad reproduction in the wild was not detected, and may not have occurred.

**Post-release monitoring:** Differentiating between captive raised and wild individuals is challenging, as most techniques (e.g. toe clipping, elastomers, passive intergrated transponders) have innate failure rates that can reduce the detection of previously marked individuals if releases are made when the individuals are small. Specifically, it is extremely challenging to mark larvae for an evaluation of the success of releasing different life stages. Genetic markers can be used to differentiate individuals from different cohorts or sibling groups (Blouin, 2003), and if a cohort is adequately sampled and released at the same life stage, it is possible to genetically “tag” any individual and determine its origin when recaptured. Our previous population genetics work (McHenry, 2010) provides the highly polymorphic marker suite required, and research by Vandewege (2011) has confirmed the utility of those markers to detect kinship against unknown wild caught individuals.

## Major difficulties faced

- Due to the rarity and secretive nature of the Houston toad, very little is known about commensal organisms and naturally occurring pathogens. This results in

Typical habitat with researchers

large delays to any releases when new organisms (e.g. *Mycobacteria sp.*) are detected in head-started toads.

- Juvenile amphibians consume a tremendous quantity of invertebrate prey, which is a testament to the ecological services of amphibians, but can become quite expensive in an *ex situ* conservation program.
- Determining the most effective (highest survivorship for the lowest cost) life stage to release is extremely important, but fraught with difficulties. As survivorship probability is positively linked to size, larger individuals should fare better after release, and the larger a female is, the closer she is to reproductive maturity. However, captive acclimation is likely to be more significant the longer an individual is reared in captivity. Likewise, cost is correlated to duration in captivity, requiring optimization of limited financial resources to either maximize numbers (larval population supplementation) or size (large juveniles). The data necessary to guide these decisions are not yet available.
- As Texas is primarily privately owned, Houston toad recovery will rely heavily on the ability of wildlife agencies to bring private landowners and other stakeholders to the table. Returning head-started endangered species into stakeholder communities, which have a mosaic of opinions about the toad and the government, can cause delays and even halt progress.

## Major Lessons learned

**State of the Science**

- Amphibian declines and consequent stewardship programs are well established, but frameworks for optimizing amphibian population supplementation are not. Endangered species suffer from multiple impacts culminating in their declines. In many cases inherent rarity serves to increase the difficulty of accurate statistically supported assessment methods for a given management option. Seemingly too often, any population increases detected are assumed to be the results of a given management strategy, even if little or no data support those suppositions. We have found very little data to guide decisions about population supplementation strategy and success in amphibian populations. The lack of published evaluations of population supplementation using genetic markers or strong mark-recapture data was surprising to us.

- The math of survivorship reveals that any successful population supplementation effort in the Houston toad will require a much more industrial scale effort than was initially perceived. On average we have been able to head-start and release six egg strands or partial egg strands per year since 2007. On the one hand this is tremendously valuable, as those represent a significant proportion of the total reproduction in the wild, and an even larger proportion of the reproduction for the two largest sub-populations remaining for the species. Thus, reducing mortality from complete (i.e. drought desiccation losses) to "normal" is a significant contribution when reproduction is this rare in the wild. Unfortunately, that low level of overall reproductive success will not enable a population to rebound, much less recover. Wild egg strand head-starting also requires half of the overall program effort necessarily devoted to field monitoring, detection, and acquisition of wild egg strands. While the situation in the wild is improving and we have demonstrated that part of the positive change in abundance is a direct result of head-starts, it will not be enough and captive propagation must be carefully considered as a viable option.

## Success of project

| Highly Successful | Successful | **Partially Successful** | Failure |
|---|---|---|---|
| | | √ | |

**Reason(s) for success/failure:**

**Successes:**

- As one of the goals is to significantly increase juvenile survivorship, this has been a remarkable success thus far. Both standard mark-recapture methods and genetic tracking have detected head-started individuals months and years after release, albeit at low total numbers but relatively high frequencies given the released life stage (~8% near adults and large juveniles, and ~0.1% among initial metamorphs of annual wild captures) as constrained by the expected natural survivorship frequencies in the wild.
- Another remarkable outcome has been the stakeholder response to head-starting and supplementation. The concept is easily grasped and the close involvement of those private stewards has provided a stronger engagement with the conservation efforts. Seeing juvenile toads hop away is not an abstract conservation program in the way that chorus monitoring or annual pitfall trapping can be. The response to the program has included media attention and the consequential additional public outreach.
- The captive assurance colony is in place and a genetic comparison of the wild populations and captive assurance colony has been completed. While results vary among subpopulations, 67% of the genetics detected in the wild is retained by the current captive colony.

**Failures:**

- Our field procedural techniques did not account for the resampling of recaptured individuals. We have completed more than a decade of mark-recapture and monitoring of the species at the field sites. Historically, animals that were recaptured and had been previously marked were not resampled for DNA, with the knowledge that they were sampled at initial capture. For our purposes during the first two years of the population supplementation, this had not been fully modified for the head-start tracking. Previously marked head-starts were recaptured but not resampled for DNA, decreasing the power of our DNA mark-recapture analyses and preventing final confirmation of those individuals as head-starts. This is particularly relevant for metamorphs with a cohort toe-clip released during the first two years of the study. It is less relevant, but still an issue, for larger releases that were microchipped but not resampled at recapture.

- Persistent drought conditions have resulted in very few wild egg strands, with attendant consequences to the study. Captive propagation should have been incorporated during the planning stages to compensate for this recurring problem.

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