Ex Situ Conservation of Imperiled Amphibians in AZA Institutions

Thanks!

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What is *ex situ* conservation?

San Antonio Zoo

Detroit NACC


ave the
Yoboree Frog?


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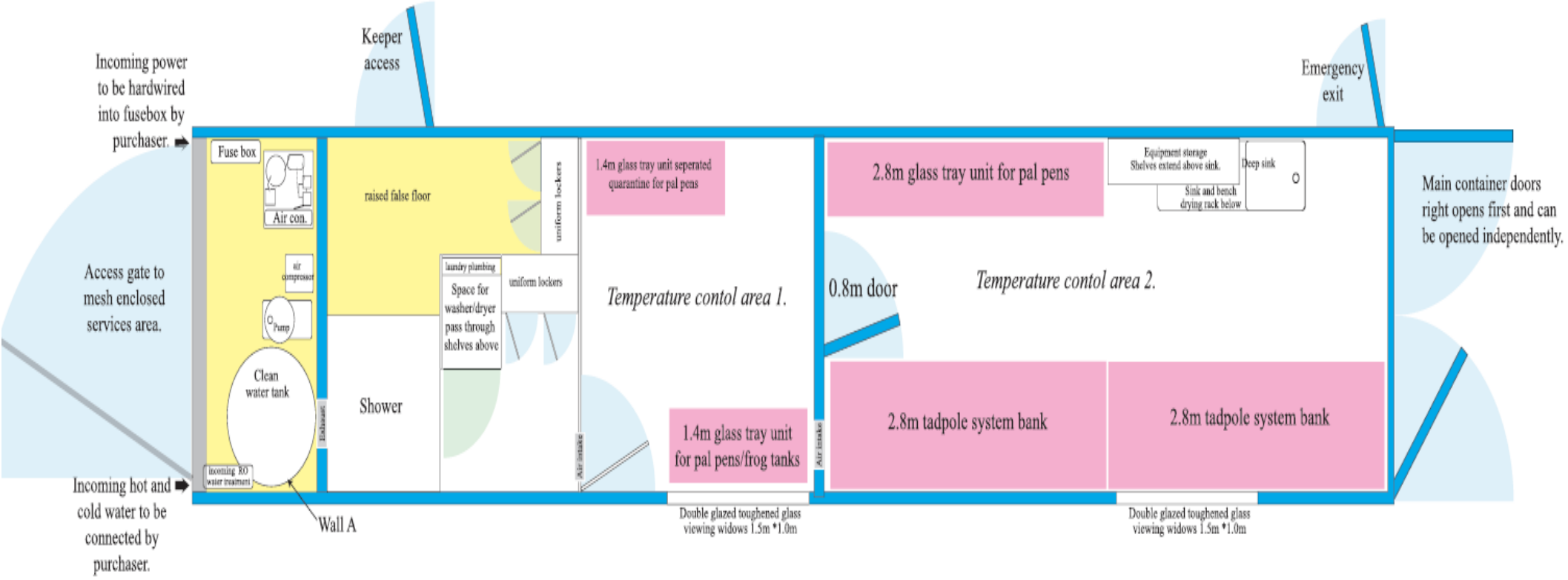
Quarantine unrestricted areas (potentially exposed to background pathogens or staff prior to disinfection)

Door openings and direction of opening

Fully insulated waterproof walls rated for use in -30°C freezers (usually stainless steel inside and out with expanded foam internal insulation)

Frog and tadpole enclosure banks



in situ conservation

- **Highest priority**
- **Fails to protect against some threats**

ex situ conservation

- **When *in situ* is too slow or ineffective**
- **Buying time for species that would otherwise become extinct**
- **Coupled with an obligation to deliver *in situ* threat mitigation**
- **Success = end of captive program**
- **Politics, expense, biosecurity, inbreeding/artificial selection**
- **The only hope for ~500 species**
- **Where do all of these animals go? Who takes care of them?**

AZA

The Association of Zoos & Aquariums (AZA) provides its members the services, high standards and best practices needed to be leaders and innovators in animal care, wildlife conservation and science, conservation education, the guest experience, and community engagement.

Accreditation

Every candidate for accreditation fills out a detailed questionnaire which includes copies of their policies, procedures, records, lists, and reports. The application takes many months to complete and six months to study and evaluate. After the Accreditation Commission studies the application, a team of inspectors visit the zoo or aquarium in person. Each team includes at least one veterinarian along with animal and operations experts.

Why use AZA institutions for *ex situ* conservation?

>1200 accredited zoos

>100,000 employees

Experts in amphibian husbandry

In 2010, AZA-accredited institutions provided $130 million in support of approximately 2,000 conservation projects in more than 100 countries

>600 million visitors/year
1 in 10 people every year

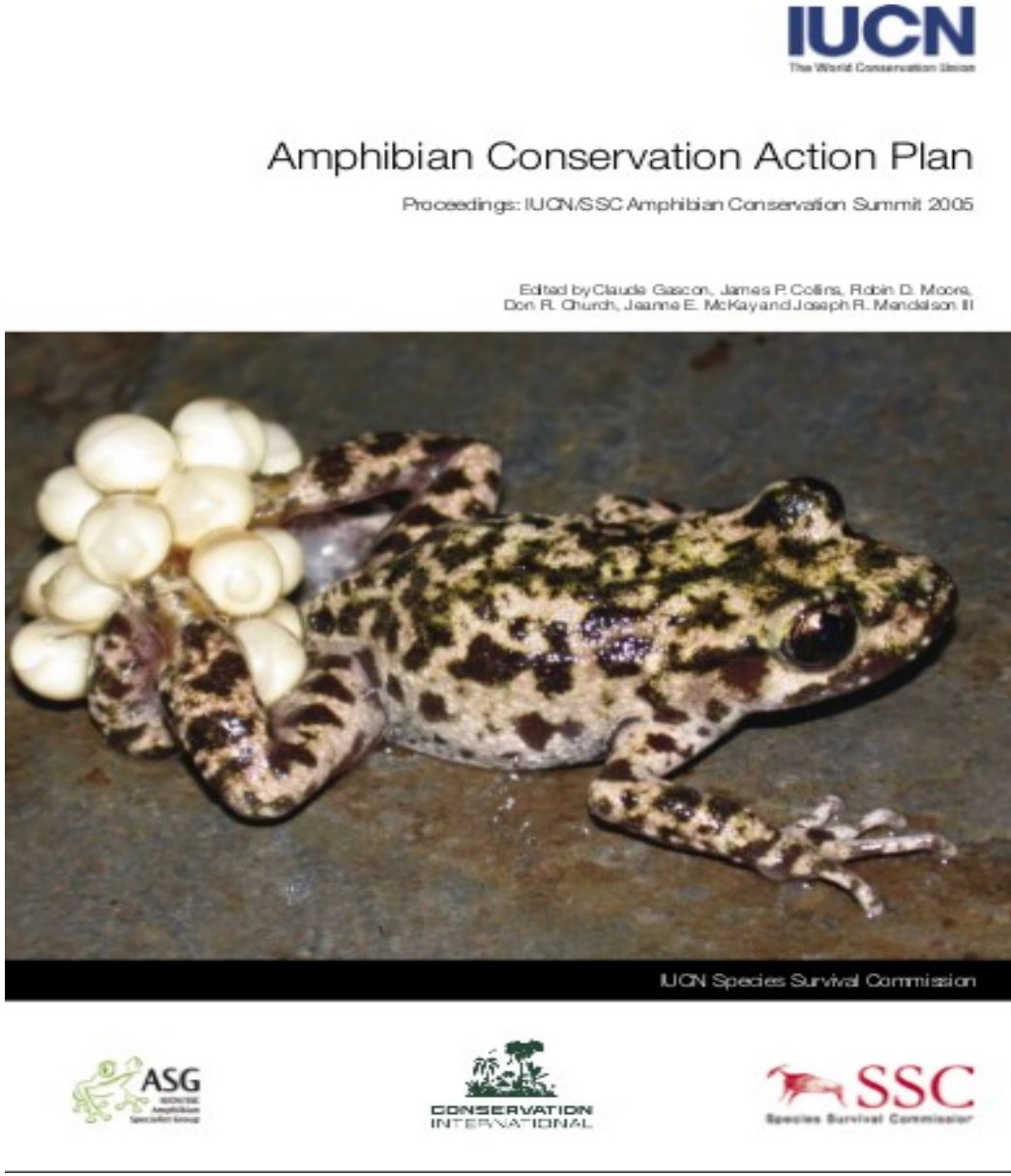
~250,000 amphibians of ~400 species
TAGs, studbooks

Problems using AZA institutions for *ex situ* conservation?

- Zoos are adapting to meet the needs, but they still aren't ready for something of this magnitude
- Many zoos are broke (biosecurity is expensive)
- Not everyone is an amphibian specialist
- Range countries are outside of the reach of AZA
- Managed by people who may not prioritize amphibians

ACAP

- Increase of research and understanding of declines and extinctions
- Assess amphibian diversity and populations
- Develop and implement long-term conservation programs
- Respond to emergency crises



Amphibian Ark

- The captive management role of the Amphibian Conservation Action Plan
- Joint effort of the World Association of Zoos and Aquariums, the IUCN's Conservation Breeding Specialist Group, and the Amphibian Survival Alliance
- Their mission is, "ensuring the global survival of amphibians, focusing on those that cannot currently be safeguarded in nature."

Institutional Collection Plan

- Status in the wild
- Status in zoos and aquariums
- Existence and priorities of cooperative management programs
- Ability to maintain the species in both a physically and psychologically healthy environment
- Exhibit value
- Education value
- Exhibit suitability (may include climatic considerations)
- Need for husbandry and other research
- Recommendations stated in AZA TAGs' Regional Collection Plans
- Any other issues specific to your institution's mission and vision

Taxon Advisory Group

- The development of an Action Plan
- The development of a RCP
- Serving as an AZA expert and providing a discussion forum for topics applicable to the taxa under its purview
- Assisting in the selection of appropriate species for AZA Conservation and Education Programs
- Establishing management, research, and conservation priorities
- Advancement of animal management techniques based on scientific studies
- Oversight of SSP and Studbook Programs
- Serving a specific role in conflict resolution issues that arise
- The development of a Taxon-Specific Animal Care Manual

Regional Collection Plan (RCP)

RCPs describe a list of species recommended for management in AZA zoos and aquariums, the level at which those species should be managed, detailed explanations for how those recommendations were developed, and an evaluation of how much space should be dedicated to each

Wildlife Conservation and Management Committee

- Monitoring and evaluation of the efficiency and effectiveness of AZA Animal Management Programs and Centers, and providing additional support to Program Leaders and Centers as needed
- Evaluating and ensuring AZA Program Leader and Institutional performance and participation
- Ensuring Animal Management Program effectiveness through accountability measures
- Generating policies/procedures as necessary
- Facilitating conflict resolution processes
- Providing professional oversight, guidance, and support for the Animal Management Programs
- Reviewing and approving required Animal Management Program outputs/documents including Regional Collection Plans
- Maintaining direct communication and collaboration with the AZA Board and Staff

Species Survival Plan (SSP)

- Currently there are over 300 SSP programs
- First created in 1981
- Historically used for Flagship species: African Elephants, gorillas, California condors, et cetera
- Less showy species were maintained as Population Management Plans (PMP): e.g. most herps, birds, and inverts

SSP

- Last year AZA did away with the PMP listing and renamed breeding plans as either SSP Green, SSP Yellow, or Red Studbook.
- Designations were determined by Population Size and Genetic Diversity.
- The lower vertebrates were finally given their day in the sun!

SSP Green

- **Maintain Genetic Diversity over 90% for 100 years or 10 generations.**
- **Must follow full participation policy set by AZA.**
- **All non-AZA partners must be approved by the WCMC.**

SSP Yellow

- Managed population with minimally 50 animals but can not maintain G.D. at 90% for the 100 years or 10 generations.
- Private participation is accepted in this group without approval by the WCMC.
- Participation in management plans are voluntary not required as with SSP-Green

Red Studbook

- Population has less the 50 individuals.
- Participation is voluntary by zoos and privates.
- No mandated breeding plans are published.
- Typically used with newer species in zoo collections.

Studbook?

Documents the pedigree and entire demographic history of each individual in a population of species. These collective histories are known as the population's genetic and demographic identity and are invaluable tools that track and manage each individual cared for in AZA-Accredited Zoos and Aquariums, Certified Related Facilities and by Approved Non-Member Participants as part of a single *ex situ* population.

AZA Population Management Center (PMC)

Located and hosted by the Lincoln Park Zoo in Chicago, IL, is responsible for conducting the genetic and demographic analyses needed to develop and distribute population management recommendations for all Species Survival Plans.

	Northern		Southern		Entire	
	Current	Potential	Current	Potential	Current	Potential
Founders	4	0	26	1	30	1
Founder genome equivalents (FGE)	0.83	1.12	11.72	22.52	5.34	23.67
Gene diversity (GD %)	39.97	55.46	95.76	97.78	90.64	97.89
Population mean kinship (MK)	0.6003	-	0.0424	-	0.0936	-
Mean inbreeding (F)	0.5708	-	0.0168	-	0.1974	-
Percentage of pedigree known before exclusions and assumptions	100	-	95.7	-	87	-
Percentage of pedigree known after exclusions and assumptions	100	-	100	-	100	-
Effective population size/census size ratio (Ne / N)	0.0667	-	0.0856	-	0.0761	-
Years To 90% Gene Diversity	-	-	-	-	> 100	-
Years to 10% Loss of Gene Diversity	-	-	-	-	> 100	-
Gene Diversity at 100 Years From Present (%); Assuming λ = 1.03, Target size = 832, import 4 founders ever 4 years	-	-	-	-	92	-
Gene Diversity at 10 Generations (T(4.3) x 10 = 43 years) From Present (%); Assuming λ = 1.03, Target size = 832, import 4 founders ever 4 years	-	-	-	-	93	

	Current	Potential
Founders	28	138
Founder genome equivalents (FGE)	15.23	165.88
Gene diversity (GD %)	96.72	99.70
Population mean kinship (MK)	0.0328	-
Mean inbreeding (F)	0.0000	-
Percentage of pedigree known before assumptions and exclusions	84.2	-
Percentage of pedigree known after assumptions and exclusions	100	-
Effective population size/census size ratio (Ne / N)	0.0231	0.05
Years To 90% Gene Diversity	5	15
Years to 10% Loss of Gene Diversity	9	25
Gene Diversity at 100 Years From Present (%); Assuming λ = 1.01, Target size = 828; Potential projections Ne/N = 0.05	30.72	61.39
Gene Diversity at 10 Generations ((T x 10) = 27 years) from Present (%);Assuming λ = 1.01, Target size = 828; Potential projections Ne/N = 0.05	68.02	84.13

Biosecurity and Husbandry

ASSOCIATION OF ZOOS & AQUARIUMS

Amphibian Husbandry Resource Guide

Edited by:
Vicky A. Poole, National Aquarium – Baltimore
Shelly Grow, Association of Zoos & Aquariums
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For more information about AZA and its amphibian programs, visit
http://www.aza.org/ConScience/Amphibians_Intro/

ATAG

ASSOCIATION OF ZOOS & AQUARIUMS

ATAG

Chapter 1

General Amphibian Husbandry

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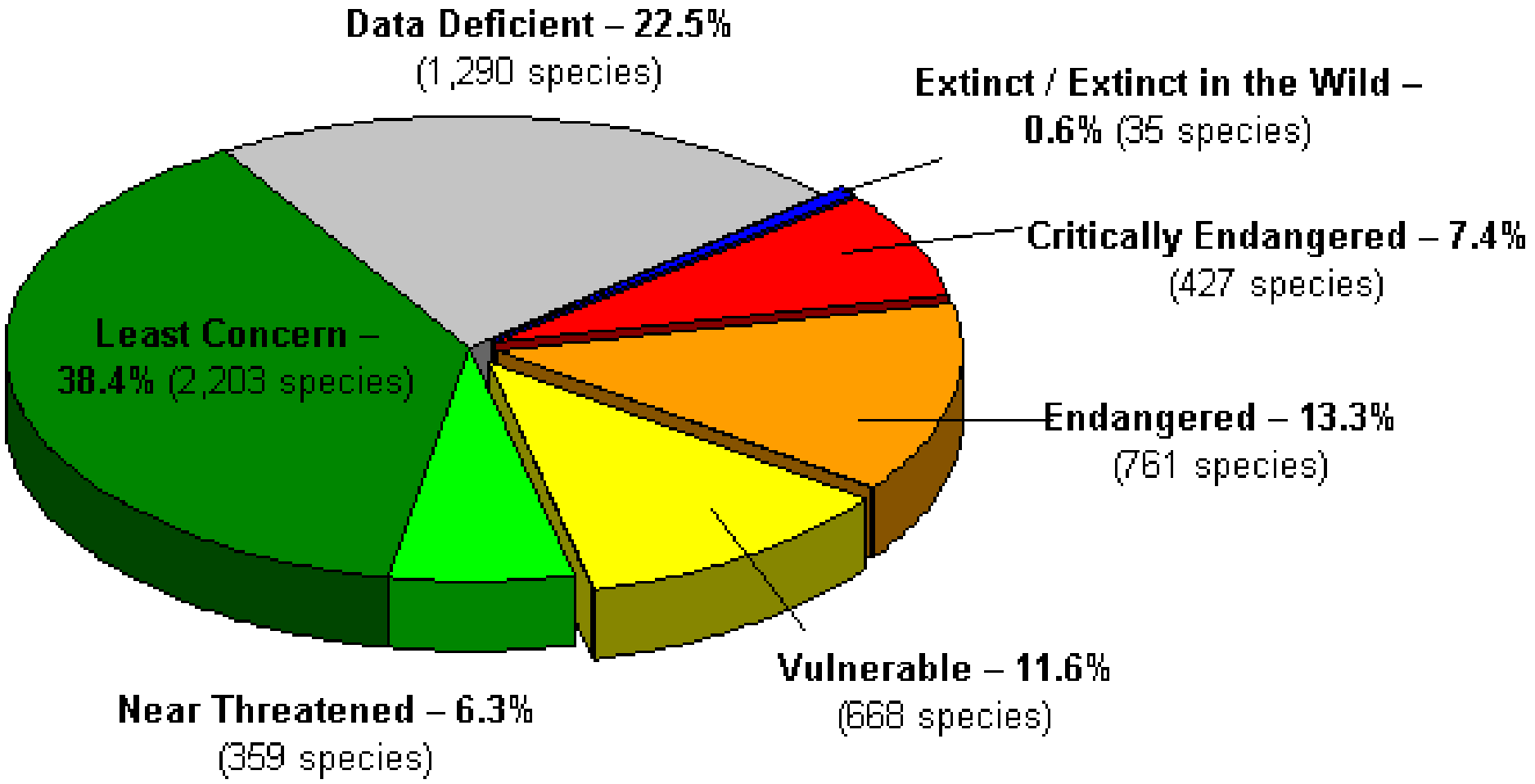
A "red eft" phase eastern newt (*Notophthalmus viridescens*)
(photo courtesy of Brad Wilson, DVM)

"Biosecurity is the protection of the environment and its native species from foreign pathogens. In a zoo situation with display animals from different geographic locations (a cosmopolitan collection), biosecurity is applied to prevent pathogens from coming into the collection, transferring among amphibians in the collection, or moving outside the zoo into the native amphibian populations. For reintroduction programs, this concept similarly embraces all directions of disease transfer where pathogens should not move into, among, or out of assurance colonies."

How is that accomplished?

- Sixty to ninety day quarantine. All in, all out.
- Complete separate building per species or species assemblage
- Staff showers and building specific clothing (Tyvek jumpsuits)
- Animal enclosures need to be cleaned frequently and in a directional order
- Wastewater may need to be treated by means of heat, ozone, or chlorine bleach
- Solid waste needs to be incinerated or heated to 60 C for 15-20 minutes

Will it work?



Source: Global Amphibian Assessment

Anaxyrus baxteri

Range and habitat for *Anaxyrus baxteri*, the Wyoming Toad

Historically, 2330 sq. km in Albany County, in the Laramie Basin of Wyoming

Small ponds or lakes in the floodplains of Big and Little Laramie Rivers with a mixture of rush and sedge; short grass communities

Habitat use varies with age class; rodent burrows used for hibernation and refuge

Habitat is altered by weather events, irrigation and other agricultural practices, and cattle grazing

Current status

In the wild:

- **Only two known populations:** Mortenson Lake NWR and one Safe Harbor site near Laramie WY. making it probably the most endangered amphib in N. America
- Both populations exist **entirely due to reintroductions of captive bred animals** (= gene pool for wild and captive toads is the same)
- As of 2012 populations appear to be in trouble again at both locations = quasi-extinction in the wild
- Searches for undiscovered toad populations and good habitat to establish new ones are still underway

In captivity:

- SSP Population is normally between 400 - 550 toads, currently 213.187.114 (514) held at ten facilities

Toad Timeline, part 1

- Abundant in 1960’s, declining in 1970’s, feared extinct by early 1980’s
- 1984 -Listed as Federally Endangered
- 1987 -Re-discovered at Mortenson Lake fishing club
- 1989 - Recovery efforts begun by Wyoming Game and Fish , began bringing toads into captivity
- 1991 – 1993 Wild numbers declining again, no egg masses found
- 1993 – USFWS acquires Mortenson Lake property and creates closed NWR for protection of WY toad
- Considered extinct again by 1994; “last toad” brought in to captivity from Mortenson Lake


Mortenson Lake NWR July 2012

WHAT HAPPENED?

- Aerial insecticides (Fenthion, Malathion)
- Drainage changes for agriculture (habitat loss)
- Water quality (manmade organic compounds; other pollutants)
- Weather events –late cold springs, droughts
- Lack of genetic diversity as numbers declined
- Predation at all life stages
- Disease

Toad Timeline part 2

- 1994- First captive breeding at Sybille (WGF facility); AZA Zoos formally invited to join program
- 1995- Re-stocking of Mortenson began, using captive produced tadpoles and metamorphs
- 1996-SSP approved for Bufo baxteri by AZA
- 1998- four egg masses discovered at Mortenson; population rescued from extinction by reintroduction efforts
- 2000-Chytrid discovered at Mortenson
- 2003- Reintroductions discontinued at Mortenson to see if population could sustain itself
- 2005- Safe Harbor program initiated to allow reintroductions of endangered species on private land thus increasing release site options

Federal fish hatcheries can be great resources for amphibian programs.
Saratoga has been a mainstay of the Wyoming toad recovery effort since 1997and has led the group with consistent production of large numbers of healthy offspring for release and future breeding stock.

AZA and USFWS attending 2012 SSP meeting release captive produced tadpoles and metamorphs at Safe Harbor site

Reintroduction history

- **~160,168 captive produced tadpoles and toads released on at least six sites on private and Federal land since 1995**
- **Natural history of species and its requirements are poorly understood**
- **Some release sites failed due to improper habitat, predation or lack of persistence (not enough numbers invested for long enough) or were abandoned if surveys indicated toads were not surviving**
- **Success--current Safe Harbor release site had a wild breeding in 2011 after release of over 75,000 tadpoles and metamorphs since 2005. Drought in 2012 has had undetermined impact**
- **Mortenson Lake population persisted with no augmentation since 2003 with high chytrid infection rates-- but began decline in 2010 , zero located in 2012**

Rush Lake is an early release site at Hutton NWR that failed to take.
Dense vegetation and abundant bird life may be among causes.

- **Drastic population decline over past several years , few-to-zero located in 2011/12 during surveys and other activities**

- **New info about large release events suggests persistence of the Mortenson population after 2003 may have been more due to survival of released toads than consistent wild reproduction.**

- **Other causes of decline may be predators, chytrid, habitat**

- **USFWS/Recovery Team decided to resume reintroductions in 2012 that had been discontinued in 2003**

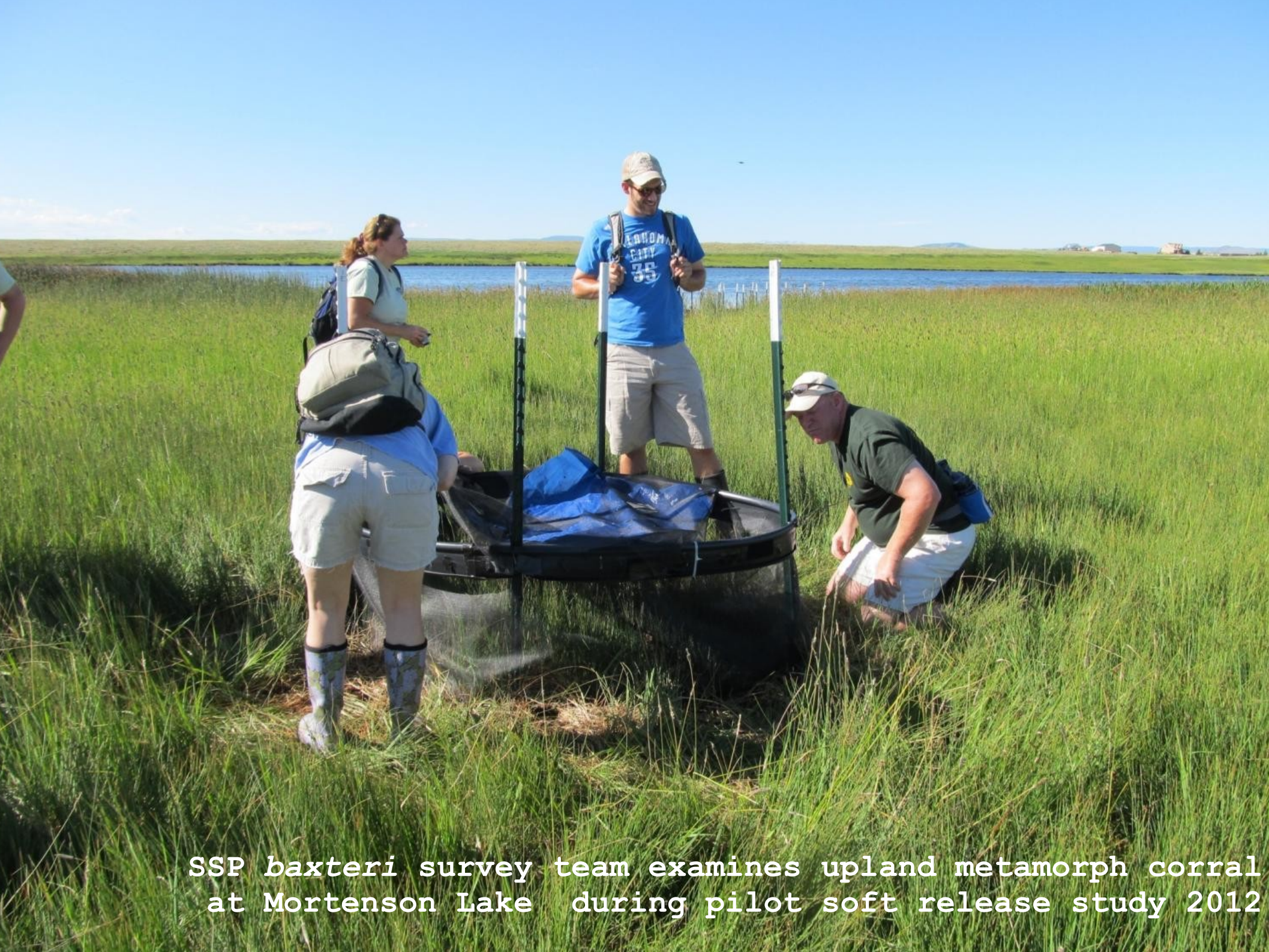
- **Habitat management was increased with prescribed burn conducted in April 2012 and controlled grazing continued**

- **Soft release pilot study began June 2012, conducted by UWY and USFWS, tadpoles supplied by SSP breeding facilities**

- **Follow-up surveys and continuation of soft releases planned for 2013**

2012 Soft release pilot study at Mortenson Lake

Tadpole enclosures based on reptariums developed by Mike Lanoo for crawfish frog research



SSP *baxteri* survey team examines upland metamorph corral at Mortenson Lake during pilot soft release study 2012

Anaxyrus baxteri

Captive breeding facilities continue to improve husbandry and breeding success with 13,100 tadpoles and metamorphs produced for release in 2012.

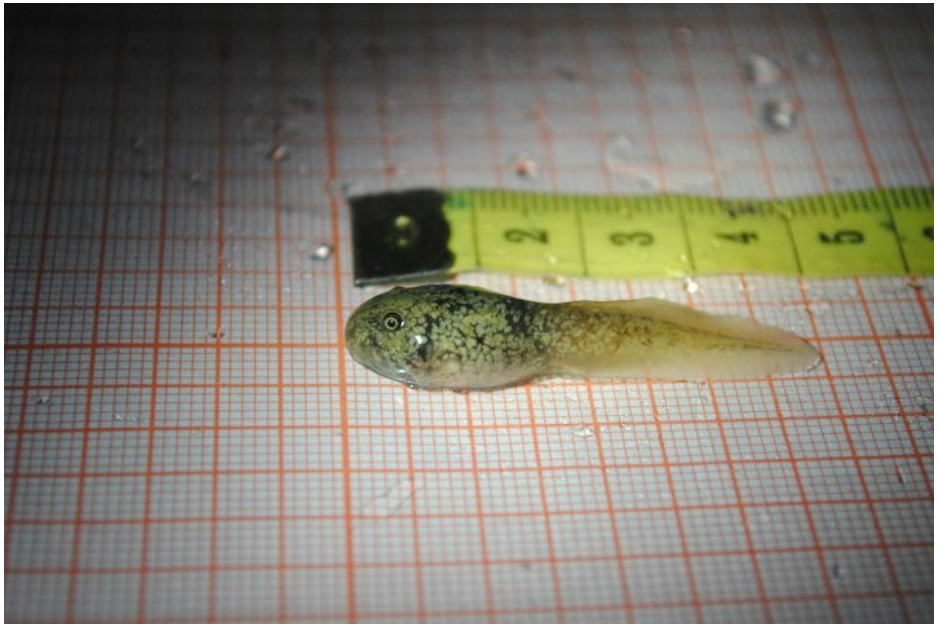
- **Progeny in 2012 split between Mortenson NWR soft release project and single Safe Harbor site (the only two known locations of this species in the wild)**
- **Grow-out project to provide additional age classes for release being planned at Cheyenne Mountain Zoo**
- **New SSP post-release tadpole monitoring study will take place at Safe Harbor site, working with Wyoming Natural Diversity Database from University of Wyoming**
- **2012 summer surveys in Wyoming included habitat assessment and searches for toads at historic release sites (Hutton Lake NWR)**

Telmatobius culeus

Telmatobius culeus

- **World's largest aquatic frog (Up to 137mm)**
- **Endemic to Lake Titicaca**
- **Ranked Critically Endangered by the IUCN**
- **Denver Zoo is working very closely with Peruvian universities in order to create a conservation program for this vanishing species**

Telmatobius culeus



- Chytrid has been detected, but primary threats are collection for human consumption
- No assurance colonies exist, but a small population of confiscated animals are in captivity
- Multiple species/subspecies may exist. DNA analysis is currently being done.
- Confiscated animals are typically returned to the wild, but without testing for disease or regard for the animals' origin.

Telmatobius culeus

Lithobates sevosus

Lithobates sevosus

- Wild population vacillates wildly, but typically consists of 100-200 individuals
- Ranked Critically Endangered by the IUCN
- Population is constrained to DeSoto National Forest
- Traditions
- Wild and captive population infected with *Dermoycoides.* This pathogen can (and has) caused massive die offs.
- Unstable assurance colony exists (22.15.791), but there are no current plans for release

Nectophrynoides asperginis

Nectophrynoides asperginis

- **Wasn't described until 1999**

- **Endemic to Kihansi Gorge, Tanzania**

- **Dam construction 1996-2000 followed by population crash caused by chytrid fungus in 2003 led to extinction in 2009**

- **Prior to extinction, *in situ* conservation was attempted (installation of spray misters to replicate spray zone), but all attempts failed**

- ***Ex situ* conservation also had its share of problems. Massive deaths due to improper husbandry has stymied the population**

- **Several releases of captives have occured, but it is uncertain how successful these releases are**

Nectophrynoides asperginis