Project Partnership between: Cheyenne Mountain Zoo, Houston Zoo, Smithsonian’s National Zoological Park, Smithsonian Tropical Research Institute and Zoo New England.
We developed the following goals at a strategic planning meeting of the Panama Amphibian Rescue and Conservation Project in spring 2016 at the Smithsonian Conservation Biology Institute’s Front Royal Campus. Footnotes detail how our current goals compliment the 2011 National Amphibian Conservation Action Plan published by the Ministry of the Environment in Panama.

**Workshop Participants:** Facilitator: Dave Wildt (SCBI) Implementation team: Eric Baitchman, Zoo New England; Matthew Evans, National Zoo; Jorge Guerrel, Smithsonian Tropical Research Institute (STRI); Brian Gratwicke, Smithsonian Conservation Biology Institute (SCBI); Roberto Ibáñez, STRI; Heidi L. Ross, STRI; Brad Wilson, Atlanta Botanical Gardens. Guests: Kevin Barratt, Maryland Zoo in Baltimore; Matt Becker, SCBI; Lisa Belden, Virginia Tech; Lesli Creedon, National Zoo; Gina Della Togna, SCBI; Alan Pessier, SanDiego Zoo; Sharon Ryan, STRI.

**Steering Committee:** The Panama Amphibian Rescue and Conservation Project is overseen by Bob Chastain, President and CEO Cheyenne Mountain Zoo; Lee Ehmke, CEO, Houston Zoo; Dr. Steve Monfort, Director Smithsonian Conservation Biology Institute; Dr. Matthew Larsen, Director Smithsonian Tropical Research Institute; John Linehan, President and CEO Zoo New England.

Citation: PARC (2017) Panama Amphibian Rescue and Conservation Project Strategic Plan 2017-2021. Smithsonian Institution, Washington D.C.
MISSION

Our mission is to rescue and establish sustainable assurance colonies of amphibian species that are in extreme danger of extinction throughout Panama. We will also focus our efforts and expertise on developing methodologies to reduce the impact of the amphibian chytrid fungus and proceed to reintroduction trials.
GOAL 1: ENSURE ADEQUATE PHYSICAL INFRASTRUCTURE AND STAFFING CAPACITY TO EFFECTIVELY MANAGE AND BREED THE LIVING COLLECTION.¹

Objectives
- Consolidate ex-situ assurance populations at the Gamboa Amphibian Rescue and Conservation Center and expand that facility to ensure minimum space requirements are met.
- Improve availability of veterinary care in Panama.
- Expand husbandry staff commensurate with the size of the collection.
- Improve training of new staff and population management capacity.

Strategies
- 7 pods will be allocated for 12 species of frogs using an approximate ratio of 2 species per rescue pod one pod and allowing one pod for overflow. We will construct a new 1,600 square feet insect production facility to move our insect production out of the current pods and make space for frogs.
- Work with Panamanian veterinarians with a long-term interest in the project who could be trained by vet team and be available on call.
- Explore new financial support avenues to support additional staff salary costs.
- Develop formal training and testing program for interns and induction process for new employees focusing on the why, not just how. Update husbandry protocols for each genus in English and Spanish.

¹ National Amphibian Conservation Action Plan Component VI.2. Conservation Objective 4: Support the implementation of fast response actions, such as the rescue and reproduction of species in captivity, for which in situ conservation is insufficient.
Goal 2: Manage genetically viable assurance colonies of 12 species in captivity that are at risk of extinction from chytridiomycosis.¹

Objectives
- By 2021 the program will be managing 12 species of approximately 250-500 adult animals per species.
- Use all available tools to maintain and maximize the genetic integrity of captive populations.
- Animals produced that are surplus to ex-situ population goals will be allocated to 1) reintroduction trials (wherever possible) 2) fulfil experimental research requests 3) euthanasia will be used as a management tool if reintroduction trials are not possible and there are no standing research requests for the animals.
- Improve cost-effectiveness, workflow and recordkeeping to allow for more efficient management of the collection and production of animals.

<table>
<thead>
<tr>
<th>Species</th>
<th>IUCN Redlist category</th>
<th>Panama action plan priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agalychnis lemur</td>
<td>CR</td>
<td>high</td>
</tr>
<tr>
<td>Andinobates geminisae</td>
<td>(CR)</td>
<td>not evaluated</td>
</tr>
<tr>
<td>Anotheca spinosa</td>
<td>(EN)</td>
<td>high</td>
</tr>
<tr>
<td>Atelopus certus</td>
<td>(CR)</td>
<td>high</td>
</tr>
<tr>
<td>Atelopus glyphus</td>
<td>CR</td>
<td>high</td>
</tr>
<tr>
<td>Atelopus limosus</td>
<td>(CR)</td>
<td>high</td>
</tr>
<tr>
<td>Atelopus varius</td>
<td>CR</td>
<td>very high</td>
</tr>
<tr>
<td>Atelopus zeteki</td>
<td>CR</td>
<td>very high</td>
</tr>
<tr>
<td>Craugastor evanescio</td>
<td>(CR)</td>
<td>not evaluated</td>
</tr>
<tr>
<td>Gastrotheca cornuta</td>
<td>(CR)</td>
<td>high</td>
</tr>
<tr>
<td>Hemiphractus fasciatus</td>
<td>(EN)</td>
<td>high</td>
</tr>
<tr>
<td>Oophaga vicentei</td>
<td>(VU)</td>
<td>not evaluated</td>
</tr>
<tr>
<td>Strabomantis bufoniformis</td>
<td>(CR)</td>
<td>high</td>
</tr>
</tbody>
</table>

* Parentheses indicate recommendations at 2015 IUCN redlisting workshop.

Strategies
- Coordinate with other holders of priority species to ensure adequate genetic representation for all target species in Panama that will require re-importation of US stocks, and create biorepositories of cryopreserved sperm as an insurance against captive genetic bottlenecks.
- Define captive population goals, research goals and reintroduction strategies for each species and manage them in an adaptive-management framework, updating based on lessons learned or input from external collaborators.
- Move to ‘frog farming mode’ defined as actively refining and improving procedures and workflow to maximize the production of animals and minimize costs.
- Recruit a registrar at least 50% time working on ZIMS for both facilities and conduct quality control checks.
Anothecs spinosa
Agalychnis lemur
Atelopus certus
Atelopus zeteki
Gastrotheca cornuta
Andinobates geminisae
Atelopus glyphus
Atelopus limosus
Atelopus varius
O. vicentei
Strabomantis bufoniformis
Craugastor evanesco
Hemiphractus fasciatus
GOAL 3: RESEARCH FACTORS TO IMPROVE LONG-TERM SUSTAINABILITY OF THE CAPTIVE COLLECTIONS AND INCREASE SUCCESS OF RELEASE TRIALS.  

Objectives
- Captive research will focus on rate-limiting steps such as 1) infectious and non-infectious diseases, 2) nutrition, 3) reproduction, 4) husbandry & food production.
- Conduct taxonomy and genetics research on cryptic species and establish accessible biomaterials repositories in anticipation of future needs and opportunities.
- Conduct field research to evaluate conservation status of target species, disease prevalence, and why some species/individuals persist in Bd-positive habitats.

Strategies
- Use all available technologies and tools including assisted reproduction and cryopreservation as tools to achieve our long-term population targets.
- Review production rate-limiting factors for each species and prioritize husbandry research to resolve known problem areas.
- Actively seek and facilitate external investigators and collaborators who will help us to answer these and other research questions and develop grant proposals that expand our capacity to answer high priority questions.
- Develop a webpage describing the living collection, space and infrastructure and a list of research priorities to recruit external collaborators, and guidance on how to request space and animals.
- Make biorepository accessible to external researchers through the STRI herpetology collections and ensure that it is indexed and complies with Smithsonian collection plans and repository policies and tie it in with Smithsonian cryo initiative.

2 National Amphibian Conservation Action Plan Component VI.1. Research Objective 1: Promote research to increase the knowledge on the diversity and biology of amphibians in Panama. Objective 2: Expand and encourage research on the causes and consequences of declines and disappearances of amphibian populations, particularly in relation to chytridiomycosis. Objective 3: Update information on the status of amphibian populations already affected by the fungus. Objective 4: Promote research on the potential factors influencing the response capacity and possible resistance to the effects of the chytridiomycosis.
GOAL 4: BEGIN EXPERIMENTAL FROG REINTRODUCTION TRIALS. ²

Objectives
- Reintroduce surplus offspring at sites where they have been extirpated or reduced in numbers, and conduct post-release monitoring as feasible to learn how to improve survival of released animals.
- Reintroduction trials should prioritize (but not be limited to) designs that test of potential tools to mitigate the amphibian chytrid fungus, e.g. vaccines, climate refuges, probiotics, breeding for resistance.
- Select at least 3 potential reintroduction sites and begin socializing the idea of reintroductions among stakeholders and conduct baseline monitoring.
- Build awareness and acceptance of release trials with peers, government, land owners and local communities.

Strategies
- Conduct literature review of reintroduction strategies and liaise with IUCN amphibian reintroduction planning group for best practices.
- Manage expectations, release trials may not succeed, but lessons learned will help to inform and achieve long term reintroduction and restoration goals. Every reintroduction event should be a learning opportunity to test a research question.
- Release strategy will vary depending on the species’ life history and demographics.
- Reintroduction sites should be carefully evaluated for baseline Bd prevalence, persisting community, water quality and habitat quality measures.
- Identify researchers whose interests may align with our objectives and actively seek and facilitate external investigators and collaborators who could implement trials and provide the resources for monitoring.
- Post-release monitoring will be labor and cost intensive, we should prioritize sites where our likelihood of securing post-release monitoring logistic and financial support is high.
GOAL 5: CULTIVATE AND FOSTER AN APPRECIATION FOR AMPHIBIANS IN THE PUBLIC MIND-SET AND WORK ON COMMUNITY ENGAGEMENT AT THE FIELD LEVEL.  

Objectives

- Raise awareness of amphibians as a biodiversity and cultural heritage in Panama that should be valued.
- Work to understand potential negative perceptions of researchers in the field and channels to reach small rural communities particularly at research and reintroduction sites.
- Expand our capacity to work on schools engagement, event coordination and marketing.
- Measure engagement and attitude shifts though targeted social research.

Strategies

- Get gate access to Gamboa exhibit opened, and refresh the species exhibition plan at Punta Culebra to highlight additional target species.
- Secure an intern who can focus on assisting with education, marketing and event coordination and build goodwill with other stakeholders and organizers of the Golden Frog Day parade by participating in planning meetings and offering support, advertising etc.
- Conduct 3-day workshops for rural schools in conjunction with MiAmbiente focused in communities where reintroductions will take place.
- Solicit an academic research partnership to understand attitude baselines, and how to change people’s behavior for positive amphibian conservation efforts in Panama and focused on communities in reintroduction areas vs urban audiences.
Goal 6: Ensure the financial sustainability of the project.

Objectives
- Recruit 2 new NGO/ zoo and aquarium partners.
- Ensure we meet captive population management targets so that existing partners and corporate sponsors can justify continued support.
- Diversify funding base among high-net worth individuals, corporations, foundations, government sources, multilateral sources and public contributions, to be less dependent upon single sources of revenue.

Strategies
- Request that any larger grants requested by our external collaborators also include husbandry support associated with costs of producing frogs for experiments and reintroduction trials.
- Tie local philanthropy requests to education-related requests.
- Ensure that newsworthy achievements are covered in local and international media to remind people we still need help and are making progress towards securing a future for Panama’s amphibians.

Andinobates geminisae Photo © Joel Sartore (Photo Ark)
