Global Amphibian Biodiversity

Frogs and Toads

Salamanders and Newts

Extant Amphibians

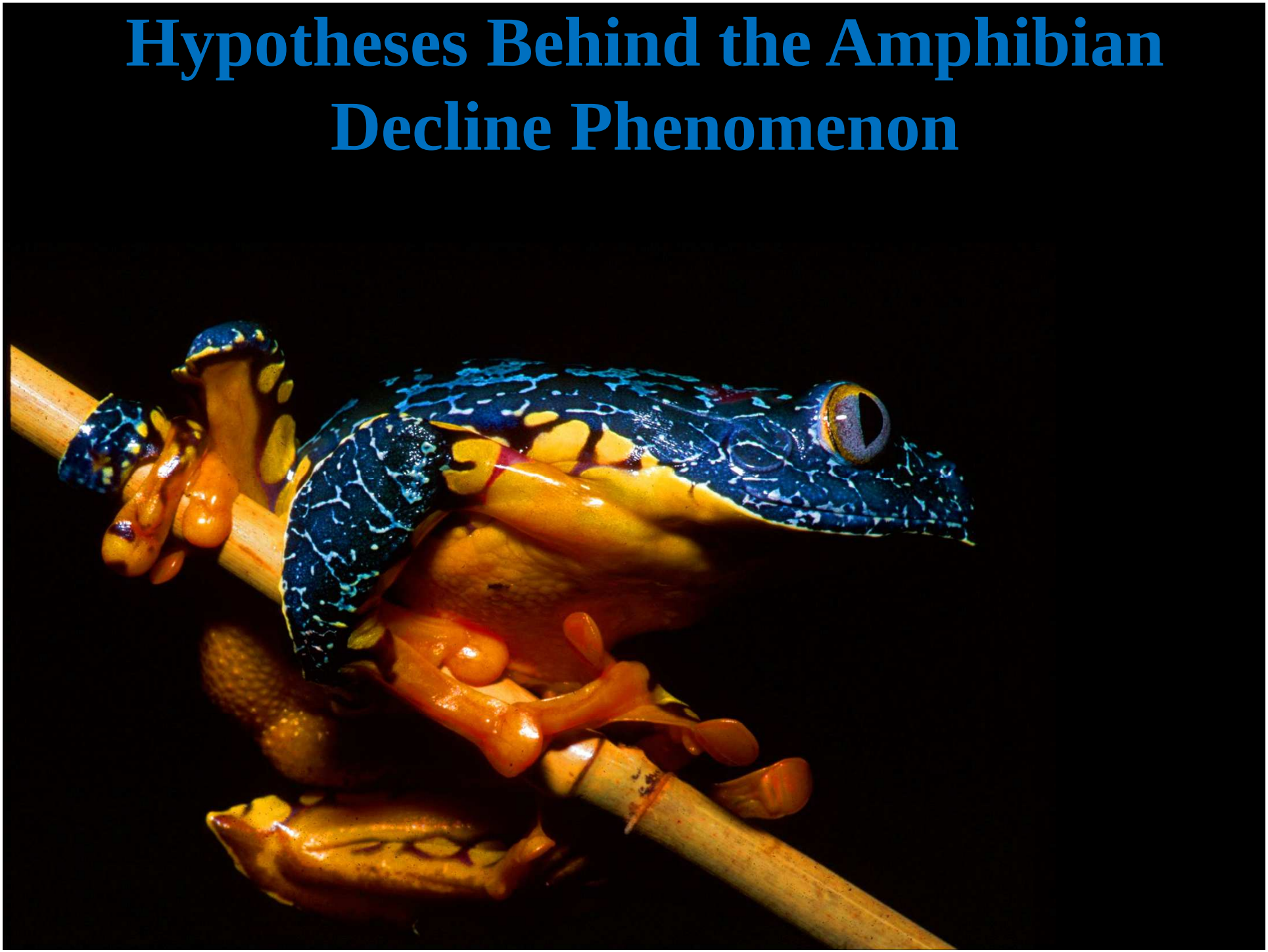
- Over 7000 described amphibian species
- One third of them in decline or extinct (GAA, 2007) – recent estimates closer to 50%
- Of the remaining two thirds, many data deficient
- Some estimates suggest as many as 200 species have already disappeared
- Many of the declines have been sudden and were recorded within the past 25 years

The Global Amphibian Crisis

Scientific Awareness of Amphibian Declines

- Early 1980s amphibian declines noted
- First World Congress of Herpetology, 1989 / National Research Council Workshop, 1990
- Third World Congress of Herpetology, 1997
- Amphibian Conservation Summit, 2005
- Amphibian Conservation Action Plan, 2006

Hypotheses Behind the Amphibian Decline Phenomenon



#1 Habitat Alteration

- 90% of all extant species in decline, and recently extinct species, suffer/suffered from habitat alteration (GAA, 2007)
- Includes diverse human activities

#2 Harvest

- Food items
- Medicinal purposes
- Scientific collection
- Pet trade

#3 Exotic Species

- Predators
- Competitors
- Prey

#4 Ultraviolet Light Exposure

- Ozone related
- Mainly at higher altitudes
- Evidence not conclusive

#5 Acidification of the Environment

- Acid rain
- Acidified soils

#6 Environmental Contaminants

- Pesticides
- Heavy metals
- Fertilizers

#7 Emergent Infectious Disease

- Chytrid fungus
- Iridovirus
- Bacterial epidemics

#8 Synergistic Interactions

- Fertilizer and UV exposure
- Fertilizer and Iridovirus
- Climate Change and chytrid fungus
- Shrinking habitat and water contamination

How the Atlanta Botanical Garden Wants to Make An Impact

Atlanta Botanical Garden's Goals

- Refine captive husbandry and breeding methods in our on-site facilities and publish them
- Capacity building with range country partners to develop breeding facilities and field studies of critically threatened species
- Support range country facilities into the future through facility installation, technical advice, personnel training, networking, and fund raising
- Facilitate emergent infectious disease field work with native amphibians
- Investigate the potential for "head starting" programs for endangered amphibians
- Study the potential to use groundwater salamanders as indicators of groundwater quality
- Perform ecological and taxonomic field studies and publish them

Identify key problems in amphibiaculture

Lots of untested conjecture in keeping protocol

Investigate old assertions

Develop an experimental design to test them

Put concepts to the test

Improve amphibian husbandry practices by publishing results

Capacity Building in Range Countries for Conservation of Declining Species

Internships and Training Programs

Hands-on Training

Hands-on Amphibian Reproduction

Research Directions

- Establish best practices for egg collection, hatching, and rearing
- Establish captive colony
- Develop captive reproduction protocol
- Produce eggs and attempt reintroduction program

Endangered Native Frog Work,

“Headstarting” Gopher Frogs

Monitoring Groundwater Quality Using Salamanders

Georgia Blind Salamander

Eurycea* (*Haideotriton*) *wallacei

Field Work

Darwin's Frogs in Chile

Collaborators

- Martha Crump
- William W. Lamar
- Mauricio Fabry
- Marcela Tirado
- Andres Charrier
- Mike Levy

Why Focus on South Chile's Anurans?

- Over 30 amphibian species endemic to South Chile
- Only irregular conservation efforts focused on 2 species
- Emergent infectious amphibian diseases picking up in momentum
- Deforestation and environmental contamination on par with the United States

Working in Our Favor

- Exceptional conservation partners in Chile
- Exceptional biologists and conservationists working with us
- Breeding activity in our founding stock of Darwin's Frogs immediately
- Field work turning up formerly unknown populations of frogs
- Lots of international interest in our project

Disease Testing

Darwin's Frog Conservation Initiative

Two Key Components

Field work examining current range of imperiled species and monitoring for emergent infectious disease

A Captive Breeding Facility in Santiago

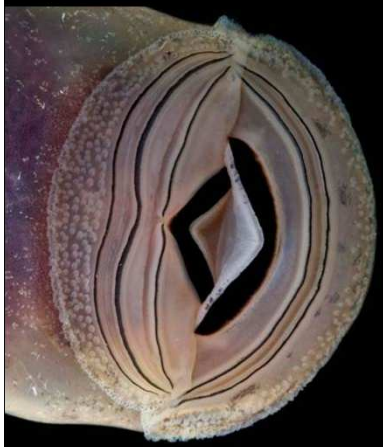
Objectives

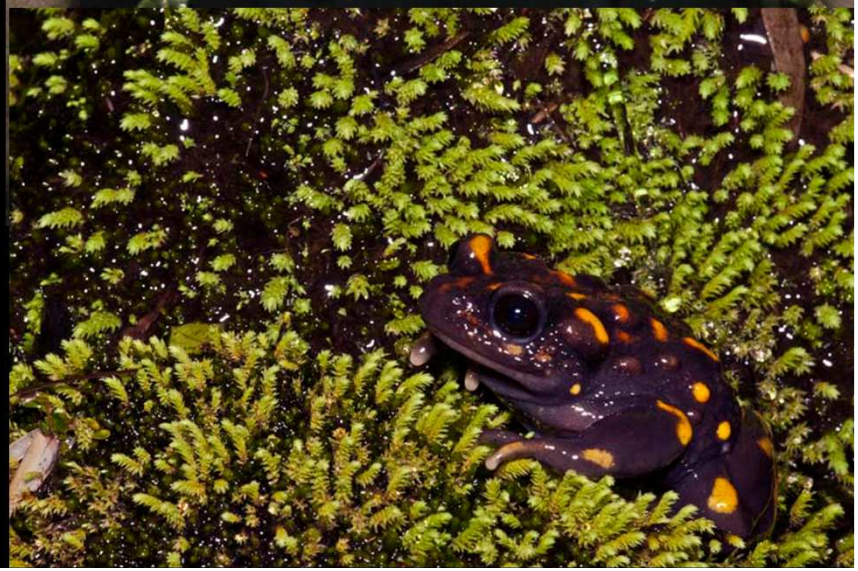
- Secure equipment & terrariums for Santiago Zoo facility
- Help install facility & establish live food cultures
- Bring Santiago personnel to ABG for captive amphibian management training
- Field work to examine traditional range of *R. darwini*
- Continue search for *R. rufum*
- Collect skin swabs from all populations visited
- Collect founding population of Darwin's Frogs & False Toads for Santiago Zoo facility
- Produce updated range map for *Rhinoderma*, overlain with spread of chytrid fungus
- Support Santiago facility via technical and veterinary assistance as long as is requested
- Develop a bilingual website detailing the project
- Leave the Santiago Zoo with a fully functioning captive breeding program that is owned, operated, and managed into the future by Chileans


Darwin's Frog Conservation Initiative
Iniciativa de Conservacion de Rana de Darwin
ATLANTA BOTANICAL GARDEN
Chile is home to many amphibians that are found only in this region and no place else on
exhibit a unique reproductive strategy in the way they care for their young. Both species lay
males stay near their eggs as they develop. Just before or when the eggs hatch, a male takes the eggs
slide through his vocal slits (like openings under the tongue), and enter the vocal sac. The developing
sac throughout development in *Rhinoderma darwinii*. The male "coughs" up fully formed juveniles when their
50 to 70 days later. In *R. rufum*, the male "coughs" up tadpoles, which he releases into water. This reproductive mode is
other species of amphibian.
Darwin's Frogs (*Rhinoderma*) are threatened species. *Rhinoderma darwinii* currently inhabits only a portion of its original known
range. Some formerly dense populations have disappeared; others are much smaller. There have been no confirmed reports for *Rhino-*
derma rufum since 1978, despite attempts to find it. Two key problems are believed to be driving the decline of Darwin's frogs. First, habitat
loss plagues these species, steadily reducing both the range and numbers of *Rhinoderma* in the wild. The presence of an emergent
infectious disease, chytridiomycosis (caused by the fungus *Batrachochytrium dendrobatidis*), is suspected to have significantly contrib-
uted to the decline of these frogs as well.
There are several groups of concerned biologists and conservationists taking steps to try to conserve these rapidly disappearing frogs. The
project you are reading about is a collaboration between the National Zoo of Chile and the Atlanta Botanical Garden. There have been a
number of organizations that have supported our conservation efforts (see below). We are doing two things to try to conserve Darwins Frogs:
First, you are standing in front of our new captive breeding center where we hope to establish and maintain a large colony of the frogs.
Second, we are studying wild populations and trying to learn more about which populations are still healthy and where diseased populations
exist. For more information regarding our project, go to www.savedarwinsfrogs.org. If you'd like to support our programs financially, please
make a donation in the receptacle in front of this exhibit.
Thank you for your time and support!
Rabb Earth Foundation • Sophia Danforth Conservation Biology Fund • Chicago Board of Trade Endangered Species Fund • George and Marry Rabb Foundation • Sysco Systems • ZooMed

Our Methods for Keeping these Frogs Stems from Observations in the Wild

Field Work

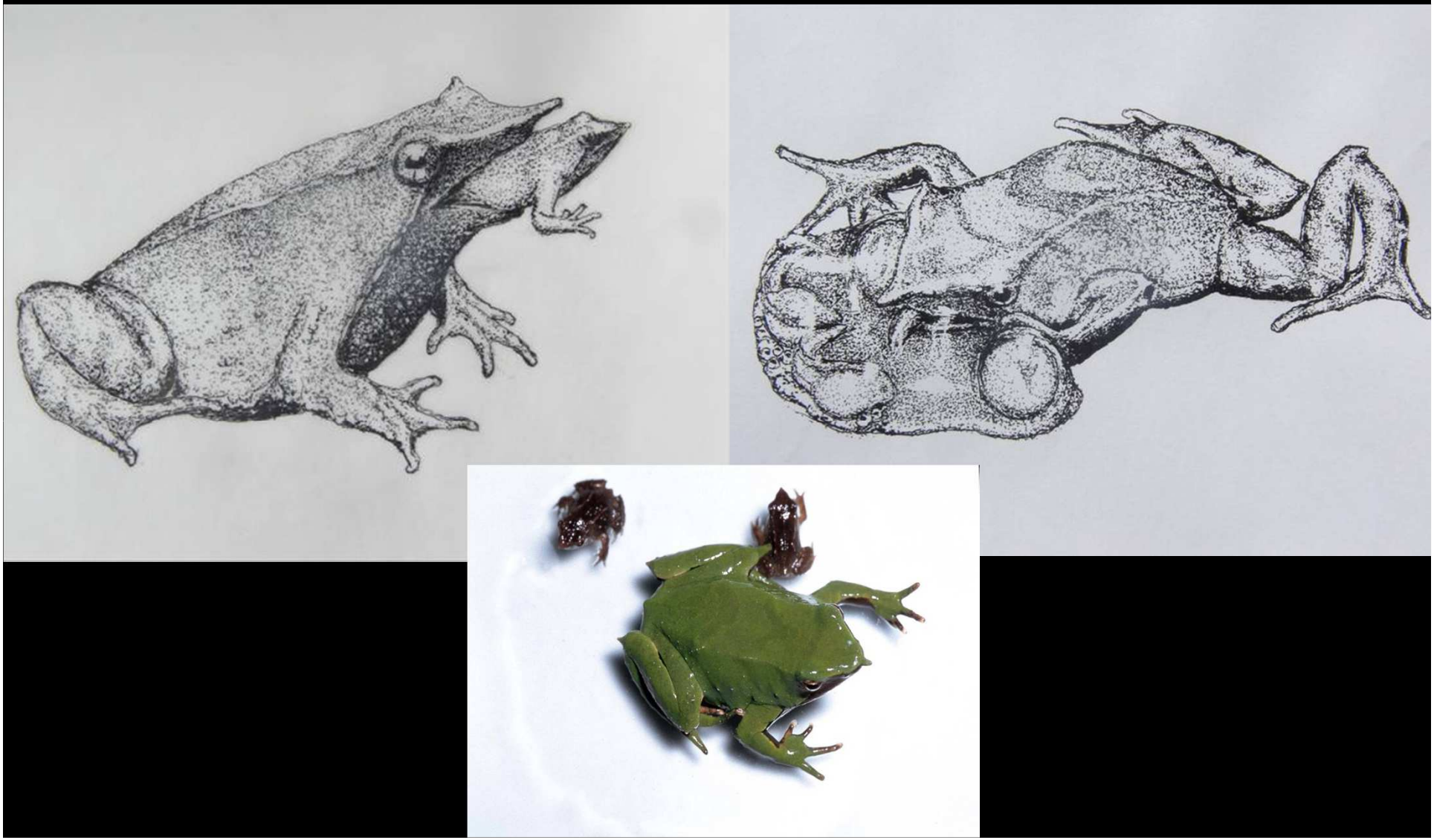




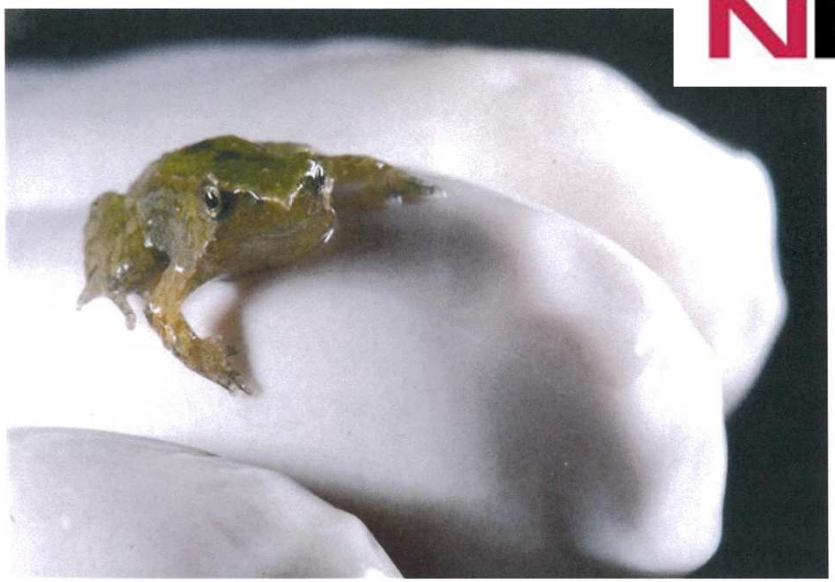
Results to Date

- Captive breeding facility up and running at the National Zoo in Santiago
- Founding individuals of Darwins frogs at the Santiago Zoo facility, breeding within 6 months
- Founding individuals of two *Telmatobufo* species acclimated
- Live food cultures doing well
- Santiago personnel trained at the Garden for captive amphibian management
- Field work has produced at least 5 new localities for *Rhinoderma darwini* and over 30 historical localities have been visited
- Our search for *R. rufum* has produced great leads
- Skin swabs from some populations demonstrate serious disease issues
- We will produce updated range map for *Rhinoderma*, overlain with spread of chytrid fungus
- ABG continues to support the Santiago facility through technical and veterinary assistance
- Developed a bilingual website detailing the project –www.savedarwinsfrogs.org
- Santiago Zoo has a fully functioning captive breeding program that is owned, operated, and managed into the future by Chileans

Website: www.savedarwinsfrogs.org



Captive male frog coughs up babies



Dante Fenolio

A captive bred Darwin's frog is held by a researcher shortly after it was coughed up from its dad's vocal sac. Ten baby frogs were coughed up at a breeding facility in Chile on Thursday.

By John Roach

A captive male Darwin's frog coughed up ten babies Thursday at a zoo in Santiago, Chile, a milestone in a project to save the amphibians from extinction.

The vulnerable species is one of two members of the only genus on Earth that rears its young inside of its vocal sac, a job taken on by the males.

"They have a small opening below their tongue. … After [the eggs] hatch, he takes the tadpoles into his mouth and manipulates them through that opening and into his vocal sac," Danté Fenolio, a conservation scientist with the Atlanta Botanical Garden, explained to me today.

"For about 60 days, they go all the way through to development inside his vocal sac. At that point when they are ready, fully developed, he coughs up fully formed miniatures of the adult."

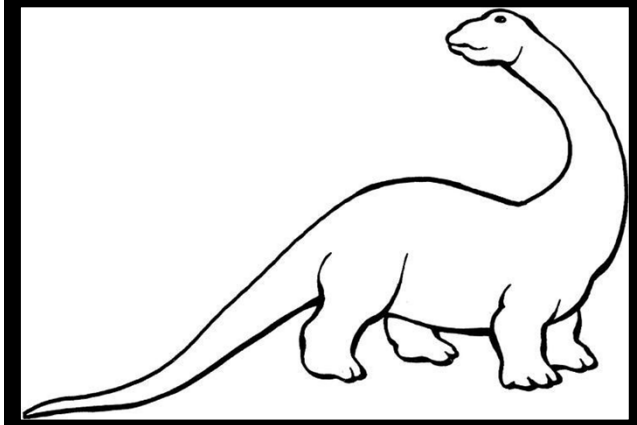
Future Directions

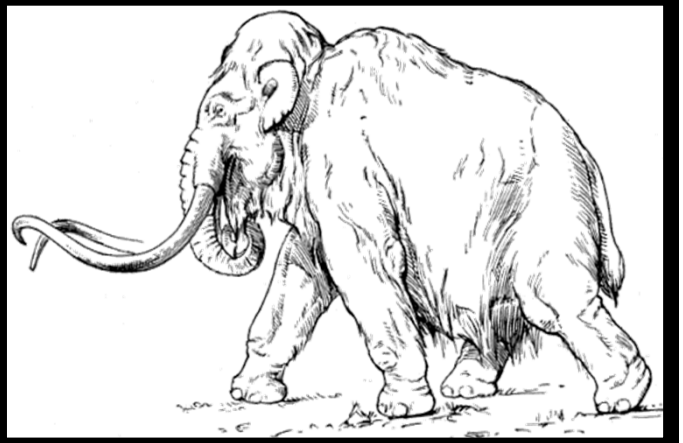
Why do we care?

Amphibian Biodiversity

The Global Amphibian Crisis:
A Mass Extinction Event

Historical Precedents





Amphibians: Pharmaceutical Treasure Chests

Amphibian Pharmaceuticals

- ***Pumiliotoxin*** **Cardiac stimulant**
- ***Epibatidine*** **Analgesic**
- ***Magainin*** **Organ glues and antibiotics**
- ***Caerulein*** **Intestinal ailments and pain relief**
- ***Adenoregulin*** **Depression and Alzheimer's**

Amphibians: Pharmaceutical Treasure Chests

Medicinal Potential: *Adenoregulin*

- Depression
- Stroke
- Seizures
- Alzheimer's disease

Amphibians: Pharmaceutical Treasure Chests

- Medicinal Potential of *Compound X*
  - Blocks mucosal HIV transmission!

Take Home Messages

- Time is short and methods for conserving amphibian biodiversity need to be investigated in the short term
- If roughly 50% of extant amphibian species are in decline/threatened, then there are now more endangered amphibians than all mammal, bird, and fresh water fish species combined
- No one is arguing that the methods we investigate today will solve amphibian decline
- If we don’t look into each potential pathway, how will we know where to focus resources?
- Developing capacity to accommodate assurance colonies of critically endangered species is paramount

SPONSORS / PARTICIPANTS

Association of Zoos and Aquariums, Conservation Endowment Fund (08-809)

European Association of Zoos and Aquariums

Shared Earth Foundation

The Sophie Danforth Conservation Biology Fund

The George and Mary Rabb Charitable Foundation

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Thank You

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