

American Zoo and Aquarium Association

# **Amphibian Taxon Advisory Group Regional Collection Plan**

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### *How to Use This Collection Plan*

The AZA Amphibian Taxon Advisory Group's North American Regional Collection Plan (RCP) has been designed to be user-friendly for a variety of potential consumers in both small and large zoological institutions. It is our hope that any interested individual may pick up this plan and use it to meet his or her specific institutional needs in a manner that contributes to the goals of the Amphibian Taxon Advisory Group (ATAG).

The defined user groups are as follows:

**Directors** – There are over 4,500 described species of amphibians worldwide, the majority of which are poorly known. The RCP has included those taxa of amphibians that are considered in need of national and international cooperative efforts such as may be facilitated by participating in the ATAG. While it is important to participate in high profile programs such as the Puerto Rican crested toad or the Wyoming toad SSPs, more institutions need to take the lead with poorly known amphibians and develop prominent programs for additional species. While the RCP also has included those taxa of amphibians that may meet specific display or research goals of the ATAG, it is important to note that the ATAG assigns a high priority for developing local or regional programs with amphibians and that institutions continue to work with poorly known taxa so that knowledge of amphibian husbandry and propagation increases. For this reason the ATAG recommends that at least 50% of the amphibian space within an institution be used to meet that institution's specific goals which may include working with category 5 animals. Institutions are not to be discouraged from working with Priority 5 taxa since the ATAG recognizes acquisition of knowledge about any amphibian taxon and interpreting that taxon to the public as valid institutional goals.

**Curators of Herpetological Collections** – The RCP may be used to help prioritize your development of an institutional collection plan. The ATAG places a high priority of the initiative of individual institutions and recommends that at least 50% of the amphibian space within an institution be developed to meet that institution's specific goals for its herpetological collection. While institutions are encouraged to participate in existing programs for Priority 1 taxa, the ATAG supports the efforts of individual institutions to work with amphibian taxa from other categories and develop new collaborative programs for these taxa wherever possible. As advancements are made with low priority taxa, their priority may be reassessed and upgraded by the ATAG.

**Educators** – Amphibians that are suitable for use in outreach programs are included in Priority 2 taxa and include the letter "E" in the ranking to indicate their potential for educational efforts. Any Priority 2E taxon is considered hardy, easily accommodated in a teaching animal collection and providing a venue to interpret the goals of the ATAG such as maintaining biodiversity and the catastrophic decline of amphibians in the past decade.

In addition to using the RCP to determine educational collections, it is important for educators to view amphibians in a broader context and integrate interpretation of an institution's collection of living amphibians within the context of the ATAG's goals as well as meeting specific institutional goals.

**Research and Conservation Personnel** -- Amphibians that are in need of research programs are included in Priority 2 taxa and include the letter "R" in the ranking to indicate their potential for research efforts. Any Priority 2R taxon has specific worth in a research collection to better define the goals of the ATAG such as preserving biodiversity via *ex situ* and *in situ* efforts.

In addition to using the RCP to determine research efforts by an institution, it is important for zoo scientists to view amphibians in a broader context and integrate use of an institution's collection of living amphibians within the context of the ATAG's goals as well as meeting specific institutional goals.

**Keepers** – The RCP may help focus attention on particular taxa that are especially suitable for display so that the ATAG's goals may be achieved. The keeper's role is extremely important since spectacular displays of living amphibians are one of the best ways to increase the public interest in amphibian issues. Amphibians that are particularly suited toward display are included in Priority 2 taxa and include the letter "D" in the ranking to indicate their potential as display animals. The RCP may help focus attention on particular taxa in need of husbandry research so that the ATAG's goals may be achieved. Keepers play an important role in the implementation of the RCP and the ATAG encourages the individual pursuit of husbandry advances and advances in display techniques within each institution's framework. Amphibians that are in need of research programs are included in category 2 taxa and include the letter "R" in the ranking to indicate their potential for research efforts.

*Space Available for Amphibians in AZA Institutions*  
*(or, Space, there just isn't enough of it!)*

The summation of the 1999 space survey (see below) is that there is only enough space existing in AZA institutions to accommodate 10 taxa of amphibians at the management level of PMP or SSP. In these same institutions there is enough space allocated for mammals to accommodate at least 57 SSPs and the majority of these mammals have a body mass of more than 10 kg and significant space requirements. If each AZA institution allocated an additional 400 square foot building to amphibian management and provided keeper support for the facility, the number of taxa that could be managed at a PMP or SSP level would easily exceed 100 taxa. If AZA is to “Keep all the Pieces”, the theme of its 1996 annual conferences, then a wave of dedicated amphibian facilities must be built. Amphibians need dedicated space and should not be simply incorporated into Reptile Houses or included as a small part of biome or zoogeographically-themed facilities. If this dedicated space is lacking, zoos will never play a major role in maintaining amphibian biodiversity.

A survey of ATAG institutional representatives was conducted in February 1999 to provide baseline data for developing the Regional Collection Plan (RCP). This survey was conducted in via “Amphibtalk”, the AZA listserv for the Amphibian TAG.

The survey has many inherent limitations, but was a helpful tool for developing the RCP. The following assumptions were made with regard to this space survey:

- 1) The “5 gallon equivalent” (5GE) was considered the “organizing subunit” for this data even though data cannot always be directly translated by this subunit. For example, a 100 gal enclosure may represent 20 subunits but in actuality it may not be subdivided.
- 2) A 5 or 10 gal enclosure is adequate for raising many larval amphibians.
- 3) A 5 or 10 gal enclosure is adequate for breeding many smaller anurans (e.g., dendrobatids, mantellas). Typically this space holds no more than 5 adult specimens.
- 4) A 20 gal enclosure is adequate for breeding many salamanders and larger anurans (e.g., *Peltophryne lemur*, *Ambystoma opacum*, *Pseudobranchius* sp.). Typically this space holds nor more than 5 adult specimens.
- 5) An enclosure over 20 gal is required for breeding many large amphibians (e.g., cryptobranchids, amphiumas, *Dermophis mexicanus*) and amphibians with particular environmental needs (e.g., stream-dwelling amphibians). For this survey, 40 gal will be the assigned value for this response although it is recognized that enclosures may be much larger than the assigned value.
- 6) Quarantine space has not been included in this survey

Interpretation of the survey is dependent on the final recommendations of taxa for the regional collection plan. An assessment of the size of an enclosure needed for breeding versus the size of an enclosure needed for the maintenance or display of nonbreeding specimens of a taxon is required for the best utilization of space available for amphibians in North American Institutions. In many instances the enclosures may be used for multi-taxa enclosures for both display and managed groups so the space available for amphibian management may be much larger than this survey indicates (See below). However, the majority of enclosures are not large enough for group management or display of large amphibians such as cryptobranchids. If taxa requiring large amounts of space are included in the RCP, then a high priority of the ATAG should be increasing the number of large enclosures (i.e., enclosures > 20 gal).

The RCP must account for the individual needs of ATAG institutions and the fact that these institutions may not always have goals in keeping with the recommendations of the RCP. Local

concerns may be given a higher priority by some institutions than the (inter)national goals of the ATAG and it is important that the RCP not conflict with these autonomous programs. The ATAG should encourage institutions to develop additional amphibian programs so the RCP will be developed using the assumption that the majority of an institution's space will be for regional initiatives. The ATAG will target no more than 50% of the currently available space for amphibians as managed space for RCP priority I or II taxa.

It is important for the ATAG to develop a RCP that encourages incorporation of under-represented taxa in captive collections and minimizes the impact of over-represented or nonpriority taxa on ATAG priority taxa. The RCP should indicate suitable "partners" for management with over-represented or nonpriority taxa. Dendrobatid frogs, for example, are an over-represented taxon that may be managed with minimal impact on other amphibian taxa. Dendrobatids have become the "ABC animals" of the amphibian world and the casual visitor expects to see them on display in a zoo even if no other amphibians are presented. The space survey confirms that dendrobatids are the most commonly managed family of amphibians and are reproducing even in institutions with little management space. Some dendrobatids, such as *Dendrobates auratus* and *D. azureus*, appear to be quite amenable to captive management. The husbandry of some taxa is so well understood that even inexperienced institutions may consider participation in a captive propagation of a dendrobatid recommended within the RCP. It is highly likely that dendrobatids will be held in institutions at numbers far exceeding the perceived need by the ATAG. If dendrobatids are over-represented in North American collections, it does not dictate that this precludes using the space for other amphibians. Dendrobatids typically may be housed with small hylid frogs and small tropical bolitoglossine salamanders (as well as some reptiles). Dendrobatids may have little impact on amphibian space provided thought is given to development of suitable exhibit partners.

On the opposite end of the management spectrum from dendrobatids are taxa such as cryptobranchid salamanders. Although cryptobranchids are relatively easy to maintain, captive breeding has not occurred in ATAG institutions. From what is known of breeding parameters for captive *Andrias japonicus*, few institutions currently have the space available for propagation. Cryptobranchids typically consume anything living and there are few partners suitable for incorporation in multi-taxa enclosures. If an institution places a priority on the diversity of its amphibian collection, space devoted to cryptobranchids may be at the cost of maximizing that diversity.

The RCP must be realistic in its scope in order for it to appeal to AZA institutions. The majority of institutions have suitable space available to participate in one or more captive amphibian management and propagation programs. The RCP must provide clear practical advice to an institution so that the ATAG's priorities are readily achieved with minimal effort by an institution. Finally, the RCP must be flexible enough to respond to new information about amphibian biology; the RCP should not be wedded to any one species. The RCP must allow for growth and diversity in the realm of amphibian husbandry and conservation and encourage institutions to allocate space to pursue their own goals with respect to their amphibian collections.

## RESULTS OF SURVEY

A total of 28 institutions responded to the survey, less than 1/3 of the current number of institutions that have designated an institutional representative to the ATAG. I speculate that this survey accounts for about 80% of that space which is currently in use for amphibian management in AZA institutions.

There are 1135 enclosures for amphibian management among these 28 institutions (Table 1); the number of enclosures within an institution available for amphibians ranged from 3 to 127. This amounts to at least 4090 5GEs for amphibian management. I speculate that there are at least a total of 1,400 enclosures within ATAG institutions. The average size of an enclosure is approximately 20 gallons, so I speculate that 6,400 5GEs are available for amphibian management. Of these enclosures, there are at least 149 displays > 20 gal, 77 - 20 gal displays, 52 - 10 gal displays, and 9 - 5 gal displays.

A total of 87 taxa were being evaluated for the RCP. Theoretically, with solely the space accounted for in the survey and allowing 50% of the space to be outside ATAG management, there are at least 8 enclosures available per taxon. In reality, the expertise of individual institutions varies as does the management goals for the animal collections of individual institutions. It is unrealistic to expect that the “managed” amphibian space will be equitably apportioned across taxa so the RCP must factor in the appeal of certain taxa.

Husbandry and reproductive expertise is presented in Table 2. Husbandry efforts were noted for Caeciliidae (11 institutions). Reproduction was noted for Caeciliidae (5 institutions). The majority of experience is for aquatic caecilians, *Typhlonectes* sp. Although more institutions are working with caecilians now than five years ago, the ATAG expertise with this taxon is low.

Husbandry efforts were noted for Ambystomatidae (12 institutions), Amphiumidae (4 institutions), Cryptobranchidae (7 institutions), Plethodontidae (5 institutions), Proteidae (4 institutions), Salamandridae (14 institutions), and Sirenidae (4 institutions). Reproduction was noted for Ambystomatidae (3 institutions), Salamandridae (3 institutions) and Sirenidae (1 institution, although at least 1 other institution has achieved success). Salamanders appear to be under-represented in ATAG institutions, and reproduction is still minimal. The expertise level of the ATAG must be considered low although individual institutions within the ATAG have moderate to high levels of expertise with particular taxa.

Husbandry efforts were noted for Ascaphidae (1 institution), Arthroleptidae (1 institution), Bombinatoridae (2 institutions), Bufonidae (19 institutions), Centrolenidae (1 institution), Dendrobatidae (21 institutions), Discoglossidae (10 institutions; note that some of this may be Bombinatoridae), Hylidae (19 institutions), Hyperoliidae (3 institutions), Leptodactylidae (16 institutions), Microhylidae (14 institutions), Pelobatidae (5 institutions), Pipidae (14 institutions), Pseudidae (1 institution), Ranidae (15 institutions), and Rhacophoridae (7 institutions). Reproduction was noted for Bufonidae (5 institutions), Centrolenidae (1 institution), Dendrobatidae (16 institutions), Discoglossidae (4 institutions; Bombinatoridae?), Hylidae (6 institutions), Leptodactylidae (4 institutions), Microhylidae (3 institutions), Pipidae (3 institutions), Ranidae (7 institutions), and Rhacophoridae (1 institution). Anurans are well represented in ATAG institutions, and reproduction has occurred in several families. The expertise level of the ATAG is moderate although some institutions within the ATAG have high levels of expertise with particular taxa.

## **RECOMMENDATIONS FOR RCP EVALUATION**

Assuming that a viable population consists of a minimum of 200 individuals and that this population represents at least 40 enclosures of 5-10GEs, I believe sufficient off-exhibit space exists within ATAG institutions to include in the RCP at least 10 I-SSP or I-PMP taxa. This represents 400 enclosures out of an estimated 1,400 available.

Management of the remainder of the space should not be allotted at this time. The space allotted for a II-DERP is an institutional decision. Assuming that when a IV-PIP taxon converts it will typically be to a II-DERP taxon. If an institution develops a II-DERP taxon into a viable candidate for category I, the ATAG may consider prioritizing additional holding space.

Unfortunately, using these assumptions, there is only space for 10 taxa to be included in the RCP at the category I level and that requires 29% of the space available for captive amphibian management (400/1400 enclosures). This is about 0.2% of the known number of amphibian species. There is little space available for the growth of the RCP and inclusion of additional taxa since the remaining space should remain available for the priorities of individual institutions.

The survey did not allow much opportunity to document the “undiscovered” or “hidden” space for amphibians that exists in most institutions for multispecies enclosures, on- or off-exhibit. Amphibians may often be integrated into reptile, bird or mammal exhibits and also horticultural exhibits and holdings. Likewise, the water features of zoological parks are opportunities for amphibian management that are overlooked and not included in the survey. It is likely that the holdings of amphibians could be significantly increased if institutions made amphibian conservation a priority and looked for ways to integrate them into other ongoing efforts.

**Table 1. Space available for amphibian management.**

Institution	5 gal On	5 gal Off	10 gal On	10 gal Off	20 gal On	20 gal Off	> 20 gal On	> 20 gal Off	Total Subunits
1	0	15	0	18	1	2	4	4	
2	0	25	0	0	0	23	12	8	
3*	0	11	8	8	5	26	5	5	
4*	0	2	0	0	0	14	2	0	
5	0	0	0	3	0	0	5	0	
6	0	0	1	0	0	1	0	0	
7	0	3	2	20	0	0	9	5	
8	0	15	5	25	7	20	13	18	
9	0	0	0	0	6	0	13	0	
10	0	0	0	20	7	10	1	4	
11	0	6	0	4	0	2	3	0	
12	0	1	3	1	1	0	1	0	
13	0	1	0	0	0	1	2	1	
14	0	5	4	2	0	0	2	0	
15	0	40	12	20	4	8	1	7	
16*	0	0	5	10	5	10	5	10	
17	0	20	0	40	2	40	11	12	
18	1	0	1	0	1	1	0	0	
19	0	4	0	4	8	2	7	0	
20	2	0	0	3	4	5	6	3	
21	0	0	0	0	3	0	0	0	
22	6	4	6	3	0	10	0	0	
23	0	0	2	2	0	1	1	0	
24	0	0	0	20	5	15	10	3	
25	0	10	3	19	18	10	22	7	
26	0	0	0	3	0	2	4	0	
27	0	34	0	132	0	0	7	9	
<b>28</b>	0	0	0	0	0	3	3	0	
<b>total enclosures</b>	9	181	52	357	77	206	159	96	1135
<b>total 5GE**</b>	(x1 ) 9	(x1 ) 181	(x2 ) 104	(x2 ) 714	(x4 ) 308	(x4 ) 824	(x8 ) 1272	(x8 ) 768	4090

\* one or more answers on enclosure space did not fit survey categories

\*\* **“5 Gallon Equivalents” or smallest divisible space subunit**

**Table 2. Institutional Expertise with Families of Amphibians as of 1999**

H = Husbandry efforts within 5 years

R = Reproduction occurring within 5 years

Family	H	R
<b>CAECILIANS</b>		
Caeciliidae	11	5
Ichthyophidae	0	0
<b>SALAMANDERS</b>		
Ambystomatidae	12	3
Amphiumidae	4	0
Cryptobranchidae	7	0
Dicamptodontidae	0	0
Hynobiidae	0	0
Plethodontidae	5	0
Proteidae	4	0
Rhyacotritonidae	0	0
Salamandridae	14	3
Sirenidae	4	1
<b>ANURANS</b>		
Ascaphidae	1	0
Arthroleptidae	1	0
Atelopidae	0	0
Bombinatoridae	2	1
Bufo	19	5
Centrolenidae	1	1
Dendrobatidae	21	16
Discoglossidae (Bombinatoridae?)	10	4
Hylidae	19	6
Hyperolidae	3	0
Leptodactylidae	16	4
Microhylidae	14	3
Myobatrachidae	0	0
Pelobatidae	5	0
Pelodytidae	0	0
Pipidae	14	3
Pseudidae	1	0
Ranidae (includes Mantellinae)	15	7
Rhacophoridae	7	1

**Goals of the Amphibian TAG**

The Amphibian TAG reaffirmed its commitment to five primary goals at the 1999 working meeting:

- 1) To determine which species should be included in the North American Regional Collection Plan and publish a draft plan for ratification
- 2) To integrate public education into species conservation plans
- 3) To utilize the expertise of zoos and aquariums for intensive management of species of concern and their habitats
- 4) To maintain Amphibtalk, a listserv run through the AZA, as a forum for communication and distribution of conservation and scientific literature among TAG members
- 5) To develop a working relationship with declining amphibian and amphibian monitoring programs

Details of the ATAG's progress towards its goals may be found in the AZA's Annual Report on Conservation and Science.

### *How Taxa Were Evaluated for Inclusion in the Regional Collection Plan*

The following people made the initial assessments of the taxa for the regional collection plan:

Craig Berg, Milwaukee Zoo  
Will Brown, National Aquarium in Baltimore  
Eli Bryant-Cavazos, Sedgwick County Zoo (currently at Baltimore Zoo)  
Diane Callaway, Henry Doorly Zoo  
Jody E. Martin de Camilo, Research Department, Saint Louis Zoo and Saint Louis University  
Jack Cover, National Aquarium in Baltimore  
Mike Demlong, Phoenix Zoo (currently at Arizona Game and Fish Commission)  
Jeff Ettling, St. Louis Zoo  
Karen Graham, Sedgwick County Zoo  
Linda Greenup, Fort Worth Zoo  
Don Harris, Baltimore Zoo (currently at Memphis Zoo)  
Bob Johnson, Toronto Zoo  
R. Andrew Odum, Toledo Zoo  
Scott Pfaff, Riverbanks Zoo  
Andy Snider, Detroit Zoo  
Anthony Wisniewski, Baltimore Zoo  
Kevin Wright, Philadelphia Zoo, (currently at Phoenix Zoo)

The assessments were made according to the worksheet suggested by AZA. (See below.) The initial assessments were reviewed by the ATAG Steering Committee prior to the 1999 working meeting and recommendations were made to the ATAG membership. A draft collection plan was circulated to the ATAG Steering Committee before final presentation to the ATAG membership.

#### **Species Selection Criterion:**

##### **Conservation status of the taxon – Endangered, Threatened, Near Threatened, Not At Risk, Data Deficient**

- This criterion was based on the review of primary scientific references or reputable secondary sources (e.g., IUCN Red Data Books), and uses standard terminology. When insufficient information was available the interpretation was based on the experience of the ATAG members.

##### **Reintroduction potential – High, Moderate, Low, Not Needed, Data Deficient**

- This criterion was based on the availability of protected habitat and associated cultural support for the maintenance of the taxon within its native lands.

##### **Existence and viability of captive populations – High, Moderate, Low, Data Deficient**

- This criterion was based on widely available reputable sources (e.g., ISIS census survey data) as well as the knowledge of ATAG members of work occurring outside AZA institutions.

##### **Scientific and research potential – High, Moderate, Low**

- This criterion was based on the ATAG members' perception of the research potential of the species within the ethical limits of their respective institutions.

##### **Number of other regional captive programs – Number of taxon that compete for similar space needs**

- This criterion was based on the results of a space survey conducted by the ATAG in 1999. The ATAG endorsed utilization of space to develop programs for a total of 10 Priority 1-SSP or 1-PMP taxa.

##### **Exhibit value – High, Moderate, Low, Data Deficient**

- This criterion was based on the ATAG members' perception of the ability of the general public to become fascinated with the taxon based on the existing exhibit technology.

**Husbandry expertise – High, Moderate, Low, Data Deficient**

- This criterion was based on published primary references, reputable secondary sources, and the experience of the ATAG members.

**Educational value – High, Moderate, Low, Data Deficient**

- This criterion was based on the ATAG members' perception of the value of this taxon to promoting the goals of the ATAG as well as the educational goals of their respective member institutions. The ability to use a taxon in outreach programs was assessed. If a Priority 2 taxon was practical for outreach programs, an "E" was included in its prioritization.

**Availability of potential founders – Difficult to Acquire, Easy to Acquire, Data Deficient**

- This criterion was based on the ATAG members' perception of the impediments, or lack thereof, to acquiring sufficient founder stock to achieve the genetic management goals for a captive and wild populations.

**Taxonomic uniqueness – At what level is this taxon unique?**

- This criterion was based on the ATAG members' perception of the current accepted taxonomic scheme for this taxon. Special attention was given to those families with few representatives as well as those taxa that display highly specialized adaptations or highly restricted ranges.
- **Potential to affect *in situ* conservation of species or ecosystem – High, Moderate, Low, Data Deficient**
- This criterion was based on the ATAG members' perception of the charismatic potential of this species and its value as a flagship taxon for a given species or ecosystem.

**ATAG Recommendations:**

**Management Category --** The following categories help identify the prioritization of ATAG recommendations.

- **1-SSP = Species Survival Plan (SSP):** Those species that are considered an 1-SSP population with associated intense management, a studbook, a genetic management goal (Maintain 95% genetic diversity for 100 years), and a master plan is developed that includes breeding recommendations. Institutions are expected to comply with SSP recommendations, participating institutions must sign a Memorandum of Participation (MOP), and a management group exists to oversee the SSP.
- **1-PMP = Population Management Plan (PMP):** Those species that are considered 1-PMP populations with associated moderate management, a studbook, and with a long-term goal to maintain captive populations. A master plan is not required, and a management group is not required, but institutions are encouraged to comply with breeding recommendations but there exists not formal MOP.
- **2-DERP = Display/ Education/ Research Population (DERP):** Those species considered 2-DERP lack a studbook and do not yet require long-term genetic management. This category covers those taxa used as surrogate species to develop captive management plans for Priority 1 taxa, as well as those species that meet specific display and education goals consistent with the overall goals of the ATAG. All 2-DERP taxa will have a target population of "as needed to meet institutional needs" unless a specific institution commits to maintaining that taxon to meet specific goals and associated action plans. The Priority 2 taxa have been further defined to facilitated the use of the RCP by consumer groups. For example, a Priority 2 taxon recommended for display would be II-D, those for outreach programs would be II-E, etc. A taxon that is recommended for either display or education would be II-DE.

- **3-POP = Phase Out Population (POP):** This is a problematic category for the Amphibian TAG and is not used for this collection plan. Other TAGs have used this category for taxa that do not meet the TAG's priorities and occupy space that is needed for other taxa. POP taxa may represent surrogate species that have been well studied and are due to be replaced with species meeting TAG priorities. However, given the current state of amphibian husbandry the Amphibian TAG does not consider any taxa to meet this categorization. This decision may be revisited in future editions of the collection plan if advances in husbandry and institutional support of amphibian conservation suggests that the attention given certain taxa are interfering with efforts for Priority 1 or Priority 2 taxa. If this happens, then Priority 5-II will be revisited since some taxa may indeed be "not recommended by the ATAG. If a taxon is reclassified into Priority 3-POP, the ATAG supports the disposition of surplus 3-POP specimens to qualified non-AZA institutions and individuals. All 3-POP taxa will have a replacement taxon indicated. For example, before the southern tomato frog, *Dyscophus guineti*, is classified as 3-POP, there must be enough northern tomato frogs, *Dyscophus antongili*, available for institutions to replace their current holdings of *D. guineti* with *D. antongili*. In the event that there are not enough specimens of an appropriate species to allow substitution, a proposed 3-POP taxon will be classified as category 5-II.
- **4-PIP = Phase In Population (PIP):** Those species considered PIP are considered priorities by the ATAG, and development of a captive population is desired. Once a taxon is held in a North American ATAG member institution, it will be reassigned to another category. All Priority 4-PIP will have a target population of "as needed to meet institutional needs". All Priority 4-PIP will convert by default to 2-DERP unless a compelling case is made for upgrade to I-PMP or I-SSP. The ATAG will support acquisition of these taxa and provide a letter of support to an institution if needed on the condition that the institution provides goals and associated action plans for the desired taxon.
- **5-II = Institutional Initiative (II):** The ATAG has listed many taxa as Priority 5-II since there was no perceived need for a collaborative effort with these taxa by ATAG zoos. This priority includes, but is not limited to, many taxa that are recognized as problematic to manage in captivity (e.g., difficult or unknown husbandry, difficult to acquire specimens). Institutions may choose to include Priority 5-II taxa within their own collection plan since the ATAG recognizes acquisition of knowledge about any amphibian taxon and interpreting that taxon to the public as valid institutional goals. The ATAG does not discourage an institution from working with a given taxon from this category but the ATAG bears the responsibility of explaining obstacles to managing this taxon in that taxon's entry in the RCP. This decision may be revisited in future editions of the collection plan if advances in husbandry and institutional support of amphibian conservation suggests that the attention given certain taxa are interfering with efforts for Priority 1 or Priority 2 taxa. If this happens, then Priority 5-II will be revisited since some taxa may indeed be "not recommended by the ATAG. All 5-II taxa will not have a target population.

**Primary role and purpose of taxa recommended for captive management --** The following categories are designed to help participating institutions understand how they can participate in each program. This has not been included for 5-II taxa. Some examples are listed below:

- Role: Genetic reservoir. Purpose: Long-term maintenance of genetic variation for reintroduction and/or supplementation of the wild population.
- Role: Research population. Purpose: Develop husbandry and propagation program for stream-breeding species.
- Role: Flagship species. Purpose: Generate attention and support for field conservation.

- **Role:** Educational population. **Purpose:** Use in educational programs that meet ATAG and individual goals of member institutions.

**Target population size --** Each Priority 1-SSP or 1-PMP taxon has been assigned a target population size that is reasonable to the role and purpose of the taxa and the space limitations of the participating institutions. For Priority 2-DERP taxa, the target population is “as needed to meet institutional needs” unless a specific institution commits to maintaining that taxon to meet specific goals and associated action plans. This has been omitted for Priority 5-II taxa.

- 50.50.100 (50 males, 50 females, 100 unknown or juveniles)

**ATAG contact:** The ATAG representative with a special interest in the taxon or the ATAG representative that completed the evaluation for the taxon.

**Basis for listing and comments:** This is a readable summation of the points established in the criteria above.

**Recommendations:** This includes a series of “action points” for ATAG members to consider for the taxon. Some examples of action points are publishing a TMA, acquiring additional founders, finding a studbook keeper, and supporting specific fieldwork.

**References:** This is a list of references used to evaluate this taxon.

*Taxonomy of Amphibians*

The accepted nomenclature used for amphibians in this document is listed below. Quotation marks are placed around those families for which a polyphyletic origin seems likely even though the taxa are currently placed in a monophyletic structure.

**Gymnophiona (300+ species)**

- Caeciliidae
  - Dermophinae
  - Caecilinae
  - Typhlonectinae
- Scolecophoridae
- Ichthyophiidae
- Uraeotyphiidae
- Rhinatremitidae

**Caudata (500+ species)**

- Sirenidae
- Amphiumidae
- Plethodontidae
  - Desmognathinae
  - Plethodontinae
    - Hemidactyliini
    - Plethodontini
      - Plethodonini
      - Bolitoglossini
- Rhyacotritonidae
- Proteridae
- Salamandridae
- Ambystomatidae
- Dicamptodontidae
- Cryptobranchidae
- Hynobiidae

**Anura (3500+ species)**

- Ascaphidae
- Leiopelmatidae
- Bombinatoridae
- Discoglossidae
- Pipidae
- Rhinophrynidae
- Pelodytidae
- Pelobatidae

Bufonoidea

- Allophrynidae
- Atelopidae
- Brachycephalidae
- Bufonidae
- Centrolenidae
- Heleophrynidae

Hylidae  
"Leptodactylidae"  
Myobatrachidae  
Pseudidae  
Rhinodermatidae  
Sooglossidae

Ranoidea

Arthroleptidae  
Dendrobatidae  
Hemisotidae  
Hyperoliidae  
Microhylidae  
"Ranidae"  
Rhacophoridae

Regional Collection Plan Phylogenetic Distribution Exclusive of 5-II Taxa

PHYLOGENY	TAXON AND PRIORITY
<b>Gymnophiona (300+ species)</b>	
Caeciliidae	
Dermophinae	<i>Dermophis mexicanus</i> 2-DERP
Caecilinae	<i>Geotryptes seraphini</i> 2-DRP
Typhlonectinae	<i>Typhlonectes natans</i> 2-DRP
Scolecophoridae	
Ichthyophiidae	
Uraeotyphiidae	
Rhinatremitidae	
<b>Caudata (500+ species)</b>	
Sirenidae	<i>Pseudobranchius striatus</i> 2-DRP
Amphiumidae	
Plethodontidae	
Desmognathinae	
Plethodontinae	
Hemidactyliini	<i>Eurycea rathbuni</i> 1-PMP
Plethodontini	
Plethodonini	
Bolitoglossini	
Rhyacotritonidae	
Proteidae	<i>Necturus</i> sp. 2-DP
Salamandridae	<i>Tylotriton shanjing</i> 1-PMP
Ambystomatidae	<i>Ambystoma cingulatum</i> 4-PIP <i>Ambystoma mexicanum</i> 2-DRP
Dicamptodontidae	
Cryptobranchidae	<i>Cryptobranchus alleganiensis</i> 2-DRP
Hynobiidae	
<b>Anura (3500+ species)</b>	
Ascaphidae	
Leiopelmatidae	
Bombinatoridae	
Discoglossidae	
Pipidae	<i>Pipa pipa</i> 2-DRP
Rhinophrynidae	
Pelodytidae	
Pelobatidae	<i>Megophrys montana</i> 2-DRP
<b>Bufonoidea</b>	
Allophrynidae	
Atelopidae	<i>Atelopus zeteki</i> 4-PIP
Brachycephalidae	
Bufonidae	<i>Bufo baxteri</i> 1-SSP <i>Peltophryne lemur</i> 1-SSP
Centrolenidae	

Heleophrynidae	
Hylidae	<i>Agalychnis callidryas</i> 2-DEP <i>Hyla</i> sp. (North American) 2-DERP <i>Phyllomedusa sauvagei</i> 2- DERP
“Leptodactylidae”	<i>Ceratophrys cornuta</i> 2-DEP <i>Ceratophrys ornata</i> 2-EP <i>Eleutherodactylus coqui</i> 2-RP <i>Eleutherodactylus</i> sp. 5-II <i>Leptodactylus fallax</i> 2-RP
Myobatrachidae	
Pseudidae	
Rhinodermatidae	
Sooglossidae	
<b><u>Ranoidea</u></b>	
Arthroleptidae	
Dendrobatidae	<i>Dendrobates azureus</i> 1-PMP
Hemisotidae	Hemisotidae
Hyperoliidae	
Microhylidae	<i>Dyscophus antongilli</i> 2-DERP
“Ranidae”	
Mantellinae	<i>Mantella aurantiaca</i> 1-PMP
Raninae	<i>Ceratobatrachus guntheri</i> 2-DRP <i>Rana aurora draytoni</i> : 2-DERP <i>Rana boylei</i> : 2-DERP <i>Rana cascades</i> : 2-DERP <i>Rana catesbeiana</i> : 2-DERP <i>Rana chiracahuensis</i> : 2-DERP <i>Rana luteiventris</i> : 2-DERP <i>Rana muscosa</i> : 2-DERP <i>Rana onca</i> : 2-DERP <i>Rana pipiens</i> : 2-DERP <i>Rana pretiosa</i> : 2-DERP <i>Rana subaquavocalis</i> : 2-DERP <i>Rana tarahumarae</i> : 2-DERP
Rhacophoridae	

**Priority I-SSP Taxa****Gymnophiona:Caecilians**

None

**Caudata:Salamanders**

None

**Anura:Frogs**Bufonidae: Wyoming toad, *Bufo baxteri*Bufonidae: Puerto Rican crested toad, *Peltophryne lemur***Species Selection Criteria**

**Conservation Status:** U.S. Endangered. Although not listed in Red Data Book, this species meets all criteria for Critical. It may be the most endangered amphibian in the United States

**Reintroduction Potential:** High. The SSP currently has an ongoing program in cooperation with U. S. Fish and Wildlife Service and Wyoming Game and Fish to reintroduce the Wyoming toad into the Laramie Basin. This species went extinct in the wild in 1995. It has since been reintroduced from captive-bred stock into Mortensen Lake and wild breedings occurred in 1998 for the first time since the early 1990's.

**Existence and viability of captive population:** Moderate – Captive population is currently over 350 animals. Unfortunately, the current FGE is less than 2.59 (GD~80%). Since this animal became extinct in the wild, this is the entire gene diversity for this species.

**Scientific and Research potential:** High. Many research possibilities exist for this species. These include husbandry, diet, wild population ecology, inbreeding depression, artificial insemination, cryo-preservation of gametes, and reintroduction. Research is currently underway in all these areas.

**Number of other regional captive programs:** *Peltophryne lemur* is the only other bufonid at 1-SSP status but has different husbandry requirements than *Bufo baxteri*.

**Exhibit value:** Moderate. Is there anything prettier than a toad?

**Husbandry expertise:** Moderate. Some success, but problems with husbandry and breeding still need to be addressed.

**Education Value:** Not suitable for outreach programs at this point. It is an excellent example of declining amphibian populations and cooperative efforts for reintroduction of a species.

**Availability of potential founders:** Moderate. No new gene diversity available, but we have all there is.

**Taxonomic uniqueness:** Low. Although of high uniqueness within Bufonidae, there are over 200 recognized species within the genus.

**Potential for in situ conservation of species or ecosystem:** High. Ongoing reintroduction in Laramie Basin. Some education efforts are needed.

**ATAG Recommendations****Bufonidae: Wyoming Toad (*Bufo baxteri*)**

**Management Category: I - SSP****Primary Role and Purpose of taxon recommended for captive management:**

1<sup>o</sup> role—Genetic reservoir for reintroduction or supplementation of wild populations. The AZA should commit to the Wyoming toad SSP program for at least 10 years (through 2010). At the end of this time, the species should be re-evaluated to determine the level of success of the program and probability of future success for the reintroduction.

**Target population size:** 125.125 + juveniles for release. A minimum of 250 adults and sub-adults animals should be held in U.S. Zoos.

**ATAG Contact:** R. A. Odum, Toledo Zoo, raodum@aol.com

**Basis for listing and comments:** This is one of two flagship amphibian SSP programs for the AZA. The *Bufo baxteri* reintroduction efforts are the first ever attempted using a captive population with a known and very small amount of gene diversity. This program may be able to be used as a model for other amphibian reintroductions in the future. In any case, this SSP will increase the basic knowledge of amphibian reintroduction techniques.

**Recommendations:**

- 1) Continue SSP. Create a Bufonid SSP or management group.
- 2) Increase the number of institutions involved.
- 3) Carry out basic husbandry research
- 4) Examine diets of free ranging toads.
- 5) Continue field research program with University of Wyoming through 2000.
- 6) Develop release screening protocols.

**References:**

Baxteri, G.T. and M.D. Stone. 1985. Amphibians and Reptiles of Wyoming. Wyoming Game and Fish, Cheyenne

**Bufonidae: Puerto Rican Crested Toad**  
**(*Peltophryne lemur*)****Species Selection Criterion:**

**Conservation status of the taxon – IUCN –**  
Vulnerable; USFWS - threatened

**Reintroduction potential –** High and ongoing.  
Included as a recovery goal in USFWS recovery plan.

**Existence and viability of captive populations –**  
High. 64.52.79 (195) in 20 institutions. USFWS has agreed to provide additional founders as necessary.

**Scientific and research potential –** High. Relatively little is known about its natural history. Captive populations have provided much of the information known about this species and there is currently great potential for additional research in captive populations.

**Number of other regional captive programs –**  
Currently an SSP species but does not compete for space with *Bufo baxteri* due to differing captive requirements. *Bufo baxteri* is only other bufonid at Priority I-SSP.

**Exhibit value –** Moderate although some zoos are able to exhibit them successfully. Attention must be given to providing hiding spots that are acceptable to the toad but also visible to the public. Thoughtfully designed graphics and models may improve the sightings in an exhibit.

**Husbandry expertise –** High. Husbandry manual is written and updated as needed. Several institutions have participated successfully in the captive breeding effort.

**Educational value –** Not suitable for outreach programs. Zoos have played a key role in the recovery of this taxon. An ongoing relationship with regional programs in Puerto Rico has been cultivated and zoos may increase their involvement with this *in situ* educational efforts.

**Availability of potential founders –** Additional founders are available through USFWS as necessary. A total of 40 tadpole were exported from Puerto Rico in 1998.

**Taxonomic uniqueness –** Low. There are seven members of this genus, all endemic to Puerto Rico and Virgin Gorda. There are over 200 recognized species within Bufonidae.

**Potential to affect *in situ* conservation of species or ecosystem –** High. The only known breeding pond is within the Guanica Forest. The opportunity exists for constructing breeding ponds within its historic range. Local zoo and university involvement increases the opportunity to expand the program to include the surrounding ecosystem and critical habitat in need of protection.

**ATAG Recommendations:**

**Management Category –** I-SSP

**Primary role and purpose of taxa recommended for captive management –**

1. Genetic reservoir for supplementation of wild populations. Long-term maintenance of genetic variation for reintroduction and possible supplementation of wild population.

2. Education. Increase public's awareness of amphibian biodiversity and population declines. Promote role of local communities for *in situ* conservation.

**Target population size** – 100.100

**ATAG contact** – Bob Johnson, SSP Coordinator, Toronto Metrozoo, bjohnson@zoo.metrotor.on.ca

**Basis for listing and comments** – This endangered toad was thought to be extinct for several years. Since its rediscovery, animals have been brought into captivity and bred to supplement the wild population. It is the only remaining native toad in Puerto Rico and faces threats from the introduced *Bufo marinus*.

**Recommendations:**

Increase *in situ* educational opportunities

Provide increasing support for transfer of expertise to Puerto Rican institutions.

Support *in situ* conservation efforts. Seek additional sites for construction of release ponds. Maximize releases to wild from captive stock.

All adult animals can be pit tagged so that they can be housed together. Explore possible release site in British Virgin Islands.

DNA test pre-released larvae for future evaluation of wild established populations.

Develop release screening protocols.

**References :**

Crawshaw, Graham J. 1990. Conservation of an endangered species. 6th International conference of the Wildlife Disease Association, Berlin

Lentini, A. 1998 Husbandry Manual for the Puerto Rican Crested Toad. Toronto Zoo.

Johnson, R.R. 1994. Model programs for reproduction and management: *Ex situ* and *in situ* conservation of toads of the family Bufonidae, in Murphy, J.B., K. Adler and J.T. Collins (Eds.): Captive Management and Conservation of Amphibians and Reptiles. Society for the Study of Amphibians and Reptiles, Ithaca, NY, pp/ 243-254.

Johnson, R.R. 1990. Release and translocation strategies for the Puerto Rican crested toad, *Peltophryne lemur*. Endangered Species Update Special Issue 8:54-57.

Paine, Frederick L. 1984. The husbandry, management and reproduction of the Puerto Rican Crested toad. In

8th International Herpetological Symposium on captive propagation and husbandry. 59-75. Hahn, R. (ser Ed.). Thurmont, MD: Zoological Consortium

Paine, Frederick L. et al. 1989. Status of the Puerto Rican Crested toad. Int. Zoo Yb. 28: 53-58.

Rivera, J., Mayorga, H., Estremera, E., Izquierdo, I. 1990. Sobre el Bufo lemur. Carib. J. Sci. 15 (3-4), 33-40

Priority I-PMP TaxaGymnophiona- CaeciliansCaudata- Salamanders

Plethodontidae: Texas blind salamander, *Eurycea rathbuni*

Salamandridae: Mandarin newt, *Tylototriton shanjing*

Anura- Frogs

Dendrobatidae: Blue poison dart frog, *Dendrobates azureus*

Ranidae: Golden mantella, *Mantella aurantiaca*

**Plethodontidae: Plethodontidae: Hemidactyliini:  
Texas Blind Salamander (*Eurycea rathbuni*)****Species Selection Criterion**

**Conservation status of the taxon :** State and federally endangered.

IUCN Red list vulnerable section D2 (*Population is characterized by an acute restriction on its area of occupancy (typically less than 100 km<sup>2</sup>) or in the number of locations (typically less than 5). Such a taxon would be prone to the effects of human activities (or stochastic events whose impact is increased by human activities) within a very short period of time in an unforeseeable future, and is thus capable of becoming Critically Endangered or even Extinct in a very short period.*

**Reintroduction potential:** Data deficient.

**Existence and viability of captive populations :** High. 0.0.63 potential founders at Cincinnati ; 0.0. 83 potential founders at the National Fish Hatchery at San Marcos; 3.0 potential founders at Aquarena Springs; 0.0.10 potential founders at Southwest Texas State; 8.1.17 at The Dallas Aquarium (most are F1s).

**Scientific and research potential :** Moderate. Work needs to be done to individually mark animals. This is not only needed for captive programs to identify individuals , but for mark and recapture studies in the wild. There is also the need to determine if salamanders collected from different collection sites are indeed genetically different enough to warrant not mixing specimens from different sites.

**Number of other regional captive programs:** No other plethodontid at Priority I-PMP pr higher.

**Exhibit value :** Moderate. They are a small (3 1/4 - 5 3/8 inches) aquatic salamander, white to pale pink with bright red external gills. Creative solutions to exhibitry may be needed.

**Husbandry expertise :** Moderate. Work done on *Eurycea neotenes* will be very valuable in breeding *T. rathbuni*. Dallas Aquarium has had much success with these animals.

**Educational value:** Not suitable for outreach programs. This is great representative of the need for clean ground water and water conservation.

**Availability of potential founders :** There are already over a hundred potential founders in captivity. The National Fish Hatchery at San Marcos has been asked to hold 125 animals and currently has 83. More will be collected depending on how many come up from the aquifer.

**Taxonomic uniqueness :** There is some controversy over whether this animal deserves to be moved out of

*Eurycea*. Molecular data (Chippendale, 1995) suggest that its not warranted.

**Potential to affect *in situ* conservation of species or ecosystem :** High. The water issues in Texas are a big deal and people either love the salamander or they hate it. I think public support will end up on the side of the salamander and it is a good flagship species for water conservation and the fragile state of the Edwards Aquifer.

**ATAG Recommendations:**

**Management Category :** 1-PMP with upgrade to 1-SSP.

**Primary role and purpose of taxa recommended for captive management :**

Genetic reservoir to supplement wild populations. Flagship species to generate attention and support for field conservation. Research into marking techniques and other appropriate research.

**Target population size :** 100-100 This is not unrealistic (and probably is low) with several institutions wanting to become involved with this species and 187 *T. rathbuni* in captivity currently.

**ATAG contact :** Eli Bryant-Cavazos, Baltimore Zoo, elibzherp@aol.com

**Basis for listing and comments :** This is a state and federal listed endangered species with numerous potential founders in captivity. USFWS are participating and this salamander is part of a recovery plan “ San Marcos & Comal Springs and the associated aquatic ecosystems” (Revised) 1996 ( MIN # 80-9680128). Eli Bryant-Cavazos petitioned the studbook in 2000 and has attended both Studbook I and Population Management classes. This is a federally endangered animal that is part of a recovery plan with U.S. Fish & Wildlife support. Ed Diebold, WCMC chair, and Alan Shoemaker stated this species would be a good candidate for an SSP (in a conversation about how to proceed with the stud book petition).

David Roberts and David Schleser of Dallas Zoo and Dallas Aquarium have demonstrated an imaginative collaborative effort in replicating the necessary environmental conditions to maintain and breed *Eurycea neotenes* ( slides and video of the “breeding well” , courtship, egg laying and egg development of this secretive species are available). The husbandry techniques that have resulted in the tremendous success in breeding *Eurycea neotenes* will be used to induce captive reproduction in *Typhlomolge rathbuni* (see below). David Schleser continues to work with several state agencies that are reviewing water use in the Edwards Plateau, Texas.

A large group of potential founders were recovered from a pump in an aquifer. Several dozen

are in non-AZA institutions ( e.g., Southwest Texas State University’s Edwards Aquifer Research and Data Center). Cincinnati Zoo currently holds over 50 animals, but this group has not been made available to other institutions. Dallas Aquarium and Texas parks and Wildlife are collaborating on the project. The basic husbandry of this animal is simple : long lived 14+ years, 3 captive breedings although none recently, temperature range of 19-20°C, 4-6 animals can live in 10 gal aquarium with aged water, no gravel, and feeding brine shrimp to juveniles and cut red worms to adults. Multiple institutions have expressed an interest in obtaining this species and supporting conservation efforts. This is an excellent prospect for a regional conservation program. Eli Bryant-Cavazos (Baltimore Zoo) is interested in becoming a studbook keeper for this taxon providing specimens become available to institutions for cooperative management. A high priority is assigned to dispersing animals held at Cincinnati to other interested institutions, but the prospects are low given Cincinnati’s previous unwillingness to be active in the Amphibian TAG.

**Recommendations :**

Publish the TMA

Get the studbook up and running.

Compile current list of institutions willing to take animals.

Speak with Cincinnati about moving at least 50 animals to other institutions.

Move F1s to other institutions.

Maintain dialogue with USFWS and cooperate in achieving goals.

Public relations and education.

**References :**

Petranka, James W. 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington and London, 587pp.

IUCN web page

Endangered Species homepage, U.S. Fish and Wildlife Service

**Salamandridae: Mandarin Newt (*Typhotriton shanjing*)**

**Species Selection Criteria:**

**Conservation Status :** Data deficient, but probably Threatened. Protected in China under Schedule II protection, Species Subject to Local Key Protection.

Due to its limited range, its being killed on sight by local Chinese people, and its continued smuggling in the international pet trade, this species is at some risk of becoming extinct in the wild.

**Reintroduction Potential :** Data deficient, but probably Low.

**Existence and Viability of Captive Populations :** ISIS abstracts (June 1998) list 222 individuals (11.8.203) of this species in AZA institutions. However, an additional 37 specimens (0.2.35) are listed in this reference as *T. verrucosus*, for a total of 259 (11.10.238) specimens. It should be understood that all of these specimens are and should be listed as *T. shanjing*, according to current taxonomy. In addition, at least one non-reporting institution keeps this species in its collection and has reproduced it, as have at least 5 other zoos to date. This species currently represents the most commonly held salamander currently held in AZA institutions.

**Scientific and Research Potential :** High - Because of the large numbers in captivity and the reproductive capabilities of this species, the potential to experiment with various methods of husbandry and reproduction/rearing is enormous. This species could provide an ideal model for reproductive studies of other similar salamander.

**Number of Other Regional Captive Programs:** No other salamandrids are Priority 1-PMP or higher. Quite a number of other taxa under the ATAG umbrella utilize the same amount and type of space as this taxon. However, no other caudate amphibian species is kept to the extent of this species.

**Exhibit Value:** High - This species is very colorful, with bright orange and black predominating. It is not a particularly shy species, and can usually be seen readily if exhibited correctly. Also, it is a moderate-sized species which doesn't take up too much room, yet is big enough to see easily.

**Husbandry Expertise :** High - This species has been successfully kept and reproduced for quite some time. The Detroit Zoo has kept this species for many years, and has reproduced this animal successfully since 1989, resulting in hundreds of progeny being sent to other institutions. At least 5 other institutions have also reproduced this species in captivity.

**Educational Value :** Moderate. Because of its bright coloration and ease of exhibitry, this species can be used as an educational model of the salamander world. In addition, because of its extremely limited range, it can be used to teach the concepts of restricted populations and overcollection for the pet trade. This may be suitable for use in outreach programs with appropriate facilities.

**Availability of Potential Founders :** The current U.S.

population is genetically diverse enough at present without the addition of more potential founders to the population. No further genetic infusion to this population should be needed in the near future, if the population is managed well.

**Taxonomic Uniqueness :** Low. The genus *Tylotriton* currently contains several species.

**Potential to Affect In-situ Conservation of Species or Ecosystem :** Data deficient - It may be possible to use this species as a readily-identifiable flagship amphibian for the region of China in which it is found. However, because of its role in Chinese culture as a harbinger of doom, it may be difficult to overcome these biases in favor of its conservation.

#### **ATAG Recommendations:**

**Management Category :** 1-PMP Because of its very limited range, this animal should remain a high priority of the Amphibian TAG, and should be upgraded to a Category I species. Because there is currently no coordinated program for this species, captive reproduction is occurring without regard to long-term consequences of space availability, genetic viability, etc. A studbook should be published, which would allow this population to be more closely managed.

**Primary Role and Purpose of Taxa Recommended for Captive Management :** This species can be used as a model for husbandry and reproductive protocols for similar urodele amphibians. If properly managed, this population can also be used as a genetic reservoir to return animals to the wild, should this ever become feasible and needed.

**Target Population Size :** 50.50.100 (200 total). Because of its bright coloration and ease of exhibitry, many institutions continue to include this species in their master plans. It appears that a population of this size could be easily managed.

**ATAG Contact:** Andrew T. Snider, Detroit Zoo, [asnider@detroitzoo.org](mailto:asnider@detroitzoo.org)

**Basis for Listing and Comments :** *T. shanjing* has a very limited range in Yunnan Province in China. It has been kept and bred for quite a number of years in AZA institutions. However, the population at this time is unmanaged, and random breedings are occurring. A Population Management Plan (PMP) should be implemented after a studbook is completed for the taxon. This would be the first regional studbook and/or PMP for a caudate amphibian.

**Recommendations:** A TMA has been compiled for the species. A Regional Studbook should be undertaken, after which a PMP should be established.

**References:**

Frost, D.R. (ed.) 1985. Amphibian Species of the World, A Taxonomic and Geographical Reference. Allen Press, Inc. and The Association of Systematics Collections, Lawrence, KS. p: 616.

Humphrey, S.R., and J.R. Bain. 1990. Endangered Animals of Thailand. Flora and Fauna Handbook 6: 65-68.

Nussbaum, R.A., and E.D. Brodie, Jr. 1982. Partitioning of the salamandrid genus *Tylotriton* Anderson (Amphibia: Caudata) with a description of a new genus. Herpetologica 38 (2): 320-332.

Nussbaum, R.A., E.D. Brodie, and Y. Datong 1995. A taxonomic review of *Tylotriton verrucosus* Anderson (Amphibia: Caudata: Salamandridae). Herpetologica 51 (3): 257-268.

Pope, C.H., and A.M. Boring 1940. A Survey of Chinese Amphibia. Peking Natural History Bulletin 15 (1): 20-21.

Salmonson, J.A. 1989. The mandarin salamander in captivity. The Vivarium 2 (6): 21-31.

Zhao, E.M., and K. Adler 1993. Herpetology of China. Society for the Study of Amphibians and Reptiles, St. Louis, MO. p. 111

Zhao, E.M., Y. Jiang, Q. Hu, and Y. Yang 1988. Studies on Chinese Salamanders. The Herpetology Society of Japan and Japan Wildlife Research Center. Society for the Study of Amphibians and Reptiles, Lawrence, KS.

### **Dendrobatidae: Blue poison-dart frog** **(*Dendrobates azureus*)**

#### **Species Selection Criteria:**

**Conservation status of the taxon** -The genus *Dendrobates* has had CITES Appendix II protection status since 22 October, 1987. The Suriname Forest Service prohibits commercial collection and export of this species. *Dendrobates azureus* is a relic species that has survived a natural climate shift that changed rain forest habitat into the Sipaliwini savanna. It is currently only known to occur in a few forest islands, at or near the type locality in southern Suriname (Hoogmoed, 1969). The original rain forest vegetation survived at these forest islands because the groundwater table comes close to the surface forming permanent intermittent streams. These populations are isolated from each other by the savanna habitat and are probably somewhat inbred.

Two field surveys conducted by the NAIB (June 1996, August 1997) found viable populations still existing at five localities (Cover, 1997). Suitable habitat is very

limited within this dry savanna. Forest islands with *Dendrobates azureus* are very small in size (average about 1 square mile). The main threats to this species are a shift to a dryer climate in the region, a change in course of the groundwater table, and illegal collecting.

**Reintroduction potential** - Moderate. At this time, reintroduction is not needed, however, a managed captive population could serve as a back-up to the wild populations if a catastrophic event extirpates any of these populations. *D. azureus* live in a protected area that is extremely remote and has no Forest Service personnel stationed permanently in the area. This isolation makes illegal collecting a continual threat. Extirpation from illegal collecting is an example of the type of event that may be corrected through reintroduction. Note: Captive-born and raised dendrobatids lack the defensive skin toxins of wild-caught frogs. These toxins appear to be produced through a dietary source and feeding on the wild diet should restore them.

**Existence and viability of captive populations** - ISIS (current 2/24/99) lists 73,834,445 *D. azureus* held at 59 institutions. This reflects the high desirability of this species for zoo and aquarium collections. NAIB has had reproductive success with 10.10 (currently 9.10) wild-caught founders. F1s from this population are available for distribution in March 2000.

**Scientific and research potential** - Low. Dendrobatids are a well studied group. NAIB has assisted in an ongoing research project conducted by John Daly at the National Institute of Health on how dendrobatids produce defensive toxins (alkaloids) in their skins. Closely related and more common species are utilized for this type of research.

**Number of other regional captive programs** – No other dendrobatids are Priority 1-PMP or higher.

**Exhibit value** -High. This is an aposematically colored, diurnally active frog. It continues to be the most popular dart frog exhibit at NAIB.

**Husbandry Expertise** - High. This species is relatively long-lived and easy to keep in captivity. A TMA is available for this species.

**Educational Value** – Not suitable for outreach. Dart frogs have high educational value due to their defensive skin toxins and interesting life histories. One species of dart frog, *Epipedobates tricolor*, has a potent painkiller (200 times more effective than morphine and non-addictive) in its skin which is now being synthesized by Abbott Laboratories and is in phase II human trials on a path to USDA approval for human use. This drug, if approved, has the potential to replace morphine as a painkiller. Therefore, dart frogs could be utilized as the poster-child for the benefits of preserving biodiversity. Only dart frogs from wild

habitats (rain forests) produce these potentially medically significant alkaloids.

**Availability of potential founders** - Difficult to acquire, however, through the collection of 10.10 founders (NAIB) and the existing captive-born population, enough genetic variability is available for a managed captive population.

**Taxonomic uniqueness** - Low. There are currently 26 species in the genus *Dendrobates*. *D. azureus* is in the "tinctorius" tribe and is very closely related to *D. tinctorius* (Hoogmoed 1969; Duellman 1993; Frost 1985).

**Potential to affect *in situ* conservation of species or ecosystem** - High. This very charismatic species has been utilized by Conservation International - Suriname (through the production of a poster) to instill the uniqueness of Suriname's endemics and the need to protect them and their habitats. The use of dart frogs as flagship species for rain forest conservation has been mentioned previously.

#### **ATAG Recommendations:**

**Management category** - 1-PMP

**Primary role and purpose of taxa recommended for captive management** - Genetic reservoir for a wild population with an extremely small distribution. Secondary roles include use as a flagship species and educational use.

**Target population size** – To be determined.

**ATAG contact** - Jack Cover, National Aquarium in Baltimore, jcover@aquarium.org

**Basis for listing and comments**- This is a project that scores high on many criteria and is well underway. A TMA exists, interest in this species is high and it is relatively easy to keep and breed in captivity. Wild-caught founders are available and an *in situ* conservation program exists. Field work confirming the status for this species in the wild has been conducted.

#### **Recommendations -**

The PMP requirements are developed and implemented by NAIB. Distribution for the offspring of wild-caught animals needs to occur. At this time, these offspring will be distributed free of charge with ownership by the Suriname Forest Service. (Similar to the Golden Lion Tamarin SSP)

Complete summary report with conservation recommendations for the field work conducted to date by NAIB

Continue to investigate health aspects of *D. azureus* management since previously several institutions reported die-offs for this species.

#### **References -**

Cover, J. 1997. A pilot field study of the blue poison-dart frog *Dendrobates azureus* in Suriname. Proc. AZA Central Regional Conf., Cleveland, OH, AZA, Wheeling, West Virginia, p. 492-498.

Duellman, W. E. 1993. Amphibian Species of the World: Additions and Corrections. University of Kansas special publication No. 21, Lawrence, Kansas. p. 53-67.

Frost, D. 1985. Amphibian Species of the World, A Taxonomic and Geographic Reference. Allen Press and Association of Systematic Collections, Lawrence, Kansas. p. 86-104.

Hoogmoed, M. 1969. Notes on the herpetofauna of Suriname III - a new species of *Dendrobates* (Amphibia, Salientia, Dendrobatidae) from Suriname. Zool. Med. Leiden, 44: 133-141.

#### **Ranidae: Mantellinae: Golden mantella (*Mantella aurantiaca*)**

##### **Conservation Status:**

Listed as a CITES II species. Very limited range in Madagascar.

**Reintroduction Potential:** Data deficient, but probably Low at this time.

##### **Existence and Viability of Captive Populations:**

ISIS abstracts (June 1998) list 345 specimens (6.15.324) of this species in 22 AZA institutions. Almost 100 additional captive-bred specimens are known to occur at this time at the Detroit Zoological Institute. Over 50% of these totals are known to be captive-bred individuals. At least 6 institutions are known to have reproduced this species within the past few years. The population appears to be very viable at this time.

**Scientific and Research Potential:** High - Because of the large numbers in captivity and the reproductive capabilities of this species, the potential to experiment with various methods of husbandry and reproduction/rearing is enormous. In addition, although 2nd generation young have now been produced, this is still very rare, with mostly wild-caught founders reproducing at this time.

**Number of Other Regional Captive Programs:** No other ranid (mantellid) frog is Priority 1-PMP or higher. However, no other mantellid frog is exhibited or kept to the extent of this species.

**Exhibit Value:** High - This species is very colorful and is not as shy as many other species of mantellid

frogs. It can be used successfully in multi-species exhibits, and is very popular with the public.

**Husbandry Expertise:** High - This species has been successfully kept and reproduced for quite some time by multiple institutions.

**Educational Value:** Not suitable for outreach. High - Because of its bright coloration and ease of exhibitry, this species can be used as an educational model for declining wildlife in Madagascar. In addition, because of its extremely limited range, it can be used to teach the concepts of restricted populations and overcollection for the pet trade.

**Availability of Potential Founders:** The current U.S. population is genetically diverse enough at present without the addition of more potential founders to the population. No further genetic infusion to this population should be needed in the near future, if the population is managed well.

**Taxonomic Uniqueness:** Not unique. The genus *Mantella* currently contains several species.

**Potential to Affect In-situ Conservation of Species or Ecosystem:**

Moderate - Preliminary plans have been discussed with the AZA Madagascar CAP (formerly called FIG) to construct an exhibit for this species at Parc Ivoloina in Madagascar. This facility already exhibits the tomato frog (*Dyscophus antongili*), and it may be possible in the next few years to construct an adjacent exhibit to show off this colorful small frog to the local Malagasy people.

**ATAG Recommendations:**

**Management Category:** 1-PMP

**Primary Role and Purpose of Taxa Recommended for Captive Management:** If properly managed, this population can be used as a genetic reservoir to return animals to the wild, should this ever become feasible and needed. In addition, this species can be used as a model to develop husbandry protocols for similar mantellid frogs.

**Target Population Size:** 50.50.150 (250 total). Because of its bright coloration and ease of exhibitry, many institutions continue to include this species in their master plans. It appears that a population of this size could be easily managed.

**ATAG Contact:** Andrew T. Snider, Detroit Zoo, asnider@detroitzoo.org

**Basis for Listing and Comments:** Because of its very limited range, this animal should remain a high priority of the Amphibian TAG, and should be considered a Category I species. Because there is

currently no coordinated program for this species, captive reproduction is occurring without regard to long-term consequences of space availability, genetic viability, etc. A studbook should be published, which would allow this population to be more closely managed.

*Mantella aurantiaca* has a very limited range in east central Madagascar. It has been kept and bred for quite some time in a number of AZA institutions. However, the population at this time is unmanaged, and random breedings are occurring. A Population Management Plan (PMP) should be implemented after a studbook is completed for the taxon. It is understood that a studbook would be difficult to publish, based on the fact that these animals cannot be readily identified by color, pattern, or size from one another. Perhaps a "colony-management" strategy would work well for this species.

**Recommendations:**

A TMA has been compiled for this species. A Regional Studbook should be undertaken, after which a PMP should be established.

**References:**

- Garraffo, H.M., J. Caceres, J.W. Daly and T.F. Spande 1993. Alkaloids in Madagascan Frogs (*Mantella*): Pumiliotoxins, Indolizidines, Quinolizidines, and Pyrrolizidines. *Journal of Natural Products* 56 (7): 1016-1038.
- Glaw, F., and M. Vences 1994. A Fieldguide to the Amphibians and Reptiles of Madagascar, Second Edition. Vences and Glaw Publishers. Germany pp: 180-181.
- Matz, G. 1975. Les Grenouilles du Genre *Mantella* (Ranidae). *Aquarama* 9 (3): 20, 84. [Translation: The Frogs of the Genus *Mantella*, trans. by Ingrid Fauci (1984) in *Bulletin of the Chicago Herpetological Society*. 20 (2): 52-53.]
- Zimmermann, E. 1986. *Breeding Terrarium Animals*. T.F.H. Publications, Inc., Ltd., New Jersey.
- Zimmermann, H. (?). *Breeding and Care of Mantella crocea, Mantella viridis, and of the Madagascar Gold Frog, Mantella aurantiaca*. [Translated from German by Walter Bourgoyne (1992), original title unknown].

**Priority 2-DERP Taxa**

Caeciliidae: Dermophinae: Central American caecilian, *Dermophis mexicanus* (DERP)  
 Caeciliidae: Typhlonectinae: Aquatic caecilian, *Typhlonectessp.* (DRP)

Ambystomatidae: Axolotl, *Ambystoma mexicanum* (DRP)  
 Ambystomatidae: Mexican lake salamanders, *Ambystoma* sp.  
 Cryptobranchidae: Hellbender, *Cryptobranchus alleganiensis* spp. (DRP)  
 Proteidae: Mudpuppies, *Necturus* spp. (DP)  
 Sirenidae: Dwarf sirens, *Pseudobranchius* spp. (DRP)

Hylidae: Red-eyed tree frog, *Agalychnis callidryas* (DEP)  
 Hylidae: North American tree frogs, *Hyla* spp. (DERP)  
 Hylidae: Waxy tree frog, *Phyllomedusa sauvagii* (DERP)  
 Leptodactylidae: *Ceratophrys cornuta* (DEP)  
 Leptodactylidae: *Ceratophrys ornata* (EP)  
 Leptodactylidae: *Eleutherodactylus coqui* (RP)  
 Leptodactylidae: *Leptodactylus fallax*, Montserrat form (RP)  
 Microhylidae: Northern tomato frog, *Dyscophus antongili* (DERP)  
 Pelobatidae: Malayan leaf frog, *Megophrys montana* (DRP)  
 Pipidae: Surinam toad, *Pipa pipa* (DRP)  
 Ranidae: Solomon Island leaf frog, *Ceratobatrachus guntheri* (DRP)  
 Ranidae: North American true frogs, *Rana* spp. (DERP)

**Caeciliidae: Dermophinae: Central American caecilian (*Dermophis mexicanus*)****Species Selection Criterion:**

**Conservation status of the taxon** – Data deficient. Caecilians have undergone local extirpations in many areas, and concern has been expressed that several species are seriously endangered or extinct (personal communication, Marvalee Wake, 1997). *Dermophis mexicanus* was locally abundant in southern Mexico when Dr. Aaron Bauer collected for Dr. Wake in the 1970's, but revisits to the same site in the 1990's have yielded no caecilians (personal communication, Marvalee Wake, 1997).

**Reintroduction potential** – Data deficient. There have been no published reports of reintroduction efforts for caecilians. It is not known if there are protected areas within its range that contain suitable habitat for *Dermophis mexicanus*. It appears that this caecilian is of little or no significance in local cultures.

**Existence and viability of captive populations** – Data deficient. There are 0.1.47 *Dermophis mexicanus* reported in ISIS (December 1997) among 5 institutions. Captive births have occurred as a result of imported gravid females, but captive breedings have not been reported. Gestation is prolonged. A specimen housed singly in an enclosure at the Philadelphia Zoo gave birth after 11 months in captivity. Sexual maturity is not reached for at least 2 years based on growth data of captive specimens. Copulation was observed at the Philadelphia Zoo in 1998 (personal communication, Tanya Minott, 1998), so a breeding program is likely. Due to the extended gestation period and slow growth rate, the viability of captive populations cannot be assessed for several years.

**Scientific and research potential** – High. A comprehensive study of the reproductive cycles of a single wild population has been published (Wake, 1980), but almost every aspect of captive behavior, physiology and natural history remain unknown for all caecilians. Key husbandry questions remain such as the impact of soil chemistry and composition on behavior (Ducey et al., 1993), the need for temperature, humidity, and photoperiod cycling, and long-term nutritional needs. The impact of pollution, poor agrarian practices, and other disturbances to the caecilian's habitats have not been assessed. *Dermophis mexicanus* and other viviparous caecilians are considered key taxa to evaluate with respect to the evolution of viviparity in vertebrates (Wake, 1977).

**Number of other regional captive programs** – No other caeciliids are Priority 2 or higher. There are three other terrestrial caecilians (*Schistosometopum thomense*, *Geotryptes seraphini*, and *Ichthyophis kohtaoensis*) in captive collections that have similar housing requirements and may compete with *Dermophis mexicanus* for space in institutions.

**Exhibit value** – Moderate. *Dermophis mexicanus* is a somber colored animal, but reaches an impressive

length and girth for an amphibian. Adult animals are approximately 25-40 cm in overall length with a circumference of 6-8 cm. Although fossorial, they can be displayed on shallow substrate with light leaf cover or bark retreats. Research into improving exhibitry techniques will be essential to improving the profile of this taxon. The research population at Philadelphia Zoo is an excellent conversation piece for tour groups, many of whom did not realize such an animal exists.

**Husbandry expertise** – Moderate. *Dermophis mexicanus* is a reasonably hardy animal once acclimated (O'Reilly and Ready, 1995; Wake, 1994). Earthworms are a suitable primary food source. Caging and associated technology for proper maintenance are commonly available. A suitable enclosure size for 1.1 *D. mexicanus* is 12" x 30". It prefers warm temperatures, 80-84°F and low to moderate light levels. Individual identification can be easily established by photocopying and analyzing the ventral pattern of annular rings (Wright and Minott, 1999), and adult specimens can be permanently identified by intracoelomic implantation or transponders. A TMA for this species is available.

**Educational value** – High. Very few people have heard of, much less seen, a caecilian. Few educational programs from AZA institutions even mention caecilians despite growing emphasis on biodiversity and amphibian declines in educational programs. This species is hardy enough to be used in outreach programs, and evokes a mixture of fascination and uncertainty, similar to reactions elicited by snakes, based on guest comments overheard at the Philadelphia Zoo.

**Availability of potential founders** – Easy to Acquire. A sufficient number of founders exist in captive collections to meet standard long-term management goals should the need arise. If more founders are needed, *Dermophis mexicanus* are irregularly available from animal dealers.

**Taxonomic uniqueness** – Moderate. *Dermophis mexicanus* is within the family Caeciliidae (Tayler, 1968), and represents a monotypic genus within a monotypic subfamily (Dermophinae). It is the only caecilian living in Central America.

**Potential to affect *in situ* conservation of species or ecosystem** – Low. Charismatic megavertebrates such as jaguars, psittacine birds, and monkeys occupy the tropical forest habitats within the same range as *Dermophis mexicanus*. It is unlikely that caecilians can compete as “flagship” taxa for these habitats. However, caecilians may be important as a “flagship” taxa for soil conservation and appropriate agricultural practices. *Dermophis mexicanus* is highly dependent on earthworms and other invertebrates that are important for healthy soil. The presence of viable populations of *Dermophis mexicanus* may well serve as indicators for sustainable agricultural practices.

### **ATAG Recommendations:**

**Management Category**-- 2-DERP

#### **Primary role and purpose of taxa recommended for captive management –**

1° Research population - Develop husbandry and propagation program for terrestrial viviparous caecilians

2° Education and display population - Use in educational efforts, including display and outreach programs, to increase public's knowledge of amphibian biodiversity, population declines, and other goals consistent with ATAG and institutional goals. Generate attention and support for sustainable agricultural practices.

**Target population size** – As needed to meet institutional needs.

**ATAG contact** – Kevin Wright

**Basis for listing and comments** – Little is known of the status of wild populations of *Dermophis mexicanus*, but it is likely that they have suffered declines as noted in other taxa of amphibians throughout Central America. There appears to be a large enough captive population for long-term genetic management should it be deemed necessary, but lack of experience with the taxon precludes comment on the long-term viability of a captive breeding program. This viviparous terrestrial caecilian offers many avenues for research as little is known of its natural history. *Dermophis mexicanus* competes for space with three other taxa of caecilians currently in collections, but is the most suitable as a starting taxon for inexperienced institutions wishing to display caecilians. The taxon is large, relatively hardy to maintain and can be incorporated into educational outreach programs. This taxon is available frequently through herpetofauna importers, and additional founders may be acquired easily. This taxon represents a unique subfamily of the order Gymnophiona, and is the sole caecilian found throughout large portions of its range. Although it is unlikely to have the same appeal as charismatic megavertebrates, this caecilian can serve as a flagship taxa for soil conservation programs and sustainable agricultural practices. Institutions are encouraged to display caecilians, and this taxon should be managed to ensure that caecilians are available to those institutions with an interest in presenting all three extant orders of class Amphibian.

Husbandry and display techniques developed for *Dermophis mexicanus* may be applicable to other more endangered species, such as the insular Sao Tome caecilian, *Schistosometopum thomense*.

**Recommendations –**

Distribute a TMA.

Find a studbook keeper and PMP manager.  
Recommend developing a studbook for this taxon. As the sole representative of caecilians in Central America, this taxon should be upgraded to 1-PMP if captive reproduction is successful and multiple institutions want to become involved in a collaborative captive management program.

Encourage additional institutions to allocate space for display and maintenance of this taxon.

Support fieldwork to document status of wild populations especially within protected areas.

Any dead specimens should be preserved and held for potential research. Contact Kevin Wright if you have preserved specimens.

**References :**

Ducey, P.K., D.R. Formanowicz, Jr., L. Boyet, J. Mailloux, and R.A. Nussbaum. 1993. Experimental examination of burrowing behavior in caecilians (Amphibia: Gymnophiona): effects of soil compaction on burrowing ability of four species. *Herpetologica* 49(4):450-457.

O'Reilly, J., D. Fenolio and M. Ready. 1995. Limbless amphibians: Caecilians. *The Vivarium* 7(1): 26-54.

Taylor, E.H. 1968. *The Caecilians of the World*. University of Kansas Press, Lawrence, KS.

Wake, M.H. 1977. The reproductive biology of caecilians: an evolutionary perspective, in S. Guttman and D. Taylor, (eds.): *Reproductive Biology of the Amphibian*, Plenum Press, New York, NY. pp. 73-102.

Wake, M.H. 1980. Reproduction, growth, and population structure of the Central American caecilian *Dermophis mexicanus*. *Herpetologica* 36(1):244-256.

Wake, M.H. 1994. Caecilians (Amphibia: Gymnophiona) in captivity, in J.B. Murphy, K. Adler and J.T. Collins (eds.): *Captive Management and Conservation of Amphibians and Reptiles*. Society for the Study of Amphibians and Reptiles, St. Louis, MO. pp. 223-228.

Wright, K.M., and T. Minott. 1999. Individual identification of captive Mexican caecilians (*Dermophis mexicanus*). *Herpetological Review*.

**Caecilidae: Typhlonectinae: Aquatic caecilian (*Typhlonectes* sp.)****Species Selection Criteria**

**Conservation Status:**Data deficient, but probably not at risk.

**Reintroduction Potential:**Data deficient, but probably not needed at this time.

**Existence and Viability of Captive Populations:**ISIS abstracts (June 1998) lists 118 specimens (2.4.112) of this species in AZA institutions, with an additional 29 specimens (2.2.25) recorded as either *Typhlonectes compressicaudus* (sic) or *Typhlonectes* (unk sp). Because of the difficulty in exact identification between *T. natans* and *T. compressicauda*, it is possible that many of the counts above contain one or both taxa. These animals are very difficult to sex accurately, although it appears that adult females are somewhat larger than adult males.

**Scientific and Research Potential:**High. Very little is known of these and most other caecilians. This species remains one of the hardest caecilians in a captive environment and, as such, significant research potential exists. Observations of neonates appearing to feed on the slime coat of females have already been made by several individuals, and research into the pH parameters for successful husbandry has also been discussed and begun.

**Number of Other Regional Captive Programs:** No other typhlonectiid is Priority 2 or higher. Although similar amounts of space are dedicated to other amphibian taxa under the ATAG umbrella, this species is rather unique in that most institutions that want a caecilian on exhibit use this species. It is also one of the very few truly aquatic amphibians that are readily available.

**Exhibit Value:**Moderate to High. Aquatic caecilians can be very active exhibit animals in a well-designed display.

**Husbandry Expertise:** High. This species has been worked with in a captive setting for quite some time, and reasonable husbandry guidelines have been developed. A suitable enclosure size for 1.1 *Typhlonectes* sp. is a 20 gallon long tank. A tight-fitting cover is necessary.

**Educational Value:** This taxon is not suitable for outreach programs.

**Availability of Potential Founders:** Relatively easy to acquire, but becoming more difficult. These animals often come into the pet trade imported as fish, and the U.S. Fish and Wildlife Service is now paying closer attention to this fact. However, sufficient potential founder base already exists for a coordinated program.

**Taxonomic Uniqueness:**Low. The genus

*Typhlonectes* is currently recognized as having 3 species within its boundaries.

**Potential to Affect In-situ Conservation of Species or Ecosystem:** Probably Low.

**ATAG Recommendations:**

**Management Category:** 2-DRP

**Primary Role and Purpose of Taxa Recommended for Captive Management:**

1° Develop husbandry and propagation program for aquatic caecilian species. Use as an exhibit species of caecilian.

**Target Population Size:** As needed to meet institutional needs.

**ATAG Contact:** Andrew T. Snider, Detroit Zoo, [asnider@detroitzoo.org](mailto:asnider@detroitzoo.org)

**Basis for Listing and Comments:** For those institutions wishing to exhibit a caecilian species as part of their comprehensive exhibit plan, this taxon should be the target. Its ease of care, ability to reproduce in captivity, availability, and potential for research make it the optimal species to tackle, especially for those institutions with relatively little amphibian experience. Ideal aquatic amphibian exhibit.

**Recommendations:**

A TMA has been compiled on this species. Continued research on husbandry parameters and possible parental care of offspring should be undertaken.

Any dead specimens should be preserved and forwarded to Bob Johnson, Toronto Zoo, to help sort out the identification of the specimens held in captivity.

**References:**

Ducey, P.K., D.R. Formanowicz, Jr., L. Boyet, J. Mailloux, and R. A. Nussbaum. 1993. Experimental examination of burrowing behavior in caecilians (Amphibia: Gymnophiona): effects of soil compaction on burrowing ability of four species. *Herpetologica* 49 (4): 450-457.

O'Reilly, J., D. Fenolio and M. Ready. 1995. Limbless Amphibians: Caecilians. *The Vivarium* 7 (10): 26-54.

Taylor, E. H. 1968. *The Caecilians of the World*. University of Kansas Press, Lawrence, KS.

Wake, M.H. 1977. The reproductive biology of caecilians: an evolutionary perspective, in S. Guttman and D. Taylor, (eds.): *Reproductive Biology of the*

*Amphibian*, Plenum Press, New York, NY. pp. 73-102.

Wake, M.H. 1994. Caecilians (Amphibia: Gymnophiona) in captivity, in J.B. Murphy, K. Adler and J.T. Collins (eds.): *Captive Management and Conservation of Amphibians and Reptiles*. Society for the Study of Amphibians and Reptiles, St. Louis, MO. pp. 223-228.

Wilkinson, M. 1998. Caecilian Taxonomy. on Internet at <http://www.bio.bris.ac...ch/markwilk/caecysyst.htm>

**Ambystomatidae: Mexican axolotl (*Ambystoma mexicanum*)**

**Species Selection Criterion:**

**Conservation status of the taxon - Threatened.** A recent doctoral thesis by Dr. Graue Wiechers estimates the total population at 7800 individuals. It is only found in the Xochimilco channels, 20 km South-west of Mexico city. The remaining freshwater habitat experiences severe pollution and has 3 species of introduced carp.

**Reintroduction potential- High.** There is a laboratory set up near the canals with eggs and larvae ready to be released. Dr. Graue Weichers is planning a three year propagation program including research into the effects of carp and contaminants. The animal is significant in local cultures, it was very important to the Aztecs as a food and medicine and is still thought to cure respiratory illnesses.

**Existence and viability of captive populations-High.** The axolotl is kept in 20 ISIS zoos (24.10.201.6) as well as in many universities because of its high use in experiments. Graue showed that the genetic diversity of the captive populations and the wild populations based on allozyme analysis is within the diversity reported for other ambystomid species.

**Scientific and research potential-High.** The axolotl is already used in many laboratories to study evolution, regeneration, mutations, and embryonic development. Its physiology and behaviour in the laboratory is well documented. Behavior in naturalistic settings is relatively undocumented.

**Number of other regional captive programs-** The only other ambystomatids at Priority 2 are other Mexican lake salamanders, *Ambystoma* sp. The axolotl is bred in many institutions in the world as well as in Mexico. Cave salamanders compete for aquatic salamander space. A good species for those who want to display tailed amphibians.

**Exhibit value- High.** Their neotenuous nature makes them unique and they can almost always be seen in the

display tanks. They are soft black and grey and look like a small “water dragon”. There are many color morphs developed from laboratory strains.

**Husbandry expertise-** High. Aquariums and associated technology for proper maintenance are commonly available. They prefer their water cool (18-20°C) with added minerals. Individual identification can be easily maintained by differences in coloration. Axolotls are hardy animals that seldom gets sick (Duhon, 1980). Suitable surface area for 1.1 adult is 14” wide by 20” long.

**Educational value-** High. Axolotls are reasonably hard and may even be used in outreach programs with appropriate equipment and training of personnel.

**Availability of potential founders-** Easy to acquire. The University of Indiana has received new wild stock from Graue’s research laboratory. A breeding colony had just been assembled near the canals using wild caught axolotls.

**Taxonomic uniqueness-** Moderate. *Ambystoma mexicanum* is within the family Ambystomatidae. Out of 33 species in this family, 17 are found in Mexico and 5 of these routinely reproduce in the larval form (Shaffer, 1989). Four of these five species are endemic to the Valley of Mexico and almost all ambystomatidae salamanders have a very small territory (Conant, 1975; Stebbins, 1985).

**Potential to affect in situ conservation of species of ecosystem-** High. The axolotl is well known to the older community as a food and a medicine but because of its decline in population few young people have seen or heard of the axolotl. There are already Mexican biologists interested and ongoing *in situ* programs are established that are serving to make this a flagship species to save the canal zone of Xochimilco, one of the last freshwater habitats remaining from a huge lake system that used to cover the Mexican basin. A good flagship species for freshwater ecosystems.

### **ATAG Recommendations**

**Management Category-** 2-DERP. ATAG efforts should focus on lake salamanders that do not have *in situ* programs established.

**Primary role and purpose of taxa recommended for captive management-** Education. Increase public’s awareness of amphibian biodiversity and population declines in Mexico and around the world.

**Target population size-** As needed to meet institutional needs.

**ATAG contact-** Bob Johnson, Metro Toronto Zoo, bjohnson@zoo.metrotor.on.ca

**Basis for listing and comments-** All Mexican *Ambystoma* species are threatened with extinction due to suitable habitat being greatly reduced through drainage and pollution of lake water (B. Shaffer, verbal comm.). The ranges of most ambystomatid salamanders are small (Conant, 1975) this is particularly true of the Mexican species (Smith and Taylor, 1948) most of which are known virtually only from their type localities. Part of the reason is that their ranges are poorly known and further fieldwork remains to be carried out. Neither is there enough information on morphological and genetic variation among most known populations to allow satisfying taxonomic treatment of these known populations. However, Dr. Virginia Graue Wiechers, Universidad Nacional Autonoma de Mexico, has completed a genetic study of the axolotl *A. mexicanum*, from Lake Xochimilco (Graue Wiechers, 1998). The reported genetic diversity of the wild population based on allozyme analysis is within the diversity reported of other ambystomatid species. Dr. Graue urges that captive populations be developed and managed to ensure maintenance of genetic diversity while protective measures are instituted for the wild populations.

For specific taxa or unnamed populations, known only from single crater lakes, threatened with imminent destruction or fish stocking programs, establishing captive populations until the threat to wild habitat has passed should be considered. (Brandon, verbal communication).

*Ambystoma mexicanum* is an attractive velvet black axolotl with a bluish sheen. Captive bred varieties include albinos, piebalds and yellows. This axolotl appears to be indigenous to the spring-fed lakes of Xochimilco and Chalco along the southern edge of the Basin of Mexico. Most of the original habitat of these animals is gone and remaining populations surely are in danger of extirpation. The unfortunate fact is that current distribution of the axolotl and other species of *Ambystoma* within the Basin of Mexico remains poorly known.

*Ambystoma mexicanum* has been maintained in laboratory colonies around the world for some time. Some lab colonies have been hybridized intentionally and fortuitously with closely related species. Many lab types of the axolotl are found to carry a white gene but it is felt this would be bred out if these captive animals were introduced to the wild. Genetic analysis of *Ambystoma mexicanum* lab animals in 1980, showed no difference between lab and wild specimens (B. Shaffer, verbal comm.) and the same held true in 1998 (Graue Wiechers, 1998). However, several founder colonies should be established in case of disease or death. Toronto Zoo and Philadelphia Zoo are collaborating to assist existing Mexican conservation projects, including *in situ* breeding and release. Mexican zoos are interested in this taxon and ATAG institutions should support the development of axolotl programs by these institutions.

**Recommendations-**

Maintain correspondence with Mexican contacts and support *in situ* conservation projects. Develop this into a self-sustaining program by Mexican zoos and environmental agencies.

The ATAG should pursue other neotenic *Ambystoma* spp. as a target flagship species illustrative of the plight of all the endemic lake salamanders.

**References-**

Conant, R., 1975. A field guide to reptiles and amphibians of eastern and central North America. Houghton Mifflin Company, Boston

Duhon, 1980. Short guide to axolotl husbandry. The Axolotl Newsletter. The University of Indiana.

Graue Weichers, Virginia. 1998. Estudio genetico y demografico de la poblacion del anfibio *Ambystoma mexicanum* del lago de Xochimilco. Doctoral Thesis. Universidad Nacional Autonoma de Mexico, Instituto de Ciencias del Mar y Limnologia. Mexico

Shaffer B., 1989. Natural History, Ecology, and Evolution of the Mexican Axolotls. The Axolotl Newsletter Vol.18. University of Indiana.

Smith. H.M., and Taylor, 1945. Herpetology of Mexico. United States Printing Office. Washington.

Indiana University's Axolotl Colony website, <http://www.indiana.edu/~axolotl/>

**Ambystomatidae: Mexican Lake Salamanders (*Ambystoma* sp.)**

**Species Selection Criteria:** To be reviewed in 2001.

**Cryptobranchidae: Hellbender (*Cryptobranchus alleganiensis* spp.)****Species Selection Criteria:****Conservation status of the taxon -**

Endangered/Threatened/Near Threatened. *Cryptobranchus alleganiensis* is one of the most impressive native salamanders, which is due in part to its unusual appearance and large size. Prior to the European colonization this species was probably common in the large streams throughout its range. During this century it has declined throughout much of its range as a result of siltation, pollution and stream impoundment (Petranka, 1998). The species is not listed on the Endangered Species Act (ESA),

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), or the 1996 IUCN Red List of Threatened Animals. However, at the state level of government the species is fully protected (endangered, threatened, legally protected species of concern, etc.) in nine states: Alabama, Arkansas, Georgia, Illinois, Indiana, Maryland, North Carolina, Ohio and Tennessee. In Missouri the collection of *Cryptobranchus* is restricted and by special permit only (Levell, 1997).

**Reintroduction potential -** Data deficient. There are no published reports of reintroduction efforts for hellbenders. Nickerson (1980) reported on the return of captive *Cryptobranchus alleganiensis bishopi* to the site of capture following 4 - 6 months in captivity. Of the 27 animals which were returned to the site of capture on 19 February 1976, five (18.5%) were recaptured on 26 May 1976. All of the recaptures had gained weight and several had grown more than 1 cm. A detailed assessment of available stream habitat and competency testing of captive produced animals would be necessary prior to development of a reintroduction program.

**Existence and viability of captive populations -** Low. There are 11.4.10 *Cryptobranchus alleganiensis* reported in ISIS (September 1998) in 12 institutions. To date, there has not been a successful captive reproduction of the species.

**Scientific and research potential -** Moderate. The natural history of *Cryptobranchus* in the wild is well documented (Nickerson and Mays, 1973). However, the life history of juvenile hellbenders is unknown. Zoological institutions should focus their efforts on reproducing this species in a captive environment. The results of such a program would not only provide exhibition specimens but would also provide a reservoir of animals should reintroduction be needed in the future.

**Number of other regional captive programs -** No other cryptobranchids are Priority 2 or higher. *Cryptobranchus* competes for the same space that would be used by other large native aquatic salamanders such as *Necturus* spp.

**Exhibit value:** High. The hellbender is certainly a giant among American salamanders and due to its unique appearance it attracts the attention of zoo visitors. Our experience with the species in St. Louis has proven them to be a popular exhibit. When provided with rocky alcoves for security the animals are always visible to the visitor.

**Husbandry expertise:** High. The institutions which have worked with *Cryptobranchus* have found them to be hardy captives. They require cool (60-65°F), well-oxygenated water and low light levels. If these requirements are met they do quite well and are known to attain captive longevities over 30 years

(Indiviglio, 1997; Snider et al, 1992). A suitable enclosure size for propagation is likely to be at least 24" x 60" and of variable depth.

**Educational value:** Not suitable for outreach programs. The hellbender, *Cryptobranchus alleganiensis* may be used to illustrate the adaptations for a totally aquatic lifestyle, such as the flattened head and body which allows them to move along the bottom of swift moving rivers, lungs which appear to be used in buoyancy control, and that the numerous folds of skin along the head and body used to increase the surface area for oxygen absorption.

*Cryptobranchus* is a good indicator of the health/quality of a stream. The species is restricted to rivers and streams which are clean, cool and have good water movement. When pollutants are introduced into the ecosystem hellbenders are among the first species affected (Indiviglio, 1997).

**Availability of potential founders:** Difficult to acquire. It has become increasingly difficult to acquire specimens due to the protection afforded this species in many of the states throughout its range. In Missouri the zoos are allowed to collect them for exhibition/breeding programs, but they are not allowed to be collected and sent out of state to other institutions.

**Taxonomic uniqueness - High.** *Cryptobranchus alleganiensis* is one of three species belonging to the family Cryptobranchidae and the only North American representative. The other two species, *Andrias japonicus* and *Andrias davidianus*, are restricted to Asia.

**Potential to affect *in situ* conservation of species or ecosystem - Low.** Charismatic mammals such as river otters (*Lutra canadensis*) are more likely to appeal to the zoo visitor as a flagship species for freshwater streams and rivers.

#### **ATAG Recommendations:**

**Management Category – 2-DRP** upgrade to 1-PMP if reproduction occurs and a collaborative management program is desired by holding institutions.

#### **Primary role and purpose of taxa recommended for captive management -**

Research population - Develop propagation program for North American cryptobranchid salamanders.

Education population - Utilize in conservation education efforts, including exhibits with associated interpretive graphics, to increase the public's knowledge of stream ecology/conservation and the effects of habitat alteration, siltation, pesticide runoff, etc.

**Target population** – As needed to meet institutional needs.

**ATAG contact** - Jeff Ettling, St. Louis Zoo, ettling@stlzoo.org

#### **Basis for listing and comments -**

*Cryptobranchus alleganiensis* is the only North American representative of the family Cryptobranchidae and it is also one of our largest salamanders. The species has declined over much of its range during this century as a result of siltation, pollution and stream impoundment. The species is hardy and adapts well to captivity, however, it has not been reproduced. Zoos maintaining this species in their collection should focus their efforts on (1) known locality (river system) animals, (2) trying to determine the environmental parameters necessary for eliciting reproduction and, (3) conditions necessary for successful hatching of eggs and rearing of larvae. Zoos within the range of this species are encouraged to develop interpretive displays depicting the natural history of this large salamander as well as the need for conservation.

#### **Recommendations-**

Prepare and publish TMA (St. Louis Zoo).

Develop techniques for captive reproduction of *Cryptobranchus alleganiensis*.

Institutions within the range of the species are encouraged to develop interpretive displays focusing on the conservation of streams and rivers.

Support fieldwork to document status of wild populations.

#### **References -**

Ballie, J., and B. Groombridge (Compiled and Edited). 1996. 1996 IUCN Red List of Threatened Animals. The World Conservation Union (IUCN), Gland, Switzerland.

Convention on International Trade in endangered Species of Wild Fauna and Flora (CITES). 1973. United States Department of the Interior, Fish and Wildlife Service, Arlington, Virginia.

Endangered Species Act of 1973. 1973 List of Endangered and Threatened Wildlife and Plants. United States department of the Interior, fish and Wildlife Service, Arlington, Virginia.

**Indiviglio, F. 1997. Newts and Salamanders. Barron's Educational Series, Inc. pp. 115-118.**

Levell, J.P. 1997. A Field Guide to Reptiles and the Law (Second Edition). Serpent's Tale. 270 pp.

Nickerson, M.A. 1980. Return of captive Ozark hellbenders, *Cryptobranchus alleganiensis bishopi*, to site of capture. Copeia 1980:536-537.

Nickerson, M.A. and C.E. Mays. 1973. The Hellbenders: North America's Giant Salamanders. Pub. Biol. Geol., Milw. Publ. Mus. 1:1-106.

Snider, A.T. and J.K. Bowler. 1992. Longevity of Reptiles and Amphibians in North American Collections (Second Edition). Society for the Study of Amphibians and Reptiles. iii + 40 pp.

**Proteidae: Mudpuppies and Waterdogs (*Necturus* spp.)**

**Species Selection Criterion:**

**Conservation status of the taxon** - Not given State or Federal protection. Some species and subspecies have restricted ranges. The Neuse River water dog, *Necturus lewisi*, is found only in the Tar and Neuse River systems of the Piedmont and Coastal Plain of North Carolina. A survey of the Swift Creek Basin in the Tar River Drainage (a high quality area where habitat maintenance has been given priority) suggested that that population of *N. lewisi* was stable. However, terrestrial and aquatic habitats in the region continue to decline due to rapid growth and development. The cumulative and secondary impacts from state and federal funded highway and water and sewer infrastructure projects are accelerating the fragmentation of remaining natural areas and exacerbating water quality problems (personal communication, Alvin Braswell 1999).

**Reintroduction potential** - Low. At this time, maintaining current standards and working towards implementing legislative water quality protection are priorities. No protected sites are available at this time.

**Existence and viability of captive populations** - There are 28 specimens of 4 taxa of *Necturus* in June 1998 ISIS.

**Scientific and research potential** - High. Mudpuppies and waterdogs are popular subjects for biomedical research and may be good subjects for monitoring water quality of streams. As an example, Neuse River Water Quality Conditions are being monitored by the US Geological Survey. Pesticide and PCB residues have been documented in *Necturus lewisi* (Hall et al. 1985), but long-term impacts have not been examined. In 1977, the Office of Endangered Species, USFWS, and the N.C. Wildlife Resources Commission initiated pre-listing studies. A three year contractual study of the *N. lewisi*'s distribution, ecology, and ethology began in 1978 (Cooper, 1985). Most *in situ* work on this animal is over 20 years old. The most recent population survey is approximately 5 or 6 years old and only encompassed the Swift Creek

Basin of the Tar River Drainage. Current and thorough population surveys are needed and interest in doing so has been expressed (Personal Communication, Alvin Braswell, 1999). Assistance by zoo professionals might be well received. Information on proteid husbandry parameters, captive breeding requirements and larval rearing is lacking and needs to be researched.

**Number of other regional captive programs** - No other proteid are Priority 2 or higher. *Necturus* spp. competes for space with *Cryptobranchus* sp. and other large aquatic salamanders.

**Exhibit value** - High. This is an "ABC" salamander and the name is well-recognized by many guests. Due to their large size, they are easy to exhibit.

**Husbandry expertise** - Moderate. Much is known about the natural history of *Necturus* and this information can be applied to captive husbandry. As an example, *Necturus lewisi* is found near swift moving waters in wide, shallow rivers. They tend to be associated with clay or hard soil substrate. They appear to be photophobic, as activity away from cover is nocturnal. They are generally associated with leaf litter and other debris. The adult diet consists primarily of aquatic insects. Terrestrial insects, fish, and salamanders are occasionally eaten. Larvae primarily eat small crustaceans and insects (e.g. copepods and dipterans). Mudpuppies, *Necturus maculosa*, has been maintained in biomedical labs throughout the 20<sup>th</sup> century and is easily accommodated in a 20 gal long tank that is kept between 64-68°F.

**Educational value** - This taxon require cool highly oxygenated water and is not suitable for outreach programs. May be excellent link to stream water quality and watershed issues.

**Availability of potential founders** - Easy to acquire.

**Taxonomic uniqueness** - High. The Neuse River waterdog, *Necturus lewisi*, is one of six species within this unique family of salamanders and has the smallest distribution of the North American proteids. Five species in the genus *Necturus* are restricted to North America while the sixth species, the olm, *Proteus anguis*, is found only in Europe.

**Potential to affect in situ conservation of species or ecosystem** - Low to Moderate. Current political atmosphere in North Carolina is sympathetic towards maintaining the Neuse water system. There is good potential for legislative protection, but funding will be needed to ensure implementation. The attitude in other states toward their endemic waterdogs is variable.

**ATAG Recommendations:**

**Management Category – 2-DRP****Primary role and purpose of taxa recommended for captive management -**

Display population – Generate regional attention and support for wetlands protection.

Research population - Develop husbandry and propagation program for stream-breeding species.

**Target population size** – As needed to meet institutional needs.

**ATAG contact** - Karen Graham, Sedgwick County Zoo, herps@scz.org

**Basis for listing and comments** - Although the mudpuppy, *Necturus maculosa*, is commonly displayed in collections, there is no ATAG supported program for this or any other *Necturus* species. Given the few taxa in this family, the fact that *Necturus* is endemic to North America, and the lack of protected suitable habitat, ATAG members are encouraged to develop expertise with indigenous taxa.

**Recommendations -**

Maintain local specimens of *Necturus* sp. to increase the expertise with husbandry and captive propagation.

Encourage institutions, particularly in the Southeastern region of the U.S., to allocate space for display and maintenance.

A collaborative effort with the Neuse River waterdog, *Necturus lewesi*, should be encouraged. This taxon may be suitable for a 1-PMP category if enough institutions express an interest in proteids.

**References**

Braswell, Alvin L. and Ray E. Ashton, Jr. 1985. Distribution, Ecology, and Feeding Habits of *Necturus lewesi* (Brimley). *Brimleyana* (10): 13-35.

Conant, Roger, and Joseph T. Collins. 1998. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Third Edition, Expanded. Houghton Mifflin Company, New York, NY pp. 422-423.

Cooper, John E. and Ray E. Ashton, Jr. 1985. *The Necturus lewesi* Study: Introduction, selected literature review, and comments on the hydrologic units and their faunas. *Brimleyana* (10) 1-12.

Hall, Russell J., R.E. Ashton, Jr., and R.M. Prouty. 1985. Pesticide and PCB residues in the Neuse river waterdog, *Necturus lewesi*. *Brimleyana* (10): 107-109.

**Sirenidae: Dwarf sirens (*Pseudobranchius* sp.)****Species Selection Criteria**

**Conservation status of the taxon** – Data Deficient. Little is known about the status of *Pseudobranchius* in the wild. Although *Pseudobranchius* has a wide range extending from South Carolina to south Florida, habitat requirements may be narrow. In South Carolina, habitat preferences seem to be limited to vernal ponds and pocosins occurring in pine flatwoods and long-leaf pine forests that are currently undergoing significant alteration due to forestry practices and coastal development. *Pseudobranchius* is listed by the South Carolina Department of Natural Resources as a species of special concern (Steve Bennett, personal communication).

**Reintroduction potential** – Data deficient. Exact habitat requirements for *Pseudobranchius* have not been established. There are protected areas throughout the range of the two species that may contain suitable habitat. *Pseudobranchius* is a little known species that has no cultural significance other than at times to be collected for use as fish bait.

**Existence and viability of captive populations** – Low. *Pseudobranchius* are currently maintained at only two institutions (ISIS Specimen Reference, September, 1998. Slavens 1997, IZY 1996). The first known managed reproductions of *Pseudobranchius* occurred at both the Philadelphia and Riverbanks zoos in 1998. At Riverbanks, 75 *P. s. striatus* hatched from eggs laid by a group of 0.0.4 adults that were collected as juveniles in 1994. Philadelphia hatched ~ 20 *P. axantha* from eggs laid by a group of 0.0.6 adults. In 1999, Philadelphia had more reproduction from 1.2 adults. In all instances, the females laid single eggs indicating that *Pseudobranchius* may reproduce via internal fertilization even though other members of *Sirenidae* reproduce via external fertilization (Duellman and Trueb, 1986). There is also a report of reproduction of *Pseudobranchius* in Germany in a private collection (Paul Moler, personal communication).

**Scientific research potential** – High. The natural history of *Pseudobranchius* is largely unknown. Likewise, captive husbandry data is lacking as few institutions have maintained this genera. Recent captive breedings have shed some light on reproductive strategies and growth rates of juveniles.

**Number of other regional captive programs** – No other sirens are Priority 2 or higher. There are few *Sirenidae* in captive collections. They may compete for space with any small amphibian.

**Exhibit value** – Moderate. Although they are small (10-15cm) and somberly colored, *Pseudobranchius* are generally visible in a well-designed exhibit. However an exhibit of *Pseudobranchius* at Riverbanks Zoo

generates little enthusiasm from most visitors. Philadelphia maintained exhibit *Pseudobranchus* in a heavily planted mixed species exhibit with *Hyla squirrella* and *Notophthalmus viridescens* spp.. They were unpredictably active and visibility may have been increased with more specimens. Overall they were a nice addition to a community tank.

**Husbandry expertise** – Moderate. Although husbandry experience is limited, *Pseudobranchus* do not appear to be difficult to maintain in captivity. Both adults and juveniles are hardy and long lived as captives and can be maintained in naturalistic, outdoor enclosures requiring little or no maintenance. A minimum enclosure size for 1.1 adults is a 10 gal tank with a tight fitting lid. *P. pseudobranchus* are diminutive, totally aquatic amphibians that can be maintained in very small aquariums, even glass jars.

**Educational value:** This taxon is not suitable for outreach programs. There is no evidence of population declines; in fact, the extensive range of the introduced water hyacinth may have expanded the range and population density of some *Pseudobranchus* sp.

**Availability of potential founders** – Data deficient. Availability of *Pseudobranchus* varies depending on species and locality. In general, it should not be too difficult to obtain wild caught animals.

**Taxonomic uniqueness** – High. *Pseudobranchus* is in the family Sirenidae (5 species) which is limited in distribution to southeastern North America. There are only two species within the genus, *Pseudobranchus axantha* and *P. striatus*.

**Potential to affect in situ conservation of species and ecosystem** – Low. *Pseudobranchus* currently have little potential to serve as a flagship species for aquatic environments.

#### **ATAG Recommendations**

**Management Category** – 2-DRP

**Primary role and purpose of taxa recommended for captive management** –

Research – Investigate ova fertilization method of *Pseudobranchus*

Display – Display endemic family of North American salamanders.

**Target population size** – As needed to meet institutional needs.

**ATAG contact** – Scott Pfaff

**Basis for listing and comments** – This is an easy to maintain small salamander that may be part of a mixed

species exhibit featuring native frogs and small fish. The natural history and biology of *Pseudobranchus* is poorly known and zoos may make significant contributions to this field with careful observation of captive specimens.

**Recommendations** – Interested zoos may wish to maintain a small research and display population of *Pseudobranchus*. This is a taxa best suited for institutions supporting regional interests rather than national management.

#### **References** –

Conant, Roger and Joseph T. Collins, 1991. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Houghton Mifflin Company, Boston.

Duellman, William E. and Linda Trueb. 1986. Biology of the Amphibians. Johns Hopkins University Press, Baltimore.

Stebbins, Robert C. and Nathan W. Cohen. 1995. A Natural History of Amphibians. Princeton University Press, Princeton, NJ.

#### **Hylidae: Red-eyed Tree frog (*Agalychnis callidryas*)**

#### **Species Selection Criteria:**

**Conservation status of the taxon** - Distributions per Frost (1985). *Agalychnis callidryas* is found throughout Central America. From Mexico to Panama. Not CITES listed.

**Reintroduction potential** - Not needed.

**Existence and viability of captive populations** : 21.21.63 *A. callidryas* found in 25 institutions. Reproduction has occurred at multiple institutions. There are a large number of private breeders producing morphs for the pet trade.

**Scientific and research potential** - Low.

**Number of other regional captive programs** – There are two other hylid taxa at Priority 2, North American *Hyla* sp. and *Phyllomedusa sauvagii*.

**Exhibit value** – Low due to cryptic behavior when at rest. This is an amphibian that the public expects to see in a rainforest exhibit.

**Husbandry Expertise** – *Agalychnis callidryas* is well represented in captive collections and its husbandry and captive breeding are relatively simple. A 20 gal tank is suitable to house 2.2 adults but breeding may require a more complex enclosure.

**Educational Value** - Moderate. *Agalychnis callidryas* may be used for outreach programs with suitable training of the educators. Guests are amazed to see a cryptically colored *A. callidryas* at rest explode into color when roused from its leaf. Can illustrate rainforest-related issues.

**Availability of potential founders** - Easy to acquire

**Taxonomic uniqueness** - Low. The genus *Agalychnis* is made up of 8 species. All are considered to be monotypic. Geographic variation occurs in *A. callidryas*. There are several hundred species of hylids worldwide.

**Potential to affect *in situ* conservation of species or ecosystem** - High. *A. callidryas* is possibly the world's most photographed frog. *A. callidryas* are highly charismatic and colorful making them potential flagship species for rain forest conservation.

#### ATAG Recommendations:

**Management category:** 2-DERP

#### **Primary role and purpose of taxa recommended for captive management -**

Education purposes.

Flagship species for rain forest conservation

Research population to develop husbandry expertise at inexperienced institutions

**Target population size** – as needed to meet institutional needs

**ATAG contact** - Jack Cover, National Aquarium at Baltimore, jcover@aqua.org

**Basis for listing and comments-** *Agalychnis callidryas* is an extremely popular frog and is ubiquitous on souvenir shop paraphernalia. Even though it is not endangered, it is inextricably linked with rainforest conservation in the public's mind and zoos can take advantage of its popularity to forward other issues. It is an easy to keep and display animal and is certainly an "ABC" amphibian for the zoo community.

#### **Recommendations -**

Revise and publish a TMA.

#### **References -**

Duellman, William E. 1970. The Hylid Frogs of Middle America Vol. 1. Museum of Natural History, The University of Kansas. pp. 87-130.

Frost, Darrell R. 1985. Amphibian Species of the World, A Taxonomic and Geographical Reference. Allen Press and the Association of Systematics Collections, Lawrence Kansas. pp. 197-199.

#### Hylidae: North American tree frogs (*Hyla* spp.)

#### Species Selection Criterion:

**Conservation status of the taxon** – Although most North American species are "Not at Risk", certain taxa, such as the Pine Barrens tree frog, *Hyla andersoni*, are considered threatened or endangered at the state level.

**Reintroduction potential** – Data Deficient.

**Existence and viability of captive populations** – Low. Using a common species, the green tree frog, *Hyla cinerea*, as an example, there are 2.0.68 reported in 20 institutions (ISIS, December 1997), and the majority of institutions have 3 or fewer specimens. Captive breeding was not reported in the previous year for this or any other North American hylid.

**Scientific and research potential** – Moderate.

**Number of other regional captive programs** – If programs develop for endangered North American hylids, such as the Pine Barrens treefrog (*Hyla andersoni*), other North American hylids would compete for space and should be phased out. There are two other hylid taxa at Priority 2, red-eyed treefrog, *Agalychnis callidryas*, and waxy treefrog, *Phyllomedusa sauvigii*.

**Exhibit value** – Moderate. Most are easy to exhibit. Visibility is greatly improved with larger enclosures with a large number of specimens over small enclosures with a few specimens.

**Husbandry expertise** – Moderate. Reproduction has not been reported for most North American *Hyla* sp.

**Educational value** – Moderate. The locally available tree frogs often are suitable for outreach programs. They may be used to illustrate regional conservation concerns.

**Availability of potential founders** – Easy to Acquire.

**Taxonomic uniqueness** – Low level of taxonomic uniqueness. There are several hundred species of hylids worldwide.

**Potential to affect *in situ* conservation of species or ecosystem** – Moderate. Tree frogs are familiar amphibians and locally available species often have a readily recognizable call. It can serve as a focus for developing regional educational and conservation

programs by bridging the gap between “backyard” animals and rare amphibians.

**ATAG Recommendations:**

**Management Category** – 2-DERP

**Primary role and purpose of taxa recommended for captive management** –

Research population to develop husbandry and propagation program for poorly known and endangered North American hylids (e.g., *Hyla andersoni*).

Education. Expand collection of animals used in outreach programs

**Target population size** – As needed to meet institutional needs.

**ATAG contact** – Kevin Wright, The Phoenix Zoo, kwright@thephezoo.com

**Basis for listing and comments** – Very little information is available on the status of species within the large Hylidae family. For this reason emphasis has been placed on developing TMA's for species previously identified by the TAG. *Hyla cinerea* is a readily available taxon that can serve as a model for other more threatened taxa. Although *Hyla cinerea* is a widely available species, institutions may concentrate on regional species that are likely to be higher profile in their area (e.g., *Hyla regilla* in the West Coast).

**Recommendations** –

Encourage institutions to attempt captive-breeding and long-term husbandry research on locally available hylids as pilot taxa for more endangered species.

Use as focus for frog calling surveys

Encourage use as outreach animals and incorporation into educational programs

**References** –

Conants, R. and J. Collins. 1996. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Houghton Mifflin Company, Boston.

Stebbins, R.C. 1985. A Field Guide to Western Reptiles and Amphibians. Houghton Mifflin Company, Boston.

**HYLIDAE: Waxy treefrog (*Phyllomedusa sauvagii*)**

**Species Selection Criteria:**

**Conservation status of the taxon** - Data deficient. Found in the Chacoan region of eastern Bolivia, northern Paraguay, Mato Grosso do Sul (Brazil), and northern Argentina (Frost 1985). This species is not CITES protected.

**Reintroduction potential** - Data Deficient

**Existence and viability of captive populations** - As of 2/24/99, ISIS reports 10.18.28 animals in 15 institutions. There are a large number of specimens in the pet trade produced by private breeders.

**Scientific and research potential** - Moderate. Areas of interest include defensive skin peptides (Mor and Nicolas 1994), behavioral and physiological adaptations to living in a very dry environment (McClanahan et al. 1978; McClanahan et al. 1987; Shoemaker et al. 1979).

**Number of other regional captive programs** – There are two other hylid taxa at Priority 2, North American *Hyla* sp. and the red-eyed treefrog, *Agalychnis callidryas*.

**Exhibit value** - Moderate. Though they are nocturnally active, this large treefrog will “perch” on small branches during the day (normal exhibit hours), making them highly visible to the public.

**Husbandry Expertise** - Moderate. *Phyllomedusa sauvagii* tends to be rather hardy in captivity once acclimated. They are now routinely bred by several individuals in the private sector. Breeding to the F2 generation has been accomplished by commercial breeders. There have been several reports of large bladder stones developing in adult animals which eventually killed them. It is speculated that allowing these uricotelic frogs to have access to standing water over long periods of time may be one cause for these problems. One hobbyist has had animals in his collection for nearly 10 years without ever having this problem occur. However, he never allows his animals to have access to standing water; instead the water source is in the form of damp paper towels on which the frogs will sit to absorb water when needed. More work needs to be done in this area. A TMA for this species would be useful.

**Educational Value** - High. Their large size and slow gait make these animals good animals for education outreach. Many people are surprised to learn that frogs can be found in very dry regions.

**Availability of potential founders** - Currently, *Phyllomedusa sauvagii* is easy to acquire as either captive-bred or wild-caught animals.

**Taxonomic uniqueness** - Low. *Phyllomedusa sauvagii* is one of 34 species in the genus *Phyllomedusa*. There are several hundred hylids worldwide.

**Potential to affect *in situ* conservation of species or ecosystem** - Moderate. This species has much appeal and charisma and could compete as a “flagship” taxa for a region such as the Chaco. For example: Of the many species that could have been used, *Phyllomedusa sauvagii* was used on the cover of the book *Amphibians and Reptiles of the Paraguayan Chaco - Volume I* by David R. Norman (1994).

**ATAG Recommendations:**

**Management category** – 2-DERP

**Primary role and purpose of taxa recommended for captive management** - Education purposes

**Target population size** - To be determined by ATAG

**ATAG contact** – Jack Cover, National Aquarium in Baltimore, jcover@aqua.org

**Recommendations -**

1. Prepare and publish a TMA.
2. Support fieldwork to document status of wild populations.

**References -**

Frost, D. 1985. *Amphibian Species of the World, A Taxonomic and Geographic Reference*. Allen Press and Association of Systematic Collections, Lawrence, Kansas. 199-203.

McClanahan, Lon L. and Vaughn H. Shoemaker, 1987. Behavior and Thermal Relations of the Arboreal Frog, *Phyllomedusa sauvagii*. *Natl. Geogr. Res.*; 3 (1): 11-21.

McClanahan, Lon L.; Stinner, Jerry N. and Shoemaker, Vaughn H. 1978. Skin Lipids, Water Loss, and Energy Metabolism in a South American Tree Frog (*Phyllomedusa sauvagii*). *Physiol. Zool.*; 51(2): 179-187. Apr.

Mor, A. and Pierre Nicolas, 1994. Isolation and Structure of Novel Defensive Peptides from Frog Skin. *Eur. J. Biochem.*; 219 (1-2): 145-154.

Norman, David R. 1994. *Amphibians and Reptile of the Paraguayan Chaco Volume 1*. D. Norman, San Jose, Costa Rica.

Shoemaker, Vaughn H. and Bickler, Philip E. 1979. Kidney and Bladder Function in a Uricotelic Treefrog (*Phyllomedusa sauvagei*). *J. Comp. Physiol. B Biochem. Syst. Environ. Physiol.*; 133 (3): 211-218.

**Leptodactylidae: Surinam horned frog**  
**(*Ceratophrys cornuta*)**

**Species Selection Criterion:**

**Conservation status of the taxon** - Not listed by CITES, USFWS, or IUCN. This is a wide-ranging species of the Amazonia and Central Cis-Andean Lowland forests. It's found from the rainforests of Eastern Guiana, into Northern Brazil, West to Amazonian Columbia, and South to Amazonian Peru.

**Reintroduction potential** - Not Needed

**Existence and viability of captive populations** - 9.6.12 held in 9 N. Am. zoos (ISIS abstracts, Sept. 1998)

**Scientific and research potential** - Commonly bred in captivity

**Number of other regional captive programs** – One other *Ceratophrys*, *C. ornata*, is in the RCP at Priority 2. Two other leptodactylids, *Eleutherodactylus coqui* and *Leptodactylus fallax*, are in the RCP at Priority 2.

**Exhibit value** - High. Very charismatic anurans.

**Husbandry expertise** - Bred at Fort Worth in 1985. Related species (*C. calcarata*, *cranwelli*, and *ornata*) have been bred at various institutes.

**Educational value** - Good. Hardy and charismatic.

**Availability of potential founders** - Not deemed essential at this time for maintaining education and exhibit specimens.

**Taxonomic uniqueness** – Low. There are several species in this genus, all specialized to be a voracious predator.

**Potential to affect *in situ* conservation of species or ecosystem** - Moderate. This is certainly a charismatic species. Because *Ceratophrys* are fairly popular in the pet trade, many zoo-goers will identify with the mass destruction of its Amazon forest habitat.

**ATAG Recommendations:**

**Management Category** – 2-DEP

**Primary role and purpose of taxa recommended for captive management** -

Education - provide specimens for education programs that meet ATAG, Brazil FIG, and individual goals of member institutions.

Flagship species - generate attention and support for Amazonia conservation.

**Target population size** - 10.10.20 (A few facilities should breed on an as-need basis to provide specimens for display and for education departments.)

**ATAG contact** - Karen Graham

**Basis for listing and comments** - *Ceratophrys* are highly charismatic frogs that are very hardy. They're big and unforgettable and are great animals to capture the interest of young children.

**Recommendations** -

Provide ATAG endorsement for this animal's use in education programs.  
Promote its availability and desirability to educators. Maintain a small supply of surplus animals (at least 20) that can be made readily available to educators. Create a TMA and education packet to be delivered with requested frogs.

**References**

Duellman, William E. (Ed.) 1979. The South American Herpetofauna: Its Origin, Evolution, and Dispersal. The Museum of Natural History. The University of Kansas, Lawrence, KS. pp: 194, 256, 270.

**Leptodactylidae: Ornate horned frog (*Ceratophrys ornata*)**

**Species Selection Criterion:**

**Conservation status of the taxon** - Not listed by CITES, USFWS, or IUCN. This is a wide-ranging species of northern and central South American forests.

**Reintroduction potential** - Not Needed

**Existence and viability of captive populations** - This species is common in the pet trade. 17.21.92 held in over 50 North American zoos (ISIS abstracts, December 1998)

**Scientific and research potential** - Low to moderate. Although this species is commonly bred in captivity, little is published about its physiology and aspects of its natural history. It may be a worthwhile model for biomedical and embryological research.

**Number of other regional captive programs** - One other *Ceratophrys*, *C. cornuta*, is in the RCP at Priority 2. Two other leptodactylids, *Eleutherodactylus coqui* and *Leptodactylus fallax*, are in the RCP at Priority 2.

**Exhibit value** - High. Easy to exhibit and very visible. *Ceratophrys cornuta* is a more bizarre-looking animal for exhibit than this taxon.

**Husbandry expertise** - Bred at Fort Worth in 1985 and Philadelphia in 1993. Related species (*C. calcarata*, *cranwelli*, and *ornata*) have been bred at various institutes.

**Educational value** - Good. Hardy and charismatic.

**Availability of potential founders** - Not deemed essential at this time for maintaining education and exhibit specimens.

**Taxonomic uniqueness** - Low. Several species in this genus, all specialized to be voracious predators.

**Potential to affect *in situ* conservation of species or ecosystem** - Low. This is certainly a charismatic species. Because *Ceratophrys* are fairly popular in the pet trade, many zoo-goers may empathize with the mass destruction of its tropical habitat.

**ATAG Recommendations:**

**Management Category** - 2-EP

**Primary role and purpose of taxa recommended for captive management** -

Education - provide specimens for education programs that meet ATAG and individual goals of member institutions.

**Target population size** - 10.10.30 (A few facilities should breed on an as-need basis to provide specimens to education departments.)

**ATAG contact** - Karen Graham

**Basis for listing and comments** - *Ceratophrys* are highly charismatic frogs that are very hardy. They're big and unforgettable and are great flagship animals, particularly for young children.

**Recommendations** -

Provide ATAG endorsement for this animal's use in education programs.  
Promote its availability and desirability to educators. Maintain a small supply of surplus animals (30) that can be made readily available to educators. Create a TMA and education packet to be delivered with requested frogs.

**References**

Duellman, William E. (Ed.) 1979. The South American Herpetofauna: Its Origin, Evolution, and Dispersal. The Museum of Natural History. The University of Kansas, Lawrence, KS. pp: 194, 256, 270.

**Leptodactylidae: Coqui (*Eleutherodactylus coqui*)**

**Species Selection Criteria:**

**Conservation status of the taxon** - Not at risk. This species is common across the entire island of Puerto Rico (Joglar 1999). Population dynamic studies indicate that the species is very abundant in the Luquillo Experimental Forest (Woolbright 1991,

1996) despite human and natural disturbances. In fact, this species seems to be well adapted to the natural disturbance regime of the forest which includes tropical storms and hurricanes (Stewart and Woolbright 1996, Woolbright 1996). Despite the abundance of this species across the island, a recent study indicates that populations of *E. coqui* at the highest elevations of the rain forest, commonly known as cloud or dwarf forest, are decreasing (Joglar and Burrowes 1996). Reasons for the decline are difficult to pinpoint. However, speculations range from pharmaceutical contaminants in the atmosphere to increased ultraviolet radiation at these higher elevations.

Data on population dynamics of this and other *Eleutherodactylus* species in the Luquillo Experimental Forest are collected by the wildlife office of the US Forest Service, Caribbean National Forest, Catalina Ranger Station by Ernesto García.

**Reintroduction potential** – High. *Eleutherodactylus coqui* is the most studied species of the genus in Puerto Rico (Stewart and Woolbright 1996, Rivero 1998, Joglar 1999 and references therein). This species habitat and feeding requirements are well documented and should provide guidelines for reintroduction. The Puerto Rican Department of Natural Resources maintains several reserves across the island, but specific habitat requirements and forest management strategies need to be addressed.

**Existence and viability of captive potential** – Moderate. A captive population is currently established at the Buffalo zoo. In addition, breeding populations have been established in at least four higher education institutions: State University of New York, Albany (Margaret Stewart), Sienna College, NY (Lawrence Woolbright), Scranton University, PA (Daniel Townsend), University of Alabama, Birmingham (Scott Michael). No data on genetic diversity of these captive populations is available in the literature. Published guidelines on how to establish and maintain populations of this species exists already (Michael, 1995).

**Scientific and research potential** – High. *Eleutherodactylus coqui* lends itself to serve as a model species for the study of reproductive biology and behavior for arboreal frog species. This species is one of the best studied tropical frogs in the world, and certainly within the genus (see reviews by Narins, 1995; Stewart and Woolbright 1996; Joglar, 1999). The basic knowledge can be applied to the development of specific research objectives of husbandry and captive population management programs.

**Number of other regional captive programs** – *Eleutherodactylus coqui* is currently being captivity reproduced in one North American zoo, Buffalo Zoo and four academic research institutions (see above section: Existence and viability of captive

potential). This species may compete for exhibit space with several neotropical and tropical anurans taxons including (*Dendrobates*, *Hyla* etc.).

**Exhibit value** – Low. The behavior of this species allows for the display of reproductive individuals in a simplistic manner. Brooding males can be easily displayed during egg guarding by providing and positioning bamboo retreat sites, where males maintain and protect their egg clutches. The calling behavior is very dramatic, especially when in chorus behavior (Naris, 1996).

**Husbandry experience** – Moderate to High. Published information (Michaels, 1995) and expertise at various universities (see above) points to a fair amount of knowledge on the husbandry of this species.

**Educational value** – Not suitable for outreach. In North American zoos this keystone species could be used to represent the functioning of a tropical ecosystem food web (Reagan et al. 1996, and references therein). *E. coqui* unique educational value includes courtship calling, internal fertilization, male parental care of the egg clutch, direct development of the embryos, and keystone species status in the food web. This combination of factors is an allure attained by few species.

**Availability of potential founders** – Easy to Acquire. This species is very common to abundant in forest areas, from low to moderately high (900m) in elevation (Woolbright, 1996; Joglar, 1999).

**Taxonomic uniqueness** – Low to Moderate. *Eleutherodactylus coqui* is considered a generalist occurring through out the island of Puerto Rico. However it is a keystone species in the Luquillo Experimental Forest (LEF; Stewart and Woolbright 1996). This is a vital ecological role that supports and maintains the food web of the LEF (Reagan 1996, Reagan et al. 1996). The uniqueness of this species resides on the fact that has internal fertilization, direct embryological development, and male parental care. Any of this conditions is rare among frogs. All occurring in a single species is quite unique.

**Potential of affect in situ conservation of species or ecosystem** – High. The charismatic potential of this species lies beyond its monotonous morphological coloration. *E. coqui* is used as a symbolic representation of the island and the El Yunque Rainforest for the native population, in effect, a flagship species.

#### ATAG RECOMMENDATIONS:

**Management category** – 2-RP

**Primary role and purpose of taxa recommended for captive management-**

Research population – study and develop husbandry criteria for other *Eleutherodactylus* species

Educational population – to demonstrate the various points stated in Educational value section.

**Target population size-** As needed for institutional needs

**ATAG contact-** Jody E. Martin de Camilo, Research Department, Saint Louis Zoo and Saint Louis University. (compiled for Jeff Ettling, St. Louis Zoo, ettling@stlzoo.org)

**Basis for listing and comments-** This species should be used as a surrogate to develop husbandry and management protocols for other *Eleutherodactylus*. Even though this is the most species rich anuran genus, the rate at which species are declining and even going extinct is alarming. *Eleutherodactylus jasperi*, the only viviparous frog species in all of the Neotropics was discovered in 1972, described in 1974 and is believed to have become extinct by 1981. That is less than a decade since its discovery.

**Recommendations-**

Establish captive breeding populations of *E. coqui*.

Develop a literature database on husbandry, reproductive biology, and habitat requirements and make it available via the Internet.

Involve and collaborate with academic research institutions.

Develop educational program describing keystone species and how animal communities organize as food webs.

**References-**

Joglar, R. L. 1999. Los coquíes de Puerto Rico su historia natural y conservación. Editorial de la Universidad de Puerto Rico, San Juan, Puerto Rico.

Joglar, R. L. and P. A. Burrowes. 1996. Declining Amphibian Populations in Puerto Rico, p. 371-380. In R. Powell and R. W. Henderson (eds.), Contributions to West Indian Herpetology: A Tribute to Albert Schwartz. Society for the Study of Amphibians and Reptiles, Ithaca (New York). Contributions to Herpetology, volume 12.

Michael, S. F. 1995. Captive breeding of two species of *Eleutherodactylus* (Anura: Leptodactylidae) from Puerto Rico, with notes on behavior in captivity. Herpetological Review 26 (1):27-28.

Michael, S. F. 1997. Captive breeding of *Eleutherodactylus antillensis* (Anura: Leptodactylidae) from Puerto Rico, with notes on

behavior in captivity. Herpetological Review 28 (3):141-142.

Narins, P.M. 1995. Frog communication. Scientific American 273 (2):78-83.

Reagan, D. P. 1996. The role of amphibians and reptiles in a West Indian rain forest food web. Pp. 217-229 In R. Powell and R. W. Henderson (eds.), Contributions to West Indian Herpetology: A Tribute to Albert Schwartz. Society for the Study of Amphibians and Reptiles, Ithaca (New York). Contributions to Herpetology, volume 12.

Reagan, D. P., Camilo, G. R., and Waide, R. B. 1996. The community food web: Major properties and patterns of organization. In D. P. Reagan and R. B. Waide (eds.) The food web of a tropical rain forest. University of Chicago Press, Chicago, IL.

Rivero, J. A. 1998. Los anfibios y reptiles de Puerto Rico. Segunda edición. Editorial de la Universidad de Puerto Rico.

Stewart M. M. and L. L. Woolbright. 1996. Amphibians. In D. P. Reagan and R. B. Waide (eds.) The food web of a tropical rain forest. University of Chicago Press, Chicago, IL.

Townsend D. S. and M. M. Stewart. 1986. Courtship and mating behavior of a Puerto Rican frog, *Eleutherodactylus coqui*. Herpetologica, 42 (2):165-170.

Townsend D. S. 1989. The consequences of microhabitat choice for male reproductive success in a tropical frog, *Eleutherodactylus coqui*. Herpetologica, 45 (4): 451-458.

Woolbright L. L. 1991. The impact of Hurricane Hugo on forest frogs in Puerto Rico. Biotropica 23 (4a):462-467.

Woolbright L. L. 1996. Disturbance influences long-term population patterns in the Puerto Rican frog, *Eleutherodactylus coqui* (Anura: Leptodactylidae). Biotropica 28 (4a):493-501.

Woolbright L. L. 1997. Local extinctions of anuran amphibians in the Luquillo Experimental Forest of Northeastern Puerto Rico. Journal of Herpetology 31 (4):572-576.

**Leptodactylidae: Mountain Chicken**  
**(*Leptodactylus fallax*)**

**Species Selection Criteria:**

**Conservation status of the taxon -** Data deficient. The species is not listed on the Endangered Species Act (ESA), Convention on International Trade in

Endangered Species of Wild Fauna and Flora (CITES), or the 1996 IUCN Red List of Threatened Animals. This large anuran (max. SVL 167 mm) is only found on the islands of Dominica and Montserrat where it is heavily exploited for food by man. The Montserrat population is currently not threatened by human collection since there is no tourism on the island at present and therefore little or no collecting as it was primarily for the restaurant trade and not local consumption (R. Gibson, personal communication, 2000).

Durrell Wildlife Conservation Trust, Fauna and Flora International and RSPB are partners with the Montserratian Govt. in monitoring the populations of the herps, especially mountain chicken (work which led to the redicover of *Diploglossus montisserati*) and the endemic oriole. This consortium have been working on this project for the past three years or more. FFI staff carried out a detailed survey in 1998/9 and since then there have been quarterly censuses carried out by forestry staff. For details of this work please contact Dr Jenny Daltry at FFI offices in Cambridge UK ([jdaltry@aol.com](mailto:jdaltry@aol.com)) (R. Gibson, personal communication, 2000).

**Reintroduction potential** - Data deficient. An evaluation of the available habitat needs to be conducted.

**Existence and viability of captive populations -**

Low. There are currently 3.8.0 in three North American zoos. An additional 1.3.0 are in the collection of Dr. Godfrey Bourne at the University of Missouri - St. Louis. The animals residing at the Minnesota Zoo and St. Louis Zoo are on loan from Dr. Bourne. These animals all originated from Montserrat. Although foam nests have been produced by the St. Louis group no offspring have yet been produced. Dr. Bourne has successfully propagated them one time in his laboratory, but was only able to raise them to the froglet stage. The species has been propagated in France (Lescure and Letellier, 1983) but there is some doubt as to whether the tadpoles metamorphosed successfully. Durrell Wildlife Preservation Trust (DWPT) as 7.6 Montserratian animals in captivity as of 2000.

**Scientific and research potential** - Moderate/High. Results of any field studies needs to be published to document the status of the population following the volcanic activity of 1997. The animals have a large body size which makes them a good candidate for a radio telemetry based study. However, some observations suggest that the frogs are not far-ranging and radio telemetry would add little to our understanding of its natural history. It has been hypothesized that the form residing on Dominica could be a different species (Bourne, pers. comm.). A study, using molecular data, should be conducted to determine whether the frogs on Dominica and Montserrat are both *Leptodactylus fallax*. Animals at DWPT are available as source material.

**Number of other regional captive programs** – There are three other leptodactylids at Priority 2, *Ceratophys cornuta*, *C. ornata*, and *Eleutherodactylus coqui*. No other leptodactylid in the RCP has the same perceived level of vulnerability of wild populations. Other large anurans such as *Bufo blombergi* and *Conraua goliath* may possibly compete for the same space in zoos.

**Exhibit value** - Moderate. *Leptodactylus fallax* is a nocturnal species which prefers to hide in burrows during the day. Careful planning of the exhibit can provide security for the frogs while making them visible to the zoo visitor. At St. Louis we have mixed large *Anolis* species into our *L. fallax* exhibit. DWPT's animals are visible in broad daylight in the leaf litter provided the enclosure glass is screened with only small slots for visitor viewing

**Husbandry expertise** – Moderate. The zoos which have kept this taxon have found them to be hardy captives. Successful reproduction has not yet occurred in a North American zoo although multiple breedings occurred at DWPT in 2000. DWPT's specimens have several blood-borne parasites. Their specimens tended not to thrive in small spaces (R. Gibson, personal communication, 2000). The diet of tadpoles is unknown and nutritional deficiencies may be expected until this is determined.

**Educational value** – Not suitable for outreach at this point. These frogs can be used to illustrate the vulnerability of island endemics to natural disasters (volcanic eruptions) and over collecting for the food market.

**Availability of potential founders** - Unknown. Possibly good, the 3.11.0 were collected in Montserrat by Dr. Godfrey Bourne. Since he has contacts in that country it may be possible to arrange to collect additional frogs. DWPT has 7.6 Montserratian animals. Until husbandry and propagation parameters are better understood, additional founders are unnecessary.

**Taxonomic uniqueness** - Moderate. The species only occurs on Dominica and Montserrat. Four other species of *Leptodactylus* are found in the West Indies. However, this is a fairly speciose genus ranging widely throughout Latin America.

**Potential to affect *in situ* conservation of species or ecosystem** - Moderate. It is more likely that the oriole or psittacine birds, which occupy the same habitat, would appeal to the zoo visitor as a flagship species for tropical rainforests.

**ATAG RECOMMENDATIONS:**

**Management Category** – 2-RP

**Primary role and purpose of taxa recommended for captive management -**

Research population - Determine status of wild population. Concentrate efforts on reproducing the species in captivity.

**Target population size** - To be determined by TAG; dependent on results of Amphibian space survey.

**ATAG contact** - Jeff Ettling, St. Louis Zoo, ettling@stlzoo.org

**Basis for listing, and comments -**

The current status of *Leptodactylus fallax* on Dominica is unknown and fieldwork on Montserrat is ongoing. The volcanic activity that occurred on Montserrat in 1997 is speculated to have had a devastating affect on the population. In addition, this species is heavily exploited as a food resource by man. Dr. Godfrey Bourne, who has worked with the species both in the wild and captivity, has proposed a reconnaissance trip to Montserrat to evaluate the status of the populations on the island. The St. Louis Zoo staff will be working with Dr. Bourne on a grant proposal to acquire the funding necessary to complete this field survey. However, if DWPT and FFI are actively supporting Montserrat fieldwork, other efforts to fund include determining the taxonomic status of the two populations. The species is hardy and adapts well to captivity, however, reproduction has not yet occurred in a North American zoo. Institutions maintaining this species should focus their efforts on (1) trying to determine the environmental parameters necessary for eliciting reproduction and (2) conditions necessary for successful rearing of tadpoles and froglets.

**Recommendations -**

Prepare and publish TMA (St. Louis Zoo and DWPT). Develop techniques for captive reproduction of *Leptodactylus fallax*.

Support fieldwork to document status of wild populations. Collaborative efforts with European institutions should be sought.

Encourage institutions to develop interpretive graphics illustrating the plight of island endemics

**References -**

Ballie, J. and B. Groombridge (Compiled and Edited). 1996. 1996 IUCN red List of Threatened Animals. The World Conservation Union (IUCN), Gland, Switzerland.

Brooks, G.R., Jr. 1982. An analysis of prey consumed by the anuran, *Leptodactylus fallax*, from Dominica, West Indies. Biotropica 14(4):301-9.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). 1973. United States Department of the Interior, Fish and

Wildlife Service, Arlington, Virginia. Endangered Species Act of 1973. 1973 List of Endangered and Threatened Wildlife and Plants. United States Department of the Interior, Fish and Wildlife Service, Arlington, Virginia.

Heyer, W.R. 1979. Systematics of the *pentadactylus* species group of the frog genus *Leptodactylus* (Amphibia: Leptodactylidae). Smithson. Contr. Zool. (301):1-43.

Lescure, J. 1979. Etude taxonomique et eco-ethologique d'un amphibien des Petites Antilles: *Leptodactylus fallax* Muller, 1926 (Leptodactylidae). Bull. Mus. Natl. Hist. Nat., Paris, 4e ser., 1, sect. A (3):757-74.

Lescure, J., and Letellier, F. 1983. Reproduction en captivite de *Leptodactylus fallax* Muller, 1926 (Amphibia, Leptodactylidae). Rev. fr. Aquariol. 10:61-64.

Schwartz, A., and Henderson, R.W. 1991. Amphibians and Reptiles of the West Indies: Descriptions, Distributions and Natural History. Univ. Florida Press, Gainesville.

**Microhylidae: Duscophinae: Northern Tomato Frog (*Duscophus antongili*)****Species Selection Criterion:**

**Conservation status of the taxon**- Endangered. This is the first amphibian species listed on C.I.T.E.S. (Appendix I) from Madagascar. It is now considered the flagship species for amphibian diversity in that country.

**Reintroduction potential**- Moderate. This species is known to breed in disturbed habitat (Glaw and Vences, 1994), therefore reintroduction efforts should have an excellent chance of success. If the breeding program at Parc Zoologique Ivoloina is successful, a pilot program involving the release of marked captive-raised specimens should be considered.

**Existence and viability of captive populations**- Existence-High Viability-Low. There are presently 29.23.242 specimens reported to ISIS by 30 North American member institutions as of September 1998, 133 of which were bred in captivity that year. Lack of genetic diversity in the captive population continues to be a problem.

**Scientific and research potential**- High. On-going genetic research by Ed Louis at Omaha's Henry Doorly Zoo should clarify this species relationship to the morphologically similar *Duscophus guineti*. As mentioned previously, a mark and recapture study involving captive raised specimens from Parc

Zoologique Ivoloïna could be conducted *in situ*. This species produces toxic skin secretions (Evans and Brodie, 1994), so there is the potential for pharmacological studies.

**Number of other regional captive programs-** No other microhylids are Priority 2 or higher.

**Exhibit value-** High. This is an extremely attractive species that exhibits well as long as hiding places are positioned in a way that allows for public viewing. It has also been successfully exhibited with other Malagasy species of herps, including *Langaha nasuta*, *Chameleo pardalis*, and *Phelsuma madagascariensis*. Smaller anurans, such as *Mantella* sp., are preyed upon.

**Husbandry expertise-** Moderate. This species has been bred with the use of hormones at UC-Berkeley (on three occasions), The Fresno Zoo, The San Antonio Zoo, The Memphis Zoo, and in at least two private collections. The Baltimore Zoo has also bred this species for the last two years, solely through environmental manipulation (Wisnieski, et al., 1997).

**Educational value-** High. This is an excellent Malagasy flagship amphibian species due to its uniqueness, size and brilliant coloration. It is also hardy species that tolerates frequent handling. This makes it an ideal candidate for use in educational outreach programs.

**Availability of potential founders-** Difficult to acquire. Due to its C.I.T.E.S. Appendix I listing, wild caught specimens will be difficult to import. It may be somewhat easier to obtain the necessary permits for captive bred specimens from Parc Zoologique Ivoloïna, if their program is successful. Genetic studies being conducted by Ed Louis should identify any potential founders in North American collections.

**Taxonomic uniqueness-** Low. *Dyscophus antongili* is one of three currently recognized species in this genus of Microhylid frogs, all of which are endemic to Madagascar. Though slight differences in coloration, size of the tympanum, and calls have been reported (Parker, 1934; Glaw and Vences, 1994), to date, Ed Louis has been unable to distinguish between *D. antongili* and *D. guineti* genetically. There are over a hundred microhylids worldwide.

**Potential to affect *in situ* conservation of species or ecosystem-** High. The tomato frog has already been designated as a flagship amphibian by The Madagascar Fauna Group and is featured on their poster of endemic endangered species. An exhibit and related graphics at Parc Zoologique Ivoloïna (funded by The Baltimore Zoo) and ongoing educational programs are helping to enlighten the Malagasy people about this unique endangered anuran.

#### **ATAG Recommendations:**

**Management category-** 2-DERP

**Primary role and purpose of taxa recommended for captive management-** Flagship species to support conservation efforts in Madagascar, educational population to raise awareness of the many factors causing the world-wide decline in amphibian populations, and potentially, genetic reservoir for the supplementation of wild populations.

**Target population size-** 50.50.200

**ATAG contact-** Anthony Wisnieski, Baltimore Zoo, bzherps@aol.com

**Basis for listing and comments-** Due to its demand in the international pet trade (Andreone, 1991) and the rate of deforestation in Madagascar (Glaw and Vences, 1994; Raxworthy, 1988), this flagship species, as currently recognized, is disappearing in the wild and a PMP is warranted. If Ed Louis is unable to distinguish *D. antongili* from *D. guineti*, however, the ATAG will need to readdress their assessment of this taxon.

**Recommendations-** Complete genetic work being conducted by Ed Louis of Omaha's Henry Doorly Zoo to determine if *Dyscophus antongili* and *D. guineti* are distinct at the species level. If so, continue with the DNA analysis to determine lineages and identify any potential founders, publish the studbook, and develop a PMP. Revise the TMA. Acquire additional potential founders, if possible. Continue support for the breeding and education programs at Parc Zoologique Ivoloïna in Madagascar. Replace *D. guineti* with *D. antongili* in zoo exhibition and education collections.

#### **References:**

- Andreone, F. 1991. Conservation aspects of the herpetofauna of Malagasy rain forests. Zoological Society "La Torbiera", Novara, Italy. Scientific Reports n. 1, pp. 14-15.
- Evans, C.M. and E.D. Brodie. 1994. Adhesive strength of amphibian skin secretions. *Journal of Herpetology* 28(4):499-502.
- Glaw, F. and M. Vences. 1994. A Fieldguide to the Amphibians and Reptiles of Madagascar, Second ed. Vences & Glaw Verlags GbR, Koln, pp. 29, 189-196.
- Parker, H.W. 1934. A Monograph of the Frogs of the Family Microhylidae. British Natural History Museum, London, pp. 22-24.
- Raxworthy, C.J. 1988. Reptiles, rainforest, and conservation in Madagascar. *Biological Conservation* 43:181-211.

Wisnieski, A., V. Poole, and E. Anderson. 1997. Conservation Spotlight: Tomato Frogs. Endangered Species Update 14(9&10):17-18.

**Pipidae: Surinam toad (*Pipa pipa*)**

**Species Selection Criterion:**

**Conservation status of the taxon-** This species occurs throughout most of northern and central South America. Little information is available on its status, probably due to the fact it is very well-camouflaged and rarely moves.

**Reintroduction potential-** Not required

**Existence and viability of captive populations** High/Moderate. There are 11.16.181.66 *Pipa pipa* reported in ISIS (September 1998) in 32 institutions.

**Scientific and research potential-** High/ Moderate. *Pipa pipa* have been studied and breed in captivity since at least 1765 (Fermin, 1765). The upside down egg-laying process and the maternal incubation of eggs on the back of the female are unique among the anurans (Rabb, 1960).

**Number of other regional captive programs-** Xenopus may compete with space but *Pipa* can be mixed in fish or caecilian displays.

**Exhibit value-** High/Moderate. This toad is very interesting for a few reasons. They have adapted to an entirely aquatic life having lost their tongues and developed lateral line organs to detect wave motion in water (Cannatella, D., 1995) As well, it is very large and is so dorso-ventrally flattened it appears to have been run over. Females of the genus *Pipa* are unique in that they carry their eggs adhered to their back until they emerge as tadpoles or toadlets. *Pipa pipa*, however are the only ones of this genus to engage in an elaborate breeding ritual (Cannatella, D., 1995) which involves the attached male and female swimming in loops where the falling eggs are caught by the males belly and legs and adhered to the females back.

**Husbandry expertise-** High. They are fully aquatic, can be kept at temperatures of 21-29 C and readily feed off tongs (Burke-Johnson). They can also be kept together with other amphibians i.e. caecilians.

**Educational value-** High. The *Pipa pipa* could accentuate the variety of amphibians in the world and the need to discover and protect them before they disappear. The also highlight unusual feeding and breeding adaptations.

**Availability of potential founders -** Not as readily available as in past and not reliably bred.

**Taxonomic uniqueness -** There is a lot of diversity in larval morphology and ecology of pipids (Cannatella, D., 1995). There are 7 genera in the family Pipidae but only two species of *Pipa*.

**Potential to affect in situ conservation of species of ecosystem-** Low/ Data deficient

**ATAG Recommendations**

**Management Category-** 2-DRP

**Primary role and purpose of taxa recommended for captive management-** Education. Increase public's awareness of amphibian biodiversity and population declines

**Target population size-** 15.15

**ATAG contact-** Bob Johnson, Metrotoronto Zoo, bjohnson@zoo.metrotor.on.ca

**Basis for listing and comments-** Toronto Zoo has completed an internal management plan for *Pipa pipa*. Several zoos have bred *P. pipa* and new data will be collected for a possible TMA. There seems to be a large enough captive population for long term genetic management.

**Recommendations-** Complete TMA to improve breeding success.

**References-**

Fermin, P. 1765. Developpment parfait du mystere de la generation du fameux crapaud de Suriman, nomme *Pipa Maastricht*, Netherlands. [not seen, as quoted in Rabb, 1960]

Rabb, G., Rabb, M., 1960. On the mating and egg-laying behaviour of the Surinam Toad, *Pipa pipa*. Copeia #4 Dec.

Burke-Johnson B., 1991. Management plan for Surinam Toad (*Pipa pipa*). Toronto Zoo

Cannatella, David 1995. <http://www.zo.utexas.edu/research/salientia/pipidae/pipidae.html>

**Ranidae: Solomon Island Eyelash Frog (*Ceratobatrachus guentheri*)**

**Species Selection Criteria:**

**Conservation Status:** Data deficient, but probably not at risk at this time.

**Reintroduction Potential:** Data deficient, but probably Low.

**Existence and Viability of Captive Populations:**

ISIS abstracts (June 1998) list 70 individuals (12.9.49) of this species in 12 AZA institutions. Over 80% of these individuals are captive bred, and many of these are at least partially related. At least 4 institutions have reproduced this species.

**Scientific and Research Potential:** Moderate - The most pressing research involves the identification and elimination of internal parasites, which seem to plague this species heavily, at least in a captive setting. These parasites seem to be very persistent, and do not seem to be gotten rid of easily. Although the husbandry and reproductive parameters have been met successfully, until these parasite problems can be overcome, this species will remain difficult to keep for long periods of time in captivity.

**Number of Other Regional Captive Programs:**

Quite a number of other taxa under the ATAG umbrella utilize the same amount and type of space as this taxon. However, this is a popular species for institutions that want to exhibit and interpret an amphibian that does not go through the traditional route of metamorphosis.

**Exhibit Value:** Moderate to High - This species is found in a series of colors ranging from bright yellow to burnt orange to the more typical tan or brown. It tends to be a bold animal, and seems to exhibit well. It can also be exhibited successfully with other Solomon Island species, such as *Corucia zebrata*.

**Husbandry Expertise:** Moderate - This species has been kept for varying lengths of time by several institutions, and has been bred by at least 4 facilities. However, internal parasite problems plague this species, and no completely successful method has been found to eliminate these parasites. More work needs to be done in this area.

**Educational Value:** Moderate to High. *Ceratobatrachus* can be used as a model of a non-traditional amphibian breeding strategy, as the metamorphosed young hatch directly from the egg, forgoing the traditional aquatic tadpole stage. It can also be used as an example of a "camouflage" amphibian, as many of the color phases are subdued and resemble lichen-like or leaf-like patterns.

**Availability of Potential Founders:** Relatively easy to acquire. These animals still arrive in the U.S. with some frequency, and can be procured at relatively reasonable prices.

**Taxonomic Uniqueness:** Monotypic genus of the family Ranidae. There are several hundred ranids worldwide.

**Potential to Affect In-situ Conservation of Species or Ecosystem:** Data deficient, but probably Low.

**ATAG Recommendations:**

**Management Category:** 2-DRP

**Primary Role and Purpose of Taxa Recommended for Captive Management:** This species can be used as a good exhibit model of a non-traditional mode of reproduction in an amphibian. Protocols need to be developed for the identification and elimination of internal parasites which typically plague this animal.

**Target Population Size:** 20.20.40 (80 total). A population of this size should allow for proper genetic exchange, should the species become well-enough established in a parasite-free (or nearly-so) state.

**ATAG Contact:** Andrew T. Snider, Detroit Zoological Institute, [asnider@detroitzoo.org](mailto:asnider@detroitzoo.org)

**Basis for Listing and Comments:** This species is still being exported from the Solomon Islands in some numbers, and has not traditionally done well long-term in captivity due to heavy infestations of internal parasites. Protocols should be developed for proper deworming of these animals, as well as long-term husbandry and propagation.

**Recommendations:** A TMA has been compiled for the species. Several institutions should make a priority of developing deworming protocols for this taxon, so that a long-term captive population can be established. When this is accomplished, a studbook could be established to better manage the growing population.

**References:**

- Boulenger, B. A. 1884. On the Reptiles and Batrachians of the Solomon Islands. Proc. Zool. Soc., 212. pp. 56-58.
- Brown, W. C. 1952. The Amphibians of the Solomon Islands. Bull. Mus. Comp. Zool. 107 (1): 28-31.
- Brown, W. C., and A.C. Alcalá. 1980. Modes of Reproduction of Philippine Anurans. Advances in Herpetology and Evolutionary Biology. pp. 416-428.
- Duellman, W.C., and L. Trueb. 1986. Biology of Amphibians. McGraw-Hill Book Co., New York
- Gibbons, 1986. The Biogeography and Evolution of Pacific Island Reptiles and Amphibians. Univ. of the South Pacific. pp. 125-142.
- Hediger, H. 1937. Selsame Reptilien und Amphibien der Solomon Inseln. Natur. und Volk. 67: 590-595.
- Kinghorn, J.R. 1928. Herpetology of the Solomon Islands. Records of the Australian Museum 16 (3): 123-178.

Lutz, B. 1947. Trends towards non-aquatic and direct development in frogs. *Copeia* 14: 242-252.

Tyler, M.J. 1976. *Frogs*. William Collings Pty. Ltd., Sydney.

**Ranidae: North American Leopard Frogs, *Rana* spp.**

**Species Selection Criterion:**

**Conservation status of the taxon :** Several species of North American ranids are declining and are considered species of special concern, threatened or endangered at a state level. Others, such as the bullfrog, *Rana catesbeiana*, and the plains leopard frog, *Rana blairi*, have expanded their range and pose threats to endemics.

- California Red-legged Frog, *Rana aurora draytoni*: Listed as Threatened by USFWS and protected in the state of California.
- Foothill Yellow-legged Frog, *Rana boylei*: Not listed by the USFWS or IUCN, but has been declining in many areas of California because of predation from introduced species and is protected at the state level.
- Cascades Leopard Frog, *Rana cascades*: Vulnerable per IUCN. Not listed by USFWS but is protected in California, Oregon, and Washington. IUCN lists this species as Vulnerable (VU A1a by World Conservation Monitoring Centre). A taxon is vulnerable when it is not critically endangered or endangered, but is facing a high risk of extinction in the wild in the medium-term future. Population reduction from a direct observation or reduction of at least 20% over the last 10 years or three generations, whichever is longer. Range of *Rana cascades* slightly overlaps that of *R. pretiosa* complex and *Rana aurora*. Cascades frog ranges from Cascade Mountains from northern Washington to vicinity of Lassen Peak, California, with an isolate population in Butte County in northern Sierra. Additional isolated populations occur in Olympic Mountains, Washington; Mount Shasta and Lassen Peak area, and Trinity Mountains, California.
- Bullfrog, *Rana catesbeiana*: This frog has undergone a significant expansion of its historical range through accidental and deliberate introductions. Unfortunately, these introduced populations of the bullfrog appear to contribute to the decline of several frog species.
- Chiricahua Leopard Frog, *Rana chiracahuensis*: This species is a candidate for federal listing in the USA. A proposed rule is in preparation as of 1999. It's status is unknown in Mexico. Closed season species and listed on Arizona's "Wildlife of Special Concern" list. Not protected in New Mexico. The taxonomy of this species is currently being reviewed (J. E. Platz), and may be divided into two species. The known range of *Rana chiracahuensis* is divisible into two portions. One extends from central Arizona east and south along the Mogollon Rim into western and central New Mexico. The second includes southeastern Arizona, southwestern New Mexico, and in the adjacent Mexican states of Sonora and Chihuahua. In Arizona, the populations along the Mogollon Rim (Gentry Creek drainage) and White Mountains (the "Rim form") are more precarious than populations in southeastern Arizona. However just the opposite is true in New Mexico.
  - Columbian Spotted Frog, *Rana luteiventris*: Not federally listed but the Wasatch Front, West Desert and Great Basin populations in Utah are candidates. Protected in California, Idaho (Great Basin population), Nevada, Oregon, Utah, Washington. *Rana luteiventris* was elevated to species status in a recent review of *Rana pretiosa* populations. *Rana luteiventris* is found in British Columbia, extending into Alaskan panhandle through Rocky Mountains of Canada in Yukon Territory, and Alberta south through eastern / central Washington, Oregon and eastward through Idaho, Nevada, Utah, Montana, and Wyoming. *Rana luteiventris* appears to be a widespread complex of populations which may represent at least three taxa. Populations in Utah and northern Nevada that comprise at least one of these taxa have federal candidate status with USFWS.
  - Mountain Yellow-legged Frog, *Rana muscosa*: Vulnerable per IUCN. Not listed by USFWS but protected in California. Listed as vulnerable by IUCN (VU A1a by World Conservation Monitoring Centre). A taxon is vulnerable when it is not critically endangered or endangered, but is facing a high risk of extinction in the wild in the medium-term future. Population reduction from a direct observation or reduction of at least 20% over the last 10 years or three generations, whichever is longer. Found in scattered sites in Southern California, Sierra Nevada. Panik (1995) considers the species likely extinct in the Carson range in Nevada near Lake Tahoe and in neighboring sites in California. This species has disappeared from more than 99 percent of its historic range in Southern California.
  - Relict Leopard, *Rana onca*: Vulnerable per IUCN. This species has the dubious distinction of being the first North American leopard frog thought to be extinct, only to be re-discovered. Currently this "species" is restricted to the Virgin River drainage of extreme southern Nevada (Lake Mead), northwestern Arizona (Littlefield), and southwest Utah. It is not listed at a federal level but in Arizona it is considered a closed season species and listed on Arizona's "Wildlife of Special Concern" list. *Rana onca* is protected in Nevada and considered "extinct" in

Utah. IUCN lists this species as Vulnerable (VUA1ac, B1 & 2ade by World Conservation Monitoring Centre). A taxon is vulnerable when it is not critically endangered or endangered, but is facing a high risk of extinction in the wild in the medium-term future. Population reduction from a direct observation or reduction of at least 20% over the last 10 years or three generations, whichever is longer. A decline in area of occupancy, extent of occurrence, and or quality of habitat. Extent of occurrence estimated less than 20,000 km<sup>2</sup> or area of occupancy estimated less than 2000 km<sup>2</sup>. Severely fragmented or known to exist at no more than 10 locations. Continuing decline, inferred, observed, or projected in extent of occurrence, number of locations or subpopulations, or number of mature individuals.

- Northern Leopard Frog, *Rana pipiens*: As currently recognized, *Rana pipiens* ranges from Newfoundland and New England across the northern plains and southern boreal forests to the Canadian Rocky Mountains and south across the Great Basin and Colorado Plateau, to the Pacific Coast from California to British Columbia. In Arizona this species occurs in northcentral and northeastern Arizona. In Arizona this species is listed as “Wildlife of Special Concern” and is a closed season species.
- Oregon Spotted Frog, *Rana pretiosa*: Some populations are candidates for federal listing and this species is protected in California, Idaho, Oregon, Utah, Washington. The *Rana pretiosa* complex was recently reevaluated and *R. luteiventris* elevated to full species status. *Rana pretiosa* ranges from south central Washington state, Cascade Mountains of Oregon, northern Nevada, northeastern California, and extreme southwest British Columbia. Scattered remnant populations occur in the Oregon Cascades.
- Ramsey Canyon Leopard Frog, *Rana subaquavocalis*: To preclude federal listing, a conservation agreement was drafted for this species in 1996. Voluntary participants in the conservation team include state and federal agencies, private landowners, and The Phoenix Zoo. In Arizona this is a closed season species and listed on Arizona’s “Wildlife of Special Concern” list. CITES: Not listed. *Rana subaquavocalis* has been reduced to one, possibly three, small breeding populations on the eastern slope of the Huachuca Mountains, in southern Arizona.
- Tarahumara Frog, *Rana tarahumarae*: Not federally listed but in Arizona it is a closed season species and listed as “Wildlife of Special Concern”. In Mexico they are listed as as rare by the Norma Oficial Mexicana (NOM-059-ECOL-1994). Extirpated from Arizona in the early 1980’s. Originally known from six mountain canyons and two mountain ranges, in extreme south-central Arizona. Currently restricted to

scattered populations in the Sierra Madre Occidental and its foothills of Mexican states of Sonora, Sinaloa, and Chihuahua.

**Reintroduction potential** : Data deficient.

Reintroduction programs exist for some Arizona ranids but the programs are too new to be evaluated. In 2000, egg masses were laid by *Rana subaquavocalis* that had been head-started at The Phoenix Zoo and released in previous years.

- California Red-legged Frog, *Rana aurora draytoni*: High. The USFWS is re-evaluating the need to introduce this species into historical habitat.
- Foothill Yellow-legged Frog, *Rana boylei*: Not needed
- Cascades Leopard Frog, *Rana cascades*: Data deficient for this species. No documentation was found on potential or actual population supplementations or reintroductions. Supplementations and reintroductions of ranid species in other states are too recent to evaluate. The receptivity of government agencies, local residents, and regional zoos/aquariums to participate in conservation programs, and, the existence of suitable habitat, is largely unknown.
- Bullfrog, *Rana catesbeiana*: Not Needed. Where introduced populations of bullfrogs are contributing to the decline of indigenous ranids and other fauna, extirpation programs may be needed.
- Chiricahua Leopard Frog, *Rana chiracahuensis*: Moderate. In Arizona Effectiveness of population supplementations, translocations, or reintroductions of the “Rim form” and “southeastern form” are too recent to evaluate. In New Mexico, embryos, larvae, and froglets have also been recently transplanted to a historic locality along the Mimbres River. The success of that has yet to be determined. Additionally, frogs were translocated to a livestock tank in Hidalgo County. Additional translocations of embryos, larvae, or juveniles may occur in the spring of 1999.
- Columbian Spotted Frog, *Rana luteiventris*: Data deficient for these species. No documentation found on previous population supplementations or reintroductions.
- Mountain Yellow-legged Frog, *Rana muscosa*: Data deficient for these species. No documentation found on potential or actual population supplementations or reintroductions found. However, the potential for translocations being discussed. Currently there is no enthusiasm or need for captive-bred or head-started animals for reintroduction or translocation efforts.
- Relict Leopard, *Rana onca*: Low. There is a tentative plan to introduce larvae/frogs to an artificial creek near Boulder City, Nevada. However no other translocations or reintroductions are planned until the taxonomic status of this species is resolved. The existence of

suitable habitat may also be a limiting factor in the recovery of this species.

- Northern Leopard Frog, *Rana pipiens*: Data deficient for this species. No documentation found on potential or actual population supplementations or reintroductions in Arizona. A salvage attempt by Arizona Game and Fish to translocate frogs from a drying tank to another nearby failed. The Phoenix Zoo may head-start embryo masses from the “Heber” locality in the or remove the few remaining frogs to captivity, in partnership with Arizona Game and Fish Department.
- Oregon Spotted Frog, *Rana pretiosa*: Data deficient for these species. One salvage attempt to move larvae from a drying pool to another pond was unsuccessful. No documentation found on previous population supplementations or reintroductions. Translocations of wild origin larvae or frogs, or captive reared animals, have been discussed at least for the state of Oregon. *Rana luteiventris* populations outside of the state of Oregon are at the highest risk.
- Ramsey Canyon Leopard Frog, *Rana subaquavocalis*: Moderate. Population supplementations/ reintroductions have occurred (1995, 1996, 1997, 1999) with reasonable success. Survivorship of captive-reared animals released into the wild is low. However some reproduction by captive-reared frogs has been observed in the wild after three or more years. Many of the surrounding land owners and community members are supportive toward efforts to protect the frogs. Several new ponds are being considered as future release sites, a few at the invitation of private landowners. Metamorphs and larvae may be released to a new locality in the early fall of 2000.
- Tarahumara Frog, *Rana tarahumararum*: Moderate. Suitable habitat remains on federal and state owned land in southern Arizona. Hypotheses of the original decline of this species need to be investigated before reintroductions or captive breeding programs are initiated. Agency support for reintroduction efforts in Arizona are high.

#### Existence and viability of captive populations –

Low. The Arizona ranids are the only ranids for which captive propagation programs have been established. Few zoos display *Rana* frogs other than the bullfrog.

- California Red-legged Frog, *Rana aurora draytoni*: Low. There are 0.0.3 being exhibited at Monterey Bay Aquarium. (ISIS 1998)
- Foothill Yellow-legged Frog, *Rana boylei*: There are none listed in captivity in ISIS(1998) and Slavens (1997).
- Cascades Leopard Frog, *Rana cascades*: No ISIS reporting institution holds this

species. Some animals may be held in non-ISIS reporting institutions (e.g. universities, nature centers, private collectors) for research or exhibition purposes

- Bullfrog, *Rana catesbeiana*: Moderate. Several zoos display bullfrogs or use them in outreach programs.
- Chiricahua Leopard Frog, *Rana chiricahuensis*: Low. The recent edition of ISIS online (September 1998) lists Rio Grande Zoological Park as having 1.0 and The Phoenix Zoo holds 0.0.1. No other reporting institutions or research institutions are known to hold this species. An unknown number of specimens of the southeastern form are maintained in outdoor ponds at several schools in Douglas, Arizona, and in artificial ponds at the San Bernardino National Wildlife Refuge. A small self-sustaining population of the “rim form” is maintained at Grand Canyon University, Phoenix, Arizona.
- Columbian Spotted Frog, *Rana luteiventris*: The recent edition of ISIS online (September 1998) lists no holdings. No other reporting institution holds this species.
- Mountain Yellow-legged Frog, *Rana muscosa*: No reporting institution holds this species, however at least one private herpetoculturist maintains a small, breeding population in California.
- Relict Leopard, *Rana onca*: Low. None are listed on the recent edition of ISIS online (September 1998) or are known to exist in reporting captive facilities. However a small captive population is currently being held by a private party in California
- Northern Leopard Frog, *Rana pipiens*: The recent edition of ISIS online (September 1998) lists the Vancouver Aquarium as having 0.0.3 specimens
- Oregon Spotted Frog, *Rana pretiosa*: The recent edition of ISIS online (September 1998) lists Vancouver Aquarium as having 0.0.2 wild caught animals. No other reporting institution holds this species. Some animals may be held by private herpetoculturists or in residential backyard ponds.
- Ramsey Canyon Leopard Frog, *Rana subaquavocalis*: Low. The recent edition of ISIS online (September 1998) lists The Phoenix Zoo as having 0.0.1 specimen
- Tarahumara Frog, *Rana tarahumararum*: Low.

#### Scientific and research potential : High.

Disappearance of North American ranids was one of the supporting reasons for establishing the IUCN’s Declining Amphibian Population Task Force. In general, leopard frogs are the “white rats” of the amphibian world. Ranids have been used for basic and applied research, and educational purposes. Their amphibious life style makes them ideal indicators of environmental health (e.g., ultraviolet-B levels,

pollution) and are key species to monitor with respect to species diversity of a habitat.

- California Red-legged Frog, *Rana aurora draytoni*: High. There is a need to learn more about the natural history of this species. There are also numerous studies that could be performed that would aid in the captive reproduction and release of this species
- Foothill Yellow-legged Frog, *Rana boylei*: High. This species is currently being studied by the California Game and Parks Department. There have been some studies conducted on the effects of predation on this species as well as land utilization studies, genetic studies, and various diet studies.
- Cascades Leopard Frog, *Rana cascades*: Data Deficient.
- Bullfrog, *Rana catesbeiana*: High. There is an urgent need to create bullfrog control programs that do not impact non-target ranid species.
- Chiricahua Leopard Frog, *Rana chiracahuensis*: High. Currently Dr. J. E. Platz is reviewing this species, to determine whether the “rim” and “southeastern” forms warrant distinct species status. The natural history of both forms is largely undocumented. Studies comparing the mortality of transplanted embryos and various developmental stages are planned.
- Columbian Spotted Frog, *Rana luteiventris*: Data Deficient.
- Mountain Yellow-legged Frog, *Rana muscosa*: Data Deficient.
- Relict Leopard, *Rana onca*: High. Currently the taxonomic relationship of *Rana onca* and *Rana yavapaiensis* is being reviewed by Jaeger et al. (pers. com.).
- Northern Leopard Frog, *Rana pipiens*: Data Deficient.
- Oregon Spotted Frog, *Rana pretiosa*: Data Deficient.
- Ramsey Canyon Leopard Frog, *Rana subaquavocalis*: Moderate. The Ramsey Canyon leopard frog is the most recently described leopard frog in Arizona. Little is known about natural history.
- Tarahumara Frog, *Rana tarahumarae*: High. Relatively little is known about the natural history of this frog, either in Mexico or Arizona. Recently funding has been provided to Mexican and American biologists to continue survey efforts in Sonora, Mexico. Strong interest exists to evaluate the affect of heavy metals on this species in the wild. In the summer of 1999, all known historic localities were surveyed to determine the status of this frog in Mexico.

**Number of other regional captive programs** : The only ranid in the collection plan at this priority is the Solomon Island Eyelash Frog, *Ceratobatrachus*

*guntheri*, at 2-DERP. While North American ranids are listed at 2-DERP, no individual taxon has been singled out at a higher priority than another although some seem ideal candidates for recategorization at a future date if AZA institutions follow the suggestions of this RCP. Institutions are encouraged to work with local species and develop conservation efforts for these species. The Phoenix Zoo and Arizona Sonora Desert Museum have committed to constructing captive breeding facilities for native Arizona amphibians, especially ranids. The Phoenix Zoo has committed rearing space to Ramsey Canyon frog, *Rana subaquavocalis*.

**Exhibit value-** High. When displayed in appropriately themed enclosures, ranid frogs (especially their larvae) make intriguing exhibit subjects. They are best displayed in groups, in exhibits in which visitors can view animals both above and below the water. Since few institutions work with ranids, the local species would be a good candidate as a taxa representative as well as for educational value for declining amphibian populations. For an entertaining yet insightful perspective on exhibiting bullfrogs, read the article “How to exhibit a bullfrog: a bed-time story for zoo men” (Conway, 1968).

- **Husbandry expertise** –Low-High. Although certain institutions (e.g., Phoenix Zoo) are proficient with one or more local taxa, the majority of zoos are lacking in experience with long-term ranid husbandry and propagation. It appears that ranids are relatively easy species to exhibit, propagate, and maintain. A few zoos have successfully bred leopard frogs, indoors and outdoors, without hormone stimulants. The Phoenix Zoo has an embryo mass to metamorph rearing guideline available upon request. Some published literature is available on rearing bullfrogs commercially (Nace). Caution is warranted when extrapolating husbandry protocols from bullfrogs to other ranids.
- California Red-legged Frog, *Rana aurora draytoni*: Low. Currently this species is maintained at one facility.
- Foothill Yellow-legged Frog, *Rana boylei*: Data deficient.
- Cascades Leopard Frog, *Rana cascades*: Data deficient.
- Bullfrog, *Rana catesbeiana*: High. Bullfrogs are hardy and tolerate a wide range of husbandry conditions. Published literature is available on rearing this taxon commercially (Nace).
- Chiricahua Leopard Frog, *Rana chiracahuensis*: High. Staff and students at the Douglas High School, Grand Canyon University, and The Phoenix Zoo have had extensive experience rearing or propagating Chiricahua leopard frogs. This species is seems relatively easy to house, propagate, and maintain in properly designed enclosures. The best breeding

results come from enclosures built outside or inside climate-controlled buildings (i.e. greenhouses). Leopard frogs can be successfully bred, either indoors or outdoors, without hormonal stimulation. An embryo mass to metamorph rearing guideline is available upon request from The Phoenix Zoo.

- Columbian Spotted Frog, *Rana luteiventris*: Low. Only one individual has successfully reared *R. luteiventris* larvae to metamorphosis. However, it is likely the husbandry and propagation this species is similar to other leopard frogs.
- Mountain Yellow-legged Frog, *Rana muscosa*: Low. At least one herpetoculturist has successfully bred this species and a few other have bred leopard frogs.
- Relict Leopard, *Rana onca*: Low. A self-sustaining captive population purportedly exists with a herpetoculturist in California.
- Northern Leopard Frog, *Rana pipiens*: Low. Although this taxon has been used extensively in biomedical research, there has been no cross-pollination” between zoos and the research laboratory vivariums. However is likely the husbandry and propagation of *R. pipiens* is not exceptionally different from montane leopard frogs from the southwestern United States.
- Oregon Spotted Frog, *Rana pretiosa*: Low. At least one or two individuals have successfully reared some larvae to metamorphosis. *Rana pretiosa* may be more sensitive to poor water quality (e.g. nitrate levels, oxygen levels) than other species.
- Ramsey Canyon Leopard Frog, *Rana subaquavocalis*: Moderate to High. The living collections staff at The Phoenix Zoo have extensive experience in rearing Ramsey Canyon leopard frogs from embryo masses. This species is relatively easy to house and maintain in properly designed enclosures. Survivorship rate from egg to metamorph has been as been very high (up to 98%).
- Tarahumara Frog, *Rana tarahumarae*: Data Deficient. It is likely the husbandry and propagation of *Rana tarahumarae* is not exceptionally different from montane leopard frogs from the southwestern United States. Staff at the Arizona Sonora Desert Museum has had some husbandry experience with this species in the past. The Phoenix Zoo has an embryo mass to metamorph rearing guideline for another species available upon request.

**Educational value-** Data Deficient to High. Any North American ranid is a good example of population declines either due to its actual decline or in the case of the North American bullfrog, *Rana catesbeiana*, due to its role in causing decline of other species. The northern leopard frog, *Rana pipiens*, has been an integral part of biomedical research for over 100 years. The North American bullfrog, *Rana*

*catesbeiana*, is a reasonably hardy animal that may be used in outreach programs.

- California Red-legged Frog, *Rana aurora draytoni*: Data Deficient
- Foothill Yellow-legged Frog, *Rana boylei*: Data Deficient
- Cascades Leopard Frog, *Rana cascades*: Data Deficient
- Bullfrog, *Rana catesbeiana*: High. Bullfrogs typically adapt quite well to captivity whether raised from tadpoles or captured as adults. They will tolerate handling for outreach programs and make impressive display animals.
- Chiricahua Leopard Frog, *Rana chiricahuensis*: Data Deficient
- Columbian Spotted Frog, *Rana luteiventris*: Data Deficient
- Mountain Yellow-legged Frog, *Rana muscosa*: Data Deficient
- Relict Leopard, *Rana onca*: Data Deficient
- Northern Leopard Frog, *Rana pipiens*: High. Northern leopard frogs are the “poster children” for amphibian world. Their attractive coloration, intriguing life cycle, and natural history provides a quantity of interpretative/presentation opportunities. When reared from larvae or metamorphs, leopard frogs will tolerate limited handling and remain calm as display animals. The life cycle of leopard frogs is well-known and popular with visitors of all ages.
- Oregon Spotted Frog, *Rana pretiosa*: Data Deficient
- Ramsey Canyon Leopard Frog, *Rana subaquavocalis*: Data Deficient
- Tarahumara Frog, *Rana tarahumarae*: Data Deficient.

**Availability of potential founders-** Difficult to Easy. Typically at least one species of ranid is not protected and readily available locally in most states. Some taxa are protected at the state level but may be obtained with the appropriate permits.

- California Red-legged Frog, *Rana aurora draytoni*: Protected, but could be obtained with the appropriate permits.
- Foothill Yellow-legged Frog, *Rana boylei*: Protected at the state level, but could be obtained with the appropriate permits.
- Cascades Leopard Frog, *Rana cascades*: Difficult to moderate. The potential to obtain founder stock will vary, depending on the collection locality. Founder animals for captive populations are best acquired as embryos or larvae.
- Chiricahua Leopard Frog, *Rana chiricahuensis*: Easy to acquire. Obtaining founder stock should not present a problem, provided AZA Amphibian TAG objectives

support agency efforts. Founder animals for captive populations are best acquired as wild embryos or larvae.

- **Columbian Spotted Frog, *Rana luteiventris*:** Difficult to moderate. Obtaining founder stock will vary, depending on the collection locality. Founder animals for captive populations are best acquired as embryos or larvae, in support of agency or recovery team efforts.
- **Mountain Yellow-legged Frog, *Rana muscosa*:** Obtaining founder stock from a wild locality may be difficult. Wild caught animals for captive populations would be best acquired as embryos or larvae to minimize stress and maximize survivorship. Captive-bred animals may be available from one individual, but are likely inbred and of an unknown locality.
- **Relict Leopard, *Rana onca*:** Difficult to acquire. Obtaining founder stock may be problematic due to taxonomic confusion and low adult numbers. Founder animals for captive populations would probably become available as embryos or larvae, provided AZA Amphibian TAG objectives support agency efforts. A private herpetoculturist in California maintains a small population, but is probably unsuitable as founder stock for other captive populations or reintroduction efforts.
- **Northern Leopard Frog, *Rana pipiens*:** Relatively easy to acquire. Obtaining founder stock from an Arizona locality may be difficult due to low adult numbers and minimal reproductive activity at some localities. Founder animals for captive populations are best acquired as embryos or larvae.
- **Oregon Spotted Frog, *Rana pretiosa*:** Difficult to moderate. Obtaining founder stock will vary, depending on the collection locality. Founder animals for captive populations are best acquired as embryos or larvae, in support of agency or recovery team efforts.
- **Ramsey Canyon Leopard Frog, *Rana subaquavocalis*:** Relatively easy to acquire. Obtaining founder stock should not present a problem, provided AZA Amphibian TAG objectives support agency objectives. Founder animals for captive populations are best acquired as embryos or larvae. Adult numbers are too precarious for establishing captive populations.
- **Tarahumara Frog, *Rana tarahumarae*:** Difficult to acquire. Acquiring founder stock may be more difficult due to field logistics in Mexico and the process required to obtain all permits (Mexican, USFWS, Arizona Game and Fish). However, in cooperation with IMADES (Instituto de Medio Ambiente y el Desarrollo Sustentable de Sonora) in Mexico, the international permitting may be accelerated. Arizona Sonoran Desert Museum had received specimens in 1998. Larvae were collected in summer of 2000 by

USFWS and distributed to several captive facilities.

**Taxonomic uniqueness** – Low. The genus *Rana* contains more than fifty recognized species while Ranidae is a large globally distributed family. However, the status of *Rana subaquavocalis* is being reviewed by Dr. J. E. Platz and N. Benedict. Although a member of the *Rana* genus, *Rana tarahumarae* are not considered leopard frogs. Little is known about natural history of this species or its role in the ecosystem.

**Potential to affect in situ conservation of species or ecosystem** – Moderate-High. Leopard frogs are well recognized and can serve as the “poster children” for the amphibian world. Most zoo visitors can identify a leopard frog, based on a childhood experience in the field or at a school laboratory.

- **California Red-legged Frog, *Rana aurora draytoni*:** Moderate. This species is listed as threatened and is an excellent example of declining amphibian populations from introduced non-native species as well as from over collecting.
- **Foothill Yellow-legged Frog, *Rana boylei*:** Moderate. This species would be an excellent example of declining amphibian populations from predation of introduced species.
- **Cascades Leopard Frog, *Rana cascades*:** Moderate.
- **Chiricahua Leopard Frog, *Rana chiricahuensis*:** Moderate.
- **Columbian Spotted Frog, *Rana luteiventris*:** Moderate
- **Mountain Yellow-legged Frog, *Rana muscosa*:** Moderate
- **Relict Leopard, *Rana onca*:** Moderate.
- **Northern Leopard Frog, *Rana pipiens*:** Moderate. Its widespread use in biomedical research may help attract funding for preserving wild populations and to develop captive management facilities.
- **Oregon Spotted Frog, *Rana pretiosa*:** Moderate. *Rana pretiosa* is the only warm water specialist amphibian in the Pacific Northwest. Its potential to affect conservation efforts of other species or ecosystems may be significant.
- **Ramsey Canyon Leopard Frog, *Rana subaquavocalis*:** High. This species was already the subject of a management agreement to help protect the habitat of the wild populations. Zoos can help bring attention to the affect of groundwater pumping, exotic pests, and fragmentation of habitat on this species.
- **Tarahumara Frog, *Rana tarahumarae*:** Moderate. Zoos can help bring attention to the affect of groundwater pumping, exotic pests, and fragmentation of habitat on this species.

**ATAG Recommendations:**

**Management Category**-All North American *Rana* sp. are recommended for management at Priority 2-DERP. However, institutions are encouraged to work with regional species and to develop a regional management approach for these species. Institutions outside the native range for a given taxa may choose to participate with that taxa but the ATAG strongly encourages that this participation supplement work done with regional species.

**Primary role and purpose of taxa recommended for captive management-**

1° Education population – local species may be used to illustrate declining amphibian story  
 2° Research population – Improve husbandry techniques as springboard for more intensive captive conservation programs.

**Target population size-** As needed to meet institutional needs.

**ATAG Contact-**

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- Foothill Yellow-legged Frog, *Rana boylei*: Diane Callaway, Henry Doorly Zoo, dianec@omahazoo.com
- Cascades Leopard Frog, *Rana cascades*: Mike Demlong, Arizona Game and Fish Commission, mdemlong@gf.state.az.us
- Bullfrog, *Rana catesbeiana*: Kevin Wright, Phoenix Zoo, kwright@thepxzoo.com
- Chiricahua Leopard Frog, *Rana chiracahuensis*: Mike Demlong, Arizona Game and Fish Commission, mdemlong@gf.state.az.us
- Columbian Spotted Frog, *Rana luteiventris*: Mike Demlong, Arizona Game and Fish Commission, mdemlong@gf.state.az.us
- Mountain Yellow-legged Frog, *Rana muscosa*: Mike Demlong, Arizona Game and Fish Commission, mdemlong@gf.state.az.us
- Relict Leopard, *Rana onca*: Mike Demlong, Arizona Game and Fish Commission, mdemlong@gf.state.az.us
- Northern Leopard Frog, *Rana pipiens*: Kevin Wright, The Phoenix Zoo, kwright@thepxzoo.com
- Oregon Spotted Frog, *Rana pretiosa*: Mike Demlong, Arizona Game and Fish Commission, mdemlong@gf.state.az.us
- Ramsey Canyon Leopard Frog, *Rana subaquavocalis*: Mike Demlong, Arizona Game and Fish Commission, mdemlong@gf.state.az.us and Kevin Wright, the Phoenix Zoo, kwright@thepxzoo.com
- Tarahumara Frog, *Rana tarahumarae*: Mike Demlong, Arizona Game and Fish Commission, mdemlong@gf.state.az.us

**Basis for listing and comments-** Ranid frogs are one of the most widely recognized frogs in North America. Ranid frogs are natural “springboards” for educational efforts about amphibian biology and natural history due in part to their long-term use in biomedical research and the likelihood that guests have seen one in the wild. Many species in the United States have undergone precipitous declines in the past 20 years and may be in need of intensive recovery efforts. However few zoos have made an effort to work collaboratively with state and federal agencies with their local ranids. Ranid husbandry is poorly understood and zoos must make an effort to increase their knowledge of ranid captive management and propagation as a background for assisting recovery programs. Rather than pick a single taxon for the RCP, the Amphibian TAG considers all North American ranids as good candidates for category 2-DERP. However, most individual species evaluations have been listed under category 5-II since the choice of species for an institution depends on the locally available taxa and the individual institution’s goals.

- California Red-legged Frog, *Rana aurora draytoni*: This species is an excellent candidate for use as an educational tool. (There is some evidence that heavy exploitation of the red-legged frog for food harvest before 1900 was more than the population could withstand, and could have been the reason for the introduction of bullfrogs, *Rana catesbeiana*.) Populations of this species continue to decline in the wild and there may be a need for a captive component to their conservation. The USFWS is currently revisiting the recovery plan for this species and there is a possibility of re-establishing some populations where they have been eradicated. Los Angeles Zoo has expressed an interest in pursuing a captive management program with the USFWS. (Personal conversation with USFWS officer, Ina Pisani. March 1999.)
- Foothill Yellow-legged Frog, *Rana boylei*: This species would be an excellent candidate to be used as an educational tool regionally within the western US. At this time the California Department of Fish and Game does not foresee a need for a captive breeding program and is in the beginning stages of writing a recovery plan for this species. (Personal conversation with Regional field officer, Betsy Bolster, Mar. 1999.)
- Cascades Leopard Frog, *Rana cascades*: Although many populations have disappeared or have been fragmented, there is currently no need to manage this species in captivity.
- Bullfrog, *Rana catesbeiana*: The bullfrog is exceptionally hardy and may be highly recommended for outreach programs. However, control of introduced populations of bullfrogs should be a high priority for managing this taxon.

- Chiricahua Leopard Frog, *Rana chiracahuensis*: Current efforts (e.g. translocations, head-starting larvae, exotic species removal) to protect this species *in situ* are important first steps. However the continuing threat of exotic species, habitat degradation, and natural population fluctuations could change the need for captive reared animals instantaneously.
- Columbian Spotted Frog, *Rana luteiventris*: Many populations have disappeared or have been severely fragmented throughout its range.
- Mountain Yellow-legged Frog, *Rana muscosa*: Preliminary discussions with agency biologists involved in recovery efforts suggest no current need, or interest, in using captive bred animals for recovery efforts.
- Relict Leopard, *Rana onca*: Until the taxonomy of this species is better defined, no captive efforts are recommended. However the continuing threat of habitat degradation or loss, natural population fluctuations, and exotic species could instantaneously change the need to establish an *in situ* population or captive-reared animals instantaneously. If the planned reintroduction is realized, head-started larvae or froglets may be needed.
- Northern Leopard Frog, *Rana pipiens*: For reasons unknown, *R. pipiens* has been extirpated from most historic localities in Arizona or reduced to small populations with no recruitment. Preliminary discussions with agency biologists from the Navajo Nation and Arizona Game and Fish Department suggest the potential need of captive propagation in the near future.
- Oregon Spotted Frog, *Rana pretiosa*: Many populations have disappeared or have been severely fragmented throughout its range. Currently The Oregon Zoo is investigating partnering with the state wildlife agency and biologists to reintroduce head-started or captive reared frogs to historic Oregon localities.
- Ramsey Canyon Leopard Frog, *Rana subaquavocalis*: Current efforts (e.g. head-starting larvae, habitat modification, exotic species removal) to protect this species *in situ* are critical conservation measures. Once the relationships of the three existing populations are determined, additional head-started or captive-reared animals would be immediately needed to strengthen reintroduction efforts.
- Tarahumara Frog, *Rana tarahumarae*: Although frog has been extirpated from the United States, minimal efforts may be necessary to re-establish populations in southern Arizona. Government and NGO's on both sides of the border are supportive of the project and suitable habitat remains. A captive population should be established with the goal to provide animals for reintroduction efforts.

#### Recommendations:

Institutions should commit to displaying at least one local *Rana* sp. in their collection and should develop off-exhibit husbandry programs for at least one local *Rana* sp. to increase expertise for future recovery efforts. Institutions (especially those within the range of a taxon) should develop partnerships or otherwise support the efforts of agencies involved in the preservation of this species or its ecosystem. Potential roles of captive facilities include head-starting embryo masses, propagation of animals for reintroduction/supplementation, technology sharing (e.g. veterinary care), removal of exotic predatory species from ecosystems, habitat modification, population monitoring, and conservation management planning.

Since introduced populations of the bullfrog, *Rana catesbeiana*, have been implicated in the decline of ranid frogs zoos are encouraged to provide financial support to build *in situ* bullfrog barriers around the most threatened localities.

The ATAG should consider writing a letter of support to any facility that wishes to work with rare species of *Rana* in the future. Attempts to acquire any taxon and develop husbandry expertise should not be discouraged.

Ramsey Canyon frog, *Rana subaquavocalis*: After the taxonomic status of the existing populations becomes clearer, identify three or four institutions interested in head-starting larvae for wild releases or maintaining a small refugium of adults. Once the interagency recovery team has completed a new conservation management plan, this taxon should be re-evaluated by the ATAG for elevation to Priority I-PMP. If this is ratified, a PMP should be initiated and plans to establish a captive population finalized.

Tarahumarae frog, *Rana tarahumarae*: Establish a list of institutions interested in participating in captive population or willing to head-start embryo masses for reintroduction efforts. Once the interagency recovery team has completed a new conservation management plan, this taxon should be re-evaluated by the ATAG for elevation to Priority I-PMP. If this is ratified, a PMP should be initiated and plans to establish a captive population finalized.

#### References-

California Red-legged Frog, *Rana aurora draytoni*

Hayes, M. and Jennings, M. 1988. Habitat Correlates of Distribution of the California Red-legged Frog (*Rana aurora draytonii*) and the Foothill Yellow-legged frog (*Rana boylei*): Implications for Management. US Forest Service General Technical Report RM 166, November:p144-158.

- Jennings, M.R., and Hayes, M.P., 1985. Overharvest of California USA Red-legged Frogs (*Rana aurora draytonii*) the Inducement for Bullfrog (*Rana catesbeiana*). *Herpetologica* 41(1):94-103.
- Foothill Yellow-legged Frog, *Rana boylei*:
- Hayes, M. and Jennings, M. 1988. Habitat Correlates of Distribution of the California Red-legged Frog (*Rana aurora draytonii*) and the Foothill Yellow-legged frog (*Rana boylei*): Implications for Management. US Forest Service General Technical Report RM 166, November:p144-158.
- Kunferberg, Sara J. 1997. Bullfrog (*Rana catesbeiana*) invasion of a California River: The Role of Larval Competition. *Ecology* (Washington DC) 78(6):1736-1751.
- Kunferberg, Sara J. 1997. Facilitation of periphyton production by tadpole grazing: Functional differences between species. *Freshwater Biology* 37(2):427-439.
- Kupferberg, Sara J. 1996. Hydrologic and geomorphic factors affecting conservation of a river-breeding frog (*Rana boylei*). *Ecological Applications* 6(4):1332-1344.
- Post, T. and Uzzell T., 1981. The relationships of *Rana-Sylvatica* and the monophyly of the *Rana-Boylei* group. *Systematic Zoology* 30(2):170-180.
- Cascades Leopard Frog, *Rana cascades*:
- Conway, W. G. 1968. How to exhibit a bullfrog: a bed-time story for zoo men. *Curator* II (4): 310-318.
- Culley, D. D. 1991. Production of aquatic animals. Crustaceans, molluscs, amphibians, and reptiles. Chapter 12: Bullfrog culture. C.E. Nash, editor. Elsevier Science Publishers B.V., New York. Pages185-205.
- Fernandez, P. J. 1996. A facility for captive propagation of Chiricahua leopard frogs (*Rana chiricahuensis*). *Advances in Herpetoculture*: 7-12.
- Nace, G. W. 19xx. Breeding amphibians in captivity. *Breeding endangered species in captivity*. 44-50.
- Nace, G. W. 1968. The amphibian facility of the University of Michigan. *Bioscience*, 18 (8): 767-775.
- Stebbins, R. C. 1985. A field guide to western reptiles and amphibians. Houghton Mifflin Company, New York.
- Unknown. The DAPTF Fieldwork Code of Practice. United Kingdom.
- Unknown. 1995. Guidelines for re-introductions. IUCN (The World Conservation Union) Re-introduction Specialist Group Species Survival Commission.
- Chiricahua Leopard Frog, *Rana chiracahuensis*:
- Arizona Game and Fish Department, In prep. Wildlife of special concern in Arizona. Nongame and Endangered Wildlife Program, Arizona Game and Fish Department, Phoenix, Arizona.
- Conway, W. G. 1968. How to exhibit a bullfrog: a bed-time story for zoo men. *Curator* II (4): 310-318.
- Culley, D. D. 1991. Production of aquatic animals. Crustaceans, molluscs, amphibians, and reptiles. Chapter 12: Bullfrog culture. C.E. Nash, editor. Elsevier Science Publishers B.V., New York. Pages185-205.
- Fernandez, P. J. 1996. A facility for captive propagation of Chiricahua leopard frogs (*Rana chiricahuensis*). *Advances in Herpetoculture*: 7-12.
- Nace, G. W. 19xx. Breeding amphibians in captivity. *Breeding endangered species in captivity*. 44-50.
- Nace, G. W. 1968. The amphibian facility of the University of Michigan. *Bioscience*, 18 (8): 767-775.
- Platz, J. E. and J. S. Mecham. 1979. *Rana chiricahuensis*, a new species of leopard frog (*Rana pipens* Complex) from Arizona.
- Sredl, M. J., editor. 1997. Ranid frog conservation and management. Nongame and endangered wildlife program technical report 121. Arizona Game and Fish Department, Phoenix, Arizona.
- Stebbins, R. C. 1985. A field guide to western reptiles and amphibians. Houghton Mifflin Company, New York.
- Unknown. The DAPTF Fieldwork Code of Practice. United Kingdom.

- Unknown. 1995. Guidelines for re-introductions. IUCN (The World Conservation Union) Re-introduction Specialist Group Species Survival Commission.
- Columbian Spotted Frog, *Rana luteiventris*:
- Conway, W. G. 1968. How to exhibit a bullfrog: a bed-time story for zoo men. Curator II (4): 310-318.
- Culley, D. D. 1991. Production of aquatic animals. Crustaceans, molluscs, amphibians, and reptiles. Chapter 12: Bullfrog culture. C.E. Nash, editor. Elsevier Science Publishers B.V., New York. Pages 185-205.
- Fernandez, P. J. 1996. A facility for captive propagation of Chiricahua leopard frogs (*Rana chiricahuensis*). Advances in Herpetoculture: 7-12.
- Green, D. M., T. F. Sharbel, J. Kearsley, and H. Kaiser 1996. Postglacial range fluctuation, genetic subdivision and speciation in the western North American spotted frog complex, *Rana pretiosa*. Evolution, 50(1): 374-390.
- Green, D. M., H. Kaiser, T. F. Sharbel, J. Kearsley, and K. R. McAllister. 1997. Cryptic species of spotted frogs, *Rana pretiosa* complex, in western North America. Copeia 1997(1): 1-8.
- HCA/CS Development Team 1995. Spotted frog (*Rana pretiosa*). Habitat conservation assessment (HCA) and Conservation Strategy (CS). (Draft) Idaho Department of Fish and Game, I.D. of P. & R. Bureau of Land Management, U.S. Forest Service, and U.S. Fish and Wildlife Service.
- Nace, G. W. 19xx. Breeding amphibians in captivity. Breeding endangered species in captivity. 44-50.
- Nace, G. W. 1968. The amphibian facility of the University of Michigan. Bioscience, 18 (8): 767-775.
- Stebbins, R. C. 1985. A field guide to western reptiles and amphibians. Houghton Mifflin Company, New York.
- Unknown. 1996. Information sheet on the spotted frog (*Rana pretiosa*). Oregon Department of Fish and Wildlife: Sensitive, Threatened, and Endangered Vertebrates of Oregon.
- Unknown. The DAPTF Fieldwork Code of Practice. United Kingdom.
- Unknown. 1995. Guidelines for re-introductions. IUCN (The World Conservation Union) Re-introduction Specialist Group Species Survival Commission.
- Wilkinson, T. 1996. Utah ushers its frogs toward oblivion. High Country News, V28, N10, May 27, 1996.
- Mountain Yellow-legged Frog, *Rana muscosa*:
- Conway, W. G. 1968. How to exhibit a bullfrog: a bed-time story for zoo men. Curator II (4): 310-318.
- Culley, D. D. 1991. Production of aquatic animals. Crustaceans, molluscs, amphibians, and reptiles. Chapter 12: Bullfrog culture. C.E. Nash, editor. Elsevier Science Publishers B.V., New York. Pages 185-205.
- Fernandez, P. J. 1996. A facility for captive propagation of Chiricahua leopard frogs (*Rana chiricahuensis*). Advances in Herpetoculture: 7-12.
- Nace, G. W. 19xx. Breeding amphibians in captivity. Breeding endangered species in captivity. 44-50.
- Nace, G. W. 1968. The amphibian facility of the University of Michigan. Bioscience, 18 (8): 767-775.
- Panik, H. R. 1995. An ecological survey of the mountain yellow-legged frog (*Rana muscosa*) in Nevada. Nevada Division of Wildlife.
- Stebbins, R. C. 1985. A field guide to western reptiles and amphibians. Houghton Mifflin Company, New York.
- Unknown. The DAPTF Fieldwork Code of Practice. United Kingdom.
- Unknown. 1995. Guidelines for re-introductions. IUCN (The World Conservation Union) Re-introduction Specialist Group Species Survival Commission.
- Relict Leopard, *Rana onca*:
- Arizona Game and Fish Department, In prep. Wildlife of special concern in Arizona. Nongame and Endangered Wildlife

- Program, Arizona Game and Fish Department, Phoenix, Arizona.
- Conway, W. G. 1968. How to exhibit a bullfrog: a bedtime story for zoo men. *Curator* II (4): 310-318.
- Culley, D. D. 1991. Production of aquatic animals. Crustaceans, molluscs, amphibians, and reptiles. Chapter 12: Bullfrog culture. C.E. Nash, editor. Elsevier Science Publishers B.V., New York. Pages 185-205.
- Fernandez, P. J. 1996. A facility for captive propagation of Chiricahua leopard frogs (*Rana chiricahuensis*). *Advances in Herpetoculture*: 7-12.
- Jaeger, J. 1999. Abstract from "Current research in the herpetofauna of the Sonoran Desert". Phoenix, Arizona.
- Nace, G. W. 19xx. Breeding amphibians in captivity. *Breeding endangered species in captivity*. 44-50.
- Nace, G. W. 1968. The amphibian facility of the University of Michigan. *Bioscience*, 18 (8): 767-775.
- Platz, J. E. and J. S. Mecham. 1979. *Rana chiricahuensis*, a new species of leopard frog (*Rana pipiens* Complex) from Arizona.
- Sredl, M. J., editor. 1997. Ranid frog conservation and management. Nongame and endangered wildlife program technical report 121. Arizona Game and Fish Department, Phoenix, Arizona.
- Stebbins, R. C. 1985. A field guide to western reptiles and amphibians. Houghton Mifflin Company, New York.
- Unknown. The DAPTF Fieldwork Code of Practice. United Kingdom.
- Unknown. 1995. Guidelines for re-introductions. IUCN (The World Conservation Union) Re-introduction Specialist Group Species Survival Commission.
- Northern Leopard Frog, *Rana pipiens*:
- Arizona Game and Fish Department, In prep. Wildlife of special concern in Arizona. Nongame and Endangered Wildlife Program, Arizona Game and Fish Department, Phoenix, Arizona.
- Conway, W. G. 1968. How to exhibit a bullfrog: a bed-time story for zoo men. *Curator* II (4): 310-318.
- Culley, D. D. 1991. Production of aquatic animals. Crustaceans, molluscs, amphibians, and reptiles. Chapter 12: Bullfrog culture. C.E. Nash, editor. Elsevier Science Publishers B.V., New York. Pages 185-205.
- Fernandez, P. J. 1996. A facility for captive propagation of Chiricahua leopard frogs (*Rana chiricahuensis*). *Advances in Herpetoculture*: 7-12.
- Meyer, J. and D. Mikesic. 1998. The status of amphibians in the Chuska Mountains of the Navajo Nation (New Mexico and Arizona): a preliminary assessment. Abstracts of the fourth annual meeting of the southwestern United States working group of the declining amphibian populations task force. Phoenix, Arizona.
- Nace, G. W. 19xx. Breeding amphibians in captivity. *Breeding endangered species in captivity*. 44-50.
- Nace, G. W. 1968. The amphibian facility of the University of Michigan. *Bioscience*, 18 (8): 767-775.
- Sredl, M. J., editor. 1997. Ranid frog conservation and management. Nongame and endangered wildlife program technical report 121. Arizona Game and Fish Department, Phoenix, Arizona.
- Stebbins, R. C. 1985. A field guide to western reptiles and amphibians. Houghton Mifflin Company, New York.
- Unknown. The DAPTF Fieldwork Code of Practice. United Kingdom.
- Unknown. 1995. Guidelines for re-introductions. IUCN (The World Conservation Union) Re-introduction Specialist Group Species Survival Commission.
- Oregon Spotted Frog, *Rana pretiosa*:
- Conway, W. G. 1968. How to exhibit a bullfrog: a bed-time story for zoo men. *Curator* II (4): 310-318.
- Culley, D. D. 1991. Production of aquatic animals. Crustaceans, molluscs, amphibians, and reptiles. Chapter 12: Bullfrog culture. C.E. Nash, editor. Elsevier Science Publishers B.V., New York. Pages 185-205.

- Fernandez, P. J. 1996. A facility for captive propagation of Chiricahua leopard frogs (*Rana chiricahuensis*). *Advances in Herpetoculture*: 7-12.
- Green, D. M., T. F. Sharbel, J. Kearsley, and H. Kaiser 1996. Postglacial range fluctuation, genetic subdivision and speciation in the western North American spotted frog complex, *Rana pretiosa*. *Evolution*, 50(1): 374-390.
- Green, D. M., H. Kaiser, T. F. Sharbel, J. Kearsley, and K. R. McAllister. 1997. Cryptic species of spotted frogs, *Rana pretiosa* complex, in western North America. *Copeia* 1997(1): 1-8.
- HCA/CS Development Team 1995. Spotted frog (*Rana pretiosa*). Habitat conservation assessment (HCA) and Conservation Strategy (CS). (Draft) Idaho Department of Fish and Game, I.D. of P. & R. Bureau of Land Management, U.S. Forest Service, and U.S. Fish and Wildlife Service.
- Jennings and Hayes (1994)
- Nace, G. W. 19xx. Breeding amphibians in captivity. *Breeding endangered species in captivity*. 44-50.
- Nace, G. W. 1968. The amphibian facility of the University of Michigan. *Bioscience*, 18 (8): 767-775.
- Stebbins, R. C. 1985. A field guide to western reptiles and amphibians. Houghton Mifflin Company, New York.
- Unknown. 1996. Information sheet on the spotted frog (*Rana pretiosa*). Oregon Department of Fish and Wildlife: Sensitive, Threatened, and Endangered Vertebrates of Oregon.
- Unknown. The DAPTF Fieldwork Code of Practice. United Kingdom.
- Unknown. 1995. Guidelines for re-introductions. IUCN (The World Conservation Union) Re-introduction Specialist Group Species Survival Commission.
- Wilkinson, T. 1996. Utah ushers its frogs toward oblivion. *High Country News*, V28, N10, May 27, 1996.
- Arizona Game and Fish Department, *In prep*. Wildlife of special concern in Arizona. Nongame and Endangered Wildlife Program, Arizona Game and Fish Department, Phoenix, Arizona.
- Conway, W. G. 1968. How to exhibit a bullfrog: a bed-time story for zoo men. *Curator* II (4): 310-318.
- Culley, D. D. 1991. Production of aquatic animals. Crustaceans, molluscs, amphibians, and reptiles. Chapter 12: Bullfrog culture. C.E. Nash, editor. Elsevier Science Publishers B.V., New York. Pages 185-205.
- Demlong, M. J. 1997. Head-starting *Rana subaquavocalis* in captivity. *Reptiles* 5: 24-33.
- Nace, G. W. 19xx. Breeding amphibians in captivity. *Breeding endangered species in captivity*. 44-50.
- Nace, G. W. 1968. The amphibian facility of the University of Michigan. *Bioscience*, 18 (8): 767-775.
- Fernandez, P. J. 1996. A facility for captive propagation of Chiricahua leopard frogs (*Rana chiricahuensis*). *Advances in Herpetoculture*: 7-12.
- Platz, J. E. 1993. *Rana subaquavocalis*, a remarkable new species of leopard frog (*Rana pipiens* complex) from southeastern Arizona that calls under water. *J. Herp.* 27: 154-162.
- Platz, J. E. 1995. *Rana subaquavocalis*: conservation assessment/conservation strategy. Final draft to The Nature Conservancy.
- Sredl, M. J., editor. 1997. Ranid frog conservation and management. Nongame and endangered wildlife program technical report 121. Arizona Game and Fish Department, Phoenix, Arizona.
- Stebbins, R. C. 1985. A field guide to western reptiles and amphibians. Houghton Mifflin Company, New York.
- Unknown. The DAPTF Fieldwork Code of Practice. United Kingdom.
- Unknown. 1995. Guidelines for re-introductions. IUCN (The World Conservation Union) Re-introduction Specialist Group Species Survival Commission.
- Ramsey Canyon Leopard Frog, *Rana subaquavocalis*:

- U.S. Fish and Wildlife Service 1997. Final draft Ramsey Canyon Leopard Frog Conservation Agreement. July 16, 1996.
- Tarahumara Frog, *Rana tarahumarae*:
- Arizona Game and Fish Department, *In prep*. Wildlife of special concern in Arizona. Nongame and Endangered Wildlife Program, Arizona Game and Fish Department, Phoenix, Arizona.
- Conway, W. G. 1968. How to exhibit a bullfrog: a bedtime story for zoo men. Curator II (4): 310-318.
- Culley, D. D. 1991. Production of aquatic animals. Crustaceans, molluscs, amphibians, and reptiles. Chapter 12: Bullfrog culture. C.E. Nash, editor. Elsevier Science Publishers B.V., New York. Pages 185-205.
- Hale, S., G. M. Ferguson, P. A. Holm, and E. B. Wart. 1998. Re-survey of selected Tarahumara Frog (*Rana tarahumarae*) localities in northern Sonora, Mexico, in May 1998. A report submitted to The Arizona Zoological Society and The Tarahumara Frog Conservation Team.
- Fernandez, P. J. 1996. A facility for captive propagation of Chiricahua leopard frogs (*Rana chiricahuensis*). Advances in Herpetoculture: 7-12.
- Nace, G. W. 19xx. Breeding amphibians in captivity. Breeding endangered species in captivity. 44-50.
- Nace, G. W. 1968. The amphibian facility of the University of Michigan. Bioscience, 18 (8): 767-775.
- Sredl, M. J., editor. 1997. Ranid frog conservation and management. Nongame and endangered wildlife program technical report 121. Arizona Game and Fish Department, Phoenix, Arizona.
- Stebbins, R. C. 1985. A field guide to western reptiles and amphibians. Houghton Mifflin Company, New York.
- Tarahumara Frog Conservation Team. 1995. Conservation plan for the Tarahumara frog, *Rana tarahumarae*. July 1995.
- Unknown. The DAPTF Fieldwork Code of Practice. United Kingdom.
- Unknown. 1995. Guidelines for re-introductions. IUCN (The World Conservation Union) Re-introduction Specialist Group Species Survival Commission.

### **Priority 3-POP Taxa**

**This category is not used by the Amphibian TAG.**

Other TAGs have used this category for taxa that do not meet the TAG's priorities and occupy space that is needed for other taxa. POP taxa may represent surrogate species that have been well studied and are due to be replaced with species meeting TAG priorities. However, given the current state of amphibian husbandry the Amphibian TAG does not consider any taxa to meet this categorization. This decision may be revisited in future editions of the collection plan if advances in husbandry and institutional support of amphibian conservation suggests that the attention given certain taxa are interfering with efforts for Priority 1 or Priority 2 taxa. If this happens, then Priority 5-II will be revisited since some taxa may indeed become "not recommended" by the ATAG. If a taxon is reclassified into Priority 3-POP, the ATAG supports the disposition of surplus 3-POP specimens to qualified non-AZA institutions and individuals. All 3-POP taxa will have a replacement taxon indicated in the RCP. For example, before the southern tomato frog, *Dyscophus guineti*, is classified as 3-POP, there must be enough northern tomato frogs, *Dyscophus antongili*, available for institutions to replace their current holdings of *D. guineti* with *D. antongili*. In the event that there are not enough specimens of an appropriate species to allow substitution, a proposed 3-POP taxon will remain classified as category 5-II.

**Priority 4-PIP Taxa****Gymnophiona- Caecilians****Caudata- Salamanders**

Ambystomatidae: Flatwoods salamander, *Ambystoma cingulatum*

**Anura- Frogs**

Atelopidae: Panamanian golden frog, *Atelopus zeteki*

Bufoidea: Kihansi spray toad, *Nectophrynoides asperigus*

**Ambystomatidae: Flatwoods Salamander**  
**(*Ambystoma cingulatum*)****Species Selection Criterion:**

**Conservation status of the taxon** – USFWS proposed listing *Ambystoma cingulatum* as a threatened species in the Federal Register Vol. 62.24 (17 Dec 1997). The Florida Committee on Rare and Endangered Plants and Animals considers *A. cingulatum* as “rare” (Ashton, 1992). This species has a limited range and limited distribution within apparently viable habitat. Paul Moler believes this species will be listed as federally threatened by the summer of 1999 (personal communication, 1999).

**Reintroduction potential** – Data deficient. Federal landholdings of suitable habitat with viable populations of *Ambystoma cingulatum* are found in Florida, Georgia and South Carolina. Federal landholdings in Florida include the Apalachicola National Forest, Osceola National Forest, St. Mark National Wildlife Refuge, and Eglin Air Force Base with a state landholding in Pine Log State Forest. Other federal landholdings include Fort Stewart Military Installation and Townsend Bombing Range in Georgia and Francis Marion National Forest in South Carolina. Over half of the known populations of *Ambystoma cingulatum* occur on private land. Individuals have a large home range (1500 m<sup>2</sup>), and may move up to 1.7 km to breeding ponds

**Existence and viability of captive populations** – Data deficient. No *Ambystoma cingulatum* were reported in Dec 1997 ISIS.

**Scientific and research potential** – High. *Ambystoma cingulatum* is currently under threat from existing silvicultural practices and there is no information available for what constitutes an appropriate “safe zone” or minimal viable population. Paul Moler (personal communication, 1999) places a high priority on protecting the non-breeding habitat for the survival of this taxa. Husbandry research with multigenerational breeding may answer some questions as to viability of a reintroduction program as well as to answer certain basic natural history information. Given the low number of salamander taxa that have exploited similar habitat, *A. cingulatum* may provide unique opportunities for physiological studies.

**Number of other regional captive programs** – *Ambystoma cingulatum* would compete for space with other terrestrial temperate salamanders and possibly temperate anurans.

**Exhibit value** – Data deficient. Typically ambystomatids are reclusive and fossorial as adults hence the common name “mole salamanders”. However, there is some expertise in displaying salamanders at a variety of institutions. *A. opacum*

exhibited well at the Philadelphia Zoo, and it is likely that *A. cingulatum* would be readily visible in a suitably designed enclosure.

**Husbandry expertise** – Moderate. Philadelphia Zoo has reared and successfully reproduced the marbled salamander, *Ambystoma opacum*, which has a similar natural history to *A. cingulatum*. It is likely that techniques developed for captive management of *A. opacum* will translate into success for *A. cingulatum*. Based on the experience with *A. opacum*, captive populations would be best established from wild-collected eggs or larvae rather than adult *A. cingulatum*.

**Educational value** – In addition to promoting the value of salamanders, this taxa could be incorporated into educational programs that promote responsible silviculture and land management, pinewoods and cypress ecosystems, threats of introduced fish (since it requires ponds without large predatory fish), etc.

**Availability of potential founders** – Data deficient. It should be easy to collect egg masses from known sites, but this may become complicated if federal or state listings become enacted.

**Taxonomic uniqueness** – High. *Ambystoma cingulatum* is one of two ambystomatids that is a terrestrial breeder with a fall laying cycle. It has the smallest distribution of the ambystomatids in the United States, and occupies a specialized and rapidly diminishing habitat.

**Potential to affect *in situ* conservation of species or ecosystem** – High. *Ambystoma cingulatum* is an exceptionally attractive salamander that is quite photogenic. It could be promoted as a flagship species for pine flatwoods and wiregrass communities with adjoining cypress heads and responsible agricultural (silvicultural) practices.

#### **ATAG Recommendations:**

**Management Category** – 4-PIP

**Primary role and purpose of taxa recommended for captive management** –

Role: Research population. Purpose: Develop husbandry and breeding program for this terrestrial-breeding species.

Role: Genetic reservoir. Purpose: Long term maintenance of genetic variation for supplementation of the wild population.

Role: Flagship species. Purpose: Generate attention for responsible silviculture practices and wetland management.

**Target population size** – 20.20.40

**ATAG contact** – Kevin Wright, The Phoenix Zoo, kwright@thephxzoo.com

**Basis for listing and comments** – *Ambystoma cingulatum* is one of two species of ambystomatids that is a terrestrial breeder (the other being the marbled salamander, *Ambystoma opacum*). *A. cingulatum* is restricted to pine flatwoods and the majority of its natural habitat, longleaf pine woods, has been replaced by cultured pine timberlands. *A. cingulatum* is considered threatened or rare where it occurs, and is a candidate species for federal listing. Due to its unusual reproductive strategy, its restricted range and the rate of destruction of its preferred habitat, it is considered a priority species for ATAG members.

**Recommendations** – Pilot programs to develop captive populations of *A. cingulatum* are strongly encouraged, and uplisting to Priority I or Priority II should be considered as ATAG members begin to work with this species in their institutions.

Support fieldwork to document the requirements for a viable population that includes breeding and non-breeding habitats.

Support listing as a threatened or endangered species at federal and state levels. It is highly unlikely that silvicultural practices will be changed to protect this species without governmental oversight and legislation. Specific effort should be targeted toward the Department of Defense, USFWS and US Forest Service to evaluate adverse impact of current management practices on *Ambystoma cingulatum* populations within Federal lands.

Public education and preservation of suitable remaining habitat are high priorities.

#### **References** –

Aston, R.E. Jr., 1992. Flatwoods salamander, *in* Mohler, P.E. (Ed.): Rare and Endangered Biota of Florida. Volume III. Amphibians and Reptiles. University Press of Florida, Gainesville, FL, pp. 39-43.

Federal Register Vol. 62.24 (17 Dec 1997), pp. 65787-65794.

**Atelopidae: Panamanian golden frog (*Atelopus zeteki*)**

#### **Species Selection Criteria:**

**Conservation status of the taxon** - Under the name *Atelopus varius zeteki*, this species has CITES Appendix I protection status since 1 July, 1975 and under the U.S.A Endangered Species Act, it has been listed as endangered since 14 June, 1976.. This

Panamanian endemic is endangered from habitat destruction, over-collection by the local human population, and is currently in line of a southeastern advancing fungal epizootic that has both eliminated other *Atelopus* species and extirpated many populations of other *Atelopus* species in Costa Rica and Panama. (Linguist, pers.comm.; Lotters 1996; Lips 1998; Halliday 1998; Berger et al. 1998). Over the past five years, Dr. Eric Linguist has observed a continual rate of deforestation in Panama. Some populations do exist in a national park. (Omar Torrijos National Park, El Cope region) However, these populations are also threatened by siltation from logging in unprotected areas near the park.

**Reintroduction potential** - High. Localities with populations that are extirpated by a passing fungal epizootic may be candidates as future release sites if the pathogen is no longer detected at the site. It should be noted that captive reared *A. varius* did not produce tetrodotoxin although other defensive skin secretions were present. (Daly et al. 1997)

**Existence and viability of captive populations** - None are currently held in captivity. A research proposal by Dr. Linguist will request that a group will be collected from sites already badly damaged by logging activities and in the direct path of the southern advancing fungal epizootic. Dr. Linguist estimates that at the current rates of advancement, the Chytrid (fungal pathogen) epizootic will reach the El Cope region in four years. This project is totally dependent on the approval of the proposal and will require field support by supporting institutions.

**Scientific and research potential** - Much research is needed on Atelopines. *A. zeteki*, an earless frog, has been the subject of communication studies. (Linguist 1995, 1996) Skin toxins are also of interest to researchers. (Daly 1998; Brown et al. 1977)

**Number of other regional captive programs** - N.A.

**Exhibit value** -High. This is a bright, aposematically colored, diurnal species.

**Husbandry Expertise** - Low. The National Aquarium in Baltimore currently has three specimens of *Atelopus varius*, a closely related species. These were obtained from a captive hatching on 1 March, 1992. Some expertise was acquired by raising a small group of *A. varius* from a spawning that occurred in a shipping bag in transit from Panama on 21 February, 1992.

In the past, *A. zeteki* egg laying and hatching occurred in captivity at the Bronx Zoo. However, the larvae did not survive. (K. Zippel, pers. comm.)

Dr. Linguist has temperature and humidity data at field sites in Panama for a seven month period. A task force would be needed to be formed to recommend

equipment, diet, etc. to duplicate the natural environment as closely as possible prior to the import of specimens.

**Educational Value** - High. This culturally significant and high profile, colorful species could serve as an excellent "poster-child" to bring attention to the declining amphibian phenomenon. Holding a group in captivity, while more research (causes and solutions) is conducted on the decline syndrome could be a significant conservation tool.

**Availability of potential founders** - Difficult to acquire. The sole source of specimens would be through a permit request from Dr. Linguist, who has conducted research on *A. zeteki* for the past several years and is known by the Panamanian permit authorities. He feels relatively confident about getting a permit to export and has been issued permits to export *A. zeteki* in the past, but did not utilize them. Dr. Linguist feels that the most difficult group to collect in numbers is adult females, which arrive at the breeding streams, spawn, and then depart for parts unknown. He suggests collecting a combination of adults, juveniles, and possibly tadpoles. Due to the current El Nino / La Nina weather patterns that have disrupted normal breeding cycles in the wild, Dr. Linguist suggests that no collecting be attempted until the year 2000.

**Taxonomic uniqueness** - Moderate. The toad genus *Atelopus* is the second largest genus of the family Bufonidae. Sixty-six species have been described (Lotters 1996) with several species now believed extinct. Atelopines live at mid to high elevations and most are stream breeders. They have toxic skins and exhibit aposematic coloration.

**Potential to affect *in situ* conservation of species or ecosystem** - High. For reasons stated previously.

#### ATAG Recommendations:

**Management category** - 4-PIP with upgrade to 2-DERP or 1-PMP when specimens are imported.

**Primary role and purpose of taxa recommended for captive management** - Genetic reservoir for possible reintroduction and/or supplementation of the wild population.

**Target population size** - unknown

**ATAG contact** - Kevin Zippel, Detroit Zoo, kzippe@detroitzoo.org

**Basis for listing and comments**- Due to the continued population declines, extirpations and extinctions of other *Atelopus* species, a request for assistance from a *A. zeteki* field researcher (E. Linguist and P. Ibanez) a captive holding and possible reintroduction plan may be a tool to ensure the long-

term survival of *A. zeteki*. This project has a strong field component and supports a high profile species. The main challenge is the lack of expertise both for long-term captive maintenance and breeding for this species. To be successful, participating institutions will have to invest appropriate resources to maintain this relatively delicate species in captivity. Without this investment, the possibility of a high profile species becoming a high profile failure is greater.

#### Recommendations -

- Assign an ATAG member to spearhead a task force, a small group of ATAG members with prior *Atelopus* experience or resources that will best match the task. Columbus Zoo has already financially supported Dr. Linquist and supplied field assistants that are currently working on a stream enclosure project in Panama.
- Develop a plan of action that includes funding proposals coordinated by Kevin Zippel and Anthony Wisnieski
- Work with Dr. Linquist to develop a proposal for submission to the Panamanian government.

#### References -

Berger, L.; R. Speare; P. Daszak; D.E. Green; A.A. Cunningham; C.L. Goggin; R. Slocombe; M.A. Ragan; A.D. Hyatt; K.R. McDonald; H.B. Hines; K.R. Lips; G. Marantelli; and H. Parkes. 1998. Chytridiomycosis causes amphibian mortality associated with population declines in the rain forests of Australia and Central America. *Proc. Nat. Acad. Sci. U.S.A.* 95: 9031-7.

Brown, George B.; Kim, Yong H.; Kuntzel, Heiner; Mosher, Harry S.; Fuhrman, Geraldine J. And Fuhrman, Frederick A. 1977. Chemistry and Pharmacology of Skin Toxins from the Frog *Atelopus zeteki* / Atelopidotoxin: Zetekitoxin. *Toxicon*; 15(2): 115-128.

Daly, J.; Padgett, W., Saunders, R.; and J. Cover Jr. 1997. Absence of terodotoxins in captive raised riparian frog. *Atelopus varius*, *Toxicon* 35: 705-709.

Halliday, T. 1998. A declining amphibian conundrum. *Nature* 394: 418(2)

Lindquist, Erik D. 1995 *Atelopus zeteki* (Panamanian Golden Frog). Pure tonal vocalization. *Herpetol. Rev.*; 26(4):200-201.

Lindquist, Erik D.; Hetherington, Thomas E. 1996. Field studies on visual and acoustic signaling in the "earless" Panamanian golden frog, *Atelopus zeteki*. *J. Herpetol.*; 30(3): 347-354.

Lips, K.R. 1998. Decline of a tropical montane amphibian fauna. *Cons. Biol.* 12: 106-117.

Lotter, S. 1996. **The neotropical toad genus *Atelopus*, checklist - biology - distribution.**

**M. Vences and F. Glaw Verlags GbR, Koln, Germany, 143 pp.**

Pounds, J. And M. Crump. 1994. Amphibian declines and climate disturbance: The case of the golden toad and the harlequin frog. *Conserv. Biol.*, 8: 72-75.

#### **Bufoidea: Kihansi spray toad (*Nectophrynoides asperginis*)**

##### **Species Selection Criteria**

**Conservation status of the taxon :** Listed as a CITES I species (along with all others in the genus). Due to the construction of a river dam, should be considered Endangered. It is restricted to the Kihansi River Gorge in Tanzania.

**Reintroduction potential :** Data deficient. If suitable spray zone regions can be found after the construction of the dam, reintroduction potential is probably Moderate to High.

**Existence and Viability of Captive Populations :** There are currently no specimens of any species of *Nectophrynoides* in captivity in the U.S. However, permits are currently being sought for the importation of a group of 100 individuals for holding and breeding purposes.

**Scientific and Research Potential – High.** Very little is known about this small toad, which was only described to science in 1998. It is endemic to spray zones within the Kihansi River Gorge and, as such, will undoubtedly be heavily impacted by the hydroelectric dam being built in the area. The proposed importation is considered a "rescue effort," and was considered at the request of the Tanzanian government. It is hoped that captive efforts will result in the production of progeny which can be introduced to suitable habitats within the region. All imported animals and their progeny will remain the property of the Tanzanian government.

**Number of Other Regional Captive Programs :** Although a number of other bufoidea are already a part of the RCP of the Amphibian TAG, this species should be considered for inclusion due to its precarious situation in the wild. Its small size (max. size approximately 2 cm) and habit of existing in dense colonies in the wild seems to suggest that a captive program would have a reasonable chance of success.

**Exhibit Value :** Probably Low. This animal is quite small and cryptically colored. Although not yet kept in captivity, it can be expected that it would remain rather shy and retiring by nature, and probably would not exhibit well.

**Husbandry Expertise – Low.** This species (or others

within the genus *Nectophrynoides*) has not yet been kept in captivity. Many other bufonids have been kept and reproduced very successfully, however. Artificial misting and fogging MAY be necessary for the successful husbandry of the species, due to its spray-zone habitat in the wild.

**Educational Value :** Low. Due to its probable difficulty in exhibitry, this species should be considered for off-exhibit husbandry and reproductive work. Its importation as a “rescue” species bodes well for possible articles to be written by the local media. It is not suitable for outreach programs.

**Availability of Potential Founders :** After the initial importation, this species’ habitat will be altered to such a degree that it may be functionally extinct in the wild. Therefore, it is imperative that this importation includes enough potential founders for good genetic variation to be maintained for several generations.

**Taxonomic Uniqueness :** Not Unique. The genus *Nectophrynoides* contains several species, and the family Bufonidae is large and diverse.

**Potential to Affect In-situ Conservation of Species or Ecosystem :** Probably Low. This species is being imported to the U.S. as a hedge against extinction in the wild due to ongoing habitat alteration. Although the government of Tanzania does not wish to see this, or any other, species go extinct, they are not willing to put a halt on building the hydroelectric dam that threatens to convert this species’ habitat to a drier, less humid environment.

#### ATAG Recommendations:

**Management Category –** 4-PIP

#### **Primary Role and Purpose of Taxa Recommended for Captive Management:**

**Role: Genetic Reservoir-** This species has the real potential of becoming extinct in the wild within the next 12-18 months, due to the construction of a hydroelectric dam. A captive reservoir would allow the possibility of introducing this species to nearby areas in Tanzania that could adequately support a population.

**Role: Husbandry/Propagation Research -** This genus has not been previously kept in captivity in the U.S., and valuable data concerning its behavior and breeding strategies could be gleaned from a captive population.

**Target Population Size :** 50.50.100 (200 total). Because of its small size, a population this size could easily be maintained in captivity.

**ATAG Contact :** Andy Snider and Kevin Zippel, Detroit Zoo, [asnider@detroitzoo.org](mailto:asnider@detroitzoo.org) or [kzippel@detroitzoo.org](mailto:kzippel@detroitzoo.org)

**Basis for Listing and Comments :** One of the principal roles of the Amphibian Taxon Advisory Group of the AZA is to help populations of amphibians. *Nectophrynoides asperginis* is a small toad in trouble...and is very likely to disappear from the wild within the next 12-18 months. Without a back-up captive population, this animal which was only described to science in 1998 may well become extinct due to the construction of a hydroelectric dam within its valley home range. Permits are currently being acquired which would allow the importation to the U.S. of a large group of these toads from which, it is hoped, captive-bred progeny can someday be returned to suitable habitat within the Kihansi River Gorge in Tanzania.

Because of its extremely limited range and potential for rapid extinction in the wild, it is recommended to establish a captive population as soon as possible. As soon as reproduction is accomplished, a studbook and PMP should be put in place to assure proper genetic management of the captive population.

**Recommendations :** Import/Export permits still need to be acquired to allow the export from Tanzania and the import to the United States. This process is now underway. All incoming animals will initially be housed at the National Amphibian Conservation Center at the Detroit Zoological Institute. Three to four other institutions will be sought to take groups of 20-25 toads each for holding and breeding. All animals and their progeny will remain the property of the Tanzanian government. After successful reproduction has commenced, it is recommended that a regional studbook and PMP be completed to track the genetics of this group.

#### **References :**

- Cordeiro, N.J., J.C. Lovett, J. Taplin, and J.H. Gerstle 1999. Ecology of the Kihansi spray toad. unknown document, Pp. A1-A12.
- Gerstle, J.H., S.L. Mhavelle, and J. Lindemark (?). Environmental aspects of the lower Kihansi hydropower project, Tanzania. 8 pages total
- Lovett, J.C., J. Hatton, L.B. Mwasumbi, and J.H. Gerstle 1997. Assessment of the impact of the lower Kihansi hydropower project on the forests of Kihansi Gorge, Tanzania. *Biodiversity and Conservation* 6: 915-933.
- Poynton, J.C., K.M. Howell, B.T. Clarke, and J.C. Lovett 1998. A critically endangered new species of *Nectophrynoides* (Anura: Bufonidae) from the Kihansi Gorge, Udzungwa Mountains, Tanzania. *African Journal of Herpetology*, 47 (2): 59-67.

**Priority 5-II Taxa****Gymnophiona : Caecilians**

Caecilidae: West African caecilian, *Geotrypetes seraphini*

Caecilidae: Sao Tome caecilian, *Schistosometopus thomense*

Ichthyophiidae: Koh Ta caecilian, *Ichthyophis kohtaoensis*

Rhinatremitidae

Scolecomorphidae

Uraeotyphlidae

Pelodytidae: Parsely frogs, *Pelodytes punctuatus*, *Pelodytes caucasicus*

Pipidae: Table Mountain clawed frog, *Xenopus gilli*

Ranidae: Goliath frog, *Conraua goliath*

Rhinodermatidae: Darwin's frogs, *Rhinoderma* sp.

Rhinophrynidae: Mexican burrowing toad *Rhinophrynus dorsalis*

Sooglossidae: Seychelle frogs

**Caudata : Salamanders**

Ambystomatidae: Streamside salamander, *Ambystoma barbouri*

Amphiumidae: One-toed amphiuma, *Amphium pholeter*

Cryptobranchidae: Chinese giant salamander, *Andrias davidianus*

Cryptobranchidae: Japanese giant salamander, *Andrias japonicus*

Dicamptodontidae: Pacific giant salamanders

Hynobiidae: Asian salamanders

Plethodontidae: Green salamander, *Aneides aneus*

Plethodontidae: Giant palm salamander, *Bolitoglossa dofleini*

Rhyacotritonidae: Torrent salamanders

Salamandridae: Ryuku Island newt, *Echinotriton andersoni*

Salamandridae: Crater Lake salamander, *Taricha granulosa mazamae*

Sirenidae: Greater siren, *Siren lacertina*

**Anura : Frogs**

Allophrynidae: Ruthven's frog, *Allophryne ruthveni*

Arthroleptidae: African frogs

Ascaphidae: North American tailed frog, *Ascaphus truei*

Brachycephalidae: Golden toads

Bufoidea: Blomberg's toad, *Bufo blombergi*

Bufoidea: Cameroon eyelash toad, *Bufo superciliaris*

Bufoidea: North American toads, *Bufo* sp. (*canorus*, *exsul*, *houstonensis*, *microscaphus californicus*, *nelsoni*)

Centrolenidae: Glass frogs

Heleophryinidae: Ghost frogs

Hemisotidae: Shovel-nosed frogs

Hylidae: Blanchard's cricket frog, *Acris crepitans blanchardi*

Hylidae: Leaf frogs, *Agalychnis* spp.

Hylidae: Crowned tree frog, *Anothea spinosa*

Hylidae: Marsupial tree frog, *Gastrotheca* spp.

Hylidae: Casque-headed tree frog, *Tripion* spp.

Leiopelmatidae: New Zealand tailed frogs

Leptodactylidae: Endangered and threatened robber frogs, *Eleutherodactylus* spp.

Microhylidae: North American narrowmouth toads, *Gastrophryne* spp.

Pelobatidae: North American spadefoot toads,

*Scaphiophus* spp.

**Caeciliidae : Caecilinae: West African caecilian  
(*Geotryptes seraphini*)**

**Species Selection Criterion:**

**Conservation status of the taxon** – Data Deficient. This species is found in forests on the west coast of Africa. Although population densities are unknown, caecilians have undergone local extirpations in many areas, and concern has been expressed that several species are seriously endangered or extinct (personal communication, Marvalee Wake, 1997),.

**Reintroduction potential** – Data deficient.

**Existence and viability of captive populations** – Data deficient. There are at least 20 individuals in AZA institutions. Additional founder animals would be needed for the population to be considered viable for long-term management.

**Scientific and research potential** – High. Almost every aspect of captive behavior, physiology and natural history remain unknown for all caecilians. Key husbandry questions remain, among those are the composition of soil most appropriate for burrowing in captivity (Ducey, et al., 1993).

**Number of other regional captive programs** – There are three other terrestrial caecilians, *Dermophis mexicanus*, *Schistosometopum thomense*, and *Ichthyophis kohtaoensis*, in captive collections that have similar housing requirements and may compete with *Geotryptes seraphini* for space in captive collections. However, *G. seraphini* prefers temperatures about 5-10°F cooler than *D. mexicanus* or *S. thomense*, and may not be suitable for some institutions.

**Exhibit value** – Data Deficient. *Geotryptes seraphini* is a dark grey with lavender rings and is of more slender build than *Dermophis mexicanus*. Philadelphia Zoo has not attempted to display any specimens, but this taxon appears to be more reclusive than *Dermophis mexicanus* and less tolerant of moderate to high light levels.

**Husbandry expertise** – Moderate. Earthworms and other annelids worms are a primary food source. The materials to house this taxon are readily available. It prefers cool temperatures, 70-76°F, and low light levels.

**Educational value** – Data Deficient. There are too few *Geotryptes seraphini* in captivity for their incorporation into outreach programs, but they may be popular if captive propagation programs are successful.

**Availability of potential founders** – Difficult to Acquire. Institutions may be able to acquire animals

through their own efforts rather than rely on animal importers, but it is likely to be a costly venture.

**Taxonomic uniqueness** – Low.

**Potential to affect *in situ* conservation of species or ecosystem** – Low.

**ATAG Recommendations:**

**Management Category** – 5-II

**ATAG contact** – Kevin Wright, The Phoenix Zoo, kwright@thephxzoo.com

**Basis for listing and comments** – The captive population needs more founders for long-term genetic management should it be deemed necessary, but lack of experience with the taxon precludes speculation on the long-term viability of a captive breeding program. This viviparous terrestrial caecilian offers many avenues for research. *Geotryptes seraphini* competes for space with three other taxa of caecilians currently in collections but needs cooler environments than the other taxa. The taxon is relatively hardy to maintain but institutions should gain experience with *Dermophis mexicanus* prior to acquiring *Geotryptes seraphini*. This taxon is irregularly available and additional founders are needed. The genus is restricted to Africa.

**Recommendations** – Attempts to acquire this species and develop husbandry expertise should not be discouraged. An effort should be made to acquire additional founders and manage captive population appropriately. Upgrade to studbook population if additional institutions acquire specimens. Continue research into husbandry. Try to develop liaison with academic institutions holding specimens. Support fieldwork to assess wild populations and current threats to their survival.

**References** –

Ducey, P.K., D.R. Formanowicz, Jr., L. Boyet, J. Mailloux, and R.A. Nussbaum. 1993. Experimental examination of burrowing behavior in caecilians (Amphibia: Gymnophiona): effects of soil compaction on burrowing ability of four species. *Herpetologica* 49(4):450-457.

O'Reilly, J., D. Fenolio and M. Ready. 1995. Limbless amphibians: Caecilians. *The Vivarium* 7(1): 26-54.

Taylor, E.H. 1968. *The Caecilians of the World*. University of Kansas Press, Lawrence, KS.

Wake, M.H. 1977. The reproductive biology of caecilians: an evolutionary perspective, in S. Guttman and D. Taylor, (eds.): *Reproductive Biology of the Amphibian*, Plenum Press, New York, NY. pp. 73-102.

Wake, M.H. 1994. Caecilians (Amphibia: Gymnophiona) in captivity, in J.B. Murphy, K. Adler and J.T. Collins (eds.): Captive Management and Conservation of Amphibians and Reptiles. Society for the Study of Amphibians and Reptiles, St. Louis, MO. pp. 223-228.

**Caeciliidae : Caeciliinae: Sao Tome caecilian**  
**(*Schistosometopum thomense*)**

**Species Selection Criterion:**

**Conservation status of the taxon** – Data Deficient. This insular species is found only on two small islands off the west coast of Africa. Although population densities are unknown, like all insular species it is vulnerable to cataclysmic events such as hurricanes, droughts, etc. Caecilians have undergone local extirpations in many areas, and concern has been expressed that several species are seriously endangered or extinct (personal communication, Marvalee Wake, 1997),

**Reintroduction potential** – Data deficient.

**Existence and viability of captive populations** – Data deficient. There are 0.0.9 juvenile *Schistosometopum thomense* held at the Philadelphia Zoo (November, 1998). An unknown number are in academic institutions but are not available to ATAG institutions. Additional founder animals would be needed for the population to be considered viable for long-term management.

**Scientific and research potential** – High. Almost every aspect of captive behavior, physiology and natural history remain unknown for all caecilians. There are few insular caecilians, and these may present different challenges for conservation than those taxa that are not restricted to small land masses. This genus is irregularly distributed across Africa, but whether this represent geophysical limits to colonization or lack of voucher specimens from intervening regions is unknown (Taylor, 1968). Key husbandry questions remain, among those are the composition of soil most appropriate for burrowing in captivity (Ducey, et al., 1993).

**Number of other regional captive programs** – There are three other terrestrial caecilians, *Dermophis mexicanus*, *Geotryptes seraphini*, and *Ichthyophis kohtaoensis*, in captive collections that have similar housing requirements and may compete with *Schistosometopum thomense* for space in captive collections.

**Exhibit value** – Data Deficient. *Schistosometopum thomense* is a brilliant saffron animal, but of more slender build than *Dermophis mexicanus*. Philadelphia Zoo has not attempted to display any

specimens, but this taxon appears to be more reclusive than *Dermophis mexicanus* and less tolerant of moderate to high light levels.

**Husbandry expertise** – Moderate. *Schistosometopum thomense* has been bred multiple generations in captivity at academic institutions (O'Reilly and Ready, 1995; Wake, 1994), but a compilation of the husbandry data has not been published. Earthworms and other annelids worms are a primary food source. The materials to house this taxon are readily available. It prefers warm temperatures, 80-84°F, and low light levels.

**Educational value** – Data Deficient. The vibrant color of this caecilian will enhance its appeal. There are too few *Schistosometopum thomense* in captivity for their incorporation into outreach programs, but they may be popular if captive propagation programs are successful.

**Availability of potential founders** – Difficult to Acquire. Exportation from Sao Tomé requires special permits. The animals acquired by Philadelphia Zoo in 1998 were the first exports to wholesalers in several years, and there has been no commitment for additional exports. Institutions may be able to acquire animals through their own efforts rather than rely on animal importers, but it is likely to be a costly venture.

**Taxonomic uniqueness** – Low. *Schistosometopum thomense* occupies the most restricted range of its genus, and has one of the smallest ranges of any Caeciliinae.

**Potential to affect *in situ* conservation of species or ecosystem** – *Schistosometopum thomense* has the potential to serve as a “flagship” species for insular amphibians and for West African vertebrates in general. Sao Tomé is a relatively wealthy African nation that has recognized that it cannot grow enough food to support its population. It has turned increasingly to technology-based industries, such as telecommunications, for income (cite talk at Int. Herp. Expo, Orlando, FL). There is the potential to develop the caecilian as a “flagship” species for creating conservation strongholds on the island.

**ATAG Recommendations:**

**Management Category** – 5-II

**ATAG contact** – Kevin Wright, The Phoenix Zoo, kwright@thephxzoo.com

**Basis for listing and comments** – The Sao Tome caecilian, *Schistosometopum thomense*, is a viviparous terrestrial caecilian that is restricted to the islands of Sao Tome and Il Principe. As an insular species, it is subject to the same risks of endangerment and extinction as other taxa inhabiting small oceanic islands. It is one of the few caecilians that is brightly

colored, ranging from a golden yellow to a fluorescent orange, and may serve as a flagship species for the caecilians. The captive population needs more founders for long-term genetic management should it be deemed necessary, but lack of experience with the taxon precludes speculation on the long-term viability of a captive breeding program. This viviparous terrestrial caecilian offers many avenues for research. *Schistosometopum thomense* competes for space with three other taxa of caecilians currently in collections, but is probably most in need of a captive management program. The taxon is relatively hardy to maintain, but institutions should gain experience with *Dermophis mexicanus* prior to acquiring *Schistosometopum thomense*. This taxon is difficult to acquire, and additional founders are needed. The genus *Schistosometopum* is patchily distributed across Africa, and requires further work to determine whether this is a zoogeographic phenomenon or simply reflects a lack of data. Although it is unlikely to have the same appeal as charismatic megavertebrates, this colorful caecilian may serve as a flagship taxa for insular amphibian fauna, West African amphibians, soil conservation programs and sustainable agricultural practices.

**Recommendations** – Attempts to acquire this species and develop husbandry expertise should not be discouraged. If possible, additional founders should be acquired. Upgrade to studbook (PMP) population if additional institutions acquire specimens. Try to develop liaison with academic institutions holding specimens. Explore options for fieldwork in Sao Tomé to determine cultural attitudes towards conservation. Support fieldwork to assess wild populations and current threats to their survival.

#### References –

- Ducey, P.K., D.R. Formanowicz, Jr., L. Boyet, J. Mailloux, and R.A. Nussbaum. 1993. Experimental examination of burrowing behavior in caecilians (Amphibia: Gymnophiona): effects of soil compaction on burrowing ability of four species. *Herpetologica* 49(4):450-457.
- O'Reilly, J., D. Fenolio and M. Ready. 1995. Limbless amphibians: Caecilians. *The Vivarium* 7(1): 26-54.
- Taylor, E.H. 1968. *The Caecilians of the World*. University of Kansas Press, Lawrence, KS.
- Wake, M.H. 1977. The reproductive biology of caecilians: an evolutionary perspective, in S. Guttman and D. Taylor, (eds.): *Reproductive Biology of the Amphibian*, Plenum Press, New York, NY. pp. 73-102.
- Wake, M.H. 1994. Caecilians (Amphibia: Gymnophiona) in captivity, in J.B. Murphy, K. Adler and J.T. Collins (eds.): *Captive Management and Conservation of Amphibians and Reptiles*. Society for

the Study of Amphibians and Reptiles, St. Louis, MO. pp. 223-228.

#### **Ichthyophiidae: Yellow-striped Caecilian** *(Ichthyophis kohtaoensis)*

#### **Species Selection Criteria:**

**Conservation Status** - Data deficient, but probably not at risk. Caecilians have undergone local extirpations in many areas, and concern has been expressed that several species are seriously endangered or extinct (personal communication, Marvalee Wake, 1997),

**Reintroduction Potential** - Data deficient, but probably not needed at this time.

**Existence and Viability of Captive Populations** – Low. ISIS abstracts (June 1998) list only 2 unsexed individuals of this species in AZA institutions, both of which are probably quite old. Both of these individuals have been in captivity for quite a number of years.

**Scientific and Research Potential** - High - Very little is known of these and most other caecilians. This species has been kept for many years in several institutions, and seems to be rather easy to accommodate in captivity. In addition, this species is a true egg-laying caecilian, and much research could be accomplished in the avenue of captive reproduction.

**Number of Other Regional Captive Programs** – No other ichthyophiids are in captivity in AZA institutions at this time.

**Exhibit Value** - Low. Has been kept for many years in full view of the public, and represents a terrestrial amphibian of which the public is generally unaware.

**Husbandry Expertise** – Moderate. This species has been kept successfully for many years by several AZA institutions, but has never been reproduced successfully in the U.S. This species appears to possess no husbandry challenges which would make its successful keeping and reproduction unreasonable.

**Educational Value:** Data Deficient.

**Availability of Potential Founders:** Difficult to acquire. Once commonly available, this species has not been available in any numbers for quite some time. It is unknown if and when these animals might once again become available in sufficient numbers to constitute a viable population.

**Taxonomic Uniqueness:** Low to moderate. The genus *Ichthyophis* currently contains 32 recognized

species, approximately 10% of the known extant species of caecilians.

**Potential to Affect In-situ Conservation of Species or Ecosystem:** Low.

**ATAG Recommendations:**

**Management Category:** 5-II

**ATAG Contact:** Andrew T. Snider, Detroit Zoo, asnider@detroitzoo.org

**Basis for Listing and Comments** - Terrestrial caecilians have long held a fascination for zoo curators interested in exhibiting the diversity of reptile and amphibian life. This species has been kept successfully for many years, and its current rarity in collections is due to the export restrictions in their country of origin. This, or a similar species such as *Ichthyophis glutinosus*, should be used as a model for successful husbandry and reproduction of a terrestrial egg-laying caecilian.

**Recommendations** - A TMA has been compiled on this species. Additional founders are needed before any further efforts can be made with this species. Attempts to acquire this taxon and develop husbandry expertise should not be discouraged.

**References:**

Ducey, P.K., D.R. Formanowicz, Jr., L. Boyet, J. Mailloux, and R. A. Nussbaum. 1993. Experimental examination of burrowing behavior in caecilians (Amphibia: Gymnophiona): effects of soil compaction on burrowing ability of four species. *Herpetologica* 49 (4): 450-457.

Himstedt, W. 1991. Zur Biologie und Larvenentwicklung der Thailandischen Blindwuhle *Ichthyophis kohtaoensis* (Amphibia: Gymnophiona: Ichthyophiidae). *Veroff. Naturhist. Museum Schleusingen*. No. 6: 16-24.

O'Reilly, J., D. Fenolio and M. Ready. 1995. Limbless Amphibians: Caecilians. *The Vivarium* 7 (10): 26-54.

Taylor, E. H. 1968. *The Caecilians of the World*. University of Kansas Press, Lawrence, KS.

Wake, M.H. 1977. The reproductive biology of caecilians: an evolutionary perspective, in S. Guttman and D. Taylor, (eds.): *Reproductive Biology of the Amphibian*, Plenum Press, New York, NY. pp. 73-102.

Wake, M.H. 1994. Caecilians (Amphibia: Gymnophiona) in captivity, in J.B. Murphy, K. Adler and J.T. Collins (eds.): *Captive Management and Conservation of Amphibians and Reptiles*. Society for

the Study of Amphibians and Reptiles, St. Louis, MO. pp. 223-228.

Wilkinson, M. 1998. Caecilian Taxonomy website, <http://www.bio.bris.ac...ch/markwilk/caecysyst.htm>

**Rhinatremitidae**

**Species Selection Criteria**

**Conservation Status** - Data deficient, but probably not at risk. Caecilians have undergone local extirpations in many areas, and concern has been expressed that several species are seriously endangered or extinct (personal communication, Marvalee Wake, 1997),

**Reintroduction Potential** - Data deficient, but probably not needed at this time.

**Existence and Viability of Captive Populations** – Low. None known to be in captivity at present.

**Scientific and Research Potential** - High - Very little is known of these and most other caecilians, especially the fossorial forms.

**Number of Other Regional Captive Programs:** No rhinatremids are in captivity at this time in AZA institutions.

**Exhibit Value** - Low

**Husbandry Expertise** - Data Deficient. Similar terrestrial caecilians have been maintained for long periods of time in captivity without significant difficulties.

**Educational Value** - Data Deficient.

**Availability of Potential Founders** - Difficult to acquire. Terrestrial caecilians have been inherently difficult to acquire in large enough numbers to constitute a viable captive population.

**Taxonomic Uniqueness** – Moderate to High. The genus *Rhinatrema* is monotypic at the genus level, with only *R. bivittata* being recognized. The genus *Epicrionops* includes eight species.

**Potential to Affect In-situ Conservation of Species or Ecosystem** - Low

**ATAG Recommendations:**

**Management Category** - 5-II

**ATAG Contact:** Andrew T. Snider, Detroit Zoo, asnider@detroitzoo.org

**Basis for Listing and Comments:** - None of the 9

currently recognized species are currently in captivity. Any of these would be difficult to acquire in sufficient numbers for a viable captive population to be established, and there is no evidence that any are in peril in the wild. However, since the genus *Rhinatrema* is monotypic, it might be worthwhile for one or more zoos to take on this taxon should any become available in the pet trade or through other collecting opportunities.

**Recommendations** –Attempts to acquire this taxon and develop husbandry expertise should not be discouraged.

**References:**

Ducey, P.K., D. R. Formanowicz, Jr., L. Boyet, J. Mailloux, and R.A. Nussbaum. 1993. Experimental examination of burrowing behavior in caecilians (Amphibia: Gymnophiona): effects of soil compaction on burrowing abilities of four species. *Herpetologica* 49 (4): 450-457.

O'Reilly, J., D. Fenolio and M. Ready. 1995. Limbless Amphibians: Caecilians. *The Vivarium* 7 (1): 26-54.

Taylor, E. H. 1968. *The Caecilians of the World*. University of Kansas Press, Lawrence, KS.

Wake, M.H. 1994. Caecilians (Amphibia: Gymnophiona) in captivity, in J.B. Murphy, K. Adler and J.T. Collins (eds.): *Captive Management and Conservation of Amphibians and Reptiles*. Society for the Study of Amphibians and Reptiles. St. Louis, MO. pp. 223-228.

Wilkinson, M. 1998. Caecilian Taxonomy website <http://www.bio.bris.ac....ch/markwilk/caecysyst.htm>

**Scolecophoridae**

**Species Selection Criteria**

**Conservation Status** - Data deficient, but probably not at risk. Caecilians have undergone local extirpations in many areas, and concern has been expressed that several species are seriously endangered or extinct (personal communication, Marvalee Wake, 1997),

**Reintroduction Potential** - Data deficient, but probably not needed at this time.

**Existence and Viability of Captive Population** - None known to be in captivity at present.

**Scientific and Research Potential** - High - Very little is known of these and most other caecilians, especially the fossorial forms.

**Number of Other Regional Captive Programs** – No scolecophorids are in captivity in an AZA institution.

**Exhibit Value** - Low

**Husbandry Expertise** - Data deficient, but similar terrestrial caecilians have been maintained for long periods of time in captivity without significant difficulties.

**Educational Value** - Data deficient.

**Availability of Potential Founders** - Difficult to acquire. Terrestrial caecilians have been inherently difficult to acquire in large enough numbers to constitute a viable captive population.

**Taxonomic Uniqueness** - Moderate to High. The genus *Crotaphatrema* contains two species, while *Scolecomorpha* contains three species.

**Potential to Affect In-situ Conservation of Species or Ecosystem** - Low

**ATAG Recommendations:**

**Management Category** - 5-II

**ATAG Contact** - Andrew T. Snider, Detroit Zoo, [asnider@detroitzoo.org](mailto:asnider@detroitzoo.org)

**Basis for Listing and Comments** - None of these species are currently in captivity, and there is no evidence to believe that these animals are at risk in their natural habitat. Acquisition would be difficult.

**Recommendations** –Attempts to acquire this taxon and develop husbandry expertise should not be discouraged.

**References:**

Ducey, P.K., D.R. Formanowicz, Jr., L. Boyet, J. Mailloux, and R. A. Nussbaum. 1993. Experimental examination of burrowing behavior in caecilians (Amphibia: Gymnophiona): effects of soil compaction on burrowing ability of four species. *Herpetologica* 49 (4): 450-457.

O'Reilly, J., D. Fenolio and M. Ready. 1995. Limbless Amphibians: Caecilians. *The Vivarium* 7 (10): 26-54.

Taylor, E. H. 1968. *The Caecilians of the World*. University of Kansas Press, Lawrence, KS.

Wake, M.H. 1977. The reproductive biology of caecilians: an evolutionary perspective, in S. Guttman and D. Taylor, (eds.): *Reproductive Biology of the Amphibian*, Plenum Press, New York, NY. pp. 73-102.

Wake, M.H. 1994. Caecilians (Amphibia: Gymnophiona) in captivity, in J.B. Murphy, K. Adler and J.T. Collins (eds.): Captive Management and Conservation of Amphibians and Reptiles. Society for the Study of Amphibians and Reptiles, St. Louis, MO. pp. 223-228.

Wilkinson, M. 1998. Caecilian Taxonomy. on Internet at <http://www.bio.bris.ac...ch/markwilk/caecysyst.htm>

### Uraeotyphlidae

#### Species Selection Criteria

**Conservation Status** - Data deficient, but probably not at risk. Caecilians have undergone local extirpations in many areas, and concern has been expressed that several species are seriously endangered or extinct (personal communication, Marvalee Wake, 1997),

**Reintroduction Potential** - Data deficient, but probably not needed at this time.

**Existence and Viability of Captive Population** - None known to be in captivity at present.

**Scientific and Research Potential** - High - Very little is known of these and most other caecilians, especially the fossorial forms.

**Number of Other Regional Captive Programs** - Quite a number of other taxa within the ATAG umbrella utilize similar space requirements.

**Exhibit Value** - Low

**Husbandry Expertise** - Data deficient, but similar terrestrial caecilians have been maintained for long periods of time in captivity without significant difficulties.

**Educational Value** - Data deficient.

**Availability of Potential Founders** : Difficult to acquire. Terrestrial caecilians have been inherently difficult to acquire in large enough numbers to constitute a viable captive population.

**Taxonomic Uniqueness** : High. The genus *Uraeotyphlus* is monotypic, with four species.

**Potential to Affect In-situ Conservation of Species or Ecosystem** - Low

#### ATAG Recommendations:

**Management Category** – 5-II

**ATAG Contact:** Andrew T. Snider, Detroit Zoo, [asnider@detroitzoo.org](mailto:asnider@detroitzoo.org)

**Basis for Listing and Comments** - None of the four recognized species are currently in captivity, and there is little evidence to believe that these animals are at risk in their natural habitat. Acquisition would be difficult. However, since this is a monotypic family within the Gymnophiona, it might be worthwhile for one or more zoos to take on this family should any become available in the pet trade (which is highly unlikely due to their limited range in India).

**Recommendations** – Attempts to acquire this taxon and develop husbandry expertise should not be discouraged.

#### **References -**

Ducey, P.K., D.R. Formanowicz, Jr., L. Boyet, J. Mailloux, and R. A. Nussbaum. 1993. Experimental examination of burrowing behavior in caecilians (Amphibia: Gymnophiona): effects of soil compaction on burrowing ability of four species. *Herpetologica* 49 (4): 450-457.

O'Reilly, J., D. Fenolio and M. Ready. 1995. Limbless Amphibians: Caecilians. *The Vivarium* 7 (10): 26-54.

Taylor, E. H. 1968. *The Caecilians of the World*. University of Kansas Press, Lawrence, KS.

Wake, M.H. 1977. The reproductive biology of caecilians: an evolutionary perspective, in S. Guttman and D. Taylor, (eds.): *Reproductive Biology of the Amphibian*, Plenum Press, New York, NY. pp. 73-102.

Wake, M.H. 1994. Caecilians (Amphibia: Gymnophiona) in captivity, in J.B. Murphy, K. Adler and J.T. Collins (eds.): Captive Management and Conservation of Amphibians and Reptiles. Society for the Study of Amphibians and Reptiles, St. Louis, MO. pp. 223-228.

Wilkinson, M. 1998. Caecilian Taxonomy. on Internet at <http://www.bio.bris.ac...ch/markwilk/caecysyst.htm>

#### **Ambystomatidae: Streamside Salamander (*Ambystoma barbouri*)**

#### **Species Selection Criterion:**

**Conservation status of the taxon** - Not given State or Federal protection. Small range and habitat makes it vulnerable. In Kentucky, *Ambystoma barbouri* has been used for several years as an *in situ* research species. Although actual population surveys have not been performed, availability of specimens indicates that most populations are doing good, and that the

primary study population is actually growing. However, at least one population is known to have been lost to development. Non-point source pollution does not appear to be effecting this species and egg counts have been high. The University of Kentucky has received a small grant to investigate the susceptibility of *A. barbouri* to estrogen disrupters (personal communication, Andrew Sih, 1999).

**Reintroduction potential** - Low. Protected habitat has yet to be established and populations appear to be stable where habitat remains.

**Existence and viability of captive populations** - Low. No animals are reported in ISIS (December 1998). Related animals have been propagated in AZA institutions (*A. maculatum*, *A. mexicanum*, *A. opacum*, and *A. tigrinum*, Slavens, 1998). However, breeding parameters (e.g. breeding season and water parameters) vary greatly among species.

**Scientific and research potential** - High. *Ambystoma barbouri* was first described as a sister species to *A. tigrinum* in 1989. Since that time, it has been used as a research species, primarily in predator-prey response studies. A macrohabitat preference study describes parameters for oviposition site choice and growth, survival, and in-stream dispersal of larvae. Interestingly, this stream-adapted species selects slow-flowing pools over riffles for oviposition. This preference may reflect a phylogenetic stronghold on a species derived from pond breeding origins (Holomuzki, 1991). Husbandry comparisons *A. barbouri* and its pond dwelling clan, including reproductive stimuli and larvae morphology, growth, and nutrition, would be interesting from an evolutionary standpoint and would also provide needed husbandry guidelines for stream dwellers. *In situ* investigation of seasonal migration to oviposition sites may provide valuable insight to conservation needs.

**Number of other regional captive programs** - Fourteen forms of *Ambystoma* are listed in ISIS holdings (September, 1998). Generally, 6 or fewer specimens are held at an institution and holdings represent native fauna.

**Exhibit value** - Moderate. Not the most brightly colored ambystomatid, but it's still large and easily exhibited. Appropriate graphics are needed to compare this animal's adaptations and habitat needs to those of other mole salamanders. High exhibit value in states where the animal is found (Ohio, Kentucky, West Virginia, Tennessee).

**Husbandry expertise** - Data Deficient - Existing macrohabitat preference studies suggest that egg and larval rearing may be similar to that of related species for which zoos have expertise. Breeding inducement may be dependent on a change in water chemistry cues as well as a period of brumation.

**Educational value** - Data Deficient. There are too few *Ambystoma barbouri* in captivity for their incorporation into outreach programs, but they may be popular if captive propagation programs are successful. Ambystomatids are charismatic and hardy and thus provide potential for hands-on education. Using a North American specimen to address habitat protection (upland mature hardwood forests and associated streams) brings responsibility home. Because many institutions exhibit native ambystomatids, presenting both could foster better understanding and empathy for at-risk kin.

**Availability of potential founders** - Easy to acquire. Animals are not Federal or State listed. Oviposition sites are well studied.

**Taxonomic uniqueness** - Low. Ambystomatidae is found throughout most of the United States, into Southeastern Alaska and Canada, and south to the edge of the Mexican Plateau.

**Potential to affect in situ conservation of species or ecosystem** - Fair. This might be a reasonably charismatic flagship species for wetlands preservation.

#### ATAG Recommendations:

##### **Management Category** – 5-II

**ATAG contact** – Karen Graham, Sedgwick County Zoo, herps@scz.org

**Basis for listing and comments** – *Ambystoma barbouri* is a specialized and endemic species that is at risk of decline due to encroaching human development. Study populations appear to be stable (except for at least one site, where a breeding pool was lost to development), though no formal survey has been performed. *A. barbouri* is unique among ambystomatids in its streamside habitat selection and will provide new challenges in the development of husbandry practices. It will provide interesting education opportunities and promote North American salamander conservation.

**Recommendations** – Attempts to acquire this staxon and develop husbandry expertise should not be discouraged. Institutions, particularly in the Southeastern region of the U.S., should be encouraged to allocate space for display and maintenance. Establish captive propagation practices. Support fieldwork to learn more about this taxon.

#### **References** -

Conant, Roger, and Joseph T. Collins. 1998. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Third Edition, Expanded. Houghton Mifflin Company, New York, NY pp. 436-437.

Floyd, Scott A., Brian T. Miller, Matthew Brown, and James W. Petranka. 1997. *Ambystoma barbouri* (streamside salamander). *Herpetological Review* 28(3), September, 1997: 155

Holomuzki, Joseph R. 1991. Macrohabitat Effects on Egg Deposition and Larval Growth, Survival, and Instream Dispersal in *Ambystoma barbouri*. *Copeia* 1991(3) pp. 687-694.

Kats, Lee B. and Andrew Sih. 1992. Oviposition Site Selection and Avoidance of Fish by Streamside Salamanders (*Ambystoma barbouri*). *Copeia*. 1992(2). pp. 468-473.

Moore, Robert D., Blake Newton, and Andrew Sih. 1996. Delayed hatching as a response of streamside salamander eggs to chemical cues from predatory sunfish. *OIKOS* 77:331-335.

Petranka, James W. and Fred Kraus. 1989. A New Sibling Species of *Ambystoma* from the Ohio River Drainage. *Copeia*. 1989(1). pp 94-110.

**Amphiumidae: One-toed Amphiuma (*Amphiuma pholeter*)**

**Species Selection Criterion:**

**Conservation status of the taxon** – Data Deficient. *Amphiuma pholeter* is the least well known of the amphiumas, and has a restricted range and is rare within known localities. *A. pholeter* is listed as “Rare” by Georgia Department of Natural Resources, but has not been included as a protected species by Florida. However, it is considered “rare” by the Florida Committee on Rare and Endangered Plants and Animals (Means, 1992). Sedimentation of streams from human activities and destruction of suitable habitat by human construction are the two main threats to this species.

**Reintroduction potential** – Data deficient. This species was described in 1964, and is found in the muck beds of the flood plains of permanent streams. There is a correlation with cypress habitats, and the muck typically derives from decomposition of cypress or hardwood litter. It is known from very few localities within northern Florida, southern Alabama and southern Georgia.

**Existence and viability of captive populations** – 0.0.5 at Philadelphia Zoo as of 1 July 1999 (donated by Paul Moler, Florida Game and Freshwater Fish Commission).

**Scientific and research potential** – High. Amphiumidae are poorly studied from a husbandry and natural history perspective. Although internal fertilization has been assumed for this family,

definitive studies are lacking. Amphiumas have been used in biomedical research for decades. *Amphiuma means* has the largest erythrocyte of any vertebrate, and amphiumas in general have large somatic cells useful for cell biologists. In addition, amphiumas have highly redundant DNA that make them well suited to genetic research. If *Amphiuma pholeter* is to be evaluated for biomedical applications, a suitable captive propagation program is imperative since the wild populations are low enough to be extirpated by commercial collecting (Means, 1992).

**Number of other regional captive programs** – *Amphiuma pholeter* would compete for the same space as would be used to maintain terrestrial caecilians or salamanders.

**Exhibit value** – Data deficient. *Amphiuma means* is easy to display but has different habits than *A. pholeter*. *A. pholeter* may be difficult to display in a naturalistic exhibit, but may display well in a tunnel-type exhibit if they prove adaptable to this husbandry. The story of the usefulness of this nondescript species to the biomedical industry may be one more powerful example of the needs to conserve even little known animals.

**Husbandry expertise** – Low. *Amphiuma pholeter* lives in mud within cypress swamps and there are no records that it has been maintained in North American zoos or aquariums. *Amphiuma pholeter* must be maintained in mud or muck and does not tolerate the aquatic conditions that *A. means* tolerates (personal communication, P. Moler and K. Zippel). *Amphiuma means* has been maintained successfully for years, but no confirmed reports of captive reproduction have been found.

**Education value** – Data Deficient. There are too few *Amphiuma pholeter* in captivity for their incorporation into outreach programs, but audiovisual materials of the salamander *in situ* may be stimulating. *Amphiuma means* have been used fairly often in educational programs. Their impressive size and anonymity is effective in stimulating the interest of school groups and visitors. The story of the usefulness of this nondescript species to the biomedical industry may be one more powerful example of the needs to conserve even little known animals. The importance of conserving wetlands habitat and more specifically the “muck” surrounding wetlands may be relayed with this species. In addition, this salamander appears to be an egg-guarder, and can be used to teach the evolution of parental behavior in vertebrates.

**Availability of potential founders** – Data deficient. It is legal to collect *Amphiuma pholeter* from Florida, and help may be available through the Game and Freshwater Fish Commission. Other amphiumas have proven easy to collect.

**Taxonomic uniqueness** – High. The one-toed amphiuma, *Amphiuma pholeter*, is one of three species within this monogeneric family of salamanders. Amphiumidae is endemic to North America and one species, the two-toed amphiuma, *A. means*, is the arguably longest salamander in North America with a maximum recorded length in excess of 4 feet.

**Potential to affect *in situ* conservation of species or ecosystem** – Data deficient. *Amphiuma pholeter* is not a charismatic animal, however the potential to exploit the biomedical commercial appeal of this species may prove invaluable.

**ATAG Recommendations:**

**Management Category** – 5-II

**ATAG contact** – Kevin Wright, The Phoenix Zoo, kwright@thephxzoo.com

**Basis for listing and comments** –

Given the few taxa in this family, the fact that the family Amphiumidae is endemic to North America, and the lack of protected suitable habitat, ATAG members are encouraged to develop expertise with indigenous taxa.

**Recommendations** – Attempts to acquire this taxon and develop husbandry expertise should not be discouraged. Support fieldwork to document current status of *A. pholeter* in the wild. Support proposal for upgrading protection in Florida.

Investigate possible links with biomedical companies for funding support.

Acquire and maintain two-toed amphiuma, *Amphiuma means*, to develop expertise applicable to one-toed amphiuma, *A. pholeter*. Institutions experienced with other salamanders may consider pilot programs with *Amphiuma pholeter*.

**References** –

Means, D.B. 1992. One-toed Amphiuma, in Mohler, P.E. (Ed.): Rare and Endangered Biota of Florida, Volume III. Amphibians and Reptiles. University Press of Florida, Gainesville, FL, pp.34-38.

Petranka, J.W. 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, D.C., pp. 134-135

**Cryptobranchidae: Chinese giant salamander (*Andrias davidianus*)**

**Species Selection Criterion:**

**Conservation status of the taxon**- Data deficient. It is listed as indeterminate-apparently in danger but insufficient information to confirm status (4(b)) by IUCN.

**Reintroduction potential**- Data deficient

**Existence and viability of captive populations** Low. At the moment only three ISIS zoos have both an adult male and female. Total population in ISIS institutions is 7.5.6.0. There have been no recent births.

**Scientific and research potential**- Low. *A. davidianus* have been studied rarely in captivity and few institutions have attempted to maintain them. They have never(?) been bred in captivity but probably have similar breeding requirements to that of *Andrias japonicus*.

**Number of regional captive programs**- There are three cryptobranchids all of which compete for enclosure space; *Cryptobranchis alleganiensis* is currently recommended for 5-II. There is a lack of animals from known river systems and this is a concern for captive propagation efforts.

**Exhibit value**- High. Display space for this large taxa remains a problem. They are aquatic and can reach four feet weighing up to forty pounds. They are a chocolate-brown colour overlaid with irregular marbling of charcoal. Fleshy dermal folds are visible along the lower sides of the body in adults. The genus *Andrias* contains the largest living salamanders, and fossil species attained even larger sizes, exceeding 2 meters in body length.

**Husbandry expertise**-Low/Data deficient. They require large tanks with cool water and they easily feed on crustaceans. Similar care conditions to that of *A. japonicus* but it is even larger.

**Educational value**- Data deficient. There are too few *Andrias davidianus* in captivity for their incorporation into outreach programs and they present many husbandry challenges that seem to preclude use in outreach programs. Audiovisual materials and artifacts may be useful. A life-size model of a giant salamander would impress most zoo visitors.

**Availability of potential founders**- Difficult to acquire. Recent attempts to import additional specimens have failed. However, occasional specimens appear in North American fish markets.

**Taxonomic uniqueness** – High. There are only three species in the Family Cryptobranchidae. The other two are *Andrias japonicus* from Japan and *Cryptobranchus alleganiensis* from eastern North America. They are thought to be derived evolutionarily from the related family Hynobiidae (Larson, 1997) The genus *Andrias* was formerly known as *Megalobatrachus* (Larson, 1991)

**Potential to affect *in situ* conservation of species or ecosystem-** High. Wushan county has indicated support for a giant salamander educational program and perhaps a salamander reserve. The new Three Gorges Dam started construction in 1998 and will impact the populations of *Andrias davidianus*.

#### **ATAG Recommendations**

**Management Category-** 5-II

**ATAG contact-** Bob Johnson, Toronto Zoo, bjohanson@zoo.metrotor.on.ca

**Basis for listing and comments-** In 1995 a letter of concern has been received from Li Yinghong, Biologist at Chongqing Zoo regarding the impact of the new Three Gorges Dam on *Andrias davidianus* populations. The construction on this dam began in 1998. Wushan county has indicated support for a giant salamander educational program and perhaps a salamander reserve. Dr. Robert Murphy of the Royal Ontario Museum was researching genetic separation in the three river populations of *A. davidianus* and has excellent contacts in this area as well as a great deal of experience as a result of ongoing visits to the area. Metro Toronto Zoo has a sister Zoo relationship with Congqing Zoo and will obtain more information for the sub-group.

Space for maintaining this large taxon remains a concern and a lack of animals from known river systems is a concern for captive propagation efforts.

**Recommendations-** Attempts to acquire this taxon and develop husbandry expertise should not be discouraged. Support research into possible species differentiation in different river systems. *Andrias davidianus* has not been the subject of major conservation efforts in its country of origin; North American zoos should focus on this species rather than *A. japonicus* if they wish to work with *Andrias* sp.

#### **References-**

Er-Mi Zhao, Adler, K., 1993. Herpetology of China. SSAR Publications.

Larson, A. 1991. A molecular perspective on the evolutionary relationships of the salamander families. *Evolutionary Biology* 25:211-277. [not seen, as taken from Larson 1997]

Larson, A. 1997. <http://biodec.wustl.edu/~larsontl/cryptobranchidae.html>

LIU: Amphibians of Western China, Fieldiana: Zoology Memoirs, Volume 2

#### **Cryptobranchidae: Japanese giant salamander (*Andrias japonicus*)**

#### **Species Selection Criterion:**

**Conservation status of the taxon-** It is listed as Rare by IUCN : 2(b).

**Reintroduction potential-** Data deficient

**Existence and viability of captive populations** Moderate/Low. In ISIS institutions, the total number of *A. japonicus* is seven, Cincinnati being the only zoo with more than one animal. In Japan however, there have had several breedings.

**Scientific and research potential-** Moderate. Breeding biology of this giant salamander is not well understood although there have been recent breedings in Japan.

**Number of regional captive programs -** There are three cryptobranchids all of which compete for enclosure space; *Cryptobranchis alleganiensis* is currently recommended for 5-II.

**Exhibit value-** High/Moderate. Display space for this large taxa remains a problem. They are aquatic, about a meter in length and can live 55 years in captivity. They are a chocolate-brown colour overlaid with irregular marbling of charcoal. Fleshy dermal folds are visible along the lower sides of the body in adults. The genus *Andrias* contains the largest living salamanders, and fossil species attained even larger sizes, exceeding 2 meters in body length (Larson, 1997).

**Husbandry expertise-** High - They require large tanks and cool water. In the wild the streams temperature varies between 4-20 C and pH is around 5.7. During breeding the males can be territorial and aggressive. Breeding requires four large connected tanks to satisfy their breeding migration urge. Since 1903, *Andrias japonicus* has been bred in captivity (Kerbert, 1980). More recently, the Asa Zoological Park in Hiroshima, Japan has been studying their reproduction ecology and has produced fertilized eggs every year from 1979-1987 (Kuwabara et al, 1988).

**Educational value-** Data deficient. There are too few *Andrias japonicus* in captivity for their incorporation into outreach programs and they present many husbandry challenges that seem to preclude use in outreach programs. Audiovisual materials and artifacts may be useful. A life-size model of a giant salamander would impress most zoo visitors.

**Availability of potential founders -** In the past Asa Zoo Japan has supplied North America with

specimens. Recently, Japan has donated eight to San Antonio Zoo.

**Taxonomic uniqueness** – High. There are only three species in the Family Cryptobranchidae. The other two are- *Andrias davidianus* from China and *Cryptobranchus alleganiensis* from eastern North America. They are thought to be derived evolutionarily from the related family Hynobiidae (Larson, 1997). The genus *Andrias* was formerly known as *Megalobatrachus* (Larson, 1991)

**Potential to affect in situ conservation of species or ecosystem**- High. Artificial caves have been built to facilitate breeding in rivers that are being diverted or changed for development (Kuwabara, 1988). They could be seen as the flagship species to protect Japan's rivers.

#### ATAG Recommendations

**Management Category**- 5-II

**ATAG contact** – Bob Johnson, Toronto Zoo, bjohnson@zoo.metrotor.on.ca

**Basis for listing and comments**- Display space for this large taxa remains a problem and a lack of animals from known river systems is a concern for captive propagation efforts.

**Recommendations**- Attempts to acquire this taxon and develop husbandry expertise should not be discouraged. Support fieldwork to explore possibility that different river systems have subspecies of *A. japonicus* and change breeding program/reintroduction program accordingly. Since Japan has taken the initiative to manage this species *in situ* and *ex situ*, there is little need for involvement by North American zoos.

#### **References-**

Duellman, W. E. and L. Trueb. 1986. Biology of Amphibians. McGraw-Hill, New York.

Kerbert, 1980. De Japane reuzensalamander, Artis Maart/April No. 6 Amsterdam.

Kuwabara K. et al. 1988. The protection and the captive breeding of the Japanese giant salamander (*Andrias japonicus*). 5th World Conference on Breeding Endangered Species in Captivity. Ohio.

Larson, A. 1991. A molecular perspective on the evolutionary relationships of the salamander families. Evolutionary Biology 25:211-277.[not seen, as taken from Larson, 1997]

Larson, 1997.

<http://biodec.wustl.edu/~larsonl/cryptobranchidae.html>

#### Dicamptodontidae: California Giant Salamander (*Dicamptodon ensatus*)

#### Species Selection Criterion:

**Conservation status of the taxon** : Data deficient.

**Reintroduction potential** : Data deficient.

**Existence and viability of captive populations** : Four animals at three institutions.

**Scientific and research potential** : High. No information is known on breeding and courtship.

**Number of other regional captive programs** – No other Dicamptodontidae are being managed.

**Exhibit value** : High. A large (17- 30.5 cm), reddish brown salamander with copper colored marbling.

**Husbandry expertise** : Low.

**Educational value**- Data deficient. There are no *Dicamptodon ensatus* in captivity, they might be used in outreach programs provided there are appropriate support materials. They are one of the few salamanders to vocalize. However, they can inflict a painful bite.

**Availability of potential founders** : Data deficient.

**Taxonomic uniqueness** – High. Endemic North American species. One of four in the genus *Dicamptodon*.

**Potential to affect *in situ* conservation of species or ecosystem** : Low. At risk from urban development and stream siltation.

#### ATAG Recommendations:

**Management Category** – 5-II

**ATAG contact** : Eli Bryant-Cavazos, Baltimore Zoo, elibzherp@aol.com

#### **Basis for listing and comments** :

The California Giant Salamander *Dicamptodon ensatus* has the most restricted range of the Dicamptodontidae, an endemic North American family of salamanders. It is one of the largest terrestrial salamanders and any of the Dicamptodontidae would be impressive display species. Given the few taxa in this family, the fact that the family Dicamptodontidae is endemic to North America, and the lack of protected habitat, ATAG members are encouraged to develop expertise with indigenous taxa. Formerly the ATAG suggested focusing on Pacific giant salamanders *Dicamptodon*

*tenebrosus* to develop expertise for *D. ensatus*. However, there are already *D. ensatus* in captivity and I feel more should be acquired and the institutions that currently hold *D. ensatus* be encouraged to develop the expertise with this species.

**Recommendations** : Attempts to acquire this taxon and develop husbandry expertise should not be discouraged. Support fieldwork to document current status in the wild.

#### References :

Petranka, James W. 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington and London, 587pp.

ISIS Amphibian Abstract as of 30 June 1998

#### Hynobiidae: Asian Salamanders

##### Species Selection Criterion:

**Conservation status of the taxon** - Varies within the taxon. According to Norman and Ramus (1995) the family Hynobiidae contains 7 genera *Batrachuperus* (Mountain salamanders 7 spp.), *Hynobius* (Asian salamanders - 22 spp.), *Liua* (the Sichuan salamander - *L. shihi*), *Onychodactylus* (Clawed salamanders - 2 species, *O. fischeri* and *O. japonicus*), *Pachyhynobius* (the Shangcheng salamander - *P. shangchengensis*), *Ranodon* (Siberian salamanders - 2 species, *R. sibiricus* and *R. tsinpaensis*), and *Salamandrella* (Dybowski's salamander - *S. keyserlingii*). The 1994 IUCN Red List (Groombridge, 1993) lists *Hynobius abei* and *H. tekadai* as endangered, *H. hidamontanus* as vulnerable, *H. dummi*, *H. okiensis*, and *H. stejnegeri* as rare, and *Batrachuperus musteri* as suspected to be threatened. *Hynobius amjiensis* is known only from the type locality (Zhao and Adler, 1993).

*Onychodactylus fischeri* is listed as endangered in the 1996 IUCN Red Data Book (Paul Griffin personal communication, 1999.) Because *O. fischeri* are restricted to torrential mountain streams, their populations may be vulnerable to local extinctions (Duellman and Trueb, 1994; Griffin and Solkin, 1995; Paul Griffin personal communication, 1999) conservation of this species depends upon the preservation of late-successional forests (Paul Griffin personal communication, 1999). *Ranodon sibiricus* appears to be limited to a very relictual distribution and should be considered to be endangered (Brushko, 1993; Paul Griffin, personal communication, 1999). *Batrachuperus karlschmidti* are harvested as a cure for stomach ailments in Sichuan, while other local beliefs protect it (Cochran, 1961). The effects of harvesting upon *B. karlschmidti* are unknown to the reviewer.

The Yuanxi (Sichuan province) population of *Batrachuperus pinchonii* has declined dramatically. It is believed that commercial exploitation is a major

factor in this decline but other factors such as climate and changes in the surrounding forests may be involved (Jiang Jian-Ping and Zheng Ming-Quan, 1998). However, the status of *B. pinchonii* in northeastern Yunnan and Guizhou provinces is unknown to the reviewer.

**Reintroduction** - Data deficient. The destruction of suitable habitat seems to be the main threat to populations of some species at this time, while commercial harvest threatens others.

**Existence and viability of captive population** - Data deficient for most species. ISIS-reporting institutions as of June 1998 report 1.1 *Onychodactylus fischeri* at the Moscow Zoological Park and 0.0.3 *Ranodon sibiricus* at the Moscow Zoological Park and 1.1 *Ranodon sibiricus* at the Riga Zoo in Latvia. At least seven species of *Hynobius* are being maintained in Europe. *Hynobius leechii* is commonly bred to multiple generations by hobbyists in Western Europe (Erik Keyster, personal communication, 1999) but the relatedness of these animals is unknown to the reviewer. Laboratory studies of the breeding behavior of *Hynobius nigrescens* and *Onychodactylus fischeri* have appeared in the literature (Serbinova and Solkin, 1992; Sato, 1992). *Onychodactylus fischeri* are extremely difficult to maintain in captivity (Paul Griffin, personal communication, 1999).

**Scientific and Research Potential** - Moderate. Russian and Japanese researchers have done extensive research on their endemic Hynobiid salamanders. An extensive body of literature already exists for *Onychodactylus fischeri*, *Salamandrella keyserlingii*, and *Onychodactylus japonicus*. Dr. Paul Griffin, at U.C. San Diego and Dr. Theodore Pappenfuss at the Museum of Vertebrate Zoology, Berkeley, CA are recognized authorities on Hynobiids in the United States. The impacts of humans on Hynobiid populations in China are unknown to the reviewer.

**Number of other regional programs** - None are held in ISIS reporting institutions in the United States. Hynobiids would compete for space with other temperate amphibians and fishes. Because many aquatic Hynobiids and Hynobiid larvae require swiftly flowing waters, they would also compete for space with other rheophilic species such as *Ascaphus* and *Cryptobranchus*.

**Exhibit Value** - Low. Like many species of salamanders, the Hynobiids tend to be small, drab and secretive, although several species are attractively colored such as *Hynobius sonani*, *Onychodactylus japonicus*, *Onychodactylus fischeri*, *Ranodon tsinpaensis*, *Salamandrella keyserlingii* (Steward, 1969).

**Husbandry expertise** - Data deficient for many of the Chinese species. No Hynobiid species have been held in ISIS reporting institutions in the United States.

*Salamandrella keyserlingii* is regarded as easy to maintain (Paul Griffin, personal communication, 1999). Obst et al, (1988) state that most species are easily maintained. At least seven species of *Hynobius* are being maintained in Europe. *Hynobius leechii* is commonly bred to multiple generations by hobbyists in Western Europe (Erik Keyster, personal communication, 1999). Russian and Japanese researchers who have maintained the cool water rheophilic species are a potential source of husbandry information. Dr. Paul Griffin, at U.C. San Diego and Dr. Theodore Pappenfuss at the Museum of Vertebrate Zoology, Berkeley, CA. are reservoirs of husbandry expertise in the United States.

**Educational Value** – Data deficient. Hynobiids do present husbandry challenges and too few are in collections to be used in outreach programs. Many of the messages that can be taught with hynobiids may be conveyed with North American species such as *Cryptobranchus alleganiensis*. However, *Salamandrella keyserlingii* is the most widespread of all salamanders. It is the only salamander that crosses the Arctic Circle and lives where winter temperatures fall as low as  $-50^{\circ}\text{C}$  (Feder and Burggren, 1992). Along with *Hyla versicolor*, *S. keyserlingii* could be used in outreach programs which discuss cryoprotectants and amphibians.

**Availability of potential founders** - Ability to acquire specimens is species specific. Export of *Onychodactylus fischeri* is strictly regulated in international commerce. The export of any wildlife from Russia would require collecting permits and export permits. *Hynobius nebulosus* and other Japanese Hynobiids are available through commercial sources in the United States. *Hynobius leechii*, *H. dunnii* and other *Hynobius spp.* are available to hobbyists in Europe.

**Taxonomic uniqueness** - *Liua* (the Sichuan salamander - *L. shihi*), *Pachyhynobius* (the Shangcheng salamander - *P. shangchengensis*), and *Salamandrella* (Dybowski's salamander - *S. keyserlingii*) are monotypic genera. The genera *Onychodactylus* and *Ranodon* only contain two species each (*O. fischeri*, *O. japonicus*, *R. sibiricus* and *R. tsinpaensis*).

**Potential to affect *in situ* conservation of species or ecosystem** - Low. Small, drab salamanders cannot compete with megavertbrates for "Flagship" status, however endangered species such as *Onychodactylus fischeri* with their need for fast flowing, clean waters could be used to argue for headwater protection.

#### **ATAG Recommendations:**

**Management Category** - 5-II

**ATAG contact** - Craig S. Berg, Milwaukee Zoo, csb@csd.uwm.edu

**Basis for listing and comments** - The ATAG, as a whole, needs to acquire greater expertise with other rheophilic species before consideration is given to rare and endangered species. Given the ATAG's focus on North American amphibian species, and the limited number of spaces available for rheophilic species, *Cryptobranchus spp.* would be more appropriate target animals. Ultimately, *Cryptobranchus spp.* would supply us with many of the same educational messages as the Hynobiids. *Salamandrella keyserlingii* would be an easily managed outreach species to discuss both the characteristics of primitive salamanders and cryoprotectants. Institutions should not be discouraged from working with this taxon.

#### **References -**

- Akita, Y. And K. Miyazuki, 1991. Migration and breeding of *Onychodactylus japonicus* on Mt. Hodatsu. Japanese Journal of Herpetology 14(2):29-38.
- Brushko, Z.K., 1993. Population dynamics, distribution and protection of *Ranodon sibiricus* in South-East Kazakhstan. Ekologiya (Moscow) 0(3):84-87.
- Cochran, D.M. 1961. Living Amphibians of the World. Hamis Hamilton, London.
- Duellman, W.E. and L. Trueb. 1994. Biology of the Amphibians. John Hopkins University Press, Baltimore and London.
- Feder, M.E. and W.W. Burggren, 1992. Environmental physiology of the amphibians. University of Chicago Press. Chicago, IL.
- Griffin, P. and V.A. Solkin, 1995. Ecology and conservation of *Onychodactylus fischeri* (Caudata: Hynobiidae) in the Russian Far East. Asiatic Herpetological Research
- Groombridge, B. 1993. 1994 IUCN Red List of Threatened Animals. IUCN, Gland, Switzerland.
- Halliday, T.R. and K. Adler. 1986. All the Worlds Animals. Torstar Books Inc., New York, NY.
- Jiang Jian-Ping and Zheng Ming-Quan, 1998. The status of amphibians in Wawushan Mountain National Forest Park. Froglog No. 25.
- Kuzmin, S.L., 1990. Feeding of sympatric species of *Hynobiidae* in the Primorski Krai (Russian SFSR, USSR). Zoologicheskii Zhurnal 69(5):71-75
- Norman, F. and E. Ramus. 1995. A Complete Guide to Scientific and Common Names of Reptiles and Amphibians of the World. NG Publishing Inc., Pottsville, PA

Obst, F.J., Richter, K. and U. Jacob. 1988. The Complete Illustrated Atlas of Amphibians for the Terrarium. TFH Publications, Neptune City, NJ.

Steward, J.W., 1969. The Tailed Amphibians of Europe. Taplinger Publishing Company, New York.

Zhao, E and K. Adler, 1993. Herpetology of China. SSAR

**Plethodontidae: Plethodontinae: Bolitoglossini:**  
**Giant Palm Salamander (*Bolitoglossa dofleini*)**

**Species Selection Criterion:**

**Conservation status of the taxon** – Data Deficient. The status taxon in the wild is unknown. However, dramatic declines in populations of Central American amphibians have been documented, and other bolitoglossine salamanders appear to be at risk of extinction or extirpation of local populations.

**Reintroduction potential** – Data Deficient.

**Existence and viability of captive populations** – Data Deficient. Philadelphia Zoo holds 1.1.4 *Bolitoglossa dofleini* and 0.1 *B. mexicana*. No bolitoglossines are held at other ISIS-reporting institutions as of December 1997.

**Scientific and research potential** – High. The neotropical Bolitoglossini have been studied rarely in captivity, and few institutions have attempted to maintain them in recent years. Natural history is incomplete or nonexistent for the majority of neotropical bolitoglossines.

**Number of other regional captive programs** – No other bolitoglossines are held. Based on captive husbandry at the Philadelphia Zoo, *Bolitoglossa dofleini* competes for the same space as many neotropical anurans.

**Exhibit value** – Moderate. *Bolitoglossa dofleini* are regularly visible in the off-exhibit enclosure at the Philadelphia Zoo. When another bolitoglossine, *Bolitoglossa mexicana*, was displayed in a group of 0.3 specimens, animals were visible to the guests almost continuously. There was a high level of interest in this smaller taxon. *B. dofleini* has not been exhibited yet.

**Husbandry expertise** – Low. Philadelphia Zoo and Fort Worth Zoo had animals survive following acquisition, but many institutions have experienced “tail drop syndrome” and subsequent mortality of specimens. “Tail drop syndrome” appears to be related to insufficient energy intake, and Philadelphia has developed a routine for stabilizing new imports that include regular tube-feeding with Feline Clinical Care Liquid until animals are maintaining or gaining

weight. Once a specimen is acclimated and has survived longer than 90 days from acquisition, it appears fairly hardy. Courtship was observed between two specimens held at the Philadelphia Zoo in October 1998.

Neotropical bolitoglossines have a poor reputation in captivity, but this may be based on misunderstanding of the energetic needs of newly imported specimens as well as inappropriate husbandry. Temperate bolitoglossines (e.g., *Batrachoseps* sp., *Hydromantes* sp.) may prove easier to work with than neotropicals.

**Educational value** – Data deficient. There are too few *Bolitoglossa dofleini* in captivity to use in outreach programs. However, specimens at Philadelphia Zoo are relatively hardy and tolerate low to moderate handling and suggest that this species could be used if surplus specimens are produced. *Bolitoglossa dofleini* may be used to illustrate adaptations for an arboreal lifestyle, such as suction cup feet and a prehensile tail, an interesting prey capture method (projectile mushroom-shaped tongue), and cryptic coloration. In addition, it occurs in Central America, the site of sudden population declines of amphibians, and can be used as a representative of the poorly known species that may be gone before they are even described. Presumed reliance on old growth forests may be used to exemplify need for protected lumbering-free areas.

**Availability of potential founders** – Low. *Bolitoglossa dofleini* is infrequently imported, and are exported from Nicaragua. Andy Odum (Toledo Zoo) has questioned the ethics of the export process for this taxon. Institutions should obtain copies of all necessary documentation prior to acquiring any specimens from a dealer.

**Taxonomic uniqueness** – Low. Bolitoglossini are the most species-rich tribe of the Plethodontidae, a primarily North and Central American taxa of salamanders. (*Hydromantes* is found in Europe.) Bolitoglossine account for at least 50% of the described species of salamanders (Pough *et al.*, 1998).

**Potential to affect *in situ* conservation of species or ecosystem** – Low. Charismatic megavertebrates or colorful anurans (e.g., red-eyed treefrog, *Agalychnis callidryas*) are more likely to appeal to the zoo-going public as flagship species for tropical rainforests.

**ATAG Recommendations:**

**Management Category** – 5-II

**ATAG contact** – Kevin Wright, The Phoenix Zoo, kwright@thephxzoo.com

**Basis for listing and comments** – Bolitoglossine salamanders account for 50% of the described salamanders (Pough *et al.*, 1998) yet few taxa from

this tribe are held in North American collections. *Bolitoglossa doylei* is one of the few neotropical taxa available to North American institutions, and may serve as a husbandry model for other taxa. Acclimation of newly acquired specimens requires some expertise in monitoring salamander health and nutritional status. Survival rates of >50% of newly imported specimens may be expected with proper management, and these rates may improve as knowledge of the taxon's needs are better understood. Many of the bolitoglossine salamanders occur in the path of the wave of amphibian declines in Central America, and husbandry techniques need to be developed immediately so that zoos are better able to serve as reservoirs for high priority taxa facing extirpation and extinction.

**Recommendations** – Attempts to work with this taxon should not be discouraged and in fact institutions with an interest in neotropical amphibians to acquire this taxon to increase the knowledge base and improve staff expertise to better assist captive programs for more endangered bolitoglossine salamanders. Institutions are encouraged to acquire local bolitoglossines, (e.g., *Batrachoseps* spp. and *Hydromantes* spp.) to develop husbandry expertise. Institutions are encouraged to develop regional conservation programs that address the needs of local populations of North American bolitoglossines.

**References** –

Pough, F.H., R.M. Andrews, J.E. Cadle, M.L. Crump, A.H. Savitsky, and K.D. Wells. 1998. Herpetology. Prentice Hall, Upper Saddle River, NJ. pp. 42-45

**Plethodontidae : Plethodonini: Green Salamander (*Aneides aeneus*)**

**Species Selection Criterion:**

**Conservation status of the taxon** – Data deficient. While this salamander is listed at the state level in many parts of its range, there is no consensus as to its overall status. It has been suggested that the current taxon comprises at least three species.

**Reintroduction potential** – Data Deficient

**Existence and viability of captive populations** – Data Deficient

**Scientific and research potential** – High.

**Number of other regional captive programs** – There are no other species within this tribe proposed for management.

**Exhibit value** – High. This colorful taxon is an easy to display and was quite visible when on display at the Philadelphia Zoo.

**Husbandry expertise** – Moderate. This taxon appears to present no untoward challenges once established. Parasitism from *Hannemania* sp. (trembiculids) was prevalent in one locality.

**Educational value** – Data deficient. There are too few *Aneides aeneus* in captivity to use in outreach programs. However, they seem to present few husbandry challenges and captive-produced specimens may prove adaptable for outreach programs.

**Availability of potential founders** – Difficult to Acquire. The salamander is protected in several states and requires permits of collection and possession. Tennessee has been willing to permit zoos to collect this species.

**Taxonomic uniqueness** – This is the only *Aneides* occurring east of the Mississippi River.

**Potential to affect *in situ* conservation of species or ecosystem** – Moderate. This may be a potential flagship species for montane North American amphibians.

**ATAG Recommendations:**

**Management Category** – 5-II

**ATAG contact** – Kevin Wright, The Phoenix Zoo, kwright@thephxzoo.com

**Basis for listing and comments** –

This salamander is endangered in several parts of its range and has received protection at the state level in some areas. However, this species is being evaluated and may end up split into three or more separate species, each of which has a restricted range. It was chosen as a target species to develop husbandry programs for a direct life cycle plethodontid (i.e., no free-living larval stage). It is a readily displayed and easily maintained salamander, and may be a good choice for an institution wishing to display terrestrial salamanders.

**Recommendations** –

Attempts to acquire this taxon and develop husbandry expertise should not be discouraged. Support fieldwork to confirm specific status of different localities.

**References :**

**Rhyacotritonidae: Cascade Torrent Salamander (*Rhyacotriton cascadae*)**

**Species Selection Criterion:**

**Conservation status of the taxon :** Washington state candidate species for conservation. All four species of rhyacotritonids depend on old-growth temperate rainforests for proper stream habitat. This is among the fastest disappearing habitat in the world.

**Reintroduction potential :** Data deficient.

**Existence and viability of captive populations :** Data deficient.

**Scientific and research potential :** Moderate. Several field studies have been done, but I did not find anything on captive husbandry issues.

**Number of other regional captive programs –** No other rhyacotritonids are in captivity.

**Exhibit value :** Low to moderate. Small to medium size (7.5-11 cm), brown with yellow venter, and largely aquatic though according to Good and Wake (1992) they are rarely found submerged in deeper than a few millimeters of water.

**Husbandry expertise :** Data deficient.

**Educational value –** Data deficient. This taxon is likely to have specialized husbandry requirements that would preclude use in outreach programs. Audiovisual materials and artifacts may be stimulating. Species depends on habitats provided by old-growth forests and could be used as an example of the diversity effected by clear-cutting practices.

**Availability of potential founders :** Data deficient.

**Taxonomic uniqueness –** High. A monogeneric family with four species. All species appear to be dependent on old-growth forests around streams.

**Potential to affect *in situ* conservation of species or ecosystem :** Low. However, amphibian decline issues are becoming better known to the general public and possibly this little brown salamander could serve as a reminder of the need to leave a buffer zone of forest near streams.

**ATAG Recommendations:**

**Management Category –** 5-II

**ATAG contact :** Eli Bryant-Cavazos

**Basis for listing and comments :** The *Rhyacotriton cascadae* is one of four species within the Rhyacotritonidae, an endemic North American family of salamanders. Given the few taxa in this family, the fact that the family Rhyacotritonidae is endemic to North America, and the lack of protected suitable

habitat, ATAG members are encouraged to develop expertise with indigenous taxa.

**Recommendations :**

Support fieldwork to learn more about this family. Attempts to acquire this taxon and develop husbandry expertise should not be discouraged.

**References :**

Good and Wake, 1992. *Need full reference from Eli.*

Petranka, James W. 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington and London, 587pp.

Washington State Fish and Wildlife web page

**Salamandridae: Ryuku Island Newt (*Echinotriton andersoni*)**

**Conservation Status:** Data deficient, but probably not at risk. However, *Echinotriton andersoni* has a very limited geographic range.

**Reintroduction Potential:** Data deficient, but probably not needed at this time.

**Existence and Viability of Captive Populations:** ISIS abstracts (June 1998) list 11 individuals of this species (listed as *Tylototriton andersoni*) in one AZA institution. Of these, the sex ratio is 6.5. All are wild caught individuals from Japan, and should be considered potential founders.

**Scientific and Research Potential:** High - Although this species does not appear to be difficult to keep successfully, it was only recently reproduced in captivity at the Detroit Zoo. It is known to lay eggs on the land, which the female guards by wrapping her body around them. In general, very little work is done in the arena of husbandry and reproduction for most of the caudates, and the potential is certainly high that we could learn a great deal about this species through husbandry and reproductive research.

**Number of Other Regional Captive Programs:**

Quite a number of salamandrids utilize the same amount and type of space as this taxon. Currently *Tylototriton shanjing* is Priority 1-PMP.

**Exhibit Value:** Low...a very shy animal.

**Husbandry Expertise:** Moderate - This species has not been worked with extensively, but does not appear to present any particular difficulty in husbandry.

**Educational Value:** Data deficient. There are too few *Echinotriton andersoni* in captivity to use in outreach programs.

**Availability of Potential Founders:** Difficult to Acquire, but not impossible. All specimens in the U.S. were collected by a private citizen in Japan and sent to U.S. zoos. This species is not yet given protected status in Japan, thus not making it subject to CITES regulations or other forms of national laws.

**Taxonomic Uniqueness:** Low. Both *Echinotriton* and *Tylototriton* contain several species each; they are considered an ancient lineage of salamander.

**Potential to Affect In-situ Conservation of Species or Ecosystem:** Low.

**ATAG Recommendations:**

**Management Category:** 5-II

**ATAG Contact:** Andrew T. Snider, Detroit Zoo, asnider@detroitzoo.org

**Basis for Listing and Comments:** This species is found in a very small geographic range, and cannot be said to be abundant in any part of that range. It is an ancient species, and one that reproduces very differently from some other related taxa.

**Recommendations:**

An additional import of potential founders is needed if this taxon is to be reprioritized. Attempts to acquire this taxon and develop husbandry expertise should not be discouraged. Support fieldwork to learn more about this taxon.

**References:**

Frost, D.R. (ed.) 1985. Amphibian Species of the World, A Taxonomic and Geographical Reference. Allen Press, Inc. and The Association of Systematics Collections, Lawrence, KS. p: 616.

Nussbaum, R.A., and E.D. Brodie, Jr. 1982. Partitioning of the salamandrid genus *Tylototriton* Anderson (Amphibia: Caudata) with a description of a new genus. *Herpetologica* 38 (2): 320-332.

Zhao, E.M., and K. Adler 1993. *Herpetology of China*. Society for the Study of Amphibians and Reptiles, St. Louis, MO. p. 111

**Salamandridae: Crater Lake Rough-skinned Newt (*Taricha granulosa mazamae*)**

**Species Selection Criterion:**

**Conservation status of the taxon :** Not at risk. *Taricha granulosa mazamae* has the most restricted range of any North American salamandrid and is restricted solely to Crater Lake within Crater Lake

National Park. No other populations are known. However, the loss of the golden toad, *Bufo perigrinus*, within a national park in Costa Rica should be a lesson that existence within a protected area does not guarantee a species survival.

**Reintroduction potential :** Not needed.

**Existence and viability of captive populations –** Although there are 0.1.15 *Taricha granulosa* in four institutions there are no *Taricha granulosa mazamae* reported in ISIS 1998.

**Scientific and research potential – Low.**

**Number of other regional captive programs -** Quite a number of salamandrids utilize the same amount and type of space as this taxon. Currently *Tylototriton shanjing* is a Priority 1-PMP salamandrid.

**Exhibit value :** Moderate. Large (12.5 -22 cm TL), light to dark brown with yellow to orange venter, and granular skin in the terrestrial phase. Other subspecies display well in aquatic exhibits but the display of the terrestrial phase may be challenging.

**Husbandry expertise :** Data deficient. Other *Taricha* sp. are hardy if collected appropriately.

**Educational value –** Data deficient for this taxon, but other more common *Taricha* have been used in outreach programs and tolerate moderate levels of handling. *Taricha* is a relatively large animal with a very different appearance (granular rather than smooth skin) than other salamanders. It also has good aposomatic coloration with a strong unken response and is quite toxic.

**Availability of potential founders –** Moderate. Some permits may be required for collection within a national park.

**Taxonomic uniqueness –** Moderate. Although the genus *Taricha* is endemic to North America, is represented by three species (*T. granulosa*, *T. rivularis*, *T. torosa*) and a disputed number of subspecies, there are over 50 species of salamandrids worldwide.

**Potential to affect *in situ* conservation of species or ecosystem :** Low. *Taricha granulosa mazamae* are found in Crater Lake, Oregon which is a national park. It does provide the opportunity to interpret an endemic species within a fully protected park.

**ATAG Recommendations:**

**Management Category –** 5-II

**ATAG contact:** Eli Bryant-Cavazos, Baltimore Zoo, elibzherps@aol.com

**Basis for listing and comments :** The genus *Taricha* is endemic to North America. The Crater Lake roughed-skinned newt *T. granulosa mazamae* is restricted to Crater Lake, Oregon. It is located on a national park which affords it some level of protection. There are already *T. granulosa granulosa* in captivity. It is my opinion that since these animals are in captivity, that efforts should be put forth to develop techniques in husbandry and propagation with this subspecies and if in the future a change in the Crater Lake population warrants bringing these animals into captivity, then the ATAG can take up that issue at that time.

**Recommendations :** Work with *T. granulosa granulosa* not *T. g. mazamae* but attempts to acquire this taxon and develop husbandry expertise should not be discouraged. Support interpretive efforts within Crater Lake National Park and support fieldwork to monitor population status so that intervention can be effected if needed.

**References :**

Petranka, James W. 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington and London, 587pp.

ISIS Amphibian Abstract as of June 1998

**Sirenidae: Greater siren (*Siren lacertina*)**

**Species Selection Criteria**

**Conservation status of the taxon** – Not at risk. *Siren lacertina* has an extensive range in the eastern United States along the coastal plain from northern Virginia throughout Florida and west to Alabama. They are relatively abundant and not listed by USFW, IUCN or state wildlife agencies.

**Reintroduction potential** – Not needed. There are protected areas within the range of *Siren lacertina*, and the species is apparently not in decline anywhere within its range.

**Existence and viability of captive populations** – Low. Few institutions work with this species (Slavens 1997, IZY 1996). The September, 1998 ISIS Amphibian Abstract only lists 14 specimens being held by 6 institutions in the US.

**Scientific research potential** – Moderate. Extensive information regarding the natural history and husbandry of *S. lacertina* is lacking, however there is a fair amount of information in the literature regarding physiology and reproduction.

**Number of other regional captive programs** – Although few institutions maintain *S. lacertina*, they

may compete for captive space with other large, aquatic Caudata.

**Exhibit value** – Moderate to High. Because of its relatively large size, up to 97.8 cm, and unusual appearance, this species makes an excellent exhibit.

**Husbandry expertise** – Moderate. Although few institutions have maintained this species, husbandry is not complex and captive longevities have exceeded 20 years.

**Educational value**- High. *Siren lacertina* (along with *Amphiuma means*) have been used fairly often in educational programs. Their impressive size and anonymity is effective in stimulating the interest of school groups and visitors.

**Availability of potential founders** –High. *Siren lacertina* is a common amphibian and can be easily acquired.

**Taxonomic uniqueness** – Moderate to High. *Siren lacertina* is in the family Sirenidae which is composed of 2 genera limited in distribution to the southeastern US and NE Mexico. There are only two described species in the genus *Siren*, although Paul Moler believes that there are several undescribed forms in north Florida (personal communication, 1999). This family is highly derived and divergent from other salamanders.

**Potential to affect in situ conservation of species and ecosystem** –Low. *Siren lacertina* is a relatively abundant species that has little potential to impact local conservation efforts.

**ATAG Recommendations**

**Management Category** - 5-II

**ATAG contact** – Scott Pfaff, Riverbanks Zoo, scottp@riverbanks.org, or Kevin Wright, the Phoenix Zoo, kwright@thephezoo.com

**Basis for listing and comments** – *Siren lacertina* is one of the largest salamanders in the world and is endemic to North America. It comes from a highly derived family of salamanders with moderate to high taxonomic uniqueness. It is readily available and an institution could contribute significantly to the knowledge base of this taxon.

**Recommendations** – Attempts to acquire this species and develop husbandry expertise should not be discouraged. Institutions should support efforts to describe new species of sirens.

**References** –

Conant, Roger and Joseph T. Collins, 1991. A Field Guide to Reptiles and Amphibians of Eastern and

Central North America. Houghton Mifflin Company, Boston.

Duellman, William E. and Linda Trueb. 1986. *Biology of the Amphibians*. Johns Hopkins University Press, Baltimore.

Stebbins, Robert C. and Nathan W. Cohen. 1995. *A Natural History of Amphibians*. Princeton University Press, Princeton, NJ.

**Allophrynidae: Ruthven's Frog (*Allophryne ruthveni*)**

**Species Selection Criterion:**

**Conservation status of the taxon** - Not listed by CITES, USFWS, or IUCN. *Allophryne ruthveni* is an endemic forest species that has a fairly extensive range in the Guyana region of South America.

**Reintroduction potential** - Not Needed.

**Existence and viability of captive populations** – Data Deficient. None listed in the ISIS abstracts (September 1998).

**Scientific and research potential** - Moderate. *In situ* and *ex situ* research would be interesting, simply because this is a little-studied taxon.

**Number of other regional captive programs** - This is a monotypic treefrog-like family. Hylidae, which is similar in its niche occupancy and likely the closest extant relative, is very common in zoo collections.

**Exhibit value** – Data Deficient.

**Husbandry expertise** - Data Deficient.

**Educational value** – Data Deficient.

**Availability of potential founders** - Difficult to acquire. It is possible, though unlikely, that they could be collected for zoos via the Biological Survey Project at the National Museum of Natural History.

**Taxonomic uniqueness** – High. Monotypic family.

**Potential to affect in situ conservation of species or ecosystem** – Data Deficient but likely to be low.

**ATAG Recommendations:**

**Management Category** – 5-II

**ATAG contact** - Karen Graham, Sedgwick County Zoo, herps@scz.org

**Basis for listing and comments** - This unique species has an extensive range and much of this range is in

areas at low risk of immediate perturbation by humans (e.g., Surinam). However, this highly unique family of frogs has not been studied in captive situations and one or more institutions are encouraged to develop a captive husbandry and propagation program for this taxon.

**Recommendations** – Encourage field research that monitors habitat destruction of the Cis-Andean Lowland forests. Attempts to acquire this taxon and develop husbandry expertise should not be discouraged.

**References**

Duellman, William E. (Ed.) 1979. *The South American Herpetofauna: Its Origin, Evolution, and Dispersal*. The Museum of Natural History. The University of Kansas, Lawrence, KS. pp: 194, 256, 270.

**Arthroleptidae: African Frogs**

**Species Selection Criterion:**

**Conservation status of the taxon** - Data deficient. According to Norman and Ramus (1995) the family *Arthroleptidae* contains 6 genera *Arthroleptis* (screeching frogs - 34 spp.), *Astylosternus* (night frogs - 12 spp.), *Cardioglossa* (Long-fingered frogs - 17 spp.), *Leptodactylodon* (egg frogs - 11 spp.), *Scotobleps* (The Gaboon forest frog - *S.gabonicus*) and *Trichobatrachus* (The Hairy frog - *T. robustus*). The only arthroleptid listed in the 1994 IUCN Red List (Groombridge 1993) is *Arthroleptis dutoitii* which is listed as extinct. *Arthroleptis* and *Cardioglossa* are extremely difficult to locate by all accounts. However, they appear to be abundant in suitable habitats judging from the ubiquitousness of their calls (Schiotz, 1963; Schmidt and Noble, 1998; Wager, 1986). No references were located concerning the status in the wild for the genera *Astylosternus*, *Scotobleps*, or *Leptodactylodon*. Zippel (1997; personal communication 1999) believes that populations of *Trichobatrachus robustus* have come under increasing predation pressure from man, resulting in population crashes at sites close to human population centers.

**Reintroduction** - Data deficient. Because *Trichobatrachus robustus* is a valued protein source and endemic peoples believe that its flesh increases fertility, reintroductions of *Trichobatrachus robustus* would be unlikely to succeed unless refugia were established and protected.

**Existence and viability of captive population** - Data deficient. No ISIS- reporting institutions as of June 1998.

**Scientific and Research Potential - High.**

Husbandry requirements of adults and larvae are unknown. Impacts of humans on wild populations are unknown or uncertain (*Trichobatrachus robustus*). The tadpoles of *Astylosternus*, *Cardioglossa*, *Leptodactylodon*, *Trichobatrachus*, and *Scotobleps* are rheophilic. The tadpoles of *Trichobatrachus* would provide a model for *Ascaphus* (Lamotte and Lescure, 1989; Zippel, 1997; Zippel, personal communication, 1999).

The function of the “hairs” of *Trichobatrachus* remains unknown (Zippel, 1997).

**Number of other regional programs - None** held in ISIS reporting institutions. The arthroleptids would compete for space with other tropical and temperate frogs.

**Exhibit Value - Low to Moderate.** *Arthroleptis*, *Astylosternus* and *Cardioglossa* are diminutive (2-6.5cm) frogs inhabiting areas of dense vegetation (Obst et al., 1988; Lambris, 1989). *Arthroleptis*, *Astylosternus*, *Cardioglossa*, *Leptodactylodon*, and *Scotobleps* are primarily nocturnal (Obst et al., 1988) but *Arthroleptis* may be active any time of the day during rainstorms (Lambris, 1989). Due to their nervousness and secretive natures these animals are best kept in large, well-planted enclosures (Obst et al., 1988). Reports seem to indicate that these animals would most likely be nervous and remain hidden in the typical zoo exhibit. Newly captured *Astylosternus* have been known to injure themselves by jumping into the sides of their enclosures (Obst et al., 1988). Most of the arthroleptids are rather drably colored although some of the *Cardioglossa* are described as very attractive and active little frogs (Obst et al., 1988). *Trichobatrachus* become rather sedentary in captivity but they are drab colored. Most authors report that the males do not exhibit the “hairy morphology” outside of the reproductive season (Breen, 1974; Duellman and Trueb, 1994; Obst et al., 1988; Zippel 1997). However, Zippel (1997) reported that some authorities state that the males maintain this morphology throughout the year. Zippel believes that this discrepancy may be due to intraspecific variation.

**Husbandry expertise - Data deficient.** Zippel (1997; personal communication 1999) held *Trichobatrachus robustus* successfully in captivity but did not breed them. *Arthroleptis spp.*, *Astylosternus spp.*, *Cardioglossa spp.*, *Scotobleps gabonicus* have been maintained by hobbyists in Europe (Obst et al, 1988.)

**Educational Value – Data deficient.** Most arthroleptids are nervous, “jumpy” frogs and do not make good outreach animals. The rheophilic larvae of most arthroleptids are too small to make a good display about their adaptations to flowing water. Assuming that the husbandry challenges can be met, the hairy frog, *Trichobatrachus robustus*, may prove to be a good educational animal if the “hairy

morphology” can be induced or if a population that exhibits this morphology throughout the year can be located. The rheophilic larvae of *Trichobatrachus robustus* are large enough to use as illustrations of adaptations to stream life.

**Availability of potential founders - Data deficient.** The arthroleptids are not listed by CITES, USFWS, or the IUCN. Members of this genus are not frequently. Adults of most species are difficult to locate, often evading capture during studies using intensive survey techniques. Tadpoles of the arthroleptids are more easily located, however, the transportation of rheophilic species is frequently difficult due to their requirements for elevated oxygen concentrations and high water quality. Animals may be available through European sources. *Trichobatrachus robustus*, however, become concentrated during the breeding season and would probably be easier to acquire.

**Taxonomic uniqueness -** There are many species of *Arthroleptis*, *Astylosternus*, *Cardioglossa*, and *Leptodactylodon*. *Scotobleps gabonicus* and *Trichobatrachus robustus* are monotypic (Obst et al., 1988). The hairlike skin growths found on breeding *T. robustus* is unique

**Potential to affect *in situ* conservation of species or ecosystem -** Although these animals are not megavertebrates they are frogs. Frogs have been enjoying an appreciable popularity as of late. Efforts should be made to produce a sustainable harvest of *T. robustus* before more serious protection measures become necessary.

**ATAG Recommendations:**

**Management Category – 5-II**

**ATAG contact -** Craig S. Berg, Milwaukee Zoo, csb@csd.uwm.edu

**Basis for listing and comments -** *Arthroleptis*, *Astylosternus*, *Cardioglossa*, *Scotobleps*, and *Leptodactylodon* do not appear to be threatened in the wild. Exhibition and educational value of these genera are limited. The hairlike skin growths found on breeding *T. robustus* is a unique adaptation. The biological function of this adaptation has yet to be explained. The tadpole of *T. robustus* may be used as models for *Ascaphus*. Conservation efforts directed toward obtaining a sustainable harvest is more likely to be an achievable goal.

**References -**

- Breen, J.F., 1974. Encyclopedia of Reptiles and Amphibians. TFH Publications, Neptune City, NJ.
- Duellman, W.E. and L. Trueb. 1994. Biology of the Amphibians. John Hopkins University Press, Baltimore and London.

Groombridge, B. 1993. 1994 IUCN Red List of Threatened Animals. IUCN, Gland, Switzerland.

Lambris, A.J.L., 1989. The Frogs of Zimbabwe. Museo Regionale Di Scienze Naturali, Monograph X, Torino.

Lamotte, M. and J. Lescure, 1989. The rheophilous and hydropetric tadpoles of the Old and New World. *Annales des Sciences Naturelles Zoologie et Biologie Animale* 10(2):111-122.

Norman, F. and E. Ramus. 1995. A Complete Guide to Scientific and Common Names of Reptiles and Amphibians of the World. NG Publishing Inc., Pottsville, PA

Obst, F.J., Richter, K. and U. Jacob. 1988. The Complete Illustrated Atlas of Amphibians for the Terrarium. TFH Publications, Neptune City, NJ.

Schiotz, A. 1963. The Amphibians of Nigeria. *Vidensk. Medd. Dansk. Naturh. Foren.*, 125.  
Schmidt and Noble, 1998. Contributions to the Herpetology of the Belgian Congo. SSAR.

Wager, V.A., 1986. Frogs of South Africa. Delta Books. Johannesburg.

Zippel, K.C., 1997. Hairy Frogs (*Trichobatrachus robustus*) In the Field. *Reptiles*. June 1997, Vol. 5, No. 6.

**Ascaphidae: North American Tailed Frog**  
**(*Ascaphus truei*)**

**Species Selection Criterion:**

**Conservation status of the taxon** – The status of *Ascaphus truei* differs throughout its range. California and Oregon list the species as protected and “at risk”. The states of Washington and Idaho do not list it as a protected species (Levell, 1997). The Canadian province of British Columbia lists *A. truei* as vulnerable (Province of British Columbia, 1997). Protection of this species seems to be based on logging activity throughout its range.

**Reintroduction potential** – Not needed. At present it is not necessary to introduce captive reared animals into the wild population. A lack of husbandry expertise would keep this from happening as well.

**Existence and viability of captive populations** – Low.

**Scientific and research potential** – High. While the habits and biology of *A. truei* are sufficiently researched, the captive husbandry of the species leaves many accomplishments to be made. The larvae of *A.*

*truei* have proven extremely difficult to maintain in the captive setting (personal communication, Slavens, 1999).

**Number of other regional captive programs** – This is a difficult area to assess. Since *Ascaphus truei* is a monotypic family, there are no competitors on a biodiversity basis. *A. truei* could conceivably be housed quite easily. However, it could be forced to compete with all anurans and many cold-water salamanders for space. The larvae would require highly specialized setups as well. These larval setups would compete with any animals or larvae requiring chilled water (Altig and Brodie, 1972).

**Exhibit value** – Moderate. With habits similar to most ranids or bufonids, *A. truei* would most likely exhibit reasonably well (Noble and Putnam, 1931).

**Husbandry expertise** – Low. There has been little or no success in keeping and breeding *A. truei* in captivity.

**Educational value** – Data deficient. There are too few *Ascaphus truei* to incorporate into outreach programs. Because it is one of the only anurans that utilizes internal fertilization (Duellman and Trueb, 1986) as its breeding mode, *A. truei* would offer an excellent opportunity for AZA institutions to use a herp as an educational tool.

**Availability of potential founders** – Moderate.

**Taxonomic uniqueness** – High. As mentioned above, *Ascaphus truei* belongs to a monotypic family. Its very unique in its breeding habits as it stays in larval form for up to three years (Duellman and Trueb, 1986).

**Potential to affect *in situ* conservation of species or ecosystem** – Moderate to high. A management program for *A. truei* could potentially affect the level that its ecosystem is protected. The high level of logging that goes on throughout the species’ range could be an issue. Any effect that a management program had would also positively affect all or most animals that live within its range.

**ATAG Recommendations**

**Management Category – 5-II**

**ATAG contact** – Anthony Wisniewski, Baltimore Zoo, bzherps@aol.com

**Basis for listing and comments** – There is a lack of expertise in the husbandry and breeding protocols of *A. truei*. As an “at risk” animal, it is worthy of research, and attempts to build a captive population would be justified. Regarding conservation, AZA institutions within its range have an opportunity to

effect its future *in situ*. This unique species should be considered valuable to its ecosystem and the ATAG should explore ways to get involved in its preservation.

**Recommendations** – Attempts to acquire this taxon and develop husbandry expertise should not be discouraged. Support fieldwork and research of wild populations and protection of habitat within its range.

**References** –

Altig, R. and E.D. Brodie. 1972. Laboratory behavior of *Ascaphus truei* tadpoles. *Journal of Herpetology* 6 (1): 21-24.

Duellman, W.E. and L. Trueb. 1986. *Biology of Amphibians*. John Hopkins University Press. Pp. 168, 515.

Levell, J.P. 1997. *A Field Guide to Reptiles and the Law*. Serpents Tale Natural History Book Distributors. Pp 44, 200.

Noble, G.K. and P.G. Putman. 1931. Observations on the life history of *Ascaphus trueistenjneger*. *Copeia* 3: 97-101.

**Brachycephalidae: Golden Frog (*Brachycephalus ephippium*)**

**Species Selection Criterion:**

**Conservation status of the taxon-** Data deficient. Not listed by USFWS or IUCN. There have been reports that this species was locally abundant, but natural history information is scarce and limited (Pombal, Sazima and Hoddad, 1994).

**Reintroduction potential-** Data deficient.

**Existence and viability of captive populations-** Low. There are none listed in captivity in ISIS (1998) or Slavens Inventory (1997).

**Scientific and research potential-** High. There is a need for natural history information as well as population studies for this species. There has been some limited work done with toxin studies and breeding behaviors.

**Number of other regional captive programs-** None.

**Exhibit value-** High. This is a small, brightly colored frog that could be used as a flagship species.

**Husbandry expertise-** Data deficient.

**Availability of potential founders-** Difficult to acquire.

**Taxonomic uniqueness-** High. Two genera and three species are currently recognized (Frost 1985; Heyer et al., 1990), but additional species will likely be added as systematic studies of the group progress (Heyer et al., 1990; Hadad and Sazima, 1992). This species has a restricted range in the coastal region of Brazil.

**Potential to affect in situ conservation of species or ecosystems-** High. This brightly colored frog is a definite candidate for a flagship species of Brazil. There is the possibility of working with the Brazilian FIG to accomplish this goal.

**ATAG Recommendations:**

**Management Category-** 5-II

**ATAG Contact-** Diane Callaway, Henry Doorly Zoo, dianec@omahazoo.com

**Basis for listing and comments-** In 1995 it was recommended by the Brazil FIG that this species be used as a flagship species. This species is from a restricted range of coastal forests that could easily fall victim to habitat destruction and a captive population could insure the survival of this species or provide supplemental animals to a threatened population in the future.

**Recommendations-** Attempts to acquire this taxon and develop husbandry expertise should not be discouraged. Support field work to document status of wild populations, and determine what type of conservation programs (if any) are needed for this species. Work with the Brazil FIG to establish this species as a flagship species.

**References-**

Duellman and Trueb, 1986. *Biology of Amphibians*. p534-535

Harding, Keith A., 1983. *New World Amphibians*. p55

Pombal, Sazima and Haddad, 1994. Breeding Behavior of the Pumpkin toadlet, *Brachycephalus ephippium* (Brachycephalidae). *Journal of Herpetology* 28(4):534-535.

Sazima, I., 1978. Convergent Defensive Behavior of 2 Leaf Litter Frogs of southeastern Brazil. *Biotropica* 10(2):158.

**Bufoidea: Blomberg's Toad (*Bufo blombergi*)**

**Species Selection Criterion:**

**Conservation status of taxon:** Not listed by USFWS or IUCN.

**Reintroduction potential:** Data deficient.

**Existence and viability of captive population-** Low. There are only three institutions that house this species currently. 1.0 in Brookfield Zoo, 1.0 in Columbus zoo and 0.0.1 in Cali zoo in Columbia. (ISIS 1998, Slavens 1997, personal communication with institutions 1998)

**Scientific and research potential-** Moderate. There is a need to learn more about the natural history for this species as well as current population status in the wild.

**Number of other regional captive programs-** There are currently two SSP programs for toad species: The Wyoming toad (*Bufo baxteri*) and the Puerto Rican Crested Toad (*Peltophryne lemur*).

**Exhibit value-** High. This species would be an extremely desirable species for exhibition since it is attractive and is the largest member of the Bufonidae family. This could be a good representative for the taxon which would garner the visitor's attention.

**Husbandry expertise-** Moderate. There has been some reproductive success in captivity, particularly in the mid-seventies in Europe. According to literature, the most recent breeding occurred in 1988 at the Brookfield Zoo.

**Educational value-** High. This toad has been used at Miami Metrozoo for outreach programs. Too few are in captivity to justify use in outreach programs, but if surplus can be produced from captive breeding programs they would be ideal candidates due to the tractable nature, large size and attractive coloration. However, they do have significant poison glands (parotids) and appropriate precautions should be taken to protect handlers and program participants. The poison can squirt up to 6 feet (2 meters) from the gland of an upset toad.

**Availability of potential founders-** Data deficient. A few years ago Cleveland zoo obtained a few toads from Volker Ennenbach out of Washington, DC. These animals were supposedly captive bred in Spain.

**Taxonomic uniqueness-** Low. Largest member of the speciose Bufonidae.

**Potential to affect in situ conservation of species or ecosystem-** High. This species could be used as a flagship species for SW Columbia because of its size and beauty.

#### **ATAG Recommendations:**

**Management Category-** 5-II

**ATAG contact-** Diane Callaway, Henry Doorly Zoo, dianec@omahazoo.com

**Basis for listing and comments-** This is the largest member of the Bufonidae family and could be used as an ambassador for toad species and for Columbia. Although population data is deficient, it is reasonable to presume that this species is declining in numbers through habitat destruction or some other variable.

**Recommendations-** Attempts to acquire this taxon and develop husbandry expertise should not be discouraged. Support field work to document status of wild populations, and determine what type (if any) of conservation programs are needed for this species.

#### **References-**

- Duplaix-Hall, Nicole, 1974. International Zoo Yearbook, Vol.14. P. 456.
- Harding, Keith A., 1983. New World Amphibians. P.60.
- Pawley, R., 1988. Blomberg toad, *Bufo blombergi*, Reproduction at Brookfield Zoo: paucity to profusion. Bulletin of the Chicago Herpetological Society 23(4):53-54.
- Schmidt, A.A., 1976. The Breeding of *Bufo-Blombergi* Salientia Bufonidae. Salamandra 12(1):37-46.

#### **Bufonidae: Cameroon Eyelash Toad (*Bufo superciliaris*)**

#### **Species Selection Criterion:**

**Conservation status of taxon-** USFWS lists as Endangered. Not listed by IUCN.

**Reintroduction potential-** Data deficient.

**Existence and viability of captive population-** Low. There are none listed in captivity in ISIS(1998) or Slavens Inventory (1997).

**Scientific or research potential-** High. There have been some genetic studies done on this species, but little is known about its natural history and population status.

**Number of other regional captive programs-** The Wyoming toad, (*Bufo baxteri*) and the Puerto Rican toad, (*Peltophryne lemur*) are other toads currently managed through SSP programs.

**Exhibit value-** High. This species conveys an obvious message because it is an endangered species and is an attractive toad that could be easily exhibited.

**Husbandry expertise-** Data deficient.

**Educational value-** Data deficient. Gerald Durrell's description of eyelash toads in *The Bafut Beagles* suggests that these would be excellent candidates for outreach programs if surplus specimens could be produced from a captive breeding program. Because this species is endangered as well as attractive it could easily be used as a flagship species for the Cameroon region.

**Availability of potential founders-** Difficult to acquire.

**Taxonomic uniqueness-** Low. Bufonidae is among the most speciose group of amphibians.

**Potential to affect in situ conservation of species or ecosystem-** Data deficient. Although this species is a potential flagship species, there is a great deal of political unrest in West Africa and could hinder any *in situ* conservation efforts in the near future.

#### **ATAG Recommendations:**

**Management Category-** 5-II

**ATAG Contact-** Diane Callaway, Henry Doorly Zoo, dianec@omahazoo.com

**Basis for listing comments-** Because this is an endangered species found exclusively in one region, there is justification for establishing a captive program to insure survivorship of the species.

**Recommendations-** Attempts to acquire this taxon and develop husbandry expertise should not be discouraged.

#### **References-**

Maxson, L.R., 1981. Albumin evolution and its phylogenetic implications in African Toads of the genus *Bufo*. *Herpetologica* 37(2):96-104.

#### **Centrolenidae: Glass Frogs**

##### **Species Selection Criteria:**

**Conservation status of the taxon -** Data deficient. Note: Hayes found a ten-fold population decrease in *Hyalinobatrachium (Centrolenella) fleischmanni* in the Monteverde, Costa Rica region when comparing data from a 1972 survey to field work conducted between 1979-1983 (Phillips 1994).

**Reintroduction potential -** Data deficient.

**Existence and viability of captive populations -** None listed on ISIS (current 2/24/99). NAIB exhibits a long-term captive male *Cochranella (Centrolenella) albomaculata* collected in Costa Rica. Centrolenellids are rarely imported due to the commercial pet trade

restrictions currently in place for most Latin American countries.

**Scientific and research potential –** High. Little is known of the natural history and behavior of most species.

**Number of other regional captive programs –** No centrolenids are in the RCP at this time.

**Exhibit value -** Moderate. They are nocturnal and somewhat secretive. *Cochranella albomaculata* on exhibit at NAIB will often perch on bromeliad fronds in full view.

**Husbandry Expertise -** Moderate. Some taxa appear to adapt reasonably well to captivity.

**Educational Value -** Low. Relatively delicate for outreach purposes but could be managed in small mobile exhibits rather than directly handled. Demonstration of the visible internal organs makes it an interesting educational tool for in-house programs.

**Availability of potential founders -** Difficult to acquire. Available sporadically through direct collection and occasionally through herp dealers. Commercial trade restrictions on herp exports in most Latin American countries account for their limited availability.

**Taxonomic uniqueness -** Low. This family contains at least 104 species, currently divided into three genera *Centrolene*, *Cochranella*, and *Hyalinobatrachium* (Frank and Ramous 1995, Ruiz-Carranza and Lynch 1991).

**Potential to affect *in situ* conservation of species or ecosystem -** Low.

#### **ATAG Recommendations:**

**Management category -** 5-II

**ATAG contact -** Jack Cover, National Aquarium in Baltimore, jcover@aqua.org

**Basis for listing and comments-** Zoos should have extensive interest with neotropical hylids before attempting to keep any centrolenids.

**Recommendations -** Frogs in this group have some exhibit and educational value (unique transparent ventrum). Attempts to acquire this taxon and develop husbandry expertise should not be discouraged.

#### **References -**

Frank, N. And E. Ramus 1995. A Complete Guide to Scientific and Common names of Reptiles and Amphibians of the World. N.G. Publishing Inc. Pottsville, PA, p. 52-53.

Phillips, K. 1994. Tracking the Vanishing Frogs, an Ecological mystery. St. Martin's Press, New York, p. 141-142.

Ruiz - Carranza, P. And Lynch, J. 1991. Ranas Centrolenidae de Columbia. I. Propuesta de una nueva clasificacion generica. Lozania 57: 1-30.

### **Heleophrynidae: Ghost Frogs (*Heleophryne* spp.)**

#### **Species Selection Criterion**

**Conservation status of the taxon** - Data deficient. The genus *Heleophryne* (ghost frogs) contains five described species: *Heleophryne natalensis*, *H. hewitti*, *H. purcelli*, *H. regis*, and *H. rosei* (Norman and Ramus, 1995). Obst et al. (1988), state that there is three species, one being polytypic. *Heleophryne hewitti* and *H. rosei* are listed as endangered in the 1994 IUCN Red List (Groombridge 1993). The heleophrynes are difficult to locate and are easily missed even when intensive survey techniques are used (Cochran, 1961; Bates, 1995; personal communication Guy Pluck, 1999). Because their known range is restricted to swiftly flowing, highland streams in South Africa ( Duellman and Trueb, 1994; Halliday and Adler, 1986; Obst et al, 1988, Passmore and Carruthers, 1979) their populations may be vulnerable to local extinctions. Deforestation, forest fires, dams, erosion and encroachment by alien vegetation threaten the group as a whole (personal communication Guy Pluck, 1999).

**Reintroduction** - Data deficient.

**Existence and viability of captive population** - Data deficient. No ISIS- reporting institutions as of June 1998.

**Scientific and Research Potential** - High. Hooks and spines imbedded in the skin of heleophrynes is believed to aid them in maintaining their position on slippery rocks but this hypothesis remains untested. Husbandry requirements of adults and larvae are unknown. Impacts of humans on wild populations are unknown.

**Number of other regional programs** - None held in ISIS reporting institutions. Because these frogs are highly aquatic, they would compete for space with other tropical amphibians and fishes. Because they require swiftly flowing waters, they would also compete for space with other rheophilic species such as *Ascaphus*.

**Exhibit Value** - Data deficient. Several species, although attractively colored, are highly secretive, nocturnal frogs. *H. purcelli*, however, is partially arboreal and might prove to be a good exhibit animal.

**Husbandry expertise** - Data deficient.

**Educational Value** – Data deficient. Although there are none in captivity, it seems that this taxon would be a challenge for outreach programs. However, audiovisual materials and artifacts of *Heleophryne* spp. may be used to illustrate unique adaptations to a rheophilic lifestyle by both adults and the large-sucker mouthed larvae. *Heleophryne* spp. can be used to illustrate the concepts of plate tectonics and biogeography because they are the last remnants of the leptodactylid lineage in Africa (Duellman and Trueb, 1994).

**Availability of potential founders** - Data deficient. The heleophrynes are not listed by CITES or the USFWS. The status in the heleophrynes in South African wildlife legislation is unknown to the reviewer. Importations of this genus are unknown to the reviewer. Adults are difficult to locate and often evade capture during studies using intensive survey techniques. Tadpoles of the heleophrynes are more easily located, however, the transportation of rheophilic species is frequently difficult due to their requirements for elevated oxygen concentrations and high water quality.

**Taxonomic uniqueness** - The heleophrynes are the last remnants of the leptodactylid lineage in Africa. Several species have hooks or spines embedded in their integuments. The morphology of their torrent adapted larvae is unique having large mouths lacking beaks. (Duellman and Trueb, 1994)

**Potential to affect *in situ* conservation of species or ecosystem** - Although these animals are not megavertebrates they are frogs. Frogs have been enjoying an appreciable popularity as of late. Their endangered status coupled with their need for fast flowing, clean waters could be used to argue for headwater protection.

#### **ATAG Recommendations:**

**Management Category** - 5-II

**ATAG contact** - Craig S. Berg, Milwaukee Zoo, csb@csd.uwm.edu

**Basis for listing and comments** - These frogs would be very difficult to obtain at best. The ATAG, as a whole, needs to acquire greater expertise with other rheophilic species before consideration is given to rare and endangered species. Given the ATAG's focus on North American amphibian species, and the limited number of spaces available for rheophilic species, *Ascaphus* would be a more appropriate target animal. Ultimately *Ascaphus* would supply us with many of the same educational messages as the heleophrynes.

**References** -

Bates, M.F. 1995. Distribution and diversity of amphibians in the Free State, South Africa. *Madoqua* 19(1):3-14.

Cochran, D.M. 1961. Living Amphibians of the World. Hamis Hamilton, London.

Duellman, W.E. and L. Trueb. 1994. Biology of the Amphibians. John Hopkins University Press, Baltimore and London.

Groombridge, B. 1993. 1994 IUCN Red List of Threatened Animals. IUCN, Gland, Switzerland.

Halliday, T.R. and K. Adler. 1986. All the Worlds Animals. Torstar Books Inc., New York, NY.

Norman, F. and E. Ramus. 1995. A Complete Guide to Scientific and Common Names of Reptiles and Amphibians of the World. NG Publishing Inc., Pottsville, PA

Obst, F.J., Richter, K. and U. Jacob. 1988. The Complete Illustrated Atlas of Amphibians for the Terrarium. TFH Publications, Neptune City, NJ.

Passmore, N.I. and V.C. Carruthers. 1979. South African Frogs. Witwatersrand University Press, Johannesburg, South Africa.

**Hemisotidae: African Shovel-nosed Frogs (*Hemismus spp.*)**

**Species Selection Criterion:**

**Conservation status of the taxon** – *Hemismus guineensis*-Data Deficient, *Hemismus guttatus*-Not at Risk, *Hemismus marmoratus*- Not at Risk. The family Hemisotidae as a whole is not endangered. However, little is known about the status or habits of *Hemismus guineensis*. Dr. Robert Drewes of The California Academy of Sciences has been studying *Hemismus* for many years and feels that the genus was stable and is not in need of management efforts (personal communication, 1999).

**Reintroduction potential** – Not Needed. Based on information on the status of the family Hemisotidae and the Arabuko-Sokoke Forest in Kenya, Africa, there is no evidence warranting reintroduction *Hemismus* sp. Most of the range of this family of frogs is protected and suitable habitat is abundant (personal communication, R. Drewes, 1999).

**Existence and viability of captive populations** – Data Deficient. There are supposedly some universities keeping *Hemismus*, but communication with those institutions has been difficult (personal communication, R. Drewes, 1999).

**Scientific and research potential** – High. This is a unique group of frogs. Little is known about its feeding and breeding biology, as well as their evolutionary relationships within its ecosystem. In short, there is much work to be done with this family (personal communication, R. Drewes, 1999).

**Number of other regional captive programs** – No hemisotids are in ISIS. As a fossorial frog, *Hemismus* will be competing with several groups that have similar housing requirements. Some might include microhylids (*Dyscophus* sp.), burrowing frogs (*Gastrophryne* sp.) and possibly even horned frogs (*Ceratophrys* sp.).

**Exhibit value** – Low. *Hemismus* is completely fossorial.

**Husbandry expertise** – Low. Only a few universities have attempted keeping *Hemismus* in their collections. No data is available pertaining to their successes or failures.

**Educational value** – Data Deficient. While they have characteristics that are unique and interesting, there is not enough data available to warrant use of hemisotids in outreach programs.

**Availability of potential founders** – Low.

**Taxonomic uniqueness** – Since little is known about the evolutionary background of these animals, it is difficult to assess their taxonomic uniqueness. Although the ATAG has adopted Hemisotidae as a monogeneric family of three species, there have been discussions in phylogenetic circles to include the genus *Hemismus* in the family Ranidae while others suggest grouping it with the Seychelles endemics in the family Sooglossidae (personal communication, R. Drewes, 1999).

**Potential to affect *in situ* conservation of species or ecosystem** – Low. Dr. Drewes suggests that there would be little or no effect on *in situ* conservation if this animal were part of a management program (personal communication, R. Drewes, 1999). The Arabuko-Sokoke Forest is shared with many high profile Kenyan mammals. The potential of the frogs in the family Hemisotidae taking precedence over elephants, leopards or forest duikers would be considered low.

**ATAG Recommendations**

**Management Category** – 5-II

**ATAG contact**– Anthony Wisnieski, Baltimore Zoo, bzherps@aol.com

**Recommendations:**

Attempts to acquire this taxon and develop husbandry expertise should not be discouraged. Support fieldwork to learn more about this family.

(Prepared by Donald Harris, The Baltimore Zoo)

**Hylidae: Leaf Tree Frogs (*Agalychnis* spp.)**

**Species Selection Criteria:**

**Conservation status of the taxon** - Distributions per Frost (1985).

- *Agalychnis annae* - Found on Caribbean slopes and Meseta of Costa Rica.
- *Agalychnis calcarifer* - Found on Caribbean slopes of Costa Rica and Panama and Pacific lowlands of Columbia and northwestern Ecuador.
- *Agalychnis callidryas* - Found throughout Central America. From Mexico to Panama.
- *Agalychnis craspedopus* - Known only from the type series in Amazonian Ecuador.
- *Agalychnis litodryas* - Found from eastern Panama to northwestern Ecuador.
- *Agalychnis moreletii* - Found on the Atlantic and Pacific slopes from Veracruz and Guerrero, Mexico to Guatemala and El Salvador.
- *Agalychnis saltator* - Found in the Caribbean lowlands of Nicaragua and Costa Rica.
- *Agalychnis spurrelli* - Found from southeastern Costa Rica to the Pacific lowlands of Columbia.

While all *Agalychnis* species may have certain populations at risk due to habitat loss and degradation, *A. annae* and *A. craspedopus* may be most at risk due to their limited distributions. *A. annae* has been reported to be extirpated from certain areas in Costa Rica. (Mike Ready, pers. comm.) None of the 8 *Agalychnis* species are CITES listed.

**Reintroduction potential** - Not necessary for most species, but Dr. Alan Pounds is reported to be working with captive *A. annae* in Costa Rica for a possible reintroduction project in areas where they have been extirpated. (Mike Ready, pers. comm.)

**Existence and viability of captive populations** - As of 2/29/99 ISIS reports the following: 0.0.2 *A. annae* found in a single institution, 21.21.63 *A. callidryas* found in 25 institutions (see also this species' evaluation in 2-DERP), 0.0.13 *A. litodryas* found in 3 institutions.

**Scientific and research potential** - Low.

**Number of other regional captive programs** – *Agalychnis callidryas* is considered Priority 2-DEP. The only other neotropical hylid included in the collection plan is the waxy frog, *Phyllomedusa sauvegii* as Priority 2-DERP.

**Exhibit value** - Low.

**Husbandry Expertise** - Species dependent.

- *A. callidryas* is well represented in captive collections. Their husbandry and captive breeding are relatively simple.
- *A. annae* has been captive-bred in England. (Andrew Gray, pers. comm.)
- *A. spurrelli* has been captive-bred in England. (Andrew Gray, pers. comm.)
- *A. litodryas* has been captive-bred privately in the U.S., but only in large outdoor enclosure in Florida
- The husbandry expertise of the remaining species is low

**Educational Value** – Low. Since red-eyed treefrogs, *Agalychnis callidryas*, are included in the regional collection plan as Priority 2-DEP, there is little reason to consider including these poorly known species in outreach programs.

**Availability of potential founders** - Species dependent.

- *A. callidryas*, easy to acquire
- All other species are difficult to acquire due to commercial trade restrictions by their countries of origin.

**Taxonomic uniqueness** - Low. Hylidae is among the most speciose family of anurans. The genus *Agalychnis* is made up of 8 species. Geographic variation occurs in *A. callidryas* and *A. spurrelli*.

**Potential to affect *in situ* conservation of species or ecosystem** - Moderate. Although *Agalychnis callidryas* is possibly the world's most photographed frog, *A. craspedopus* is also highly charismatic and colorful making it a potential flagship species for rain forest conservation.

**ATAG Recommendations:**

**Management category** - 5-II

**ATAG contact** - Jack Cover, National Aquarium in Baltimore, jcover@aqua.org

**Basis for listing and comments**- The husbandry of leaf frogs, *Agalychnis* sp., other than *A. callidryas*, is poorly known. These taxa are within the purported "wave" of extirpations in Central America and may benefit at some future date from *ex situ* efforts.

**Recommendations** - Attempts to acquire these species to develop husbandry expertise should not be discouraged. Institutions with experience with *A. annae* may wish to assist Dr. Pounds with his efforts.

**References** -

Duellman, William E. 1970. The Hylid Frogs of Middle America Vol. 1. Museum of Natural History, The University of Kansas. pp. 87-130.

Frost, Darrell R. 1985. Amphibian Species of the World, A Taxonomic and Geographical Reference. Allen Press and the Association of Systematics Collections, Lawrence Kansas. pp. 197-199.

**Hylidae: Crowned Treefrog (*Anotheca spinosa*)**

**Species Selection Criteria:**

**Conservation status of the taxon** - Data Deficient. Frost (1985) reports the distribution as southeastern Mexico, Costa Rica, and western Panama.

**Reintroduction potential** - Data Deficient.

**Existence and viability of captive populations** - As of 2/24/99, ISIS reports none in zoo or aquarium collections. NAIB currently holds 1.0 long-term captive.

**Scientific and research potential** – Low.

**Number of other regional captive programs** – *Agalychnis callidryas* and *Phyllomedusa sauvegii* are the only neotropical hylids within the regional collection plan as Priority 2-DERP.

**Exhibit value** - Low. They are nocturnal and cryptically colored.

**Husbandry Expertise** - Moderate. This species seems to be fairly easy to maintain in captivity, but there are no reports of captive breeding in the U.S. However, this species has been captive-bred in Germany. (Jungfer, 1996)

**Educational Value** – Data deficient. Too few are in captivity to use in outreach programs.

**Availability of potential founders** - Difficult to acquire. Commercial trade restrictions on herp exports in most Latin American countries account for their limited availability.

**Taxonomic uniqueness** - Moderate. Although this is a monotypic genus, there are over 650 species of Hylidae. The relationships of this genus to other genera within this family are unclear.

**Potential to affect *in situ* conservation of species or ecosystem** – Low.

**ATAG Recommendations:**

**Management category** – 5-II

**ATAG contact** – Jack Cover, National Aquarium in Baltimore, jcover@aquaria.org

**Basis for listing and comments-** Listing based on lack of availability and interest.

**References -**

Jungfer, Karl-Heinz. Reproduction and parental care of the coronated treefrog, *Anotheca spinosa* (Steindachner, 1864) (Anura: Hylidae) Herpetologica; 52(1): 25-32, 1996.

Frost, Darrell R. 1985. Amphibian Species of the World, A Taxonomic and Geographical Reference. Allen Press and the Association of Systematics Collections, Lawrence Kansas. pp. 197-199.

**Hylidae: Marsupial Treefrogs (*Gastrotheca* spp.)**

**Species Selection Criteria:**

**Conservation status of the taxon** - Data deficient. This genus has a wide distribution occurring in Panama, northern and western South America, southward to northern Argentina, eastern and southeastern Brazil (Frost 1985).

**Reintroduction potential** - Data deficient

**Existence and viability of captive populations** - ISIS (current 2/24/99) lists the following: 1.1.6 *Gastrotheca marsupiata* in 3 institutions, 0.0.3 *Gastrotheca peruana* in 1 institution, 2.10.4 *Gastrotheca riobambae* in 2 institutions .

**Scientific and research potential** - Moderate. Due to this genera's unique egg development within a brood pouch, it has been utilized in hormonal and developmental studies.

**Number of other regional captive programs** – No *Gastrotheca* spp. are at higher priority in the regional collection plan. Other neotropical hylids in the plan at Priority 2-DERP are *Agalychnis callidryas* and *Phyllomedusa sauvegii*.

**Exhibit value** - Moderate. Typical of treefrogs, they are nocturnal and relatively secretive. They tend to display best in somewhat spartan exhibits.

**Husbandry Expertise** - Moderate. The hardiness of species ranges from very hardy (*Gastrotheca peruana*, *Gastrotheca riobambae*, *Gastrotheca marsupiata*) to somewhat delicate (*Gastrotheca cornuta*). Some species have been bred successfully in captivity (Kirk 1985, Fitzgerald et al. 1979). *G. peruana* is bred in outdoor enclosures by a California-based hobbyist.

**Educational Value** – Data deficient. Hardy species, *Gastrotheca peruana*, *Gastrotheca riobambae*, *Gastrotheca marsupiata*, may be used in outreach programs. The uniqueness of the brooding pouch

makes this genus an interesting subject for educational purposes.

**Availability of potential founders** - Data deficient. They are sporadically available through commercial importers or research labs. Availability of wild-caught specimens is limited due to the commercial trade restrictions placed on many Latin American herps by their countries of origin.

**Taxonomic uniqueness** - Low. They are a wide ranging, diverse genus. The genus contains 44 species (Frank and Ramus 1995). There are over 650 species of Hylidae.

**Potential to affect *in situ* conservation of species or ecosystem** - Low.

**ATAG Recommendations:**

**Management category** – 5-II

**ATAG contact** - Jack Cover, National Aquarium in Baltimore, jcover@aquarium.org

**Basis for listing and comments**- Zoos have historically demonstrated limited interest in the genus. Specimens are irregularly available.

**Recommendations -**

Frogs in this genus have some exhibit value and unique life histories. Keeping specimens to meet individual institutional display / educational needs should not be discouraged.

**References -**

Fitzgerald, Kevin T.; Louis J. Guillette, Jr. And David Duvall 1979. Notes on the birth, development and care of *Gastrotheca riobambae* tadpoles in the laboratory (Amphibia, Anura, Hylidae. J. Herpetol 13(4): 457-460.

Frank, N. And E. Ramus 1995. A Complete Guide to Scientific and Common names of Reptiles and Amphibians of the World. N.G. Publishing Inc. Pottsville, PA, p. 52-53.

Frost, D. 1985. Amphibian Species of the World, A Taxonomic and Geographic Reference. Allen Press and Association of Systematic Collections, Lawrence, Kansas. p. 112-118.

Kirk, Barry R. 1985. Observations on the breeding of a marsupial frog, *Gastrotheca marsupiata*. Br. Herpetol. Soc. Bull.; No. 14 p. 22-24.

**Hylidae: Casque-headed Treefrogs (*Tripriion* spp.)**

**Species Selection Criteria:**

**Conservation status of the taxon** - Data Deficient. Lee (1996) stated that *Tripriion petasatus* are particularly abundant in the arid northwest portion of the Yucatan peninsula, where the duck-like quacking of the makes can be heard in the henequen fields and the thorn forest on any given rainy summer night.

Distribution per Frost (1985):  
*Tripriion petasatus* is found in the Pacific lowlands of Mexico; Yucatan peninsula of Mexico and Guatemala. *Tripriion spatulatus* is found in the Pacific lowlands of western Mexico.

**Reintroduction potential** - Data Deficient.

**Existence and viability of captive populations** - As of 2/29/99, ISIS reports 0.0.5 animals in one institution.

**Scientific and research potential** – Low.

**Number of other regional captive programs** - Other neotropical hylids in the plan at Priority 2-DERP are *Agalychnis callidryas* and *Phyllomedusa sauvegii*.

**Exhibit value** - Low. They are nocturnally active and cryptically colored.

**Husbandry Expertise** - Moderate. This species seems to be fairly easy to maintain in captivity, but there are no reports of captive breeding in the U.S.

**Educational Value** – Data deficient.

**Availability of potential founders** - It has been reported that *Tripriion petasatus* is being farmed in large outdoor enclosures in Mexico. This has not been verified by any site visit. To ensure legality, all institutions obtaining these animals should request copies of importation documents.

**Taxonomic uniqueness** - Moderate. The genus *Tripriion* contains two species. Duellman (1970) recognizes 2 subspecies of *T. spatulatus*. However, there are over 650 species of Hylidae.

**Potential to affect *in situ* conservation of species or ecosystem** - Low

**ATAG Recommendations:**

**Management category** – 5-II

**ATAG contact** – Jack Cover, National Aquarium in Baltimore, jcover@aquarium.org

**Basis for listing and comments**-

**Recommendations** - Attempts to acquire this taxon and develop husbandry expertise should not be discouraged. To ensure legality, all institutions

obtaining these animals should request copies of importation documents.

#### References -

Duellman, W. E. 1970. Monogr. Mus. Nat. Hist. University of Kansas, 1:629-637.

Frost, D. 1985. Amphibian Species of the World, A Taxonomic and Geographic Reference. Allen Press and Association of Systematic Collections, Lawrence, Kansas. p. 176.

Lee, J. 1996. The Amphibians and Reptiles of the Yucatan Peninsula, Cornell University Press

#### Leiopelmatidae: New Zealand Tailed Frogs (*Leiopelma* spp.)

##### Species Selection Criterion:

**Conservation status of the taxon** - The genus *Leiopelma* contains four described species limited in range to New Zealand (Halliday and Adler, 1986; Bell, Daugherty and Hay, 1998; Bell, Daugherty and Hitchmough, 1998). Introduced predators and food competitors have probably had a detrimental impact on *Leiopelma* (Bell, 1994; Thurley and Ben, 1994). *Leiopelma archeyi* and *Leiopelma hochstetteri* are listed as rare and *Leiopelma hamiltoni* is listed as vulnerable in the 1994 IUCN Red List (Groombridge 1993). In all likelihood *L. pakeka* will be listed as vulnerable by the IUCN because, like *L. hamiltoni*, its range is restricted to a single small island, Maud Island (Bell, Daugherty and Hay, 1998). *L. hamiltoni* is listed as endangered by the U.S.F.W.S.

**Reintroduction** - High. Adult *L. hamiltoni* have been experimentally translocated to a man made habitat. These animals have successfully bred and the locally produced young have been recruited into the population (Brown, 1994; Bell, 1994).

**Existence and viability of captive population** - High. *L. archeyi* has been bred in captivity (Bell, 1994; Obst et al, 1988). A captive population of *L. hamiltoni* has reproduced inside of a man-made structure which resembles its native habitat (Brown, 1994; Bell, 1994). None are held in ISIS reporting institutions as of June 1998.

**Scientific and Research Potential** - High. *Leiopelma* are extremely primitive distributional relicts, representatives of a group that was widespread during the Jurassic. They are unique among amphibians in possessing cartilaginous inscriptional ribs. *Leiopelma* spp. (along with *Ascaphus*) are unique amongst the anurans in having vestigial tail-wagging muscles (Cochran, 1961). The encapsulated eggs of *L. pakeka*, *L. archeyi* and *L. hamiltoni* are laid in terrestrial

situations and they undergo direct development (Duellman and Trueb, 1994). Larval development inside these capsules differs from free living larvae as they lack jaws and respiratory openings (Obst et al, 1988).

**Number of other regional programs** – No leiopelmatids are held in ISIS-reporting institutions.

**Exhibit Value** - Data deficient but probably low. Although attractively colored in green and golden browns, *Leiopelma* are highly secretive, strictly nocturnal frogs. They spend their days beneath and between large rocks (Newman, 1990; Sharell, 1966). Their small size (<2 inches) and cryptic coloration would make them difficult for the public to view in a dimly lit situation and they may be prone to stress under bright lights.

**Husbandry expertise** - Moderate. To the reviewer's knowledge, only New Zealand researchers have expertise.

**Educational Value** – Data deficient. Indications are that this animal will reproduce readily in captivity. Its mode of reproduction (large, encapsulated eggs with direct development) is unusual. They are one of many New Zealand endemics whose populations have been adversely impacted by introduced species. However, there are none in North American collections and it is unlikely that they will ever be available to determine if they could be used in outreach programs.

**Availability of potential founders** - Very difficult. These animals receive strict protection by New Zealand authorities (Obst et al, 1988),

**Taxonomic uniqueness** - The genus *Leiopelma* contains four described species all limited to New Zealand. Many of the primitive morphological characteristics described above are shared only with *Ascaphus*.

**Potential to affect *in situ* conservation of species or ecosystem** - Moderate. The new Zealanders have already developed the techniques to produce artificially constructed habitats that would allow for the establishment of satellite populations. However, an infusion of funds might be required for the production and protection of these habitats. Working with the New Zealanders on *in situ* conservation projects could facilitate AZA access to other interesting New Zealand endemics.

#### ATAG Recommendations:

**Management Category**- 5-II

**ATAG contact** - Craig S. Berg, Milwaukee Zoo, csb@csd.uwm.edu

**Basis for listing and comments** - AZA institutions interested in forming working relationships with New Zealand governmental and scientific entities would have the basis for a successful *in situ* project. Should *Leiopelma spp.* become available, their small size and limited home range (Bell and Bell, 1994) would make them ideal candidates for captive reproduction. This provides the basis of a captive reservoir. The interesting reproductive biology and history of *Leiopelma spp.* provides an interesting framework to bring home the endemics vs. exotics message to the general public. The methods have already been developed for a successful *in situ* conservation program. It can be used to draw attention to the problems associated with introduced species. It is a frog and the public likes frogs. It already receives considerable interest in New Zealand (Bell, 1994).

Although *Leiopelma pakeka* and *L. hamiltoni* would be difficult to acquire because of their status as endangered species, *L. archeyi* and *L. hochstetteri* may be more easily acquired. *Leiopelma archeyi* and *L. hochstetteri* have been used as models for *L. hamiltoni* in predation trials with Weka in New Zealand (Beauchamp, 1996).

The AZA and AZA institutions only stand to benefit from the P.R. of successful *in situ* conservation programs.

#### References -

- Beauchamp, A.J. 1996. Weka (*Gallirallus australis*) and *Leiopelma* frogs - a risk assessment. *Notornis* 43:59-65.
- Bell, B.D. 1994. A review of the status of New Zealand *Leiopelma* species (Anura: Leiopelmatidae), including a summary of demographic studies in Coromandel and on Maud Island. *New Zealand Journal of Zoology* 21(4):341-349.
- Bell, E.A., and B.D. Bell. 1994. Local distribution, habitat, and numbers of the endemic terrestrial frog *Leiopelma hamiltoni* on Maud Island, New Zealand. *New Zealand Journal of Zoology* 21(4):437-442.
- Bell, B.D., Daugherty, C.H., and J.M. Hay. 1998. *Leiopelma pakeka*, n.sp. (Anura: Leiopelmatidae), a cryptic species of frog from Maud Island, New Zealand and a reassessment of the conservation status of *L. hamiltoni* from Stephens Island. *Journal of the Royal Society of New Zealand* 28(1):39-54.
- Bell, B.D., Daugherty, C.H., and R.A. Hitchmough. 1998. The taxonomic identity of a population of terrestrial *Leiopelma*, (Anura: Leiopelmatidae), recently discovered in northern King Country, New Zealand. *New Zealand Journal of Zoology* 25(2):425-430.
- Brown, D., 1994. Transfer of Hamilton's frog, *Leiopelma hamiltoni*, to a newly created habitat on Stephens Island, New Zealand. *New Zealand Journal of Zoology* 21(4):437-442.
- Cochran, D.M. 1961. *Living Amphibians of the World*. Hamis Hamilton, London.
- Duellman, W.E. and L. Trueb. 1994. *Biology of the Amphibians*. John Hopkins University Press, Baltimore and London.
- Groombridge, B. 1993. 1994 IUCN Red List of Threatened Animals. IUCN, Gland, Switzerland.
- Halliday, T.R. and K. Adler. 1986. *All the Worlds Animals*. Torstar Books Inc., New York, NY.
- Newman, D.G. 1990. Activity, dispersion, and population densities of Hamilton's frog (*Leiopelma hamiltoni*) on Maud and Stephens Islands, New Zealand. *Herpetologica* 46(3):319-330.
- Obst, F.J., Richter, K. and U. Jacob. 1988. *The Complete Illustrated Atlas of Amphibians for the Terrarium*. TFH Publications, Neptune City, NJ.
- Sharell, R. 1966. *The Tuatara, Lizards and Frogs of New Zealand*. Collins, London
- Thurley, T. and B.D. Ben. 1994. Habitat distribution and predation on a western population of terrestrial *Leiopelma* (Anura: Leiopelmatidae) in the northern King County, New Zealand. *New Zealand Journal of Zoology* 21(4):431-436.

#### Leptodactylidae: Robber Frogs (*Eleutherodactylus spp.*)

#### Species Selection Criteria:

#### **Conservation status of the taxon –**

Threatened/Endangered. There are sixteen species of *Eleutherodactylus* in Puerto Rico. Of these, three are considered endangered by the US Fish & Wildlife or the PR Commonwealth Department of Natural Resources. Recent works by Joglar et al. (1996) and Joglar (1998) concludes that those same three species (*E. eneidae*, *E. jasperi*, *E. karlschmidti*) are very likely extinct. Not a single individual, of any of these species, has been observed or heard in the field since 1974, 1981, and 1990, respectively. Extensive work in the Luquillo Experimental Forest over the last twelve years by a large group of investigators (M. Stewart, D. Townsend, L. Woolbright, R. Joglar, P. Narins, P. Lopez, J. O'Brien, J. Martin de Camilo) has produced no evidence of any of these species in the forest.

Other species of *Eleutherodactylus* have population reduction trends over the last decade. Most noticeable was the local extinction of *E. portoricensis* at El Verde field station in the Luquillo Experimental Forest (Woolbright 1997). A similar result is reported by

Stewart (1995), where densities of *E. portoricensis* were relatively constant in the late 70's yet extremely low by 1988. After September 1989, when Hurricane Hugo struck the island, this species was restricted to the higher elevations (Stewart 1995, Woolbright 1997). *E. portoricensis* is the one of the best scientifically documented species seconded only by *E. coqui*. Similar patterns of population density reductions are also suggested for *E. gryllus*, *E. hedricki*, *E. locustus*, *E. richmondi*, and *E. wightmanae*. Two other species are considered at risk, *E. cooki* and *E. monensis*. Both of these occur in restricted habitat. One final species is *E. unicolor*, which although common in its current habitat, the cloud forest of the Luquillo Experimental Forest (Rivero 1998), is highly vulnerable to catastrophic events like hurricanes.

**Reintroduction potential** – Data deficient. The decline of *Eleutherodactylus* species in Puerto Rico involve some common denominators. All extinct and declining species share some common traits: 1) are highly specialized either morphological or ecological; 2) occur at higher elevations (Joglar et al. 1996). Both of these conditions lead to restricted habitat distributions. Electronic literature searches in biological, zoological, and ecological databases yielded no results concerning data on reintroduction or breeding programs on any of the threatened or endangered *Eleutherodactylus* species from Puerto Rico.

**Existence and viability of captive populations** – Low. None of the declining species are currently held in captivity. Literature searches yielded no papers on any of these species, thus is unlikely that captive breeding populations are held in universities.

**Scientific and research potential** – High. With the exception of *E. coqui* very little is known about the biology and ecology of *Eleutherodactylus*. Various aspects of this genus make it an attractive group to study (see Educational value section). From an evolutionary point of view this is the most species rich of all vertebrate genera and the primary evolutionary question still stands, why and how has this genus radiated in such a manner? Many aspects concerning reproductive biology of *Eleutherodactylus* are highly specialized making this an extremely unique genus. First and foremost, species in this group have direct development refers to the loss of the tadpole stage that characterizes most amphibians. Secondarily, a few species have internal fertilization. This makes *Eleutherodactylus* enter the realm of the so-called “higher vertebrates”. A few species take it a step further, retaining eggs in utero for long periods of gestation, again something not typical of “lower vertebrates”. The epitome of this evolution is *Eleutherodactylus jasperi* which is a viviparous species, the only one in the new world. Unfortunately, we lost *E. jasperi*, the one species that would have

shed the most light on this great story (Woolbright, 1997).

**Number of other regional captive breeding programs** – A captive breeding population of *Eleutherodactylus inoptatus* and *E. coqui* has been established at two North American zoo, the Toledo Zoo and Buffalo Zoo, respectively. Various research orientated captive breeding programs for *E. coqui* have been established and maintained in at least four higher education institutions: State University of New York, Albany (Margaret Stewart), Sienna College, NY (Lawrence Woolbright), Scranton University, PA (Daniel Townsend), University of Alabama, Birmingham (Scott Michael). No data on genetic diversity of these captive populations is available in the literature. Published guidelines on how to establish and maintain populations of *E. coqui*, *E. antillensis*, and *E. cochranae* exist already (Michael 1995, 1997).

**Exhibit value** – Low to Moderate. Small morphological sizes ranges: *E. antillensis* 23.4 - 29.2 mm, *E. brittoni* 16.7 - 17.2 mm, *E. cochranae* 19.4 - 21.8 mm, *E. eneidae* 22.8 - 25.6 mm, *E. gryllus* 16.9 - 17.0 mm, *E. hedricki* 32.8 - 34.6 mm, *E. jasperi* 19.4 - 19.5 mm, *E. karlschmidti* 50.7 - 48.2 mm, *E. locustus* 19.3 - 19.9 mm, *E. monensis* 26.2 - 34.4 mm, *E. portoricensis* 32.2 - 37.8 mm, *E. richmondi* 26.8 - 37.0 mm, *E. unicolor* 15.0 16.1 mm, *E. wightmanae* 19.1 - 20.3 mm (Joglar, 1998). Based on the relatively small size and cryptic coloration viewing on exhibit would be difficult. Alternatively, this could be used as an advantage given that with little effort you can maintain large population densities in multi-species displays. The light/dark cycle could then be reversed so male frogs calling choruses occurring during public exhibit hours (Narins 1995). This is usually a dramatic experience for someone who has never experienced such behavior. The unique dynamics of this genus gives it high potential as a educational tool. *Eleutherodactylus* can serve as a springboard to introduce tropical rainforest ecology, tropical ecosystem food web (Reagan et al. 1996, and references therein) and the need for preservation and conservation (see Educational value and Potential of affect *in situ* conservation of species or ecosystem).

**Educational value** – Data deficient. The small size of *Eleutherodactylus* may limit their usefulness in outreach programs. *Eleutherodactylus* is a unique genus comprise a wide diversity of reproductive specialization's including internal fertilization, a range of reproductive modes ranging from oviparous to viviparous, direct development of the embryonic young, male vocalizations and male parental care. Morphological features include characteristic toe pads enabling this genus to adhere onto slick surfaces yet in the aquatic species *E. karlschmidti* membranous webbing is located between the digits of the hind legs. The educational value of *E. coqui* is considered high (see separate review for this species). In the wild this species is abundant making it an attractive educational

tool to teach the uniqueness of this genus and the need for conservation efforts for other species.

**Availability of potential founders** – Data deficient. The Departamento de Recursos Naturales de Puerto Rico appears to be supportive of a captive-breeding program for *Eleutherodactylus richmondi*. Development of captive husbandry protocols with this species would prepare institutions for management of the rare and endangered forms, should the need arise.

**Taxonomic uniqueness** – Low. *Eleutherodactylus* is a species-rich genus with more than 600 species and many being described every year.

**Potential of affect *in situ* conservation of species or ecosystem** –High. Morphological coloration of frogs of the genus *Eleutherodactylus* are extremely cryptic within their natural environment. However, islanders consider the elaborate vocal communication systems including acoustically complex choruses, advertisement calling, territorial defense calling, to be highly charismatic characteristics. Geographic regions containing frogs in the genus *Eleutherodactylus* use this genus as an icon representative of the rainforest ecosystem, flora and fauna. The protection and conservation of these species allows for conservation efforts on a larger scale including species biodiversity and ecosystem preservation. It is actually the native population that has given this genus flagship status based on attributes discussed above (see also Educational value section).

#### **ATAG RECOMMENDATIONS:**

##### **Management category – 5-II**

**ATAG contact-** Jody E. Martin de Camilo, Research Department, Saint Louis Zoo and Saint Louis University (compiled for Jeff Ettling, St. Louis Zoo, ettling@stlzoo.org)

**Basis for listing and comments-** *Eleutherodactylus coqui* should be used as a surrogate species to develop husbandry and management protocols for other *Eleutherodactylus*. A review of long-term records of population densities depicts the alarming rate at some species are declining and even going extinct. *Eleutherodactylus jasperi*, the only viviparous frog species in all of the Neotropics was discovered in 1972, described in 1974 and is believed to have become extinct by 1981. That is less than a decade since its discovery.

**Recommendations** - Support fieldwork to learn more about this family. Attempts to acquire this taxon and develop husbandry expertise should not be discouraged. Develop a literature database on husbandry, reproductive biology, and habitat requirements and make it available via the Internet. Involve and collaborate with academic research institutions. Develop educational program describing

reasons for the protection and conservation of neotropical frogs with the ultimate goal being the conservation of the ecosystem, the tropical rainforests.

#### **References-**

- Joglar, R. L. 1998. Los coquíes de Puerto Rico su historia natural y conservación. Editorial de la Universidad de Puerto Rico, San Juan, Puerto Rico.
- Joglar, R. L. and P. A. Burrowes. 1996. Declining Amphibian Populations in Puerto Rico, p. 371-380. In R. Powell and R. W. Henderson (eds.), Contributions to West Indian Herpetology: A Tribute to Albert Schwartz. Society for the Study of Amphibians and Reptiles, Ithaca (New York). Contributions to Herpetology, volume 12.
- Michael, S. F. 1995. Captive breeding of two species of *Eleutherodactylus* (Anura: Leptodactylidae) from Puerto Rico, with notes on behavior in captivity. Herpetological Review 26 (1):27-28.
- Michael, S. F. 1997. Captive breeding of *Eleutherodactylus antillensis* (Anura: Leptodactylidae) from Puerto Rico, with notes on behavior in captivity. Herpetological Review 28 (3):141-142.
- Narins, P.M. 1995. Frog communication. Scientific American 273(2):78-83.
- Reagan, D. P. 1996. The role of amphibians and reptiles in a West Indian rain forest food web. Pp. 217-229 In R. Powell and R. W. Henderson (eds.), Contributions to West Indian Herpetology: A Tribute to Albert Schwartz. Society for the Study of Amphibians and Reptiles, Ithaca (New York). Contributions to Herpetology, volume 12.
- Reagan, D. P., Camilo, G. R., and Waide, R. B. 1996. The community food web: Major properties and patterns of organization. In D. P. Reagan and R. B. Waide (eds.) The food web of a tropical rain forest. University of Chicago Press, Chicago, IL.
- Rivero, J. A. 1998. Los anfibios y reptiles de Puerto Rico. Segunda edición. Editorial de la Universidad de Puerto Rico.
- Stewart M. M. 1995. Climate driven population fluctuations in rain forest frogs. Journal of Herpetology, 29 (3):437-446.
- Stewart M. M. and L. L. Woolbright. 1996. Amphibians. In D. P. Reagan and R. B. Waide (eds.) The food web of a tropical rain forest. University of Chicago Press, Chicago, IL.
- Woolbright L. L. 1997. Local extinctions of anuran amphibians in the Luquillo Experimental Forest of Northeastern Puerto Rico. Journal of Herpetology 31 (4):572-576.

**Microhylidae: North American Narrowmouth Toads (*Gastrophryne* sp.)**

**Species Selection Criterion:**

**Conservation status of the taxon-***Gastrophryne carolinensis* listed as Threatened in Kansas (Levell, 1995) and are included on Maryland's legally protected list (Levell, 1995). *Gastrophryne olivacea* is included in New Mexico's endangered species lists (Levell, 1995).

**Reintroduction potential-**Data deficient.

**Existence and viability of captive populations-** Currently, seven specimens are kept at one institution, as reported in ISIS (December 1998). Currently, these animals are not being bred (Jan Perry, personal communication, 1999).

**Scientific and research potential-**High. Few institutions have attempted to keep these animals.

**Number of other regional captive programs-***Gastrophryne olivacea* is the only member of the genus currently being kept at ISIS-reporting institutions. The only microhylids in the regional collection plan at a higher priority are the Madagascar tomato frogs, *Dyscophus antongilli* (1-PMP) and *D. guineti* (2-DEP).

**Exhibit value-** Low. These are small secretive animals that do not exhibit well (Jan Perry, personal communication, 1999).

**Husbandry expertise-**Low. These animals tend to be difficult to keep for long periods of time, usually dying after about six months (Jan Perry, personal communication, 1999).

**Educational value-** Data deficient. Although a common species, too little is known about its adjustment to captivity to determine if this would be a suitable taxon for outreach programs. Unique in that it has a fold of skin across the back of the head that can be pushed forward to wipe away insects that could attack the eyes (Conant and Collins, 332).

**Availability of potential founders-** Moderate. Currently seven specimens listed in ISIS abstracts (December 1998), acquiring additional wild-caught founders is a possibility.

**Taxonomic uniqueness-** Moderate. Although there are around 300 species of microhylids, the two species of *Gastrophryne* are endemic to North America. There is only one other genus, *Hypopachus* representing this family in North and Central America, although other family members are widespread, ranging in South America, Africa, Asia, the Indo-

Australian archipelago, and Australia (Conant and Collins, 332).

**Potential to affect *in situ* conservation of species or ecosystem-**Moderate. Symbiotic relationship with the tarantula could draw interest.

**ATAG Recommendations:**

**Management Category-** 5-II

**ATAG Contact-** Linda Greenup, Fort Worth Zoo

**Basis for listing and comments-** Interesting natural history, although not given higher priority due to the low captive maintenance success thus far. First, it is necessary to learn more about maintaining them in captivity, perhaps later focus on breeding.

**Recommendations-** Attempts to acquire this taxon and develop husbandry expertise should not be discouraged. Support fieldwork especially within protected areas.

**References-**

Conant, Roger and Joseph T. Collins. *Peterson Field Guides Reptiles and Amphibians Eastern/Central North America*. 1991. Houghton Mifflin Company, Boston. pp 332-335, maps 276-278, plate 45.

Duellman, William E. and Linda Trueb. *Biology of Amphibians*. 1986. McGraw-Hill Publishing Company.

Levell, John P. *A Field Guide to Reptiles and the Law*. 1995. Serpent's Tale Natural History Book Distributors. pp 101, 120, 162.

**Pelobatidae: North American Spadefoot Toads (*Scaphiopus* sp.)**

**Species Selection Criterion:**

**Conservation status of the taxon-***Scaphiopus holbrookii* is listed as Endangered in Connecticut (Levell, 1995), Threatened in Massachusetts (Levell, 1995), and is on the endangered species list in Ohio (Levell, 1995).

**Reintroduction potential-**Data deficient.

**Existence and viability of captive populations-**There are currently 4.3.31 *Scaphiopus* sp. reported in ISIS (December 1998).

**Scientific and research potential-** Moderate.

**Number of other regional captive programs-** The only other pelobatid in the regional collection plan is

the Malayan leaf frog, *Megophrys montana*, Priority 2-DERP.

**Exhibit value-**Moderate. Difficult to exhibit, as they are fossorial. Using an exhibit technique that only allows for burrowing at the front of the display usually ensures visibility of the animal (Jan Perry, personal communication, 1999).

**Husbandry expertise-**Moderate. Reasonably hardy animals, feeding on crickets and other small invertebrates (Jan Perry, personal communication, 1999).

**Educational value-** Moderate. An attractive anuran, reasonably hardy. It is probably more appropriate for outreach programs than for display due to its fossorial nature.

**Availability of potential founders-**Currently 4.3.31 in captivity (ISIS, December 1998) and would be relatively easy to acquire new founders from the wild, as members of this genus are abundant in parts of their ranges during the rainy season.

**Taxonomic uniqueness-** Moderate. There are approximately 90 pelobatids worldwide but *Scaphiopus* is the only genus of the family Pelobatidae to occur in the New World (Conant and Collins, 301).

**Potential to affect *in situ* conservation of species or ecosystem-**Moderate. It is not uncommon to see these animals in their ranges during the rainy season, so those people who live in such areas might already be familiar with them. These animals might serve as a “flagship” taxa for soil conservation and proper agricultural practices since they spend the majority of their lives buried in soil.

#### **ATAG Recommendations:**

**Management Category-** 5-II

**ATAG Contact-** Linda Greenup, Fort Worth Zoo

**Basis for listing and comments-**These animals probably have a degree of appeal to the general public and interesting natural history.

**Recommendations-** Attempts to acquire this taxon and develop husbandry expertise should not be discouraged. Support fieldwork to document status of wild populations especially within protected areas.

#### **References-**

Conant, Roger and Joseph T. Collins. *Peterson Field Guides Reptiles and Amphibians Eastern/Central North America*. 1991. Houghton Mifflin Company, Boston. p. 301.

Duellman, William E. and Linda Trueb. *Biology of Amphibians*. 1986. McGraw-Hill Publishing Company.

Levell, John P. *A Field Guide to Reptiles and the Law*. 1995. Serpent’s Tale Natural History Book Distributors. pp 52, 126, 174.

#### **Pelodytidae: Parlsev Frogs, (*Pelodytes punctuatus*, *Pelodytes caucasicus*)**

#### **Species Selection Criterion:**

**Conservation status of the taxon** - Not listed by CITES, USFWS, or IUCN. Though human encroachment is intense, *Pelodytes punctuatus* (much of western and South-Western Europe) and *P. caucasicus* (Southern Russia, Turkey) are wide-ranging and opportunistic. Although much of its range has been altered, these animals seem to adapt to urbanization. Protected areas exist in Russia (i.e. Caucasian State Biosphere Reserve, Sochi, Russia), where further habitat conservation programs are under investigation.

**Reintroduction potential** -Not needed. Wide-ranging.

**Existence and viability of captive populations** - Moscow holds 3.7 *Pelodytes caucasicus* (ISIS abstracts September 1998)

**Scientific and research potential** - Low.

**Number of other regional captive programs** – One species of *Pelodytes* is in captivity but not in an AZA-institution.

**Exhibit value** – Moderate to low. Modest sized frogs (maximum 5.0 cm). *P. punctuatus* has bright green markings. They are nocturnal and fossorial and may be difficult to exhibit.

**Husbandry expertise** – Data Deficient.

**Educational value** – Data deficient.

**Availability of potential founders** - Data deficient.

**Taxonomic uniqueness** – High. This family is comprised of one genus with two species.

**Potential to affect *in situ* conservation of species or ecosystem** - Low.

#### **ATAG Recommendations:**

**Management Category** – 5-II

**ATAG contact** - Karen Graham, Sedgwick County Zoo, herps@scz.org

**Basis for listing and comments** – Pelodytids are difficult to obtain even though the status of wild populations is believed to be good. One or more AZA institutions are encouraged to develop a captive husbandry and propagation program for this highly unique family of frogs

**Recommendations** – Although this taxon is not considered threatened in the wild, it is likely that local populations may be at risk so field efforts to monitor regional habitats should be supported. Attempts to acquire this taxon and develop husbandry expertise should not be discouraged.

#### References

Chubinsishvili, T., R K Gokhelashvili, and D N Tarkhnishvili. 1995. Population ecology of the Caucasian parsley frog (*Pelodytes caucasicus* Boulenger) in the Borjomi Canyon. Russian Journal of Herpetology 2(2) July-December 1995:79-86

Toxopeus, A.G., M. Ohm, J.W. Arntzen Reproductive biology of the parsley frog, *Pelodytes punctatus*, at the northern most part of its range. Amphibia-Reptilia 14 (1993): 131-147.

#### Pipidae: Table Mountain Clawed Frog (*Xenopus gilli*)

##### Species Selection Criterion:

**Conservation status of the taxon** - IUCN Red List: Vulnerable.

**Reintroduction potential** - Data deficient. *X. gilli* is a South African fynbos endemic that prefers the low pH environment of blackwater ponds. *X. laevis* is an invasive species that is now broadly sympatric with *X. gilli*. *Xenopus laevis* generally occupies clear, neutral waters and has been quick to exploit the roadside drainage ditches and ponds that intersperse among blackwater ponds. Though hybridization does occur, researchers are finding that *X. gilli* populations are not polluted by *X. laevis* within their preferred low pH habitat. Field studies failed to find *X. laevis* in typical *X. gilli* water bodies and laboratory investigation supports the suggestion that adults of each species actively select habitat, based on their differential tolerance of low pH (Picker, M.D., et al, 1993).

Molecular analysis suggests that two populations of *X. gilli* need to be recognized as separate management units (Evans, B. J., et al, 1997, 1998); a western population on the Cape Peninsula, and an eastern population 20 miles away, east of False Bay at Hangklip and Betty's Bay. Similar findings have been identified in lizard and land crab morphology in these regions, suggesting historic isolation of the Cape Peninsula from the mainland (personal communication, Ben Evans, 1999. Protected habitat is available for the western population at the Cape Point

nature Reserve\_, where reintroductions might be an option. No protection is allotted to the eastern population, and conservation measures are badly needed.

**Existence and viability of captive populations** - None listed in ISIS (September 1998). Jersey maintained a small group briefly. A population of captive animals may be available in the UK. Quentin Bloxam could look into this if interest exists.

**Scientific and research potential** – Moderate. Effects of low pH and tannin toxicity on *X. laevis* and *X. gilli* have been compared. Development of *X. gilli* has also been studied. A really interesting vocalization study on *X. laevis* were presented at the 1998 SSAR/IHIS meetings. Females were found to emit a fertility call, and several male/male vocalizations were determined. Zoos could replicate the lab portion of this study using *X. gilli*. Development of husbandry practices for blackwater species is needed.

**Number of other regional captive programs** - *Pipa pipa* is the only other pipid within the regional collection plan, Priority 2-DERP. *Xenopus laevis* is widespread in zoos due to its hardiness and could readily be replaced with *X. gilli*.

**Exhibit value** - Excellent. It will be difficult to get the point across that this is a different species than its common pet shop relative, so appropriate graphics are essential. Emphasis should be given to graphics that contrast the two animals and explain the significance in protecting the specialized species. They could also be used to demonstrate the concept of genetic isolation and speciation.

**Husbandry expertise** - Data deficient. Although *X. laevis* has been kept and reproduced very successfully, these artificially produced strains of a generalist species may be little indication of success rates with the more specialized, undomesticated *X. gilli*. Longevity records (Slavens, 1998) show one *X. gilli* achieving 9+ years whereas *X. laevis* have lived for 30+ years. *X. borealis* and *X. tropicalis* have been propagated at the IU Axolotl Colony, Indiana University. Four other species are listed in Slaven's longevity records. *Xenopus gilli* may thrive under similar husbandry conditions to *X. laevis* if water chemistry is adapted to simulate blackwater conditions.

**Educational value** - Moderate. Although it is likely that these would present not husbandry obstacles, if these animals prove to be difficult to maintain (and thus inappropriate for an education collection) *X. laevis* could actually be used by education departments to tell the story of invasive species and habitat loss, while *X. gilli* are displayed in the Herpetological collection.

**Availability of potential founders** - Difficult to acquire. Pure strain *X. gilli* may be available from one source in the UK (personal communication, Q. Bloxam, 1998). Locations of pure strain animals of two genetically distinct groups have recently been identified west at Cape Point Nature Reserve and east of False Bay. Permits for wild collection may be difficult to acquire and will likely only allow the exportation of a few specimens (personal communication, Dave Morgan, 1999).

**Taxonomic uniqueness** - High - Paleobatracha with highly specialized adaptations at the family level.

**Potential to affect in situ conservation of species or ecosystem** - Moderate to poor. Odd-looking anurans with unusual lifestyles make for charismatic displays. I should point out that the South African Zoo facilities do not share this view, and have not shown interest in obtaining specimens (personal communication, Dave Morgan, 1999). To use them as flagship species to promote protection of morphologically distinctive Cape inhabitants seems unlikely in an atmosphere where rhinos and other megavertebrates take precedence. A sympatric frog, *Microbatrachella capensis* is listed as endangered. Promoting the protection of the unique fynbos biome, including its inhabitants, might be more productive. As stated before, much of this area is already protected.

#### **ATAG Recommendations:**

**Management Category** – 5-II

**ATAG Contact:** Karen Graham, Sedgwick County Zoo, herps@scz.org

**Basis for listing and comments** - In 1994, the ATAG selected *X. gilli* as a possible substitute species for the numerous zoos currently holding *X. laevis*. At that meeting, Bill Branch outlined threats to the species, particularly the risk of hybridization with the invasive species, *X. laevis*. Recent research has revealed that hybridization is probably less of a threat than once believed, but that additional habitat protection is critical for the conservation of this species.

Bill suggested that *X. gilli* would be a good candidate for ATAG consideration and that South Africa would be sympathetic to a request for combined in situ and ex situ work including propagation programs. Dave Morgan is skeptical about our ability to obtain a population of these animals. Karen Graham was unable to reach Ernst Baarde (Western Cape wildlife official) or Mike Picker (University of Cape Town) for comment in 1999. Pending some measure of support from South Africa officials (i.e. issuance of a permit, interest in *in situ* cooperation), efforts may be pursued.

**Recommendations** - Attempts to acquire this taxon and develop husbandry expertise should not be discouraged.

#### **References**

Evans, B. J., J.C. Morales, M.D. Picker, D. B. Kelley, and D. J. Melnick, 1997. Comparative molecular phylogeography of two *Xenopus* species, *X. gilli* and *X. laevis*, in the southwestern Cape Province, South Africa. *Molecular Ecology* 6(4), April, 333-343.

Picker, M.D., C. J. McKenzie, and P. Fielding, 1993. Embryonic Tolerance of *Xenopus* (Anura) to Acidic Blackwater. *Copeia* 1993(4), 1072 - 1080.

#### **Ranidae: Goliath Frog (*Conraua goliath*)**

##### **Species Selection Criterion:**

**Conservation status of the taxon** –

**Reintroduction potential** – Data deficient

**Existence and viability of captive populations** – Low.

**Scientific and research potential** – High.

**Number of other regional captive programs** – *Conraua goliath* would potentially compete with programs for cryptobranchids and other stream-dwelling amphibians.

**Exhibit value** – High. The world's largest living frog, *Conraua goliath*, has generated tremendous interest at institutions that have exhibited live specimens.

**Husbandry expertise** – Low. *Conraua goliath* has been exhibited at several institutions in the past 25 years, but there has been no successful propagation efforts in zoos. Mortality of imported specimens has been higher than the acceptable risk level of many institutions, and efforts by the Lincoln Park Zoo and Brookfield Zoo have determined that proactive zoo participation is essential rather than relying on "animal dealers" alone. The space needed to hold a population large enough to serve as a genetic reservoir is far more than most institutions are currently capable of providing.

**Educational value** – Data deficient. Until the husbandry challenges around this species are resolved, it cannot be recommended for outreach programs.

**Availability of potential founders** – Difficult to acquire.

**Taxonomic uniqueness** – Moderate.

**Potential to affect *in situ* conservation of species or ecosystem** – Moderate.

#### **ATAG Recommendations:**

**Management Category – 5-II****ATAG contact** – Kevin Wright**Basis for listing and comments –**

As early as 1990 Andrea Gaski, TRAFFIC USA-World Wildlife Fund, expressed concern over the number of *Conraua goliath* arriving from Cameroon. If any status reports are available they should be forwarded to WWF. Lincoln Park, Brookfield, and Milwaukee Zoos have expressed an interest in acquiring *Conraua* as a cooperative effort and in determining the sex of live animals. Celioscopy has been used to sex these frog but ultrasonography may prove an effective (and less traumatic) technique. Frank Slavens reports that females may be differentiated from males by the texture of the skin on their sides (personal communication, 2000). None are listed in ISIS as of December 1997.

In the early 1990's, Brookfield Zoo had approached the ATAG for support for the acquisition of *Conraua goliath*. The ATAG was uncomfortable with the nature of the acquisition process and regards this a matter for individual zoos to consider.

**Recommendations** – Support fieldwork to learn more about this species. Attempts to acquire this taxon and develop husbandry expertise should not be discouraged.

If there is conclusive evidence that wild populations are declining, it may become an ATAG priority species. For this reason, the ATAG would encourage institutions to work in a responsible and ethical manner with this species.

**References –****Rhacophoridae: Flying Frogs**

This taxon was not evaluated. It will be evaluated by the ATAG meeting in 2001. Lee Jackson (Brookfield Zoo) has agreed to review the taxon.

**Rhinodermatidae: Darwin's Frogs (*Rhinoderma* sp.)****Species Selection Criteria:**

**Conservation status of the taxon** - Data deficient. This family is restricted to temperate forests in southern Chile and Argentina (Duellman and Trueb 1986).

**Reintroduction potential** - Data deficient.

**Existence and viability of captive populations** – Date Deficient. None listed on ISIS (current 2/24/99).

None known to be currently held in any zoo or aquarium collections.

**Scientific and research potential** - High. This anuran has a highly specialized form of parental care wherein the adults brood eggs and tadpoles in specialized diverticula of the oropharynx.

**Number of other regional captive programs** – No rhinodermatids are listed in ISIS institutions (1999).

**Exhibit value** - Data deficient.

**Husbandry Expertise** - Low. Imported specimens have been short lived possibly due to transport stress and exposure to inappropriately warm temperatures. Captive care suggestions are given by Schulte (1980). Field data is given by Meier (1979). Also see Boris (1986), and Cooper et al. (1978).

**Educational Value** – Data deficient. The current state of husbandry of this taxon precludes speculation about suitability for outreach programs. However, due to the unique morphology and parental care of this taxon, there are a number of artifacts and audiovisual materials that could be developed.

**Availability of potential founders** - Difficult to acquire. In the past, sporadic exports to commercial herp dealers have occurred. Specimens from these imports were short-lived.

**Taxonomic uniqueness** - High. There is one genus with two species in the family (Duellman and Trueb 1986).

**Potential to affect *in situ* conservation of species or ecosystem** - Data deficient.

**ATAG Recommendations:**

**Management category** - 5-II

**ATAG contact** - Jack Cover, National Aquarium in Baltimore, jcover@aqua.org

**Basis for listing and comments** – Rhinodermatids are not currently held in captive populations and would be difficult to obtain. However, this highly unique family of frogs has a poorly understood suite of anatomic, behavioral and physiological adaptations that should be studied. One or more institutions are encouraged to develop a captive husbandry and propagation program for this taxon.

**Recommendations** - Attempts to acquire this species and develop husbandry expertise should not be discouraged.

**References** -

Cooper, J. E.; J. R. Needham and J. Griffin. 1978. A bacterial disease of the Darwin's frog, *Rhinoderma darwini*. Lab Anim.; 12(2): 91-93.

Duellman, W. E. and L. Trueb. 1986. Biology of Amphibians. McGraw-Hill, New York. xvii + 670 pp.

Jorquera, Boris. 1986. Biology and reproduction of the genus *Rhinoderma*. An Mus. Nat. Hist. (Valparaiso); 17: 53-62.

Schulte, R. 1980. Frosche und Kroten: Tropische und Einheimische Froschlurche im Terrarium. Verlag Eugen Ulmer, Stuttgart, Germany. p. 210-211.

**Rhinophrynidae: Mexican Burrowing Toad**  
**(*Rhinophrynus dorsalis*)**

**Species Selection Criterion:**

**Conservation status of the taxon-***Rhinophrynus dorsalis* is listed as Threatened in Texas (Levell, 1995). Its status in Mexico and Central America is unknown but likely to be locally abundant in suitable habitat.

**Reintroduction potential-**Data deficient.

**Existence and viability of captive populations-**Data Deficient. There are no *Rhinophrynus dorsalis* reported in ISIS (December 1998).

**Scientific and research potential-** Data Deficient.

**Number of other regional captive programs-**No rhinophrynids are listed in ISIS-reporting institutions (December 1998).

**Exhibit value-**Data Deficient. This animal spends much of its time underground.

**Husbandry expertise-**Data deficient.

**Educational value-** Data Deficient.

**Availability of potential founders-**Difficult to Acquire. There are none listed in ISIS, and would be somewhat difficult, although not impossible, to obtain from the wild. Collection would depend of emergence of breeding specimens during infrequent rains.

**Taxonomic uniqueness-** High. This is the only living representative of its family.

**Potential to affect *in situ* conservation of species or ecosystem-** Data Deficient.

**ATAG Recommendations:**

**Management Category-** 5-II

**ATAG Contact -** Linda Greenup, Fort Worth Zoo

**Basis for listing and comments** – Rhinophrynids are not currently held in captive populations and would be difficult to obtain. However, this is a highly unique family of frogs that ranges into the United States, so it may be worthwhile for one or more institutions to develop a captive husbandry and propagation program for this taxon.

**Recommendations** - Support fieldwork to document status of wild populations especially within protected areas. Attempts to acquire this taxon and develop husbandry expertise should not be discouraged.

**References-**

Duellman, William E. and Linda Trueb. *Biology of Amphibians*. 1986. McGraw-Hill Publishing Company.

Levell, John P. *A Field Guide to Reptiles and the Law*. 1995. Serpent's Tale Natural History Book Distributors. p 202.

**Taxon: Sooglossidae: Seychelle's Frogs**

**Species Selection Criterion:**

**Conservation status of the taxon-**Data deficient. Threatened but status indeterminate (Halliday & Adler, 1986). Sooglossids are restricted to the Seychelle Islands and are subject to the same population threats affecting other insular species.

**Reintroduction potential-**Data deficient. There have been no published reports of reintroduction.

**Existence and viability of captive populations-**Data deficient. There are no members of the family Sooglossidae reported in ISIS (December 1998).

**Scientific and research potential-**Low, since there are no captive populations.

**Number of other regional captive programs-** No sooglossids are in captivity.

**Exhibit value-**Data deficient.

**Husbandry expertise-**Data deficient.

**Educational value-**Data deficient.

**Availability of potential founders-**Difficult to acquire.

**Taxonomic uniqueness-** High. This is a family with few representatives, three species in two genera. Range is restricted.

**Potential to affect *in situ* conservation of species or ecosystem-** Low. *Geochelone gigantea* is from the Seychelles, as well, and is more likely to appeal to zoo visitors as a “flagship” species. However, since Sooglossidae depends on adequate soil and water quality, they may be important “flagship” animals for soil and water conservation and appropriate agricultural practices.

**ATAG Recommendations:**

**Management Category-** 5-II

**ATAG Contact-** Linda Greenup, Fort Worth Zoo

**Basis for listing and comments-** Sooglossids are not currently held in captive populations and would be difficult to obtain. However, since this is a highly unique family of frogs restricted to a few small islands, it may be worthwhile for one or more institutions to develop captive husbandry and propagation programs for one or more taxa of sooglossids.

**Recommendations- Attempts to acquire this taxon and develop husbandry expertise should not be discouraged.** Support fieldwork to learn more about this family. Attempts to acquire this taxon and develop husbandry expertise should not be discouraged.

**References-**

Duellman, William E. and Linda Trueb. *Biology of Amphibians*. 1986. McGraw-Hill Publishing Company. p. 528.

Halliday, Tim and Kraig Adler, eds. 1986. *The Encyclopedia of Reptiles and Amphibians*. Facts on File Inc. pp 52 and 55.