

Regional Collection Plan

AZA Lizard Advisory Group

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The Association of Zoos and Aquariums (AZA) formed the Lizard Taxonomic Advisory Group (LAG) in 1990. Under the oversight of AZA's Wildlife Conservation and Management Committee, Taxon Advisory Groups (TAGs) provide informed advice on their specific taxonomic group of animals to guide collection management of North American zoological institutions. A Taxon Advisory Group's main purpose is to examine the conservation and exhibition needs of the entire taxa. Each TAG consists of AZA Species Survival Plan coordinators, studbook keepers, institutional representatives, and other individuals with special expertise on one or more of the species covered by the TAG.

Mission Statement

The LAG's mission is to guide AZA institutions in the selection of lizard species that are of high priority for cooperative management and conservation, and to facilitate information exchange between AZA institutions. Its specific objectives are to:

- Identify lizard species in greatest need of conservation action based on their population status in the wild.
- Identify lizard species that have high exhibit and educational value to AZA institutions.
- Create management programs to ensure sustainable captive populations of priority species. This includes creating and maintaining studbooks and implementing Species Survival Plans (SSPs).
- Document husbandry protocol through Animal Care Manuals (ACM) for selected species.
- Maintain a website (www.lizardtag.com) to disseminate current husbandry and propagation techniques for managed species and provide links to appropriate agencies and NGOs as a primer for AZA institutions interested in lizard conservation projects.
- Enhance cooperative interaction among zoos and aquariums and the private sector to increase the size of managed populations, pool information and focus conservation efforts.

Although the LAG's primary function is to identify species and manage captive populations that meet the objectives listed above, we recognize that there are many other lizard species of interest to curators. We do not intend to stifle individuality in zoological collections and have not recommended against keeping particular species. For managed programs to succeed, however, it is critical that institutions dedicate space and resources over the long-term. This RCP is a menu of options for institutional participation and we encourage directors, curators, and collection managers to prioritize LAG program species in their collection plans. We will continue to promote, evaluate and revise these programs as needed to maximize their success and sustainability.

Operating Structure

The LAG Steering Committee consists of a Chair, Vice Chair, Secretary and eight additional voting members. Committee member positions are elected for three-year terms, which are staggered into groups of three, and four (the Chair is a standing position). Notices announcing vacant committee positions will be posted on the LAG List Server and any Institutional Representative may be nominated, with their permission, as a candidate for vacant positions. Only Institutional Representatives can serve on the committee and only IR's can vote for new committee members.

2012 Officers:

- Chair: Brian Aucone, Denver Zoo
baucone@denverzoo.org; (720) 337-1643
- Vice Chair: Chad Peeling
- Secretary: Open position

2012 Steering Committee Contacts:

(Terms Ending 2012)

- Chad Peeling, Clyde Peeling's Reptiland
chad@reptiland.com; (570) 538-1869
- Ruston Hartdegen, Dallas Zoo
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- Diane Barber, Fort Worth Zoo
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- Dale McGinnity, Nashville Zoo
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- Jan Johnson, Arizona-Sonora Desert Museum
jjohnson@desertmuseum.org; (520) 883-3075
- Jessi Krebs, Omaha's Henry Doorly Zoo
jkrebs@omahazoo.com; (402) 557-6931
- Kevin Murphy, Philadelphia Zoo
murphy.kevin@phillyzoo.org; (215) 243-5679
- Vacant Position

Taxonomic Purview & Conservation Status

The LAG is responsible for evaluating all squamates except snakes. Lizards comprise more than 50% of the extant species of non-avian reptiles, with some 4,700 described species. Despite their ubiquity, the ecology, life history, and conservation status of most lizard species is poorly known, but habitat loss has clearly led to declines in some areas. This Regional Collection Plan (RCP) focuses on a small number of lizard taxa for which cooperative population management would directly benefit conservation in the wild or ensure future exhibit/education animals for zoo and aquarium collections. A list of the species included in this RCP, along with their conservation status as known, is provided in Appendix I.

Our Limitations

Space is clearly *the* limiting factor in captive population management and AZA institutions simply cannot manage sustainable populations for the majority of taxa represented in our living collections. The number of species under threat in the wild also vastly outstrips our resources for maintaining ex situ assurance colonies. It is essential that we acknowledge this limitation and focus efforts on a small number of species for which we can make a difference.

It is also important that species selected for cooperative management remain attractive to a significant proportion of zoological institutions over time. As curatorial staff changes, living collections naturally evolve and there is a tendency for species to fall out of fashion. Cooperatively managed species must address the needs and goals of *institutions*, rather than depending entirely on the interests and efforts of individual champions.

Our Needs

Acquisition / Disposition Flexibility

Population management requires a means to deal with surplus offspring and the trend toward more restrictive institutional disposition policies threatens to cripple our collective sustainability. AZA institutions cannot manage populations in complete isolation, because successful populations inevitably produce surplus offspring that swamp available space with limited genetic diversity (this is particularly true of live-bearing lizards). Disposition policies must allow population managers reasonable flexibility to cull and/or disperse surplus animals outside AZA in a responsible manner.

The LAG steering committee recognizes that animal disposition is laden with ethical, legal, and public relations dilemmas, but we encourage institutions to approach these issues rationally and balance risk aversion with constraining the ability of collection managers to function. Exchanging surplus animals with non-AZA facilities, while exercising due diligence to ensure animal welfare and public safety, is in line with AZA's published acquisition/disposition policies. We have included a sample document used for vetting non-AZA entities prior to animal disposition (see Appendix II).

Dedicated Holding Space

The LAG steering committee is sensitive to the economic realities faced by zoos and aquariums and we have attempted to select species that fit within existing facilities. However, sustainable populations require some dedicated off-exhibit space and this is sorely lacking for lizards in most zoos and aquariums. We have outlined off-display holding requirements for each managed species below as a planning tool.

Why Bother?

Future availability of some key exhibit and education species is in doubt. If we are not able to maintain sustainable populations of these species, they may disappear from zoo and aquarium collections in the foreseeable future. We also have an ethical responsibility to limit our take from the wild wherever possible. Where captive populations can make a bona fide contribution to in situ lizard conservation (i.e. reintroductions) we must be able to respond.

To address the realities outlined above (see “Sustainability in Lizard Collections”), the LAG steering committee took a new approach to the species selection process, based entirely on population sustainability. We established two narrow criteria that justify cooperative captive population management: direct support of field conservation programs and ensuring future availability of flagship exhibit/educational species in zoological collections.

Species managed for support of field conservation programs must have a direct and realistic link between captive animals and the wild population. This requires that repatriation of captive animals be ongoing or likely in the foreseeable future. Assurance colonies without a direct link to wild populations, or lacking a realistic plan, do not qualify for management as conservation programs, because the number of species under threat in the wild far outstrips our ability to maintain sustainable assurance populations.

Species managed to ensure availability of flagship exhibit/educational populations must be used in exhibition/education programs by a significant proportion of zoos and aquariums; considered keystone species for zoo and aquarium exhibit and/or educational programming; and not be available through other legal and ethical sources. This excludes species that are of narrow exhibit or research interest, those which are widely bred in the private sector, and species with robust wild populations where specimens may be sustainably taken into captivity legally.

All taxa in the RCP were evaluated against these criteria by asking a series of poignant questions:

Evaluating Species Managed for Support of Field Conservation Programs

- Does a head-start / release program exist?
- Is an assurance colony warranted and practical?
- Can the species be returned to the wild in the foreseeable future?
- Are there an adequate number of potential founders?
- Are the space requirements and number of institutions needed beyond our means?
- Is there substantial evolutionary distinctiveness?
- Is the species indigenous to the Americas (regional focus)?
- Are there listings from government agencies supporting endangerment?

Evaluating Species Managed to Ensure Availability of Exhibit/Educational Populations

- Is there widespread institutional interest adequate to support a managed population?
- Is the species hardy and visible on exhibit?
- Is there adequate reproduction in zoos/aquariums?
- Is the species likely to be available from the private sector?
- Does the species have visitor appeal?
- Is there a compelling story, broadly significant to AZA institutions?
- Is there substantial morphological / behavioral distinctiveness?
- Does the species fulfill common institutional exhibit size / zoogeographic needs?
- Is the species useful as an outreach / program animal?

Many of these evaluation questions are subjective and answering them requires the experience and opinions of experts. A dicotomous decision tree would not accurately represent the process involved, because answers are often not clear-cut. Extensive research, discussion among steering committee members and consultation with population managers and academic herpetologists was required. Ultimately the evaluations remain subjective, but they represent the best judgement of the steering committee, a body of professional zoo herpetologists elected to represent the AZA community.

Evaluating 4,700 species of lizards individually is a practical impossibility. We narrowed our evaluations to those species currently held in captivity and those for which bona fide field conservation efforts are underway or likely in the foreseeable future. Many species were quickly eliminated from consideration based on their widespread reproduction and availability in the private sector. Other large groups were eliminated based on paucity of data about their status in the wild or lack of foreseeable restoration of protected habitat. Absence of adequate husbandry knowledge and inability to acquire specimens were also disqualifiers.

The results of our evaluation are summarized in table 1. Detailed information and justifications for each species selected are included in the Managed Population Accounts section below.

Table 1: Species Selected for Management

Managed to Support Field Conservation Programs

| Family | English Name | Taxon |
|----------------|------------------------------|--|
| Anguidae | Haitian giant galliwasp | <i>Celestus warreni</i> |
| Helodermatidae | Motagua Valley beaded lizard | <i>Heloderma horridum charlesbogerti</i> |
| Iguanidae | Jamaican Iguana | <i>Cyclura collei</i> |
| Teiidae | Caiman Lizard | <i>Dracaena guianensis</i> |
| Varanidae | Komodo dragon | <i>Varanus komodoensis</i> |

Managed for Exhibit & Education Programs

| Family | English Name | Taxon |
|-----------------|----------------------------|---------------------------------------|
| Gekkonidae | Satanic leaf-tailed gecko | <i>Uroplatus phantasticus</i> |
| Gekkonidae | Giant leaf-tailed gecko | <i>Uroplatus fimbriatus</i> |
| Gekkonidae | Henkel's leaf-tailed gecko | <i>Uroplatus henkeli</i> |
| Gekkonidae | Lined leaf-tailed gecko | <i>Uroplatus lineatus</i> |
| Gekkonidae | Mossy leaf-tailed gecko | <i>Uroplatus sikorae</i> |
| Helodermatidae | Rio Fuerte beaded Lizard | <i>Heloderma horridum exasperatum</i> |
| Iguanidae | Fiji Island banded iguana | <i>Brachylophus fasciatus</i> |
| Iguanidae | Grand Cayman blue iguana | <i>Cyclura lewisi</i> |
| Iguanidae | San Esteban chuckwalla | <i>Sauromalus varius</i> |
| Phrynosomatidae | Texas Horned Lizard | <i>Phrynosoma cornutum</i> |
| Scincidae | Prehensile Tailed Skink | <i>Corucia zebrata</i> |
| Shinosauridae | Crocodile Lizard | <i>Shinosaurus crocodilurus</i> |
| Varanidae | Black tree monitor | <i>Varanus beccarii</i> |
| Varanidae | Crocodile monitor | <i>Varanus salvadorii</i> |

Sustainability Scores

Each selected species was assigned to one of three AZA population management levels: Green SSP, Yellow SSP, or Red Studbook (see Appendix III for definitions). These designations describe the overall sustainability of the population and delineate the policies under which the population must be managed (see Appendix IV for AZA Program Policies Overview).

Sustainability scores were not formally tabulated for all species, because the size of the captive populations was the determining metric in assigning management levels. A list of current AZA holdings for each species, target population sizes (where determined), specific goals, and the management levels assigned are listed in Table 3 below. Program objectives and challenges are described in each Managed Population Account.

Space Assessment

We did not conduct a formal space survey, because experience with previous surveys has shown them to be of little value in determining how much space will *actually* be dedicated to managed populations. Instead, we assessed the space currently given to each taxa in AZA facilities, historical curatorial interest in the species, and how well the species fits with existing facilities in North American zoos and aquariums.

| Table 2: Animal Program Summary | | | | | | | | | | | |
|--|-------------------------------|--------------------|----------------------------|----------------------|---------------------|------------------------|-----------------------------|---------------------------------|---------------------------|---|---|
| Common name (taxon) | Last Breeding / Transfer Plan | Current Population | Participating Institutions | Sustainability Score | Program Designation | Target Population Size | Target Sustainability Score | Space Needed (target - current) | 5-year Population Trend | USFWS / IUCN / CITES | Goals (1-3) |
| Haitian giant galliwasp (<i>Celestus warreni</i>) | Not Completed | 68.71.158 | 13 | Not assessed | Red Studbook | Not assessed | Not assessed | Not assessed | Stable | Not Listed Not Listed Not Listed | - Begin re-introduction at Citadel in Haiti - Increase isolation space - Plan for surplus offspring |
| Satanic leaf-tailed gecko (<i>Uroplatus phantasticus</i>) | February, 2011 | 23.27.3 | 7 | 4.76 | Yellow SSP | 75 | 90% | 22 | Poor reproductive success | Not listed Least concern CITES II | - Acquire more founders - Mitigate high mortality - Breed existing founders |
| Giant leaf-tailed gecko (<i>Uroplatus fimbriatus</i>) | February, 2011 | 46.51.0 | 10 | 31.6% | Yellow SSP | 100 | 90% | 3 | Stable | Not listed Least concern CITES II | - Acquire more founders - Breed existing founders - Improve reproduction across institutions |
| Henkel's leaf-tailed gecko (<i>Uroplatus henkeli</i>) | February, 2011 | 62.40.6 | 11 | 27% | Yellow SSP | 150 | 90% | 42 | Stable | Not Listed Vulnerable CITES II | - Acquire more founders - Reverse male bias in pop - Move out over-represented individuals |
| Lined leaf-tailed gecko (<i>Uroplatus lineatus</i>) | February, 2011 | 17.24.0 | 8 | 6% | Red Studbook | 65 | 90% | 24 | Stable | Not listed Least concern CITES II | - Acquire more founders - Breed existing founders - Improve reproduction across institutions |
| Mossy leaf-tailed gecko (<i>Uroplatus sikorae</i>) | February, 2011 | 33.25.11 | 7 | 1% | Yellow SSP | 75 | 90% | 6 | Limited improvement | Not listed Least concern CITES II | - Acquire more founders - Mitigate high mortality - Breed existing founders |
| Rio Fuerte beaded lizard (<i>Heloderma horridum exasperatum</i>) | June, 2012 | 23.25.23 | 24 | 85.4 | Yellow SSP | 175 | 97.92% | 104 | Steady | Not Listed Vulnerable CITES II | - Replace other subspecies to make space - Sex unknown animals - Breed remaining founders |

Table 2: Animal Program Summary (continued)

| Common name (taxon) | Last Breeding/ Transfer Plan | Current Population | Participating Institutions | Sustainability Score | Program Designation | Target Population Size | Target Sustainability Score | Space Needed (target - current) | 5-year Population Trend | USFWS/IUCN/ CITES | Goals (1-3) |
|---|---------------------------------|-----------------------|-------------------------------|-------------------------|------------------------|---------------------------|--------------------------------|------------------------------------|---|--|--|
| Motagua Valley beaded lizard (<i>Heloderma horridum charlesbogerti</i>) | June, 2012 | 7.5.2 | 1 | 18.68 | Red Studbook | 50 | 95.83% | 36 | Stable - little reproduction | Not listed Vulnerable CITES II | - Add founders - Improve reproduction - Replace other subspecies to make space |
| Fiji Island iguana (<i>Brachylophus bulabula</i>) | August, 2009 | 39.23.0 | 15 | Not assessed | Yellow SSP | Not assessed | Not assessed | Not assessed | Steady | Endangered Endangered CITES I | - Move animals to other institutions |
| Jamaican iguana (<i>Cyclura collei</i>) | September, 2009 | 11.22.0 | 7 | 8.04 | Red Studbook | 45.45.25 | N/A | 82 | Recent reproduction | Endangered Critical CITES I | - Support in situ efforts - Breed potential founders - Improve reproduction |
| Grand Cayman blue iguana (<i>Cyclura lewisi</i>) | Not Completed | 23.21.0 | 14 | N/A | Red Studbook | N/A | N/A | Not assessed | Increasing reproduction | Endangered Critical CITES I | - Support in situ efforts - Improve reproduction - Recruit additional institutions |
| San Esteban chuckwalla (<i>Sauromalus varius</i>) | July, 2011 | 24.34.26 | 18 | 88.18 | Yellow SSP | 50.50.50 | 96.41 | 66 | Steady | Endangered Not listed CITES I | - Add institutions - Add founders |
| Texas horned lizard (<i>Phrynosoma cornutum</i>) | Not Completed | 15.11.63 | 6 | Not assessed | Red Studbook | Not assessed | Not assessed | Not assessed | Recent reproduction & husbandry | Not Listed Not Listed Not Listed | - Add institutions - Improve reproduction - Genotype new potential founders |
| Prehensile-tailed skink (<i>Corucia zebrata</i>) | Not Completed | 99.92.125 | 96 | Not assessed | Yellow SSP | Not assessed | Not assessed | Not assessed | Steady | Not Listed Not Listed CITES II | - Revitalize institutional interest - Identify all animals - Pair similar animals |
| Crocodile lizard (<i>Shinosaurus crocodilurus</i>) | Not Completed | 46.35.54 | 22 | Not assessed | Yellow SSP | Not assessed | Not assessed | Not assessed | Steady | Not Listed Not Listed CITES II | - Sex all adult animals - Reproduce all founders |
| Caiman lizard (<i>Dracaena guianensis</i>) | Not Completed | 20.12.28 | 21 | Not assessed | Red Studbook | Not assessed | Not assessed | Not assessed | Recent reproduction | Not Listed Not Listed CITES II | - Acquire addition founders - Reproduce all founders - Add aquarium partners |
| Black tree monitor (<i>Varanus beccarii</i>) | Not Completed | 23.13.6 | 13 | Not assessed | Red Studbook | Not assessed | Not assessed | Not assessed | Slowly increasing | Not Listed Not Listed CITES II | - Refine breeding methods - Reverse male bias |
| Komodo dragon (<i>Varanus komodoensis</i>) | May, 2012 | 65.38.2 | 46 | 41 | Yellow SSP | 115 | N/A | 10 | Increasing - 10 new founders & much recent reproduction | Endangered Vulnerable CITES II | - Find solutions to female reproductive disorders |
| Crocodile monitor (<i>Varanus salvadorii</i>) | N/A | 22.12.12 | 21 | Not assessed | Red Studbook | Not assessed | Not assessed | Not assessed | Slowly increasing | Not Listed Not Listed CITES II | - Recruit more institutions - Refine breeding methods |

Satanic Leaf-tailed Gecko

Uroplatus phantasticus

(written by Sean Foley)

Species Summary:

As one of the finest masters of leaf mimicry in the animal world, *U. phantasticus* is a fascinating lizard that displays well, exemplifies the unique biodiversity of Madagascar, and illustrates the plight of rain forest fauna which is undergoing unrelenting loss of habitat in much of the world.

Program Purposes:

Uroplatus phantasticus is listed in CITES Appendix II and as a species of least concern in the IUCN red data list. Although this gecko is considered locally abundant, can be found in a few protected areas, and has shown a limited ability to use degraded forests, its habitat is under continued threat by logging, agriculture, and cattle grazing (Ratsoavina, et. al.). For the last few years, the quota for wild caught *U. phantasticus* has been zero to 100, making it very difficult and expensive to acquire this species. Captive bred animals are occasionally available from Europe and the private sector in the United States, but not in numbers that would meet the needs of AZA institutions. Currently, a decent captive population does exist in zoos and aquariums, and to ensure that geckos will be available in the future for exhibit and educational programs, this species needs to be managed.

Currently no conservation programs are planned for this species and re-introduction is unlikely for the foreseeable future. The only hope for wild populations will be the preservation of suitable habitat.



Photo by Sean Foley, Riverbanks Zoo

Exhibit Qualities:

Although the satanic leaf-tailed gecko may get its name from the small horn-like projections over its eyes, this lizard is more renowned for its incredible ability to mimic dead leaves and twigs with its tail and legs. Few animals can rival *U. phantasticus* for bizarre appearance and amazing camouflage, characteristics that help make this gecko an effective exhibit species. The most eye-catching displays are naturalistic in design and include multiple animals in a mixed species exhibit. *Uroplatus phantasticus* has been successfully maintained with the spear-point leaf-tailed gecko (*Uroplatus ebenauui*) and various species of mantella frogs

(*Mantella* sp.) It should also pair well with several of the smaller day geckos that are readily available such as the gold dust day gecko (*P. laticauda*) and the peacock day gecko (*P. quadriocellata*). Although this is a nocturnal species, it is usually visible at all times of the day, especially if multiple animals are on display.

Educational Qualities:

Uroplatus phantasticus fits nicely into programs discussing specialized gecko adaptations, island endemism, defense tactics, and deforestation. These geckos do not generally accept much handling although certain individuals may be more tolerant than others.

Interpretive Messages:

- Island endemism
- Camouflage - leaf and twig mimicry
- Nocturnal nature
- Deforestation
- Gecko adhesion – Van der Waals force

Care and Facilities:

Although *Uroplatus phantasticus* is not for beginners, most AZA facilities should be able to properly care for this gecko. To accommodate a group (4+ lizards) of satanic leaf-tailed geckos by themselves or mixed with other species, an exhibit approximately 2' tall x 2' wide x 2' deep will be needed. If only displaying a single gecko or only a pair of animals, the exhibit may be as small as a 10 gallon aquarium. Off-exhibit housing should be available in case animals need to be separated and treated for health issues or for any offspring that may be produced. A number of twiggy branches, some with dead leaves still attached, should be used for daytime perches. Various tropical plants such as small *Ficus*, ferns and bromeliads should also be employed for aesthetics as well as additional refugia. The substrate should be well-drained and damp but never wet as this may encourage mold or bacterial growth. Most leaf-tailed geckos are prone to bacterial infections in captivity so good ventilation and daily cleaning are essential to prevent problems. A 5-6" layer of soil mixed with peat moss and sphagnum moss covered with



Photo by Chad Peeling, Clyde Peeling's Reptiland *U. phantasticus* exhibit



Photo by Sean Foley, Riverbanks Zoo

leaves works well. As a rain forest species, *U. phantasticus* requires periods of high humidity through manual or timed misting. During overnight periods, the geckos should also have access to a water bowl or water feature as they will readily drink from these sources. Cool temperatures (65–78°F) are essential for the long-term health of *Uroplatus*. Of all the leaf-tailed geckos, *U. phantasticus* tends to be the most heat intolerant and institutions should make every effort to keep temperatures from rising above 79°F. A nighttime drop into the 60s or low 70s F is also recommended. Full spectrum lighting that offers some UVB is recommended as well as one or two localized hot spots that reach 90-95°F. It is important to note that when creating hot spots, the overall ambient temperature should not rise above desired levels and the geckos should have a choice of warm and cool areas.

The main diet should consist of ¼ - ½” crickets that have been fed a fortified cricket diet as well as leafy greens and carrots. Other food items such as small cockroaches and isopods may also be offered.

Reproductively active females should be offered land snails on a regular basis to augment calcium intake, which will help prevent calcium deficiency. Crickets should be dusted at each feeding with a multivitamin and a calcium supplement. A supplement with vitamin D3 should be used once per week.

Other Notes: As one of the smallest species of *Uroplatus*, the satanic leaf-tailed gecko helps solve the often difficult task of finding a lizard that will do well in a small exhibit. For breeding purposes, institutions should plan to acquire multiple animals as *U. phantasticus* displays more effectively, and often reproduces better, in group settings. Although this gecko will readily reproduce in captivity, high mortality continues to plague the captive population, making its future as a staple in herpetology collections tenuous at best. The taxonomy of *U. phantasticus* is unsettled and may result in additional species being described.

Program Goals:

- Acquire additional founders
- Try to mitigate high mortality in captive population
- Breed potential founders in current population

Program Contact:

Sean Foley, SSP Coordinator
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sfoley@riverbanks.org
(803) 779-8717 x1162

References:

- Ratsoavina, F., F. Glaw, J. B. Ramanamanjato, N. Rabibisoa, and N. A. Rakotondrazafy. 2011. *Uroplatus phantasticus*. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org>.

Giant Leaf-tailed Gecko

Uroplatus fimbriatus

(written by Sean Foley)

Species Summary:

As one of the largest geckos in the world, *U. fimbriatus* is an impressive lizard that displays well, exemplifies the unique biodiversity of Madagascar, and illustrates the plight of rain forest fauna which is undergoing unrelenting loss of habitat in much of the world.

Program Purposes:

This gecko is listed in CITES Appendix II and as a species of least concern in the IUCN red data list. Although *U. fimbriatus* is more widespread than most *Uroplatus* and does occur in several protected areas, its populations are severely fragmented and the forests are under heavy logging pressure (Raxworthy, et. al.). The species is also collected for the pet trade though the impact of commercialization is not thought to be a problem at this time (Raxworthy, et. al.). The quota for wild caught *U. fimbriatus* has been significantly reduced over the last few years and the ability to acquire this species going forward is in doubt. Captive bred animals are occasionally available from the private sector, but not in numbers that would meet the needs of AZA institutions. Currently, a solid captive population does exist in zoos and aquariums, and to ensure that geckos will be available in the future for exhibit and educational programs, this species needs to be managed.

Currently no conservation programs are planned for this species and re-introduction is unlikely for the foreseeable future. The only hope for wild populations will be the preservation of suitable habitat.

Photo by Sean Foley, Riverbanks Zoo





Photo by Chad Peeling, Clyde Peeling's Reptiland Uroplatus exhibit

Exhibit Qualities:

Because of its bizarre looks and large size, *U. fimbriatus* can make an excellent exhibit species if done well. The most eye-catching displays are naturalistic in design and include multiple animals in a mixed species exhibit. This gecko has been successfully maintained with one or more of the following: lined leaf-tailed geckos (*U. lineatus*), Henkel's leaf-tailed geckos (*U. henkeli*), mossy leaf-tailed geckos (*U. sikorae*), giant day geckos (*Phelsuma m. grandis*), Standing's day geckos (*P. standingii*), and tomato frogs (*Dyscophis guineti* or *D. insularis*). Although this is a nocturnal species, it is usually visible at all times of the day, especially if multiple animals are on display. The fact that they often can be found resting on the front glass and sides of the exhibit only enhances the visitor experience.

Interpretive Messages:

- Island endemism
- Camouflage
- Nocturnal nature
- Deforestation
- Gecko adhesion – Van der Waals force

Care & Facilities:

Although *Uroplatus fimbriatus* is not for beginners, most AZA facilities should be able to properly care for this gecko. To accommodate a group (4+ lizards) of giant leaf-tailed geckos by themselves or mixed with other species, an exhibit approximately 3-4' tall x 3' wide x 2-3' deep will be needed. If only displaying a single gecko or only a pair of animals, the exhibit may be smaller although the height should still be close to 3' tall. Off-exhibit housing should be available in case animals need to be separated and treated for health issues or for any offspring that may be produced. A number of vertically and diagonally oriented tree branches and pieces of bamboo (1-5" diameter) should be used for daytime perches. Sturdy tropical plants such as *Sansevieria* and *Dracaena* should also be employed for aesthetics as well as additional refugia. The substrate should be well-drained and damp but never wet as this may encourage mold or bacterial growth. Most leaf-tailed geckos

are prone to bacterial infections in captivity so good ventilation and daily cleaning are essential to prevent problems. A 5-6" layer of soil mixed with peat moss and sphagnum moss covered with leaves works well. As a rain forest species, *U. fimbriatus* requires periods of high humidity through manual or timed misting. During overnight periods, the geckos should also have access to a water bowl or water feature as they will readily drink from these sources. Cool temperatures (65 – 78°F) are essential for the long-term health of *Uroplatus*. Full spectrum lighting that offers some UVB is recommended as well as one or two localized hot spots that reach 90-95°F. It is important to note that when creating hot spots, the overall ambient temperature should not rise above desired levels and the geckos should have a choice of warm and cool areas.

The main diet should consist of adult crickets that have been fed a fortified cricket diet as well as leafy greens and carrots. Other food items such as cockroaches and superworms (*Zoophobia* sp.) may also be offered. Reproductively active females should be offered land snails on a regular basis to augment calcium intake, which will help prevent calcium deficiency. Crickets should be dusted at each feeding with a multivitamin and a calcium supplement. A supplement with vitamin D3 should be used once per week.

Other Notes: This species has shown a predilection for being picky about selecting mates. For those institutions wishing to reproduce this species, they should plan to acquire multiple pairs as this will give the best opportunity to find compatible pairings. Although our ability to maintain and reproduce *Uroplatus* successfully in captivity has improved over recent years, husbandry parameters are still being adjusted as our experience with these geckos increases.



Photo by Sean Foley, Riverbanks Zoo

Program Goals:

- Acquire more founders
- Breed potential founders in current population
- Improve ability to reproduce this species

Program Contact:

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References:

- Raxworthy, C.J., F. Ratsoavina, F. Glaw, and N. Rabibisoa. 2011. *Uroplatus fimbriatus*. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org>.

Henkel's Leaf-tailed Gecko

Uroplatus henkeli

(written by Sean Foley)



Photo by Sean Foley, Riverbanks Zoo

Species Summary:

As a large and unusual-looking gecko, *U. henkeli* is an impressive lizard that displays well, exemplifies the unique biodiversity of Madagascar, and illustrates the plight of rain forest fauna which is undergoing unrelenting loss of habitat in much of the world.

Program Purposes:

This gecko is listed in CITES Appendix II and rates a status of vulnerable in the IUCN red data list. Although *U. henkeli* has a somewhat widespread range and does occur in some protected areas, its populations are highly fragmented and the primary rain forests of which this species is reliant, are under heavy logging pressure (Raxworthy, et. al.). The impact of commercialization is currently unknown, though illegal

harvest does occur in protected areas (Raxworthy, et. al.). The quota for wild caught *U. henkeli* has been significantly reduced over the last few years and the ability to acquire this species going forward is in doubt. Captive bred animals are occasionally available from the private sector, but not in numbers that would meet the needs of AZA institutions. Currently, a very good captive population exists in zoos and aquariums, and to ensure that geckos will be available in the future for exhibit and educational programs, this species needs to be managed.

It could be argued that this species fills the same exhibit niche as *U. fimbriatus*, given that the two species are outwardly very similar. However, managing captive populations of both species makes sense for AZA institutions, because they may be housed and exhibited together, requiring little additional space or resources. Currently no conservation programs are planned for this species and re-introduction is unlikely for the foreseeable future. The only hope for wild populations will be the preservation of suitable habitat.

Exhibit Qualities:

Because of its bizarre looks and large size, *U. henkeli* can make an excellent exhibit species if done well. The most eye-catching displays are naturalistic in design and include multiple animals in a mixed species exhibit. This gecko has been successfully maintained with one or more of the following: lined leaf-tailed geckos (*U. lineatus*), giant leaf-tailed geckos (*U. fimbriatus*), mossy leaf-tailed geckos (*U. sikorae*), giant day geckos (*Phelsuma m. grandis*), Standing's day geckos (*P. standingii*), and tomato frogs (*Dyscophis guineti* or *D. insularis*). Although this is a nocturnal species, it is usually visible at all times of the day, especially if multiple animals are on display. The fact that they often can be found resting on the front glass and sides of the exhibit only enhances the visitor experience.

Educational Qualities:

Uroplatus henkeli fits nicely into programs discussing specialized gecko adaptations, island endemism, defense tactics, and deforestation. These geckos do not generally accept much handling although certain individuals may be more tolerant than others.

Interpretive Messages:

- Island endemism
- Camouflage
- Nocturnal nature
- Deforestation
- Gecko adhesion – Van der Waals force

Care and Facilities:

Although *Uroplatus henkeli* is not for beginners, most AZA facilities should be able to properly care for this gecko. To accommodate a group (4+ lizards) of Henkel's leaf-tailed geckos by themselves or mixed with other species, an exhibit approximately 3-4' tall x 3' wide x 2-3' deep will be needed. If only displaying a single gecko or only a pair of animals, the exhibit may be smaller although the height should still be close to 3' tall. Off-exhibit housing should be available in case animals need to be separated and treated for health issues or for any offspring that may be produced. A number of vertically and diagonally oriented tree branches and pieces of bamboo (1-5" diameter) should be used for daytime perches. Sturdy tropical plants such as *Sansevieria* and *Dracaena* should also be employed for aesthetics as well



Photo by Sean Foley, Riverbanks Zoo Uroplatus exhibit

as additional refugia. The substrate should be well-drained and damp but never wet as this may encourage mold or bacterial growth. Most leaf-tailed geckos are prone to bacterial infections in captivity so good ventilation and daily cleaning are essential to prevent problems. A 5-6" layer of soil mixed with peat moss and sphagnum moss covered with leaves works well. As a rain forest species, *U. henkeli* requires periods of high humidity through manual or timed misting. During overnight periods, the geckos should also have access to a water



Photo by Terry Wild, Clyde Peeling's Reptiland
Uroplatus exhibit

bowl or water feature as they will readily drink from these sources. Cool temperatures (65 – 78°F) are essential for the long-term health of *Uroplatus*. Full spectrum lighting that offers some UVB is recommended as well as one or two localized hot spots that reach 90-95°F. It is important to note that when creating hot spots, the overall ambient temperature should not rise above desired levels and the geckos should have a choice of warm and cool areas.

The main diet should consist of adult crickets that have been fed a fortified cricket diet as well as leafy greens and carrots. Other food items such as cockroaches and superworms (*Zoophobia* sp.) may also be offered. Reproductively active females should be offered land snails on a regular basis to augment calcium intake, which will help prevent calcium deficiency. Crickets should be dusted at each feeding with a multivitamin and a calcium supplement. A supplement with vitamin D3 should be used once per week.

Other Notes: This is probably the hardest and most readily reproduced species of *Uroplatus* and multiple generations have now been produced in AZA institutions. *Uroplatus henkeli* is a good choice for institutions wanting to work with leaf-tailed geckos, especially those lacking any previous experience with the genus. The taxonomy of *U. henkeli* is unsettled and may result in additional species being described.

Program Goals:

- Acquire more founders
- Try to reverse the heavy male bias in the population
- Replace over-represented geckos with more genetically valuable animals

Program Contact:

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References:

- Raxworthy, C.J. and M. Vences. 2010. *Uroplatus henkeli*. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org>.

Lined Leaf-tailed Gecko

Uroplatus lineatus

(written by Sean Foley)



Species Summary:

As a large and unusual-looking gecko, *U. lineatus* is an impressive lizard that displays well, exemplifies the unique biodiversity of Madagascar, and illustrates the plight of rain forest fauna which is undergoing unrelenting loss of habitat in much of the world.

Program Purposes:

This gecko is listed in CITES Appendix II and as a species of least concern in the IUCN red data list. Although this species occurs in a number of sites in the eastern part of Madagascar, including a number of national parks, its forest habitat is suffering from logging and slash-and-burn agriculture (Raxworthy, et. al.). The impact of commercialization is currently unknown, though illegal harvest may occur in one or more protected areas (Raxworthy, et. al.). The quota for wild caught *U. lineatus* has been significantly reduced over the last few years and the ability to acquire this species going forward is in doubt. Captive bred animals are occasionally available from the private sector, but not in numbers that would meet the needs of AZA institutions. Currently, a good captive population does exist in zoos and aquariums, and to ensure that geckos will be available in the future for exhibit and educational programs, this species needs to be managed.

Currently no conservation programs are planned for this species and re-introduction is unlikely for the foreseeable future. The only hope for wild populations will be the preservation of suitable habitat.

Exhibit Qualities:

Because of its bizarre looks and large size, *U. lineatus* can make an excellent exhibit species if done well. The most eye-catching displays are naturalistic in design and include multiple animals in a mixed species exhibit. This gecko has been successfully maintained with one or more of the following: Henkel's leaf-tailed geckos (*U. henkeli*), giant leaf-tailed geckos (*U. fimbriatus*), mossy leaf-tailed geckos (*U. sikorae*), giant day geckos (*Phelsum m. grandis*), Standing's day geckos (*P. standingii*), and tomato frogs (*Dyscophis guineti* or *D. insularis*). Although this is a nocturnal species, it is usually visible at all times of

Photo by Joe McDonald, Clyde Peeling's Reptiland

the day, especially if multiple animals are on display. The fact that they often can be found resting on the front glass and sides of the exhibit only enhances the visitor experience.

Educational Qualities:

Uroplatus lineatus fits nicely into programs discussing specialized gecko adaptations, island endemism, defense tactics, and deforestation. These geckos do not generally accept much handling although certain individuals may be more tolerant than others.

Interpretive Messages:

- Island endemism
- Camouflage
- Nocturnal nature
- Deforestation
- Gecko adhesion – Van der Waals force

Care and Facilities:

Although *Uroplatus lineatus* is not for beginners, most AZA facilities should be able to properly care for this gecko. To accommodate a group (4+ lizards) of lined leaf-tailed geckos by themselves or mixed with other species, an exhibit approximately 3-4' tall x 3' wide x 2-3' deep will be needed. If only displaying a single gecko or only a pair of animals, the exhibit may be smaller although the height should still be close to 3' tall. Off-exhibit housing should be available in case animals need to be separated and treated for health issues or for any offspring that may be produced. A number of vertically and diagonally oriented tree branches and pieces of bamboo (1-5" diameter) should be used for daytime perches. Sturdy tropical plants such as *Sansevieria* and *Dracaena* should also be employed for aesthetics as well as additional refugia. The substrate should be well-drained and damp but never wet as this may encourage mold or bacterial growth. Most leaf-tailed geckos are prone to bacterial infections in captivity so good ventilation and daily cleaning are essential to prevent problems. A 5-6" layer of soil mixed with peat moss and sphagnum moss covered with leaves works well. As a rain forest species, *U. lineatus* requires periods



Photo by Sean Foley, Riverbanks Zoo mixed *Uroplatus* exhibit



Photo by Sean Foley, Riverbanks Zoo

of high humidity through manual or timed misting. During overnight periods, the geckos should also have access to a water bowl or water feature as they will readily drink from these sources. Cool temperatures (65 – 78°F) are essential for the long-term health of *Uroplatus*. Full spectrum lighting that offers some UVB is recommended as well as one or two localized hot spots that reach 90-95°F. It is important to note that when creating hot spots, the overall ambient temperature should not rise above desired levels and the geckos should have a choice of warm and cool areas.

The main diet should consist of adult crickets that have been fed a fortified cricket diet as well as leafy greens and carrots. Other food items such as cockroaches and superworms (*Zoophobia* sp.) may also be offered. Reproductively active females should be offered land snails on a regular basis to augment calcium intake, which will help prevent calcium deficiency. Crickets should be dusted at each feeding with a multivitamin and a calcium supplement. A supplement with vitamin D3 should be used once per week.

Other Notes:

Although similar in size to both *U. henkeli* and *U. fimbriatus*, the lined leaf-tailed gecko offers a completely different look than either of those two species, making it the perfect companion to other *Uroplatus* in the *fimbriatus* complex. Although our ability to maintain and reproduce *Uroplatus* successfully in captivity has improved over recent years, husbandry parameters are still being adjusted as our experience with these geckos increases.

Program Goals:

- Acquire additional founders
- Breed potential founders in current population
- Improve ability to reproduce this species

Program Contact:

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References:

- Raxworthy, C.J., F. Ratsoavina, F. Glaw, N. Rabibisoa, and P. Bora. 2011. *Uroplatus lineatus*. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org>.

Mossy Leaf-tailed Gecko

Uroplatus sikorae

(written by Sean Foley)

Species Summary:

As one of the finest masters of camouflage in the animal world, *U. sikorae* is a fascinating lizard that displays well, exemplifies the unique biodiversity of Madagascar, and illustrates the plight of rain forest fauna which is undergoing unrelenting loss of habitat in much of the world.

Program Purposes:

Uroplatus sikorae is listed in CITES Appendix II and as a species of least concern in the IUCN red data list. This gecko occurs broadly throughout the forests along the eastern part of the island, including a number of protected areas, and is thought to be able to tolerate a small amount of habitat degradation (Ratsoavina, et. al.). Nevertheless, its habitat is under



Photo by Sean Foley, Riverbanks Zoo

assault from ongoing logging, mining, and slash-and-burn agriculture (Ratsoavina, et. al.). Although the quota for wild caught *U. sikorae* is much larger than for most other *Uroplatus*, the numbers have been significantly reduced and the ability to acquire this species going forward is in doubt. Captive bred animals are occasionally available from the private sector, but not in numbers that would meet the needs of AZA institutions. Currently, a good captive population does exist in zoos and aquariums, and to ensure that geckos will be available in the future for exhibit and educational programs, this species needs to be managed.

Currently no conservation programs are planned for this species and re-introduction is unlikely for the foreseeable future. The only hope for wild populations will be the preservation of suitable habitat.

Exhibit Qualities:

As its name implies, the mossy leaf-tailed gecko possesses some of the most striking color patterns in the genus, and if done well, this lizard can make an excellent exhibit species. The most eye-catching displays are naturalistic in design and include multiple animals in a mixed species exhibit. *Uroplatus sikorae* has been successfully maintained with one or more of the following: lined leaf-tailed geckos (*U. lineatus*), Henkel's leaf-tailed geckos (*U. henkeli*), giant leaf-tailed geckos (*U. fimbriatus*), giant day geckos (*Phelsuma m. grandis*), and Standing's day geckos (*P. standingii*). It should also pair well with several of the smaller day geckos that are readily available such as the gold dust day gecko (*P. laticauda*) and the peacock day gecko (*P. quadriocellata*). Although this is a nocturnal species, it is usually visible at all times of the day, especially if multiple animals are on display. The fact that they often can be found resting on the front glass and sides of the exhibit only enhances the visitor experience.



Photo by Sean Foley, Riverbanks Zoo mixed *Uroplatus* exhibit

Educational Qualities:

Uroplatus sikorae fits nicely into programs discussing specialized gecko adaptations, island endemism, defense tactics, and deforestation. These geckos do not generally accept much handling although certain individuals may be more tolerant than others.

Interpretive Messages:

- Island endemism
- Camouflage
- Nocturnal nature
- Deforestation
- Gecko adhesion – Van der Waals force

Care and Facilities: Although *Uroplatus sikorae* is not for beginners, most AZA facilities should be able to properly care for this gecko. To accommodate a group (4+ lizards) of mossy leaf-tailed geckos by themselves or mixed with other species, an exhibit approximately 2' tall x 2' wide x 2' deep will be needed. If only displaying a single gecko or only a pair of animals, the exhibit may be smaller although the height should still be close to 2' tall. Off-exhibit housing should be available in case animals need to be separated and treated for health issues or for any offspring that may be produced. A number of vertically and diagonally oriented tree branches and pieces

of bamboo (1-5" diameter) should be used for daytime perches. Sturdy tropical plants such as *Sansevieria* and *Dracaena* should also be employed for aesthetics as well as additional refugia. The substrate should be well-drained and damp but never wet as this may encourage mold or bacterial growth. Most leaf-tailed geckos are prone to bacterial infections in captivity so good ventilation and daily cleaning are essential to prevent problems. A 5-6" layer of soil mixed with peat moss and sphagnum moss covered with leaves works well. As a rain forest species, *U. sikorae* requires periods of high humidity through manual or timed misting. During overnight periods, the geckos should also have access to a water bowl or water feature as they will readily drink from these sources. Cool temperatures (65 – 78°F) are essential for the long-term health of *Uroplatus*. Full spectrum lighting that offers some UVB is recommended as well as one or two localized hot spots that reach 90-95°F. It is important to note that when creating hot spots, the overall ambient temperature should not rise above desired levels and the geckos should have a choice of warm and cool areas.

The main diet should consist of 1/2" to adult crickets that have been fed a fortified cricket diet as well as leafy greens and carrots. Other food items such as cockroaches and small superworms (*Zoophobia* sp.) may also be offered. Reproductively active females should be offered land snails on a regular basis to augment calcium intake, which will help prevent calcium deficiency. Crickets should be dusted at each feeding with a multivitamin and a calcium supplement. A supplement with vitamin D3 should be used once per week.

Other Notes:

U. sikorae is probably the most versatile species of *Uroplatus*—it's relatively small so can be housed in exhibits that would not be adequate for many of the larger species; on the other hand, it has enough size to be a part of a mixed species exhibit with *U. lineatus*, *U. henkeli*, and even *U. fimbriatus*.

Program Goals:

- Acquire additional founders
- Try to mitigate high mortality in captive population
- Breed potential founders in current population

Program Contact:

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References:

- Ratsoavina, F., F. Glaw, N. Rabibisoa, and N. A. Rakotondrazafy. 2011. *Uroplatus sikorae*. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org>.



Photo by Sean Foley, Riverbanks Zoo

Rio Fuerte Beaded Lizard

Heloderma horridum exasperatum

(written by Jan Johnson)



Photo by Joe McDonald, Clyde Peeling's Reptiland

Species Summary:

Beaded lizards are medium-sized, venomous lizards and one of only two species of truly venomous lizards in the world. These rugged, long-lived animals are staple exhibits for many herpetology departments, and their unusual appearance makes them memorable to many zoo and aquarium visitors.

Program Purposes:

In 2007, the IUCN red list categorized *Heloderma horridum* as “Least Concern” in view of its wide distribution; presumed large populations, inhabiting a number of protected areas; and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category. Four subspecies of beaded lizards are currently recognized, and additional research is needed to fully understand the systematics, distribution and threats specific to each.

AZA institutions currently hold multiple subspecies of beaded lizards, but resources are lacking to manage more than one captive population effectively. There is currently no recognized conservation need for the Mexican subspecies (*H. h. exasperatum*), but this is the most robust captive population, and should be managed for long-term exhibit availability.

Exhibit Qualities: On exhibit, beaded lizards are always visible, although not often very active. Several individuals may be housed together without incident. A number of institutions have exhibited these lizards in multi-species exhibits with *Ctenosaura*, *Gopherus*, *Heloderma suspectum* and other smaller lizards. The



Photo by Dale McGinnity, Nashville Zoo beaded lizard exhibit



Photo by John Kast, Fort Worth Zoo beaded lizard exhibit

Arizona-Sonora Desert Museum successfully kept two beaded lizards for 18 years with a *Boa constrictor imperator*, until one day the Boa constricted and killed a lizard. Beaded lizards dig and trample delicate plantings, so only sturdy species should be used on exhibit. Vertical space is surprisingly well utilized by these lizards if they are provided branches and rocks to climb.

Interpretive Messages:

- Venom - evolutionary origins, emphasis on causing pain rather than killing prey.
- Byetta - a human diabetes drug based on a component in the saliva of *Heloderma suspectum*, a close relative of beaded lizards.
- Aestivation - water storage in bladder, fat storage in tail.
- Osteoderms
- Threats to tropical deciduous ecosystems.

Care & Facilities: Beaded lizards typically thrive in captivity and do not require specialized diets or husbandry. They readily accept dead rats and mice. They do not need specialized UV lighting, although a heat spot would be appreciated. Because individuals

can be housed together reserve space is not needed to keep individuals separated. Publications concerning this species include numerous articles discussing this animal in captivity, a few articles describing wild behavior and a Taxon Management Account. A book discussing the family was published in 2005. Exhibits should be moderately large and allow for climbing.



Photo by Arizona-Sonora Desert Museum staff

Other Notes: Because this species requires considerable space and is relatively long lived, it is critical that AZA institutions not breed specimens unless recommended by the program manager.

Program Goals

- Remove all hybrids, “unknowns” and *Heloderma h. horridum* specimens from the captive population.
- Sex all unknown individuals and report to the program manager.
- Breed remaining founders in the captive population

Program Contact:

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References:

- Bogert, C.M. and R. M. del Campo. 1956. The Gila monster and its allies: The relationships, habits, and behavior of the lizards of the family Helodermatidae. *Bul. Amer. Mus. Nat. Hist.* 109:1-238.
- Beck, D. D. 2005. *Biology of Gila Monsters and Beaded Lizards*. University of California Press, xii-211pp.

Fiji Island Banded Iguana

Brachylophus bulabula

(written by Kim Lovich)

Species Summary:

The Fiji banded iguana (*Brachylophus bulabula*) is one of the more diminutive iguana species, averaging 15-19 cm in snout vent length (SVL) and up to 60 cm in total length. Small size and exquisite colors—light greens and blues with bands of pale, greenish white—make the species one of the most sought after lizards for tropical exhibits. The Pacific iguanas found within the Fijian and Tongan archipelagos are not only unique in that their closest relatives are species found in the New World, but they are also some of the most threatened species of lizards in the world

Program Purposes:

The IUCN lists the Fiji Banded Iguana as Endangered and this species has been listed as CITES Appendix I since 1981 and is also listed as Endangered by the U.S. Fish and Wildlife Service. Threats from Human disturbance and habitat modification combined with introduced predators such as cats and mongoose have significantly impacted all of the *Brachylophus* iguanas. Survey work completed throughout the island chain indicates extirpations and severe habitat loss. Genetic data also shows the existence of unique haplotypes representing distinct lineages from nearly every island surveyed. Protecting this genetic diversity requires urgent conservation measures for all *Brachylophus* species.



Photo by Ken Bohn, San Diego Zoo

Recent morphological and genetic evidence split the *Brachylophus* genera into three distinct groups, *B. vitiensis*, *B. fasciatus* and *B. bulabula* and further data collection may reveal even more speciation within the group. The US captive population is evidently a mix of multiple populations (haplotypes) and does not represent a single, viable conservation unit. Because the lizards make excellent exhibit specimens and there is no prospect of attaining additional founders in the near future, the existing captive population must be managed to ensure future exhibit availability. The San Diego Zoo has established a Fijian Iguana Conservation Fund to assist conservation efforts within Fiji and exhibits may help drive fundraising.

Exhibit Qualities:

By any account, these are beautiful lizards. Set against a dark green background color, adult males have white or pale blue spots and streaks on the neck with two large, vertical bands running down the sides of the body. Females are typically solid green with occasional spots or partial bands. Fiji iguanas are adapted to life in the trees and fare best in lushly planted arboreal exhibits. Non-toxic plants (e.g. *Ficus*, *Fatsia*, *Coccoloba*) will create a comfortable and aesthetically pleasing display for this species.

B. bulabula are generally relaxed and often bask in plain view among crisscrossing branches and leafy cover. Pairs housed together may exhibit a range of courtship behaviors, including color intensification, head bobbing and biting of the neck and forelimbs..

Interpretive Messages:

- Habitat Loss
- Island colonization & rafting (potentially across the Pacific Ocean)
- Invasive species threats
- Island endemics and biodiversity
- Supporting San Diego Zoo's field conservation fund



Photo by Ken Bohn, San Diego Zoo

Care and Facilities:

An arboreal species, the Fiji banded iguana will do quite well in a standard tropical exhibit with a variety of vertical and horizontal perching. This species may be housed in pairs provided there are adequate perching sites available and sufficient refugia for the female iguanas to utilize should they feel the need to retreat from the advances of their mate. A variety of non toxic tropical plants placed throughout the iguana's enclosure will meet this need as well as enhance guest viewing. A minimum exhibit size of 4' long by 4' wide by 4' in height is recommended. This species requires UV lighting and access to natural sunlight through UV penetrating skylights, for example, will prove beneficial.

Fiji iguanas live in moist forests and require regular misting. Substrates should retain some moisture, but drain freely. A variety of greens, some fruits and other vegetables including dandelion, collard and mustard greens along with romaine lettuce, yam, and carrot should be offered at least 3 times per week. Fruit may consist of grapes, melons, berries, papaya, kiwi and mango as well as hibiscus flowers can be offered mixed with the greens. On non salad days insects such as crickets, kingworms, and phoenix worms can be offered as well. Many institutions supplement all food with a dusting of calcium and vitamin supplements. Reproductive females require especially high calcium levels in the diet.

Recommendations:

Because this species displays so well, is not space intensive and thrives in pairs, it is a prime candidate for any tropical reptile facility. The SSP coordinator encourages facilities to consider displaying this species and assist in the new fundraising opportunity to enhance conservation and education efforts within Fiji for this beautiful lizard species.

Program Goals:

- Enhance sustainability of captive population
- Raise funds for conservation/education in Fiji
- Help create assurance colonies in Fiji

Program Contact:

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References:

- Keogh, J.S., D. L. Edwards, R. N. Fisher, and P. S. Harlow. Molecular and morphological analysis of the critically endangered Fijian iguanas reveals cryptic diversity and a complex biogeographic history. *Phil. Trans. R. Soc. B* 2008 363, 3413-3426 doi: 10.1098/rstb.2008.0120



Photo by Ken Bohn, San Diego Zoo

Grand Cayman Blue Iguana

Cyclura lewisi

(written by Chad Peeling and Tandora Grant)



Photo by John Binns

Species Summary:

Like all *Cyclura*, Grand Cayman blue iguanas are large (up to 10 kg), imposing creatures with sculpted heads, prominent dorsal spines and alert dispositions. Mature males sport a handsome turquoise-blue color in the scales of the head, spines and flanks. Rescued from the brink of extinction, this species is a flagship for conservation of West Indian iguanas and a successful example of cooperative action among zoos and other partners.

Program Purposes:

C. lewisi is ranked as Critically Endangered by the IUCN Red List, Appendix I in CITES, and listed as endangered by the US Fish and Wildlife Service. Threatened by development, agriculture, and feral predators, the total population of wild iguanas was estimated at 25 in 2002. As of 2012, more than 600 animals have been reintroduced to three protected areas on Grand Cayman and repatriated iguanas are now reproducing in these areas.

An in situ breeding and headstarting facility has been established at the Botanic Park and is managed successfully as support for the wild sub-populations. The North American captive population is not a source of animals for release in the wild, but fulfills an essential role as ambassador for the in situ program. Captive animals also provide opportunities for staff to gain experience with the taxa and continue to refine husbandry techniques. Exchanges of animals between AZA facilities and the National Trust in Grand Cayman have occurred, helping to fortify the genetic breadth of the U.S. population. It is essential that we maintain the North American population to ensure future availability of exhibit/ambassador animals and to train and inspire AZA professionals to continue support of successful field programs for endangered iguanas.

Exhibit Qualities:

Grand Cayman blue iguanas are phenomenal exhibit animals. Provided with appropriate space, heat, and access to unfiltered sunlight in warm weather, they remain active, visible, and engaging subjects. Males bask in prominent locations and frequently perform head bobs and other territorial displays. These lizards are alert and bold, often responding to the presence of visitors or staff. Exhibits should be spacious, brightly lit, and include a variety of visual barriers and refugia. Males are extremely territorial and should be maintained separately. These lizards thrive in hot, dry habitats with rocky basking perches and soil suitable for digging. Only non-toxic plants should be included as the lizards may browse. Many exhibits include *Hibiscus*, *Opuntia* sp. *Yucca*, honeysuckle, and various ornamental grasses (*Cortaderia* sp. and *Miscanthus* sp.).

Most exhibits include solitary or paired animals, as groups tend to fight. Some institutions have successfully exhibited West Indian iguanas with other species, including free-flighted birds (e.g. Psittacines, Anatines), cane toads (*Rhinella marina*), and anole lizards (*Anolis* sp.). Other Caribbean lizards (e.g. *Leiocephalus* sp., *Ameiva* sp.) may also be good candidates.

Educational Qualities:

Large iguanas are a handful and many do not lend themselves to educational programming. However, tractable individuals are fantastic presentation animals under the control of an experienced handler. The Blue Iguana Recovery Program runs a well organized volunteer program providing opportunities for AZA staff and the general public to experience hands-on field conservation.



Photo by Nate Nelson, Sedgwick County Zoo outdoor *Cyclura* exhibit

Interpretive Messages:

- Recovery from the brink of extinction - from 25 to 600+ animals in 10 years
- Conservation by cooperation - zoos, governments, and NGOs
- Endangered tropical dry forest ecosystems
- Island endemism

Care and Facilities:

C. lewisi is a space-intensive lizard. Pairs should be housed in minimum enclosures of 10' wide x 6' long x 6' high off exhibit, but larger areas (at least 12' wide x 12' long x 10' high) are preferable and access to outdoor enclosures during warm weather are essential. Enclosures should include large, secure branches for climbing and visual barriers for hiding. Palms and cacti provide handy cover for enclosures and are rarely eaten by iguanas. Sandy soil substrate is ideal for creating burrows and outdoor enclosures should include underground digging barriers to prevent escape.

All *Cyclura* require hot environments with daytime highs of approximately 85°F and basking sites of 110-120°F. Nighttime temperatures may safely drop to 65°F and heated retreats may be provided. Outdoor animals in temperate climates should be “hardened” to nighttime lows gradually when moved outside in the spring.

Re-creating appropriate diets for herbivorous lizards is a complex and evolving science. Generally, *Cyclura* should be fed a daily diet based on nutritious dark, leafy greens (e.g. dandelion, endive, kale, collard greens, mustard

greens, bok choy, escarole) with very small portions of other vegetables (e.g. root vegetables), fruits (e.g. squash, green beans, tropical fruits) and flowers (e.g. dandelion, *Hibiscus*) mixed in and varied seasonally. Most institutions supplement all dietary items with calcium and vitamins. Nutritionally complete diets (e.g. reptile carnivore/omnivore gel) are also used as dietary addendums at some institutions, but care should be taken to avoid excess protein.

A critical counterpart to diet is exposure to adequate levels of UVB radiation, which may be accomplished artificially indoors, but is best accomplished by maintaining the animals outdoors during warm weather.



Photo by John Binns



Photo by Brett Baldwin, San Diego Zoo outdoor *Cyclura* exhibit

Other Notes:

The Husbandry Manual for West Indian Iguanas is available online or from any of the program contacts.

Program Goals:

- Continue to support the in situ efforts of the National Trust for the Cayman Islands and the Blue Iguana Recovery Program (www.blueiguana.ky).
- Increase research efforts on nutritional, reproductive, behavioral, and medical aspects of iguana biology to improve breeding success in captivity.
- Recruit additional SSP participants, especially those offering off-exhibit outdoor facilities.



Photo by Rick Hudson, off-exhibit *Cyclura* indoor/outdoor enclosure

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References:

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San Esteban Chuckwalla

Sauromalus varius

(written by Jan Johnson)

Species Summary:

This medium-sized iguanid is found on one uninhabited Mexican island in the Gulf of California. It is threatened by introduced species and provides an excellent example of an island endemic. As exhibit specimens, chuckwalls represent the quintessential “desert lizards.”

Program Purposes:

This species is listed under CITES Appendix I, considered endangered by the Republic of Mexico, and classified as endangered under the U.S. Endangered Species Act.

Although the prospect for reintroduction is unlikely in the foreseeable future, there is a substantial captive population in AZA institutions, but importation of new founders is unlikely and specimens are not widely available from the private sector. The captive population should be managed for future exhibit and educational availability.



Photo by Arizona-Sonora Desert Museum staff

Exhibit Qualities:

This long-lived, diurnal, lizard is entirely vegetarian and displays interesting cryptic coloration. In a well designed enclosure, it remains visible to the public and will utilize vertical spaces if provided with rocky ledges. Narrow crevices may be provided to stimulate natural wedging behaviors. Any live plants used in exhibits should not be toxic as the lizard may try tasting them. This species may be housed with *Ctenosaura*, *Gopherus* and other non-conspecific lizards. Do not house conspecifics of unequal size as the larger individual may kill the smaller individual.

Interpretive Messages:

- Historical food source for indigenous Seri people.
- Threats to endemic species with restricted ranges.
- Arid adaptations - nasal salt glands, water-storing lymph sacs
- Defensive tactic of wedging in rock crevices and inflating lungs.



Photo by Jan Johnson, Arizona-Sonora Desert Museum San Esteban Chuckwalla exhibit

Care & Facilities:

Sauromalus varius have been kept in captivity since the early 1970s. The species requires a good vegetarian diet high in calcium. Ultraviolet B emitting lights should also be provided. Reserve space may be required to separate individuals if one becomes aggressively dominant. The species is prone to bladder stones in captivity which may be surgically removed when noticed. Reproduction was first documented in 1977.

Recommendations:

- Establish breeding groups at additional institutions. The bulk of the captive population is currently held at the Arizona-Sonora Desert Museum, but additional institutional participants are needed.



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Photo by Arizona-Sonora Desert
Museum staff

Regional Collection Plan
AZA Lizard Advisory Group

Texas Horned Lizard

Phrynosoma cornutum

(written by Diane Barber)

Species Summary:

Horned lizards have been part of cultural folklore for hundreds of years and are symbolic representatives of Western North America. They are easily distinguished from other species of lizards by their flat, round bodies and horned heads. They are striking exhibit specimens that fill a unique biological niche and serve as ambassadors for arid and semi-arid ecosystem conservation.



Photo by Patrick Alexander

Program Purposes:

There are thirteen species of horned lizards in North America, ranging from Canada to Guatemala. Many species are declining due to a variety of pressures including habitat alteration, pesticide use and introduced species. The Texas horned lizard has disappeared from the northeastern part of Texas and has experienced declines in Oklahoma and Mexico. Historically horned lizards have been viewed as somewhat “taboo” to maintain in captivity due to their specialized diet of ants and our overall lack of knowledge about their husbandry

requirements. However, recent improvements in husbandry techniques have proven that this species is actually relatively easy to keep and breed in captivity if basic needs are met. Confiscated and “abandoned” horned lizards are frequently given to zoos since they cannot be returned to the wild. These lizards have formed the basis of a new captive population that is reproducing and genetically maintained. Offspring may be distributed to other AZA facilities for exhibit purposes.

Reintroduction trials have begun in the northern part of Texas and will hopefully develop into a larger conservation-based initiative. There may be a need to increase capacity for this species in AZA facilities in the future to support field conservation. The development of conservation-based education and managed programs for Texas horned lizards will also serve as useful models for other species of horned lizards throughout their range. The captive population should be managed to ensure exhibit/educational availability and enhance institutional expertise with the taxa.

Exhibit Qualities:

Texas horned lizards are cryptically colored to blend into their environment, which makes them interesting exhibit animals. They are terrestrial, but will climb and rest on top of rocks and logs. They have a tendency to burrow, but if provided a shallow sandy substrate, they will leave their backs and heads exposed and will often bask. They are small lizards ranging from 2 ½ to 5 ½ inches in length and may be housed singly or in group situations. They require exposure to UVB light and hot basking sites. They are most active early morning and early evening. .

Educational Qualities:

In most regions where they are found, horned lizards (sometimes called “horny toads”) are well-known and evoke fond childhood memories. They are often part of local culture and many people feel a personal connection with them, which is a relatively uncommon occurrence with reptiles. They are small, can be easily handled, and will tolerate handling for short periods of time for outreach purposes. They possess unique defense mechanisms and are extremely adapted for their environment. They are also good ambassadors for promoting responsible agricultural and land stewardship practices.

Interpretive Messages:

- Camouflage
- Defense (squirting blood from eyes)
- Specialized diet
- Arid and semi-arid ecosystems
- Land stewardship
- Folklore

Care and Facilities:

Texas horned lizards are relatively easy to care for as long as their dietary and thermoregulatory needs are met. It is best if they can be rotated into outdoor enclosures for natural sunlight exposure during warmer parts of the year, but is not necessary if proper UVB lighting and adequate basking sites are provided indoors. In the wild the majority of their diet consists of harvester ants, but they are relatively opportunistic feeders and will eat other invertebrates such as termites, beetles, crickets and wax worms in captivity. Although horned lizards are generally solitary in the wild, they are



Photo by Diane Barber, Fort Worth Zoo Phrynosoma exhibit



Photo by Diane Barber; Fort Worth Zoo Phrynosoma outdoor holding

not extremely territorial and may be housed in groups. A single horned lizard may be kept comfortably in an 18" wide x 24 long" naturalistic exhibit (plants, rocks and logs as props) with a 1-2" layer of sandy substrate. Ambient temperatures should be kept at 78-85°F with supplemental UVB lighting and a basking spot of about 110-115°F. The lizards and/or plants in the enclosure should be misted regularly to encourage consumption of water. A shallow water bowl should also be provided for soaking during shedding events. If ants are offered as a food item they may be placed in a container that prevents escape and is buried in the ground. A stick or dowel placed in the middle of the bowl allows the ants to climb up and provide the lizard access to feed.

Recommendations:

- Establish new exhibit and/or breeding populations at institutions to broaden expertise with horned lizards.

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Photo by Patrick Alexander

Prehensile-tailed Skink

Corucia zebrata

(written by Kevin Wright, DVM)

Species Summary:

This giant skink is a striking exhibit specimen. It is phylogenetically distinct, possesses a powerful grasping tail for climbing, lives in family groups in captivity and exhibits some parental care. The species also represents the overall plight of the Solomon Islands, which is being deforested at an alarming rate.

Program Purposes:

These skinks face daunting threats in the wild, primarily from unsustainable logging of old-growth forests. In 2004 CITES recommended suspension of trade in *Corucia zebrata* and it is unlikely that specimens will be available from wild populations or from private breeders in the foreseeable future. Zoos and aquariums currently maintain a substantial number of individuals, and this population needs to be managed to ensure ongoing availability for exhibit and educational programs.



Photo by Joe McDonald, Clyde Peelng's Reptiland

Meaningful conservation of this species is unlikely, unless unsustainable logging practices on the Solomon Islands are curtailed. Re-introduction is not a realistic prospect for the foreseeable future.

Exhibit Qualities: Unlike most skinks this species is large (up to 32" in length) and arboreal. It uses vertical exhibit space effectively, often perching or hanging in preposterous positions. Compatible specimens may be housed together in visually complex enclosures and family groups provide dynamic social communities, rare among squamates. Some institutions have successfully exhibited this species with groups of iridescent ground skinks (*Eugongylus albofasciolatus*) or Solomon Island leaf frogs (*Ceratobatrachus guentheri*). Although the species is crepuscular, most individuals are fairly active throughout the day in suitable enclosures. *Corucia zebrata* lives in moist tropical forests and requires warm temperatures and periods of high relative humidity. It needs a spacious enclosure with sturdy diagonal and horizontal branches, basking opportunities, and elevated hides. As an obligate herbivore it is not suited to delicately planted landscapes.

Educational Qualities: Many *Corucia zebrata* will tolerate handling and may be used in outreach programs. This is a good taxon to illustrate endemism on islands as well as adaptations for an arboreal lifestyle. It also fits nicely into programs about tropical rainforests, biodiversity, and deforestation.

Interpretive Messages:

- Island endemism
- Prehensile tail
- Deforestation
- Parental care
- Live birth

Care & Facilities: This is not a delicate species and husbandry requirements are well within the capabilities of AZA institutions. Participating institutions should plan to exhibit a pair or trio (two females and one male) of adult skinks in an enclosure approximately 5' high x 3' wide x 3' deep. Optional off-display housing should be available in the event that individuals need to be separated for fighting, or if parents reject grown offspring (typically after a year or more). Ambient temperatures of 78-85°F with warmer basking spots are desirable. Regular misting (manual or timed misting system) helps maintain humidity and stimulates activity. Good drainage and ventilation are essential to prevent stagnant air and mold growth. Sturdy branches (1"-5" in diameter) should be anchored diagonally and horizontally to provide climb-ways and perching opportunities.



Photo by John Gannon, Philadelphia Zoo Corucia exhibit



These skinks are herbivorous and require a diet of dark, leafy green vegetables. Romaine lettuce, escarole, kale, mustard greens, dandelion (greens and flowers), turnip greens and other seasonally available green produce are typically offered every 1-3 days. Many institutions supplement with multivitamins and calcium. UVB light is probably important for this species and may be combined with heat-emitting basking lights.

Other Notes: *Corucia zebrata* shows dramatic morphological diversity and two subspecies have been formally described. There is also anecdotal evidence of out-breeding depression between “unlike” pairs.

Recommendations:

- It is essential that institutions holding this species identify their specimens to subspecies and report to the program manager. Instructions for identification are available from the program manager.
- The systematics of this taxa are not well settled and it may be wise to pair animals with similar physical characteristics, even within currently recognized subspecies.

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References:

- Wright, K.M. 1996. Taxon management account, Solomon Island prehensile-tailed skink *Corucia zebrata*. In Hammack, S.H. (Ed.): American Zoo and Aquarium Association Lizard Advisory Group Taxon Management Accounts, Vol. 1. Fort Worth Zoological Park, Fort Worth, TX.
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Photo by Joe McDonald, Clyde Peeling's Reptiland

Yellow SSP

Chinese Crocodile Lizard

Shinisaurus crocodilurus

(written by Andy Snider)

Species Summary:

This small, semi-aquatic lizard inhabits Guanxi Province, China and northwestern Vietnam. The species is morphologically bizarre, sporting prominent armored scales and a powerful ridged tail. It makes a fascinating subject for small exhibit spaces, is phylogenetically distinct, and offers an opportunity to interpret the threats of overharvest for traditional medicine.

Program Purposes:

Shinisaurus is threatened in the wild, currently listed on CITES Appendix II, and subject to Chinese Schedule I protection. It is not protected in Vietnam. The species is difficult to acquire, but additional founders may be available from the European zoo community or through Russian colleagues. The current US population is significant and genetically diverse and should be managed to ensure future availability for exhibits in AZA institutions.



Photo by Dr. Holger Krisp

There is little prospect for reintroduction of this species in the foreseeable future, unless suitable habitat is protected and use in traditional medicine is curtailed. The systematics of the Vietnam population is under review and may result in a second species being described.

Exhibit Qualities:

Crocodile lizards are exceptional exhibit subjects. They need relatively little space, are visually striking in groups, and are one of the few truly semi-aquatic lizards. The species is best displayed in a lushly planted exhibit with land and water. Exhibits must be carefully designed to provide these shy lizards with adequate cover, while still remaining visible. Relatively deep water should be provided for swimming and soaking, and underwater viewing is ideal. Placing one or more partially submerged branches in conspicuous locations creates natural haul out and basking sites where the lizards often perch in plain view. *Shinisaurus* are famous for remaining motionless for hours at a time, leading to the local nickname “lizard of great sleepiness.”



These lizards live in small ponds and slow-moving rivulets in the wild and are typically found among dense vegetation. They have been exhibited successfully with small fish, such as cloud minnows (*Tanichthys* sp.) and have even been kept with the much larger Chinese water dragon (*Physignathus cocincinus*), although this has not been tried long-term.



Photo by Jessi Krebs, Omaha's Henry Doorly Zoo *Shinisaurus* exhibit

Interpretive Messages:

- Convergent evolution
- Over harvest for traditional medicine (to treat insomnia)
- Osteoderms

Care and Facilities:

Shinisaurus are comfortable in relatively small enclosures. A small group of adults may be maintained in an aqua-terrarium 4' wide x 2' deep x 2' high with a water depth of 6-10". Water should be filtered or changed regularly and oxygenation is probably beneficial. Aquatic plants add welcome cover and help remove



nitrogenous wastes.

Shinisaurus are adapted to temperate environments and tolerate sharp swings in temperature in the wild (summer highs of 100°F, winter lows below 30°F). In captivity, specimens are typically kept at ambient air temperatures of 70-75°F and water temperatures of 65-70°F. A subtle basking site at 85-90°F, is essential for thermoregulation and encourages the lizards to remain visible.

Wild *Shinisaurus* consume fish, mollusks, tadpoles, insects, and caterpillars. In captivity they readily

eat crickets, earthworms, meal worms and various seasonally available insects. Food is best offered by dropping into the water. Like most lizards, this species benefits from exposure to ultra-violet light (UVA & UVB). Currently available mercury-vapor lamps or other artificial sources of UVB may be used indoors.

Other Notes:

This species is notoriously difficult to sex and there are many unsexed animals in the captive population. In animals over two-years old, manual “popping” of male hemipenes can be accomplished by skilled animal staff (probing does not appear to be effective). Animals with intense red coloration tend to be males, but brown specimens may be either sex. Mature males may also have wider, bulkier heads and display courtship behavior.

Program Goals:

Sex all animals over 2 years old
Reproduce all potential founders
Bring in new blood lines when available

Program Contact:

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References:

- Hofman, E.G. Chinese Crocodile Lizard (*Shinisaurus crocodilurus*) information, care, and breeding. Reptiles Magazine.
- Snider, A. 2010. North American Regional Studbook for the Chinese Crocodile Lizard, *Shinisaurus crocodilurus*, 4th Edition. Fresno Chaffee Zoo.
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Caiman Lizard

Dracaena guianensis

(written by Dale McGinnity & Erica Hornbrook)



Photo by Christian Sperka, Nashville Zoo

Species Summary:

This large, diurnal lizard is an impressive exhibit species. Colorful, sculpted scales and an active, semi-aquatic lifestyle make it a dynamic display, especially when mixed with other taxa in a large enclosure. The genus *Dracaena* is comprised of only two species—both from South America.

Program Purposes:

Dracaena guianensis is listed on CITES Appendix II because it is threatened by exploitation. In 1995 the U.S. Fish and Wildlife Service confiscated skins and boots of this species, worth \$1 million wholesale, from a boot company in El Paso, Texas. From 1980-86 CITES reported 304,585 *D. guianensis* skins sold for the boot and handbag trade. Although the species is widespread, it's difficult to imagine such extreme harvests being sustainable.

Prior to the mid 1990s there had been no caiman lizards in zoological institutions for several decades, because specimens were unavailable. Since then the species has bred at several AZA institutions. It is unlikely that zoos can rely on future importations or private-sector breeding for exhibit specimens. It is essential that the captive population be managed to ensure future exhibit availability.

Exhibit Qualities:

D. guianensis is a colorful, active exhibit species that may be exhibited in a “standard” zoo reptile exhibit with a pool large enough for soaking. However, these impressive lizards are better suited to large, mixed species terrestrial/aquatic exhibits with underwater viewing. They frequently bask in plain view, perching lazily on large branches overhanging water.

Caiman lizards have proven to exhibit surprisingly well with many other species including turtles, poison arrow frogs, and basilisk lizards. They also coexist with many species of fish including large cichlids, freshwater stingrays, catfish, and smaller characins. Some larger characins can be problematic—for example, large pacu have bitten the tail tips off caiman lizards before the fish were removed from exhibit. It is possible that a freshwater stingray could injure a caiman lizard, but the two taxa have been maintained together for years with no issues at the Nashville Zoo.

Educational Qualities:

Some captive born caiman lizards become tame and certain individuals may be suitable for outreach programs. However, anyone who has heard the sound produced when a caiman lizard crunches a 5-inch apple snail would have a great deal of respect for the potential damage this species could inflict.



Photo by Kathleen Gregory, Nashville Zoo mixed species *Dracaena* exhibit

Interpretive Messages:

- Illegal skin trade
- Specialized diet (snails)
- Amazonian rainforests and rivers
- Semi-aquatic life history and riparian zone buffers

Care and Facilities:

Captive born caiman lizards are not particularly difficult to maintain. In the wild the primary prey item during the wet season is large aquatic snails, and some institutions have avoided caiman lizards because of the difficulty of acquiring snails in captivity. However, captive born specimens have been raised to adulthood without snails, on primarily a rodent diet, with no apparent negative effects. Snails are no longer fed to any individuals at

the Nashville Zoo, which maintains a large breeding group of *Dracaena*. The minimum enclosure for off-exhibit holding of an adult is approximately 5' long x 3' wide x 3' tall. Multiple males and females may be housed together in larger enclosures and exhibits. Aggression between specimens is rarely seen, but if an individual in a mixed group is not doing well, it should be isolated or moved to another group situation. Unexpectedly, this has been more of a problem for females than with males in group settings. This species may require UV radiation, and this species may benefit from high light intensity as well.



Photo by Kathleen Gregory, Nashville Zoo mixed species *Dracaena* exhibit

Other Notes:

Because this species does so well in mixed species exhibit situations, there may be many existing exhibits in zoo and particularly public aquariums to which this species could be added. Caiman lizards are excellent climbers and measures to prevent escape from the enclosure will need to be taken into account for all exhibits.

Program Goals:

- Acquire additional founders
- Breed unrepresented founders
- Encourage aquariums to include in mixed species exhibits

Program Contact:

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Black Tree Monitor

Varanus beccarii

(written by Ruston Hartdegen)

Species Summary:

This handsome, gracile lizard is a highly specialized version of the basic monitor body plan. It is a sleek, small, active climber with long sharp claws and a prehensile tail. *Varanus beccarii* is an engaging exhibit specimen and represents a narrowly distributed taxa from the Aru Island chain of Indonesia.

Program Purposes:

This species is listed in CITES Appendix II and was designated as susceptible during the 1992 CAMP workshop based on the Mace-Lande criteria. Considering its narrow range and specialized lifestyle it is likely to face extraneous pressures in the future.

There is little prospect for reintroduction of this species in the foreseeable

future, unless suitable habitat is protected. Although black tree monitors are currently imported into the U.S. in limited numbers their future availability is in doubt, as import quotas become more restrictive. AZA institutions maintain a moderate captive population with abundant potential founders, but breeding is irregular and most specimens are imports. The population should be managed to ensure future exhibit availability and relieve collection pressure on wild populations.



Photo by Matt Vaughan, Dallas Zoo

Exhibit Qualities:

Varanus beccarii is an active forager that appears to be intelligent and curious, and institutions should plan exhibits that take advantage of those qualities. Although little is known about this species in the wild, the black tree monitor is presumed to inhabit mangrove swamps and lowland tropical forests. A spacious, complex exhibit that includes strategically placed tropical plants, sturdy climbing structures, and a water feature, provide an attractive setting for this monitor and meet its physical needs. Besides its active and inquisitive nature, this monitor possesses a striking jet-black coloration, unusual among lizards. Although *V. beccarii* is typically tolerant of conspecifics and may be exhibited in groups, aggression has been noted in groups with multiple males and among gravid females.

Interpretive Messages:

- Parietal eye
- Prehensile tail
- Forked tongue (refined olfactory sense)
- Adaptations for hunting active prey (claws, teeth, agility)

Care and Facilities:

These lizards require vertical space, visual complexity, and diggable substrates. They thrive in hot, humid conditions and make regular

use of standing water. Enclosures should be well ventilated and substrates should allow for drainage of excess moisture. Exhibits should include a variety of diagonal branches with some horizontal limbs, a daytime basking site of 95-110°F and loamy soil substrate for digging. Soil mixes often include ground peat moss, sand and ground coconut husk. This species requires space to move about freely and enclosures should be at least 4' tall. If provided with a pool, these lizards will venture into the water and even swim. Sturdy species of live plants may be used if located in hard-to-reach areas. Avoid fragile, soft-stemmed plants, which will be quickly obliterated. The species probably benefits from access to UVB light.

The main diet for most captive specimens consists of adult crickets and other large invertebrates (roaches, *Zoophobia* sp., etc). Small mice or birds may be fed occasionally, but should probably not comprise the bulk of the diet.



Photo by Chad Peeling, Clyde Peeling's Reptiland black tree monitor exhibit

Other Notes:

Although the rate of successful captive reproductions is sporadically increasing, this species continues to suffer high mortality rates in wild collected specimens. Several institutions have also reported difficulty rearing captive hatched neonates and significant egg mortality. This species is capable of extricating food items from hollow logs or boxes using the forelimbs and would likely respond to appropriately designed food puzzles.

Program Goals:

- Recruit program leader
- Establish successful breeding protocols
- Add wild caught females to managed population, as current population is male biased.

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Photo by Chad Peeling, Clyde Peeling's Reptiland black tree monitor exhibit

References:

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Crocodile Monitor

Varanus salvadorii

(written by Ruston Hartdegen)

Species Summary:

This powerful arboreal monitor is among the longest species of lizards, reaching 8 feet in overall length. It inhabits coastal forests and mangrove swamps in New Guinea and is adapted to climbing and hunting in trees. Very little is known about the ecology of *V. salvadorii* in the wild.

Program Purposes:

This species is listed on CITES Appendix II and was designated as Vulnerable during the 1992 CAPM workshop, based on the Mace-Lande criteria. It enjoys a large range, but its conservation status is not well known.

Although imported specimens are currently available, they are often nervous animals and may prove difficult to display. The captive population should be managed to ensure future availability of captive-hatched exhibit specimens and relieve collection pressures on wild populations.

Exhibit Qualities:

These handsome lizards fill a unique exhibit niche among monitors—they are large and arboreal. A blunt snout, intricately patterned skin, and remarkably long tail (up to 2/3 the overall body length) make this species an eye-catching choice for institutions that do not have facilities to accommodate Komodo monitors. Exhibits should be large (at least 100 square feet in plan and 5' tall) with abundant climbing opportunities and visual cover. Diggable substrates are relished and the lizards will use pools for soaking. Like most monitors, *V. salvadorii* is powerful and destructive—only sturdy plants should be used. These tropical lizards need warm temperatures, high humidity, and regular misting.

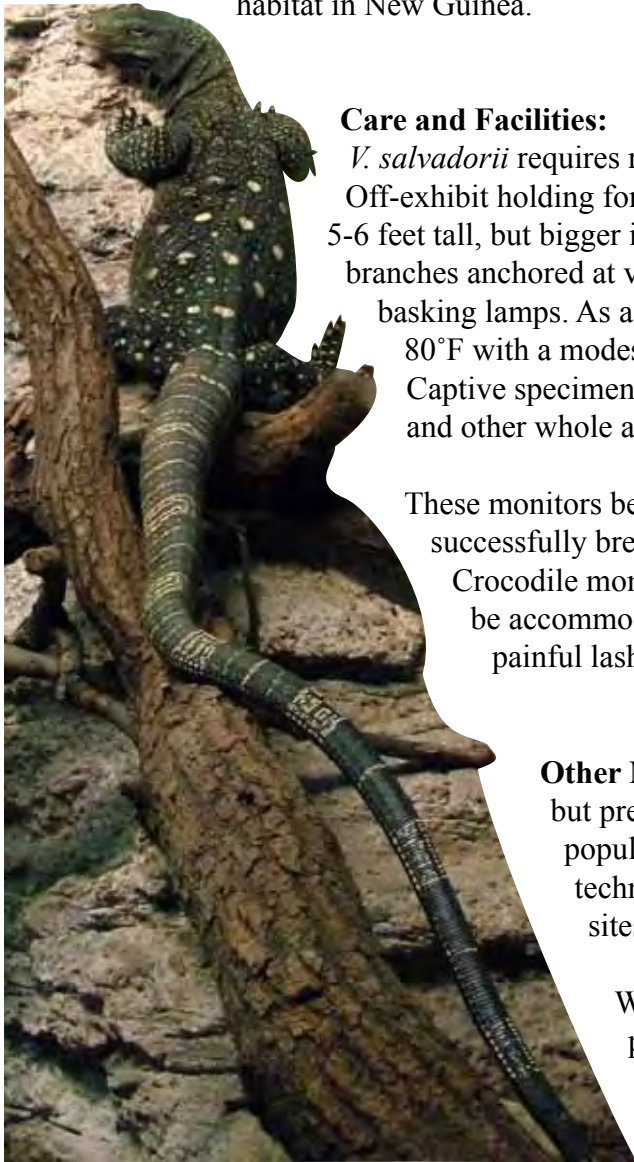


Photo by Matt Vaughan, Dallas Zoo

The most compelling exhibits include multiple specimens and Riverbanks Zoo has kept 1.2 adults together for several years without incident. Some specimens do not tolerate conspecifics so provisions must be made to separate animals if needed. Injuries are most likely during group feedings. Non-receptive females have also been injured during copulatory attempts.

Interpretive Messages:

- Island endemism
- Active hunter - gular pump analogous to mammalian diaphragm.
- Arboreal adaptations - long, straight teeth to hold struggling prey; counterbalancing tail.
 - Biological frontier - almost nothing is known about this lizard's natural history or its remote habitat in New Guinea.



Care and Facilities:

V. salvadorii requires relatively large enclosures to accommodate active climbing. Off-exhibit holding for a single adult should be at least 36 square feet in plan and 5-6 feet tall, but bigger is better. Enclosures should feature a variety of large, sturdy branches anchored at various angles, elevated and terrestrial hides, and overhead basking lamps. As a tropical species, ambient temperatures should hover around 80°F with a modest nighttime drop. Daytime basking sites should be 95-110°F. Captive specimens are not particular about prey and may be fed rodents, birds, and other whole animals.

These monitors benefit from direct sunlight and some institutions that have successfully bred the species did so in enclosures with access to the outdoors. Crocodile monitors are potentially dangerous animals and precautions should be accommodated in husbandry routines. The tail is capable of delivering a painful lashing, and the bite can cause devastating local tissue damage.

Other Notes: Modest captive reproduction has occurred in the US, but premature death of females has skewed the sex ratio of the population. Efforts are needed to establish repeatable breeding techniques and to evaluate female requirements (nutrition, nesting sites, seasonal cues).

When available, acquiring young specimens is generally preferable, as they more easily adjust to captivity and make better display animals.

Photo by Vassil, public domain

Program Goals:

- Recruit program leader
- Refine breeding techniques
- Recruit additional institutional partners
- Reverse male bias
- Pair-up potential breeders in population

Program Contact:

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References:

- Hudson, R., A. Alberts, S. Ellis, and O. Byers. 1994. Conservation assessment and management plan for Iguanidae and Varanidae. IUCN/SSC Conservation Breeding Specialist Group.
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public domain

Haitian Giant Galliwasp

Celestus warreni

(written by Dale McGinnity)

Species Summary:

At more than two feet in length, this large secretive lizard escaped the notice of science until recently—it was formally described in 1970. Although still poorly known to biologists, it is familiar to local people and figures in Haitian culture and mythology. The species is increasingly rare in the wild and offers opportunities for zoo conservation and education.



Photo by Paddy Ryan/Ryan Photographic

Program Purposes:

IUCN listed this species as Critically Endangered in 2004 due to the continuing reduction of its range, population, and already severely fragmented forest habitat in Haiti. The entire range in Haiti is approximately the size of a large Texas county.

In 1999, staff from the Nashville Zoo collected a genetically diverse founder population in small patches of forest in the hills surrounding Limbe, Haiti. This captive population has been genetically managed and maintained in isolation at the Nashville Zoo for a future re-

introduction program and all of the original founders are now represented. The captive population will continue to be managed as a genetic reservoir and surplus offspring are available to any institutions that would like to display this species. Additional isolation space would also benefit the program.

Exhibit Qualities:

Although secretive in nature, this species displays well in properly designed medium-sized exhibits. Due to their non-aggressive nature when raised in groups, giant galliwasp may be maintained in fairly large colonies and exhibit particularly well with arboreal lizards such as Haitian giant anoles (*Anolis ricordi*). While larger Haitian frogs and other lizard species such as *Liochepahalus* and *Ameiva* species have yet to be tried, we believe these exhibit combinations are worth attempting with well feed giant galliwasp. Wild caught giant

galliwasps require a substrate to burrow in, but captive born animals do well without this as long as they are misted daily. Exhibits must be designed to limit the lizard's ability to burrow and hide—fill in depressions and areas around plant pots with medium sized rounded rock or gravel and apply a thin layer of substrate on top (1-3"). Exhibits should be sprayed daily and the base kept moist to limit shedding issues. Unexpectedly, specimens on exhibit at the Nashville Zoo spend a large portion of their time in higher parts of the 48" tall exhibit, often laying on ledges 2-3 feet above the ground where various hot spots are located.

Educational Qualities:

A mixed-species Haitian exhibit, featuring *C. warreni*, is an excellent opportunity to highlight the plight of the Haitian ecosystem and its rampant deforestation. With work, some captive born galliwasps can become very tame and certain individuals may be utilized in outreach programs.

Interpretive Messages:

- Critically endangered - closely related Jamaican giant galliwasp may already be extinct.
- Invasive species - introduced mongoose prey on galliwasps.
- Deforestation in Haiti - galliwasp burrows are associated with tree roots.
- Toxic prey - primary diet is toxic millipedes in the wild.
- Mythology - significant in Haitian Voodoo religion



Photo by Kathleen Gregory, Nashville Zoo mixed galliwasp exhibit



Photo by Kathleen Gregory, Nashville Zoo

Care and Facilities:

Despite early struggles to maintain this species, giant galliwasp are fairly easy to care for in captivity. Off exhibit, groups of up to 15 individuals may be maintained in an enclosure approximately 6' long x 2' wide x 2' tall with 4-6 inches of substrate. One side should be kept warm and dry and include a heat emitting UVB lamp; the other side should be kept cool with moist substrate for burrowing. Individual animals or groups of smaller individuals may be maintained in enclosures as small as a 20-gallon long aquarium. This species is long-lived and gives birth to numerous live offspring (one clutch had more than 50 neonates). High fecundity makes genetic population management easier, but creates difficulties for institutions with restrictive disposition policies. Maintaining single sex groups helps limit surplus offspring. In cool weather climates, genetically unimportant offspring have been added to aviaries for insect control.



Other Notes:

In the mid 1980s two similar species were described from the Dominican Republic, based largely on color differences. One species, *Celestus anelpistus*, was found in the southern D.R. and may already have gone extinct—only 3 wild-caught animals had been found in a small patch of forest and their offspring died at the zoo in Santo Domingo, D.R. No other reports of this species have been documented since. The other species was described from the northern D.R. but, after further examination, was assigned to *C. warreni* in 2003.

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Motagua Valley Beaded Lizard

Heloderma horridum charlesbogerti

(written by Jan Johnson)

Species Summary:

The Motagua Valley beaded lizard is an isolated and endangered population from the dry forests of southeastern Guatemala. Discovered by science in 1984, this population of beaded lizards is of special conservation concern.

Program Purposes:

The Guatemalan subspecies of beaded lizard (*H. h. charlesbogerti*) is listed on CITES Appendix I and considered critically endangered. Project Heloderma, a consortium of institutions, including Zoo Atlanta, is working in situ to support field research, public education, and habitat protection.

There are captive animals with good locality data in AZA institutions. Given the extremely small wild population (estimated at 100-200 individuals) and the robust field conservation program underway, this captive population will be tracked as a potential source for future reintroductions.



Photo by Michael Kern, Zoo Atlanta



Photo by Michael Kern, Zoo Atlanta

Exhibit Qualities:

On exhibit, beaded lizards are always visible, although not often very active. Several individuals may be housed together without incident. A number of institutions have exhibited these lizards in multi-species exhibits with *Ctenosaura*, *Gopherus*, *Heloderma suspectum* and other smaller lizards. The Arizona-Sonora Desert Museum successfully kept two beaded lizards for 18 years with a *Boa constrictor imperator*, until one day the Boa constricted and killed a lizard. Beaded lizards dig and trample delicate plantings, so only sturdy species should be used on exhibit. Vertical space is surprisingly well utilized by these lizards if they are provided branches and rocks to climb.



Photo by Michael Kern, Zoo Atlanta

Interpretive Messages:

- Project Heloderma - the power of grass-roots conservation
- Venom - evolutionary origins, emphasis on causing pain rather than killing prey
- Byetta - a human diabetes drug based on a component in the saliva of *Heloderma suspectum*, a close relative of beaded lizards
- Aestivation - water storage in bladder, fat storage in tail
- Threats to tropical dry ecosystems

Care & Facilities: Beaded lizards typically thrive in captivity and do not require specialized diets or husbandry. They readily accept dead rats and mice. They do not need specialized UV lighting, although a

heat spot would be appreciated. Because individuals can be housed together reserve space is not needed to keep individuals separated. Publications concerning this species include numerous articles discussing this animal in captivity, a few articles describing wild behavior and a Taxon Management Account. A book discussing the family was published in 2005. Exhibits should be moderately large and allow for climbing.

Other Notes:

Because this species requires considerable space and is relatively long lived, it is critical that AZA institutions not breed specimens unless recommended by the program manager.



Photo by Michael Kern, Zoo Atlanta

Program Goals:

- Continue to support Project Heloderma's field conservation work
- Maintain *H. h. charlesbogerti* separately from other beaded lizards in the captive population
- Carefully track individuals of this subspecies in captivity

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References:

- Bogert, C.M. and R. M. del Campo. 1956. The Gila monster and its allies: The relationships, habits, and behavior of the lizards of the family Helodermatidae. Bul. Amer. Mus. Nat. Hist. 109:1-238.
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Photo by Michael Kern, Zoo Atlanta

Jamaican Iguana

Cyclura collei

(written by Tandora Grant)

Species Summary:

This critically endangered lizard is considered the flagship species for the conservation of all West Indian iguanas, and is an excellent example of the effective conservation work that zoos can accomplish when resources are pooled. Considered a model AZA program, the remarkable story of the rediscovery and reintroduction success presents an excellent educational opportunity.



Photo by John Binns

Program Purposes:

Ranked as Critically Endangered by the IUCN Red List, Appendix I in CITES, and listed as endangered by the U. S. Fish and Wildlife Service, this species was thought extinct since the 1940s. In 1990 a remnant population of less than 100 individuals was discovered surviving in the Hellshire Hills, a rugged limestone forest on the southeastern coast of Jamaica. *C. collei* is threatened by the introduced Indian mongoose, which preys heavily on hatchling and

juvenile iguanas, and charcoal burners, who degrade the remaining habitat. Considered one of the world's most endangered lizards, the recovery program is sponsored largely through the efforts of the Lizard TAG and consists of captive headstart and release, predator control and ongoing field research. To date more than 170 iguanas have been returned to the wild and the number of nesting females in the wild population has increased more than five-fold.

A high priority for securing this iguana's future is re-establishing a population on the Goat Islands, off the coast of the Hellshire Hills. If a successful population can be established and become self-sufficient on the island the species will have a far more secure future. Until then, the U.S. captive population of Jamaican iguanas is managed to maintain long-term genetic variation in the event that reintroduction and/or supplementation of the wild population is needed. Captive animals also generate attention and support for the ongoing recovery effort for the wild population.



Photo by Nate Nelson, Sedgwick County Zoo indoor *Cyclura* exhibit

Exhibit Qualities:

Like all members of the genus *Cyclura*, these large lizards make ideal exhibit animals. They are photogenic, heliothermic, and use a variety of visual displays in social behavior. They do not thrive or breed well in traditional “reptile house” settings, and should be housed in spacious outdoor enclosures, especially in warmer climates.

Most exhibits include solitary or paired animals, as both sexes may be aggressive. Some institutions have successfully exhibited West Indian iguanas with other species, including free-flighted birds (e.g. Psittacines, Anatines), cane toads (*Rhinella marina*), and anole lizards (*Anolis* sp.). At Sedgwick County Zoo birds are often seen perched next to iguanas with no negative interactions to date. Other Caribbean lizards (e.g. *Leiocephalus* sp., *Ameiva* sp.) may also be good candidates.

Live plants may be used in exhibits, but iguanas may browse on edible species. *Hibiscus*, mulberry, ornamental grasses, *Ficus*, *Yucca*, *Opuntia* sp. cactus, and honeysuckle have been used successfully in outdoor exhibits.

Although outdoor enclosures are best, three institutions have successfully maintained *C. collei* in indoor exhibits with outdoor exposure in the summer. Providing appropriate basking temperatures, bright ambient light, and adequate UVB exposure are imperative.

Educational Qualities:

Large iguanas are a handful and many do not lend themselves to educational programming. However, tractable individuals are fantastic presentation animals under the control of an experienced handler.

Interpretive Messages:

- Re-discovery in 1990
- Recovery milestones in Jamaica - more than five-fold increase in number of nesting females, successful

reproduction among repatriated animals, and long-term survival of hatchlings within core mongoose trapping area

- Endangered topical dry ecosystems of the Caribbean

Care and Facilities:

C. collei is a space-intensive lizard. Pairs should be housed in minimum enclosures of 10' wide x 6' long x 6' high off exhibit, but larger areas (at least 12' wide x 12' long x 10' high) are preferable and access to outdoor enclosures during warm weather are essential. Enclosures should include large, secure branches for climbing and visual barriers for hiding. Palms and cacti provide handy cover for enclosures and are rarely eaten by iguanas. Sandy soil is ideal for creating burrows and outdoor enclosures should include underground digging barriers to prevent escape.



Photo by Rick Hudson, off-exhibit *Cyclura* enclosures with outdoor space

All *Cyclura* require hot environments with daytime highs of approximately 85°F and basking sites of 110-120°F. Nighttime temperatures may safely drop to 65°F and heated retreats may be provided. Outdoor animals in temperate climates should be “hardened” to nighttime lows gradually when moved outside in the spring.



Photo by Rick Van Veen, released headstart iguana, Hellshire Hills

Re-creating appropriate diets for herbivorous lizards is a complex and evolving science. Generally, *Cyclura* should be fed a daily diet based on nutritious dark, leafy greens (e.g. dandelion, endive, kale, collard greens, mustard greens, bok choy, escarole) with very small portions of other vegetables (e.g. root vegetables), fruits (e.g. squash, green beans, tropical fruits) and flowers (e.g. dandelion, *Hibiscus*) mixed in and varied seasonally. Most institutions supplement each feeding with calcium and vitamins. Nutritionally complete diets (e.g. reptile carnivore/omnivore gel) are also used as a dietary addendum at some institutions, though care should be taken to avoid excess protein.

A critical counterpart to diet is exposure to adequate levels of UVB radiation, which may be accomplished artificially indoors, but is best accomplished by maintaining the animals outdoors during warm weather.

Other Notes:

The Husbandry Manual for West Indian Iguanas is available online or from any of the program contacts.

Program Goals:

- Continue to support the Hope Zoo headstart program and the field research and reintroduction project through fund-raising efforts, in-kind support and grants.
- Seek corporate sponsorship for long-term funding.
- Increase research on nutritional, reproductive, social, and medical aspects of iguana biology to improve breeding success and growth rates in captivity.
- Recruit additional SSP participants, especially those offering off-exhibit outdoor facilities.

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Photo by Glen Gerber; female nesting in Hellshire Hills

References:

- Alberts, A., (ed.) 2000. West Indian Iguanas: Status Survey and Conservation Action Plan. IUCN SSC West Indian Iguana Specialist Group. IUCN, Gland, Switzerland.
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- Wilson, B.S., A. Alberts, K. Graham, R.D. Hudson, R. Kerr Bjorkland, D. Lewis, N.P. Lung, R. Nelson, N. Thompson, J.L. Kunna and P. Vogel. 2004. Survival and reproduction of repatriated Jamaican iguanas: headstarting as a viable conservation strategy. Pages 220-231 in A.C. Alberts, R.L. Carter, W.K. Hayes, and E.P. Martins (eds.), Biology and Conservation of Iguanas. University of California Press, Berkeley.

Komodo Dragon

Varanus komodoensis

(written by Chad Peeling)

Species Summary:

Komodo dragons are the largest extant lizards and among the most widely recognized reptile species. These massive animals—some approaching 3 meters in length and 100 kg.—live on five remote volcanic islands in the Lesser Sunda Archipelago of Indonesia. Adult dragons dominate their terrestrial ecosystems and eat a wide variety of prey, including feral pigs, deer, and even water buffalo.



Photo by Joe McDonald, Clyde Peeling's Reptiland

Program Purposes:

Varanus komodoensis is listed in CITES Appendix I, as vulnerable in the IUCN Red Data List, and as Endangered under the U.S. Endangered Species Act. This species has the smallest range of any large carnivore and is vulnerable to catastrophic natural disasters and persistent human encroachment. Komodo National Park protects three of the islands in the lizards' current range and the coral reefs that surround them. Human pressures inside the park include poaching of rusa deer—the primary prey of adult dragons—and occasional conflicts between dragons and livestock. The species appears to have been extirpated from one island within the national park since 1981. Outside the park, dragon habitat is being fragmented by human population growth, poaching, and slash-and-burn agriculture.

Robust captive populations exist in Indonesian, U.S. and European zoological parks and these must be managed to ensure future availability of exhibit animals and as an assurance against catastrophic loss in the wild population. Importing additional animals from Indonesian zoos is not out of the question, but the process is encumbered by significant regulatory hurdles in both countries.

The government of Indonesia and the Nature Conservancy actively manage conservation and eco-tourism within Komodo National Park. The

Komodo SSP conservation fund supports ongoing field work in and around the park to document the behavioral ecology of the species and establish conservation management needs.

Exhibit Qualities: Komodo dragons are exceptional exhibit animals by any standard. Their size, behavioral complexity, and reputation rival any large mammal in promotional impact and visitor appeal. Exhibiting dragons requires a significant commitment of resources. These active lizards need more space than other large reptiles (100 square meters per adult is considered ideal) and safety of staff and visitors are essential considerations. Exposure to unfiltered sunlight appears to be essential for long-term health and an outdoor yard should be provided, even in climates that only allow seasonal use.



Outdoor dragon exhibit at Disney's Animal Kingdom. Photo by Chad Peeling.

Dragons are noted for intelligence and curiosity, and lend themselves to visually complex environments with live plantings and natural soils. These lizards should be provided with enrichment activities, and crate training is recommended to ease close physical examination without the need for overt physical restraint. Rockwork and other habitat furniture must be designed to limit falls and other potential injuries. Juveniles may be housed



Indoor dragon exhibit at Denver Zoo. Courtesy Denver Zoo.

together for a couple of years, but provisions must be made to house adults separately. Detailed information about facility design is available from the program coordinator, including a digital summary of existing facilities, photos, and peer-reviewed literature.

Interpretive Messages:

- Biodiversity hot spot (Komodo National Park)
- Described by Western science in 1912
- Venom glands & virulent oral bacteria
- Last of the giant varanids
- Group feeding behavior
- Parthenogenesis
- Ambush hunters
- Apex predators



Photo by Joe McDonald, Clyde Peeling's Reptiland

Care and Facilities:

Juvenile dragons are arboreal and should be provided with a sturdy network of elevated branches and hides. Young animals may be housed in small room-style enclosures, and will use space actively. Although hatchlings may be raised together for a couple of years, fighting almost inevitably occurs as they approach maturity and provisions must be made to house animals separately. Access to UVB radiation is essential and must be provided with artificial lights when dragons are kept indoors.

Like all monitor lizards, dragons are prodigious diggers and climbers. Enclosures should include mixed soil substrates, high temperature basking spots, and access to tempered water. Given ample pool space dragons may swim. These lizards require extreme tropical temperatures—daytime highs near 95°F, night time lows of about 80°F, and basking sites of 115-120°F.

The Komodo dragon Husbandry Manual, Medical Management Manual, studbook, and current Population Management Plan are available on the AZA website under Animal Management Programs.



*Off-exhibit juvenile holding.
Photo by Christian Steinbacher, Reptiland.*

Other Notes:

- A recent exchange of animals with European zoos has enhanced the genetic diversity of the North American population.
- Significant breeding success in the last two years has made animals available to a number of new institutions.
- The SSP Coordinator maintains an institutional request list for those considering participation in the SSP.
- Participating institutions are encouraged to make a monetary contribution to the Komodo SSP Conservation Fund, which supports ongoing field research.

Program Goals:

- Mitigate reproductive mortality in females
- Enhance understanding of dietary / metabolic needs
- Breed under-represented animals in population

Program Contact:

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References:

- Murphy, J.B. (ed), C. Ciofi, C. de La Panouse, and T. Walsh. 2002. Komodo Dragons, Biology and Conservation. Smithsonian Institution Press.
- IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org>.
- CITES Species Database online. <www.cites.org/eng/resources/species.html>.
- USFWS Endangered Species Program online. <www.fws.gov/endangered>.



Photo by Joe McDonald, Clyde Peeling's Reptiland

Information Deficit

Very little is known about the status of most lizard species and populations in the wild. A review of Wildlife Action Plans for each of the US Fish and Wildlife Service conservation regions emphasizes this deficit of understanding in our own backyards. With few exceptions, the lack of field data is true globally.

Undoubtedly many lizard species are under threat from habitat fragmentation, invasive species, and climate change. The first step to assessing lizard conservation needs is data acquisition. We strongly encourage institutions to participate in or initiate field studies of lizards in their regions.

Regional Emphasis

Some of the most visually compelling lizard species are found in far-flung tropical countries, but AZA institutions have the most potential to enhance conservation in North America. We encourage institutions to forge partnerships with regional wildlife agencies and non-governmental conservation groups to address lizard conservation locally.

Agency & NGO Resources

International Union for Conservation of Nature (IUCN) www.iucnredlist.org

“IUCN is the oldest and largest global environmental organization. It is a neutral forum for governments, NGOs, scientists, business and local communities to find pragmatic solutions to conservation and development challenges.” The IUCN website features a searchable database. Lizard species from North America can be easily sorted and exported as a file document..

United States Fish and Wildlife Service (USFWS) www.fws.gov

“The USFWS is a federal government agency within the United States Department of the Interior dedicated to the management of fish, wildlife, and natural habitats.” The USFWS is divided into eight regions (below). Each regional website describes conservation priorities and species of concern within their respective areas. A searchable database of federally listed threatened and endangered species by state is accessible on the main website, as well as Five- Year Action Plans, which identify threats and conservation strategies.

- Region 1- Pacific Region www.fws.gov/pacific
(Hawaii, Idaho, Oregon and Washington)
- Region 2- Southwest Region www.fws.gov/southwest
(Arizona, New Mexico, Texas and Oklahoma)
- Region 3- Midwest Region www.fws.gov/southwest
(Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio and Wisconsin)
- Region 4- Southeast Region www.fws.gov/southeast
(Kentucky, Arkansas, Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Louisiana, Florida, Commonwealth of Puerto Rico and the Virgin Islands)

- Region 5- Northeast Region www.fws.gov/northeast
(Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, New Jersey, Pennsylvania, Rhode Island, Vermont, Virginia and West Virginia)
- Region 6- Mountain-Prairie Region www.fws.gov/mountain-prarie
(Montana, North Dakota, South Dakota, Wyoming, Nebraska, Utah, Colorado and Kansas)
- Region 7- Alaska Region www.alaska.fws.gov
- Region 8- Pacific Southwest Region www.fws.gov/cno www.fws.gov/cno
(California and Nevada)

State Wildlife Action Plans www.wildlifeactionplan.org

“Congress charged each state and territory with developing a wildlife action plan. These proactive plans, known technically as “comprehensive wildlife conservation strategies,” assess the health of each state’s wildlife and habitats, identify the problems they face, and outline the actions that are needed to conserve them over the long term.” Each state’s action plan can be accessed from the website above and includes lists of species of concern.

United States Geological Service (USGS) www.usgs.gov

“The USGS is a science organization that provides impartial information on the health of our ecosystems and environment, the natural hazards that threaten us, the natural resources we rely on, the impacts of climate and land-use change, and the core science systems that help us provide timely, relevant, and usable information.” The USGS spear-heads many in situ monitoring and research programs and can provide opportunities for collaborative lizard conservation projects. This website provides contact information for all state offices and a database of current USGS programs.

Association of Fish and Wildlife Agencies (AFWA) www.fishwildlife.org

“The Association of Fish & Wildlife Agencies represents North America’s fish and wildlife agencies to advance sound, science-based management and conservation of fish and wildlife and their habitats in the public interest.” The AFWA website includes links to all of the state fish and wildlife agencies and other partner organizations.

Partners in Amphibian and Reptile Conservation (PARC) www.parcplace.org

PARC’s mission is “To conserve amphibians, reptiles and their habitats as integral parts of our ecosystem and culture through proactive and coordinated public-private partnerships.”

PARC is divided into several regional networks (below). Through a diverse membership, each network focuses on habitat preservation and restoration, threatened and endangered species conservation, as well as keeping common species common. PARC has developed various resources for conservation action specific to each region and most regions have identified lizard species of concern.

- Midwest www.parcplace.org/midwest.html
(Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota and Wisconsin)
- Southeast www.parcplace.org/southeast.html
(Alabama, Arkansas, Florida, Georgia, Kansas, Louisiana, Michigan, North Carolina, South Carolina and Tennessee)
- Southwest www.parcplace.org/southwest.html
(Arizona, California, Colorado, Hawaii, New Mexico, Nevada, Oklahoma, Texas and Utah)
- Northeast www.parcplace.org/northeast.html
(Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia and West Virginia)
- Northwest www.parcplace.org/northwest.html
(Alaska, Idaho, Montana, Oregon, Washington and Wyoming)

Acquisition / Disposition Statement

The Lizard Advisory Group (LAG) strongly encourages institutions to develop sound acquisition/disposition practices that allow for acquisition and disposition of lizards outside of AZA institutions. Space will continue to be a challenging factor towards sustainable populations. A number of lizards in this RCP can have multiple offspring in one clutch which can quickly fill available space with limited genetic diversity. To ensure that lizard populations can move towards sustainability there are times that it will require the de-accession of individuals outside of AZA institutions to make space for more genetically important animals or conversely to bring in unrelated individuals from non-AZA institutions to strengthen genetic diversity. To this end the LAG requests that institutions develop sound A&D policies that allow exchanges with non-AZA facilities while ensuring the long term welfare of all the individuals and is in line with AZA's acquisition/disposition policies.

The Lizard Advisory Group (LAG) defers to the acquisition/disposition policies for AZA accredited institutions.

Appendix I

Conservation status of RCP species

Ranked according to the IUCN Red Data List, United States Fish and Wildlife Service (USFWS), Convention on the International Trade in Endangered Species (CITES), or existing CBSG CAMP reports (CAMP) as of August, 2012.

| English Name | Taxon | Status (IUCN, CITES, USFWS, CAMP) |
|--------------------------------|--|---|
| <u>Family: Anguidae</u> | | |
| Hatian giant galliwasp | <i>Celestus warreni</i> | Critically Endangered (IUCN); CITES-not listed; USFWS-not listed; CAMP-not listed |
| <u>Family: Gekkonidae</u> | | |
| Satanic leaf-tailed gecko | <i>Uroplatus phantasticus</i> | Least concern (IUCN); CITES II; USFWS-not listed; CAMP-not listed |
| Giant leaf-tailed gecko | <i>Uroplatus fimbriatus</i> | Least concern (IUCN); CITES II; USFWS-not listed; CAMP-not listed |
| Henkel's leaf-tailed gecko | <i>Uroplatus henkeli</i> | Vulnerable (IUCN); CITES II; USFWS-not listed; CAMP-not listed |
| Lined leaf-tailed gecko | <i>Uroplatus lineatus</i> | Least concern (IUCN); CITES II; USFWS-not listed; CAMP-not listed |
| Mossy leaf-tailed gecko | <i>Uroplatus sikorae</i> | Least concern (IUCN); CITES II; USFWS-not listed; CAMP-not listed |
| <u>Family: Helodermatidae</u> | | |
| Rio Fuerte beaded lizard | <i>Heloderma horridum exasperatum</i> | Vulnerable (IUCN); CITES II; USFWS-not listed; CAMP not listed |
| Motagua Valley beaded lizard | <i>Heloderma horridum charlesbogerti</i> | Vulnerable (IUCN); CITES I; USFWS-not listed; CAMP not listed |
| <u>Family: Iguanidae</u> | | |
| Fiji Island banded iguana | <i>Brachylophus bulabula</i> | Endangered (IUCN); CITES I; Endangered (USFWS); CAMP-not listed |
| Jamaican iguana | <i>Cyclura collei</i> | Critically Endangered (IUCN); CITES I; Endangered (USFWS); CAMP-not listed |
| Grand Cayman iguana | <i>Cyclura lewisi</i> | Critically Endangered (IUCN); CITES I; Endangered (USFWS); CAMP-not listed |
| San Esteban chuckwalla | <i>Sauromalus varius</i> | Not assessed (IUCN); CITES I; Endangered (USFWS); \ CAMP-not listed |
| <u>Family: Phrynosomatidae</u> | | |
| Texas horned lizard | <i>Phrynosoma cornutum</i> | Stable (IUCN); CITES-not listed; USFWS-not listed; CAMP-not listed |
| <u>Family: Scincidae</u> | | |
| Prehensile-tailed skink | <i>Corucia zebrata</i> | Not assessed (IUCN); CITES II; USFWS-not listed; CAMP-not listed |
| <u>Family: Shinosauridae</u> | | |
| Crocodile lizard | <i>Shinisaurus crocodilurus</i> | Not assessed (IUCN); CITES II; USFWS-not listed; CAMP-not listed |
| <u>Family: Teiidae</u> | | |
| Haitian giant galliwasp | <i>Dracaena guianensis</i> | Not assessed (IUCN); CITES II; USFWS-not listed; CAMP-not listed |
| <u>Family: Varanidae</u> | | |
| Black tree monitor | <i>Varanus beccarii</i> | Not assessed (IUCN); CITES II; USFWS-not listed; Susceptible (CAMP) |
| Komodo dragon | <i>Varanus komodoensis</i> | Vulnerable (IUCN); CITES I; Endangered (USFWS); CAMP-not listed |
| Crocodile monitor | <i>Varanus salvadorii</i> | Not assessed (IUCN); CITES II; USFWS-not listed; Vulnerable (CAMP) |

Appendix II

Vetting Non-AZA Entities for Responsible Animal Dispositions

Participating with non-AZA partners in sustaining captive populations is critical to the success of these programs. To aid institutions in vetting non-AZA partners, we have included a sample facility profile and reference questionnaire (courtesy Nashville Zoo). The LAG encourages institutions to develop a vetting process and forge relationships with academics, private sector breeders, and other responsible entities.

FACILITY PROFILE REFERENCE INTERVIEW QUESTIONNAIRE

Facility/Dealer/Individual: _____

Reference: _____

Form completed by: _____ Date: _____

Curator's/ Representative's impressions after discussion with references (DO / DON'T deal with): _____

Director's Signature: _____ Date: _____

DEALINGS WITH OTHERS:

1) How long have you been dealing with this party & when was your last transaction? Known for 10+ years, have visited facility several times but never had a transaction with them. _____

2) To your knowledge, does this dealer / individual deal with the private sector – auctions, hunting ranches, the pet trade, etc. . _____ Yes _____ No _____

3) Have their dealings been fair & ethical with you? If not, explain _____ Yes _____ No _____

4) Have they always provided you with healthy animals? If not, have they worked with you to remedy the problem in a timely manner? _____ Yes _____ No _____

5) Is individual data & diet information provided? _____ Yes _____ No _____

6) Do you receive all requested paperwork, including permits, health certificates and medical histories without a problem? Upon request _____ Yes _____ No _____

7) Have they been willing to give you information regarding the eventual disposition of animals sold (etc.) to them? _____ Yes _____ No _____

8) Are animals picked up and delivered when promised? If not, are you notified promptly about changes? _____ Yes _____ No _____

9) Is this party prompt in paying bills? N/A _____ Yes _____ No _____

10) Do you have any knowledge of complaints regarding this party? If so, please explain _____ Yes _____ No _____

11) Additional Comments: _____

FACILITY:

1) Have you inspected the facility yourself? If yes, are the animals held in a safe and humane manner? Yes _____ No _____

2) Are their exhibit and holding areas in acceptable condition? _____ Yes _____ No _____

3) Would you send or have you sent them a species being considered for transfer from your facility? _____ Yes _____ No _____

4) If you have previously sent them an animal, would you send animals to them an animal again? _____ Yes _____ No _____

If no, please explain _____

5) How do you rate the professionalism of the staff? _____

6) Were individual animals ID'd and housed in appropriate genetic / taxonomic groups? _____ Yes _____ No _____
(no obvious inbreeding/hybridization)

7) Do you know what type of veterinary care is provided? _____ Yes _____ No _____

8) Additional Comments: _____

FACILITY**PROFILE****FISH and Reptiles**

Date: _____ Contact Person: _____

Facility Name: _____

Address, City, State, Zip: _____

Phone: _____ Fax: _____ Years in Business: _____

Primary Function:

a) Zoo _____ b) Private Breeding Facility _____ c) Rehabilitator _____ d) Dealer _____ e) Other _____

List all federal/state permits held and attach a copy of each permit applicable to this and future transactions: _____

Briefly describe your facilities: _____

Is there a full time veterinarian on site? Yes _____ No _____

If no, is there a consulting veterinarian? Yes _____ No _____

How often does the consulting veterinarian visit the premises? _____

Briefly describe the husbandry experience you/ your facility has with fish or herps. _____

FACILITY

PROFILE

FISH and Reptiles

Briefly describe your record keeping system & means of identifying animals: _____

Is the facility an ISIS Participant? Yes _____ No _____

Have you ever been convicted of a violation of any regulations pertaining to animals or wildlife such as the animal Welfare Act, Lacey Act, Marine Mammal Protection Act, Endangered Act, C.I.T.E.S., etc.?

Yes _____ No _____ If yes, please attach an explanation.

Have you ever or do you intend to use techniques potentially detrimental to the habitat to collect fish (i.e. cyanide shocking)? Yes _____ No _____

Do any of your collectors use these methods? Yes _____ No _____

Briefly describe how you avoid the acquisition of fish acquired by these collecting methods. _____

References

(Minimum of 3, one must be a member of AZA)

| (Name) | (Address) | (Phone Number) |
|--------|-----------|----------------|
| | | |
| | | |
| | | |

| (Name) | (Address) | (Phone Number) |
|--------|-----------|----------------|
| | | |
| | | |
| | | |

| (Name) | (Address) | (Phone Number) |
|--------|-----------|----------------|
| | | |
| | | |
| | | |

Revision 10/2001

Appendix III

AZA Management Levels Defined

Green SSP Program - Populations that are most sustainable for the long-term. The criteria to be met are:

- The population is presently sustainable demographically for 100+ years or 10+ generations.
- The population can retain a high amount of genetic diversity (>90% GD) over this time.
- The population has a total size equal to or greater than 50 individuals at the time of planning.
- These programs are called Species Survival Plans©.

Yellow SSP Program - Populations that are less sustainable, cannot retain 90% gene diversity for 100 years or 10 generations and require additional attention to make them more sustainable. They have a population size equal to or greater than 50 individuals at the time of planning. Factors currently preventing the population from achieving the Green criteria may include:

- Lack of husbandry or breeding expertise or predictability.
- Too few individual animals for the program to be sustainable.
- Too little space for holding and breeding animals.
- Low gene diversity.
- Poor population demographics.
- These populations are called Species Survival Plans©.

Red Program - Populations with fewer than 50 individuals and unlikely to be sustainable for the long-term.

- These populations are not designated as SSP's on collection sustainability criteria.
- These programs will retain an official Studbook

Appendix IV

AZA Program Policies Overview

AZA Policies

AZA Acquisition and Disposition Policy
 AZA Code of Ethics
 AZA Full Participation in SSPs Policy
 AZA Animal Management Reconciliation Policy
 WCMC Approval of Non-Member Participants

Green SSP

Required
 Required
 Required
 Required
 Required

Yellow SSP

Required
 Required
 Voluntary
 Not Required
 Not Required

Red Program

Required
 Required
 Voluntary
 Not Required
 Not Required

Sustainability Criteria

Population size (N)
 Projected gene diversity (%GD) at 100 years or 10 generations

50 and greater
 90.0% or above
 50 and greater
 Less than 90.0%
 49 or fewer
 N/A

Cooperative Management

TAG recommended Animal Program in RCP
 AZA Regional Studbook
 AZA Regional Studbook used for population management
 Formal Population planning by PMC, PMC Adjunct or
 SPMAG Advisor
 Planning Prioritization
 Management Group

Required
 Required
 Yes
 Required
 High
 If needed
 Required
 Required
 Yes
 Required
 Medium
 If needed
 Not Required
 Low
 No

Accountability

Breeding and Transfer Plan published at least every 3 years
 AZA Regional Studbook published at least every 3 years
 AZA Regional Studbook Keeper must take Population
 Management 1
 Program Leader must take Population Management 2

Required
 Required
 Required
 Required
 Recommended
 Required
 Required
 Required
 Recommended
 Not Required
 Required
 Required
 Recommended

Appendix V Management Update Table

| Common name / (taxon) | Previous Designation | Current Designation | Program Leader Change | Program Leader / Species Contact |
|--|-------------------------|------------------------|--------------------------|--|
| Haitian giant galliwasp (<i>Celestus warreni</i>) | Not Included | Red Studbook | N/A | Studbook Keeper: Steve Pfaller, Nashville Zoo, 3777 Nolensville Pike, Nashville, TN 37211 (319) 331-2761, SPFaller@NashvilleZoo.org |
| Standing's day gecko (<i>Phelsuma standingii</i>) | PMP | Removed from RCP | N/A | N/A |
| New Caledonian giant gecko (<i>Rhacodactylus leachianus</i>) | PMP | Removed from RCP | N/A | N/A |
| Satanic leaf-tailed gecko (<i>Uroplatus phantasticus</i>) | PMP | Yellow SSP | No | SSP Coordinator: Sean Foley, Riverbanks Zoo, P.O. Box 1060, Columbia, SC 29202 (803) 779-8717, SFoley@Riverbanks.org |
| Spear-point leaf-tailed gecko (<i>Uroplatus eburnei</i>) | PMP | Removed from RCP | N/A | N/A |
| Giant leaf-tailed gecko (<i>Uroplatus fimbriatus</i>) | PMP | Yellow SSP | No | SSP Coordinator: Sean Foley, Riverbanks Zoo, P.O. Box 1060, Columbia, SC 29202 (803) 779-8717, SFoley@Riverbanks.org |
| Henkel's leaf-tailed gecko (<i>Uroplatus henkei</i>) | PMP | Yellow SSP | No | SSP Coordinator: Sean Foley, Riverbanks Zoo, P.O. Box 1060, Columbia, SC 29202 (803) 779-8717, SFoley@Riverbanks.org |
| Lined leaf-tailed gecko (<i>Uroplatus lineatus</i>) | PMP | Red Studbook | No | Studbook Keeper: Sean Foley, Riverbanks Zoo, P.O. Box 1060, Columbia, SC 29202 (803) 779-8717, SFoley@Riverbanks.org |
| Cork bark leaf-tailed gecko (<i>Uroplatus pietschmanni</i>) | PMP | Removed from RCP | N/A | N/A |
| Mossy leaf-tailed gecko (<i>Uroplatus sikorae</i>) | PMP | Yellow SSP | No | SSP Coordinator: Sean Foley, Riverbanks Zoo, P.O. Box 1060, Columbia, SC 29202 (803) 779-8717, SFoley@Riverbanks.org |
| Rio Fuerte beaded lizard (<i>Heloderma horridum exasperatum</i>) | PMP | Yellow SSP | No | SSP Coordinator: Stacey Sekscienski, Oklahoma City Zoo, 2101 NE 50th Street, Oklahoma City, OK 73111, (405) 425-0232, SSekscienski@OKCZoo.com |
| Motagua Valley beaded lizard (<i>Heloderma horridum charlesbogerti</i>) | PMP | Red Studbook | No | Studbook Keeper: Brad Lock, ZooAtlanta, 800 Cherokee Ave, S.E., Atlanta, GA 30315 (404) 624-5616, Block@zooatlanta.org |
| Fiji Island iguana (<i>Brachylophus bulabula</i>) | SSP | Yellow SSP | Yes | SSP Coordinator: Kim Lovich, San Diego Zoo, P.O. Box 120551, San Diego, CA 92112 (619) 557-3984, KLovich@SanDiegoZoo.org |
| Jamaican iguana (<i>Cyclura collei</i>) | SSP | Red Studbook | No | Studbook Keeper: Tandora Grant, San Diego Zoo Institute for Conservation Research (619) 744-3380, Tandora@sandiegozoo.org |
| Grand Cayman blue iguana (<i>Cyclura lewisi</i>) | PMP | Red Studbook | No | Studbook Keeper: Tandora Grant, San Diego Zoo Institute for Conservation Research (619) 744-3380, Tandora@sandiegozoo.org |
| Anegada iguana (<i>Cyclura pinguis</i>) | PMP | Removed from RCP | N/A | N/A |
| San Esteban chuckwalla (<i>Sauromalus varius</i>) | Not Included | Yellow SSP | No | SSP Coordinator: Jan Johnson, Arizona-Sonora Desert Museum, 2021 N. Kinney Rd, Tucson, AZ 85743, (520) 883-3075, JJohnson@Desertmuseum.org |
| Texas horned lizard (<i>Phrynosoma cornutum</i>) | PMP | Red Studbook | N/A | Studbook Keeper: Vicki Poole, Fort Worth Zoo, 1989 Colonial Pkwy, Fort Worth, TX 76110 (817) 759-7183, VPoole@FortWorthZoo.org |
| Prehensile-tailed skink (<i>Corucia zebrata</i>) | PMP | Yellow SSP | Yes | SSP Coordinator: Sam Curtis, Sacramento Zoo, 3930 West Land Park Drive, Sacramento, CA 95822 (916) 808-5884, SWCurtis@saczo.org |
| Crocodile lizard (<i>Shinosaurus crocodilurus</i>) | Not Included | Yellow SSP | No | SSP Coordinator: Jennifer Pramuk, Woodland Park Zoo, 601 North 59th Street, Seattle, WA 98103 (206) 548-2508, Jennifer.Pramuk@zoo.org |

Appendix V

Management Update Table (continued)

| Common name / (taxon) | Previous Designation | Current Designation | Program Leader Change | Program Leader / Species Contact |
|--|-------------------------|------------------------|--------------------------|---|
| Caiman lizard (<i>Dracaena guianensis</i>) | PMP | Red Studbook | Yes | Studbook Keeper: Erica Hornbrook, John G. Shedd Aquarium, 1200 S. Lake Shore Drive, Chicago, IL 60605, (312) 692-3180, ehornbrook@sheddaquarium.org |
| Black tree monitor (<i>Varanus beccarii</i>) | PMP | Red Studbook | N/A | Studbook Keeper: Katherine Gore, Sacramento Zoo, 3930 W. Land Park Dr, Sacramento, CA 95822 (918) 808-5013, kgore@saczoo.org |
| Komodo dragon (<i>Varanus komodoensis</i>) | SSP | Yellow SSP | No | SSP Coordinator: Don Boyer, WCS, 2300 Southern Blvd, New York, NY 10460 (718) 220-5157, DBoyer@wcs.org |
| Gray's monitor (<i>Varanus olivaceus</i>) | PMP | Removed from RCP | N/A | N/A |
| Green tree monitor (<i>Varanus prasinus</i>) | PMP | Removed from RCP | N/A | N/A |
| Crocodile monitor (<i>Varanus salvadorii</i>) | PMP | Red Studbook | N/A | Andy Reeves, Omaha's Henry Doorly Zoo, 3701 S. 10th Street, Omaha, NE 68107 (402) 557-6931, Andy.Reeves@omahazoo.com |

Appendix VI Animal Program Status Table

| Program Name | Date Initiated | Program Leader | Date Leadership Assumed | Date of Last Studbook Update | Date of Last Plan Publication |
|--|----------------|---|-------------------------|------------------------------|-------------------------------|
| Hatian giant galliwasp (<i>Celestus warreni</i>) Studbook | 2013 | Steve Pfaller, Nashville Zoo | 2013 | N/A | N/A |
| Satanic leaf-tailed gecko (<i>Uroplatus phantasticus</i>) SSP | 1994 | Sean Foley, Riverbanks Zoo | 1994 | September, 2010 | February, 2011 |
| Giant leaf-tailed gecko (<i>Uroplatus fimbriatus</i>) SSP | 1994 | Sean Foley, Riverbanks Zoo | 1994 | September, 2010 | February, 2011 |
| Henkel's leaf-tailed gecko (<i>Uroplatus henkeli</i>) SSP | 1994 | Sean Foley, Riverbanks Zoo | 1994 | September, 2010 | February, 2011 |
| Lined leaf-tailed gecko (<i>Uroplatus lineatus</i>) Studbook | 1994 | Sean Foley, Riverbanks Zoo | 1994 | September, 2010 | February, 2011 |
| Mossy leaf-tailed gecko (<i>Uroplatus sikorae</i>) SSP | 1994 | Sean Foley, Riverbanks Zoo | 1994 | September, 2010 | February, 2011 |
| Rio Fuerte beaded lizard (<i>H. horridum exasperatum</i>) SSP | 1993 | Stacey Sekscienski, Oklahoma City Zoo | 2013 | November, 2011 | 06/06/2012 |
| Motagua Valley beaded lizard (<i>H. horridum charlesbogerti</i>) Studbook | 1993 | Brad Lock, ZooAtlanta | 2013 | November, 2011 | 06/06/2012 |
| Fiji Island banded iguana (<i>Brachylophus bulabula</i>) SSP | 1999 | Kim Lovich, San Diego Zoo | 2011 | 2008 | N/A |
| Jamaican iguana (<i>Cyclura collei</i>) Studbook | 1996 | Tandora Grant, San Diego Zoo | 1996 | October, 2010 | 09/30/2009 |
| Grand Cayman blue iguana (<i>Cyclura lewisi</i>) Studbook | 1996 | Tandora Grant, San Diego Zoo | 1996 | October, 2010 | N/A |
| San Esteban chuckwalla (<i>Sauromalus varius</i>) SSP | 2007 | Jan Johnson, Arizona-Sonora Desert Museum | 2008 | March, 2011 | 07/27/2011 |
| Texas horned lizard (<i>Phrynosoma cornutum</i>) Studbook | 2013 | Vicky Poole, Fort Worth Zoo | 2013 | N/A | N/A |
| Prehensile-tailed skink (<i>Corucia zebrata</i>) SSP | 1994 | Sam Curtis, Sacramento Zoo | 2011 | 2008 | N/A |
| Crocodile lizard (<i>Shinosaurus crocodilurus</i>) SSP | 1991 | Jennifer Pramuk, Woodland Park Zoo | 2013 | 2012 | 2008 |
| Caiman lizard (<i>Dracaena guianensis</i>) Studbook | 2013 | Erica Hornbrook, John G. Shedd Aquarium | 2013 | N/A | N/A |
| Black tree monitor (<i>Varanus beccarii</i>) Studbook | 1994 | Katherine Gore, Sacramento Zoo | 2013 | 2010 | N/A |
| Komodo dragon (<i>Varanus komodoensis</i>) SSP | 2002 | Don Boyer, WCS | 2002 | 2012 | 05/31/2012 |
| Crocodile monitor (<i>Varanus salvadorii</i>) Studbook | 1994 | Andy Reeves, Omaha's Henry Doorly Zoo | 2013 | 2010 | N/A |

Appendix VII

Quick Reference - Species Coordinator Contacts

| Program | Coordinator/Institution | Contact Information |
|--|--|---|
| Hatian giant galliwasp (<i>Celestus warreni</i>) Studbook | Steve Pfaller, Nashville Zoo | 3777 Nolensville Pike, Nashville, TN 37211 (319) 331-2761 SPfaller@NashvilleZoo.org |
| Satanic leaf-tailed gecko (<i>Uroplatus phantasticus</i>) Yellow SSP Giant leaf-tailed gecko (<i>Uroplatus fimbriatus</i>) Yellow SSP Henkel's leaf-tailed gecko (<i>Uroplatus henkei</i>) Yellow SSP Lined leaf-tailed gecko (<i>Uroplatus lineatus</i>) Studbook Mossy leaf-tailed gecko (<i>Uroplatus sikorae</i>) Yellow SSP | Sean Foley, Riverbanks Zoo | P.O. Box 1060, Columbia, SC 29202 (803) 779-8717 SFoley@Riverbanks.org |
| Motagua Valley beaded lizard (<i>H. horridum charlesbogerti</i>) Studbook | Brad Lock, ZooAtlanta | 800 Cherokee Ave, S.E., Atlanta, GA 30315 (404) 624-5616 Block@zooatlanta.org |
| Rio Fuerte beaded lizard (<i>H. horridum exasperatum</i>) Yellow SSP | Stacey Sekscienski, Oklahoma City Zoo | 2101 NE 50th Street, Oklahoma City, OK 73111 (405) 425-0232 SSekscienski@OKCZoo.com |
| San Esteban chuckwalla (<i>Sauromalus varius</i>) Yellow SSP | Jan Johnson, Arizona-Sonora Desert Museum | 2021 N. Kinney Road, Tucson, AZ 85743 (520) 883-3075 Jjohnson@Desertmuseum.org |
| Fiji Island banded iguana (<i>Brachylophus bulabula</i>) Yellow SSP | Kim Lovich, San Diego Zoo | P.O. Box 120551, San Diego, CA 92112 (619) 557-3984 KLovich@SanDiegoZoo.org |
| Jamaican iguana (<i>Cyclura collei</i>) Studbook Grand Cayman Blue Iguana (<i>Cyclura lewisi</i>) Studbook | Tandora Grant, San Diego Zoo Institute for Conservation Research | 15600 San Pasqual Valley Road, Escondido, CA 92027 (619) 744-3380 tandora@sandiegozoo.org |
| Texas horned lizard (<i>Phrynosoma cornutum</i>) Studbook | Vicky Poole, Fort Worth Zoo | 1989 Colonial Pkwy, Fort Worth, TX 76110 (817) 759-7162 vpooles@fortworthzoo.org |
| Prehensile-tailed skink (<i>Corucia zebrata</i>) Yellow SSP | Sam Curtis, Sacramento Zoo | 3930 West Land Park Dr., Sacramento, CA 95822 (916) 808-5884 swcurtis@saczoo.org |
| Crocodile lizard (<i>Shinosaurus crocodilurus</i>) Yellow SSP | Jennifer Pramuk, Woodland Park Zoo | 601 North 59th Street, Seattle, WA 98103 (206) 548-2508 Jennifer.Pramuk@zoo.org |
| Caiman lizard (<i>Dracaena guianensis</i>) Studbook | Erica Hornbrook, John G. Shedd Aquarium | 1200 S. Lake Shore Drive, Chicago, IL 60605 (312) 692-3180 ehornbrook@shedd Aquarium.org |
| Black tree monitor (<i>Varanus beccarii</i>) Studbook | Katherine Gore, Sacramento Zoo | 3930 W. Land Park Dr, Sacramento, CA 95822 (918) 808-5013 kgore@saczoo.org |
| Komodo dragon (<i>Varanus komodoensis</i>) Yellow SSP | Don Boyer, WCS | Bronx Zoo 2300 Southern Blvd, Bronx, NY 10460 (718) 220-5157 DBoyer@wcs.org |
| Crocodile monitor (<i>Varanus salvadorii</i>) Studbook | Andy Reeves, Omaha's Henry Doorly Zoo | 3701 S. 10th Street, Omaha, NE 68107 (402) 557-6931 Andy.Reeves@omahazoo.com |

Appendix VIII

Recommendations for Reptiles and Amphibians Used in Outreach Programs

(Updated by Diane Barber, October, 2012)

Introduction

This information is intended as a resource that includes a list of common species of lizards used in institutional outreach programs. With over 4,700 described species of lizards, it is obvious that there are numerous species that could be safely used in outreach programs. It is not the intent of the LAG to produce an all-inclusive or restrictive list of species. Rather, it is hoped that during the species selection process for outreach programs, educators, collection managers, and other zoo staff work together, using this document, the LAG RCP and Institutional Collection Plans as tools. It is well understood that space in zoos is limited and it is important that outreach animals are included in institutional collection plans and incorporated into conservation programs when feasible. However, this does not mean that all outreach animals need to be part of a conservation program. There are many parallel species that can be used in place of rare or “fragile” animals to convey conservation and educational messages.

There are numerous components to consider when choosing appropriate species for use in outreach programs. Some popular species used for exhibit can be categorized as “difficult” from documented experience or by reputation, rendering them unsuitable for outreach. However, it is important to remember that individual animals often have individual personalities and can sometimes be evaluated on a case-by-case basis. These considerations, as well as staff expertise, husbandry requirements, medical and nutritional requirements, length and types of programs, environmental needs, restraint and transportation methods, temperament, safety issues, and educational messaging should all factor into sound collection planning for outreach program animals.

Husbandry Considerations

It is imperative that adequate housing is provided for all animals. Housing and quarantine requirements for each species should be addressed and approved by qualified staff before animals are acquired. Because of their relatively small size, ease of availability, and seemingly routine housing components, reptiles and amphibians are oftentimes acquired before enough is learned about their husbandry requirements. Although some lizards, such as leopard geckos, can live long and seemingly well-adjusted lives housed in small, simple enclosures, this is not the case for every lizard. Many species require elaborate environments just to survive. Components such as space utilization, ultraviolet light requirements, thermoregulation needs, nutritional and medical requirements, stress factors, social structures, adequate record keeping, etc., all factor into maintaining healthy captive lizards. There is no simple recipe or cookie-cutter approach to choosing the right species for outreach. It is imperative that each animal is researched and experienced personnel are consulted before acquisition in order to evaluate whether or not the animal can be adequately housed. The LAG RCP, husbandry accounts and steering committee members can be used as resources outside of institutions if necessary, but by all means utilize Herpetological Staff if they are present.

All efforts should be made to acquire animals that can be provided appropriate environments. Some species are suitable for trained keepers or educators that have little to no reptile husbandry experience. On the other hand, there are many species that require expert care and are labor intensive. Adequate training should be given to all caregivers and expertise levels of staff should mirror the attention needed for the animals in the collection. The lizards recommended for outreach in this document have been categorized by level of experience needed by the caregiver in terms of meeting husbandry requirements, as well as the lizard's relative level of hardiness in captive situations in order to help facilitate the decision-making process.

Handling and Transport

During the handling or transporting of any lizard, safety considerations for the animal, handler, and audience are of utmost importance. Numerous factors influence proper handling protocols for outreach programs. These factors include animal transport and restraint methods, potential bite risks, animal size, temperature limitations, stress levels and temperament of the animal, audience contact with the animal, appropriate settings and situations, disease and handling protocols, and experience and number of handlers.

Each institution should develop its own handling protocols. This document touches upon some of the more common issues and suggestions for safely handling and transporting lizards. Once again, this is not an all-inclusive document and is meant to serve as a guideline for developing a handling protocol.

Animal transport and restraint methods

Many lizards are easily transported from one destination to the other with little to no demonstrable adverse effects. Acceptable transport methods for lizards include placing them in a pillowcase or snake bag, securely tied and then placed within a cooler or Styrofoam box to provide insulation from severe temperature changes. Some larger lizards are also transported in standard plastic travel kennels for short distances. As with any animal, care must be taken to keep them from direct sunlight and extreme temperature changes and to provide adequate ventilation. (See IATA's Live Animal Regulations for standard shipping methods.)

Most of the lizards recommended in this document require little restraint when handling. When choosing outreach animals, it is important to take into consideration the size and temperament of the animal and the type of restraint necessary for each species. It is imperative that the handler is experienced enough to reasonably be able to anticipate the animal's reactions and behavior in various situations. The handler should also know how to adequately provide support to the animal so that is comfortable and relaxed. The use of leather gloves is sometimes necessary for larger lizards due to their sharp claws.

Large monitor lizards and iguanas are commonly used in outreach. Again, it is imperative that handlers are experienced when working with any species that could potentially deliver a dangerous bite. It is important to be familiar with space and transportation requirements for large species and to consider loan options as opposed to transporting lizards long distance.

Evaluating the Situation

Comparing the animal's temperament and anticipated stress levels against the actual type of event will help determine the amount of time each animal should be handled. For example, a chameleon may be appropriate for an intimate 10-minute news interview, but will most likely become stressed during a 30-minute demonstration walking amongst a group of party guests. The actual environment can also have a direct effect on the amount of time an animal should be used in a program. Most lizards become very active when warmed and may be difficult to handle in hot, outdoor settings. In such cases, it is best to keep the animals in shaded areas and to keep contact with the audience at a minimum. It is important to know the natural history for each species. For example, a spiny-tailed lizard would most likely enjoy a sunny outing, but hot temperatures could be dangerous for a cool, forest dwelling species such as a leaf-tailed gecko for extended periods of time.

Whatever the case, always evaluate the setting and consider stress-related factors such as handling and amount of time handled, potential contact with the audience, and environmental influences such as temperature, as well as the animal's actual role in the program's messaging in order to help choose the most appropriate species.

Minimization of Disease Transfer

Each institution needs to decide what level of intermixing between "collection animals" and "outreach animals" is allowed to reduce the risk of spreading infectious diseases into the zoo population. This needs to be decided through thoughtful consultation of the reptile staff, veterinary staff and programs staff so that the institutional goals for the outreach program may be obtained without placing unreasonable or unnecessary limits to the use of the animals. As a general guideline, it is best to maintain outreach animals in a separate facility from the core animal collection.

Outreach animals may need to be held to a more rigorous preventive medicine program with routine fecal checks performed quarterly. Any animals that are not behaving normally or are known to be ill should not be used until the issue is resolved.

All personnel involved in handling lizards should review the ARAV-CDC recommendations for reducing the risk of contracting salmonellosis (www.arav.org). At a minimum, all people who come in contact with reptiles should wash their hands with warm water and disinfectant soap before eating, drinking or smoking. Some facilities provide antimicrobial hand wipes and gels in animal contact situations/areas. Handlers should also be informed of ways to reduce the risk of bites, scratches, tail whips and other injuries that may be inflicted. A first aid protocol should be established and first aid materials readily available wherever potentially dangerous lizards are handled.

Educational Messaging

Charismatic animals such as large monitors and iguanas can be used to awe and inspire audiences. However, they are also common pets that are often discarded when they become too large or unmanageable. This is a

major problem! If an institution chooses to use large lizards for outreach, the audience should be informed that they can often live for more than 30 years and do not make good pets. In doing so, the institution provides an important educational message that is generally not provided in other venues.

The use of threatened or endangered species in outreach can be effective and SSP species can be important ambassadors for conservation. However, all institutions should be aware of state and federal laws prior to handling and transport of the species and the audience should also be informed.

Native species are all too often overlooked in zoo programs. Through the use of locally occurring species in outreach, audiences can learn about conservation in their own backyard. This is a good opportunity to teach an audience about cohabitation, venomous vs. nonvenomous species, lizard declines, state protected species, the affects of urban sprawl, pollution, etc.

Sample List of Lizards for Outreach Programs

| Species | Husbandry | Handler | Comments |
|--|-----------|-------------|---|
| Leopard gecko, <i>Eublepharis macularius</i> | Hardy | Novice | |
| Fat-tailed gecko, <i>Hemiteconyx caudicinctus</i> | Hardy | Novice | |
| Prehensile-tailed skink, <i>Corucia zebrata</i> | Moderate | Moderate | UV requirements, bite risk |
| Blue-tongued skink, <i>Tiliqua</i> sp. | Hardy | Novice | |
| Shingleback skink, <i>Tiliqua rugosa</i> | Hardy | Novice | |
| Eastern glass lizard, <i>Ophisaurus attenuatus longicaudus</i> | Moderate | Moderate | |
| Anoles, <i>Anolis</i> sp. | Moderate | Moderate | UV requirements |
| Spiny-tailed lizards, <i>Uromastix</i> sp. | Difficult | Experienced | UV requirements |
| Collard lizards, <i>Crotaphytus collaris</i> (hand-raised) | Moderate | Moderate | UV requirements |
| Spiny lizards, <i>Sceloporus</i> sp. | Moderate | Moderate | UV requirements |
| Bearded dragon, <i>Pogona vitticeps</i> | Moderate | Moderate | UV requirements |
| Chuckwalla, <i>Sauromalus</i> sp. | Difficult | Moderate | UV requirements |
| Green iguana, <i>Iguana iguana</i> (small to medium sized) | Difficult | Moderate | Educational messaging, UV requirements, potential bite risk |
| Rhinoceros iguana, <i>Cylura cornuta</i> | Difficult | Moderate | UV requirements, bite risk |
| Desert iguana, <i>Dipsosaurus dorsalis</i> | Difficult | Moderate | UV requirements |
| Black and White tegu, <i>Tupinambis teguixin</i> | Moderate | Moderate | Potential bite risk |
| Savannah monitor, <i>Varanus exanthematicus</i> | Moderate | Moderate | Potential bite risk |

* Almost all reptiles benefit from UV lighting