ZOO VIEW

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Herpetological History of the Jacksonville Zoo and Gardens

A myriad of zoological parks and roadside animal attractions have dotted the Florida, USA, landscape over the past century and have played key roles in introducing millions of visitors to the state's wildlife, particularly its famed herpetofauna. Although few roadside attractions remain today, Florida is currently home to 17 zoological parks and aquariums accredited by the Association of Zoos and Aquariums (AZA). At least nine of these facilities continue the tradition of displaying and introducing visitors to diverse collections of both native and exotic herpetofauna, and several have made important contributions to the field of herpetology (Card and Murphy 2000; Murphy 2007).

Having recently celebrated its centennial anniversary in 2014, the Jacksonville Zoo and Gardens, located in northeastern Florida, is one of the state's oldest AZA-accredited zoological parks. Over its history, the zoo has displayed a diverse assemblage of herpetofauna and is responsible for several significant captive breeding events, has contributed numerous publications on herpetology and captive management, and has played a crucial role in recovery efforts for several imperiled reptile and amphibian species. Yet, despite its rich herpetological tradition, the Jacksonville Zoo and Gardens has received very little attention in published works highlighting the herpetological history and contributions of zoos (e.g., Card and Murphy 2000; Murphy 2007). In light of this general absence from the historical literature, here we provide an extensive overview of the history of herpetology at the Jacksonville Zoo and Gardens from its early 20th Century inception to the present day. We discuss trends in its animal collection, exhibits, and staffing over time, as well as the many important achievements and contributions made by the zoo and its staff to the fields of herpetology and herpetological husbandry.

Zoo Origins and Overview

The Springfield Park Zoo was originally established in 1914 by the city of Jacksonville in an 18-acre (7.2-ha) park in the neighborhood of Springfield, located just north of downtown. After persisting at this site for more than a decade but experiencing various problems including severe flooding from an adjacent creek and complaints from local residents of foul odors emanating from the zoo (David et al. 2014), the decision was made in 1925 to relocate the zoo to a 37.5-acre (15-ha) site along the Trout River on the north side of the city. There, it was renamed the Jacksonville Municipal Zoo and was initially accompanied by a natural history museum, which displayed a large collection of taxidermied wildlife owned by museum director B. O. Crichlow (David et al. 2014). One of the most celebrated exhibits of the museum was the mount of a large 544-kg Devil Ray (*Mobula mobular*) that had been collected off of St. Augustine, Florida with a dead 22-kg sea turtle lodged in its jaws (David et al. 2014). Although an official date or record of its eventual closing could not be ascertained, the museum and its collection had apparently relocated to Miami, Florida sometime before 1933 (Anonymous 1933).

As a municipality-run facility, many of the zoo's animal keeper staff during its first six decades lacked significant training, experience, or familiarity with animal biology or husbandry and were often workers transferred in from other city departments (Anonymous 1979), sometimes as demotions or retribution for poor work performance elsewhere (P. Sachs, pers. comm.). Like many other municipal zoos of the era, the Jacksonville Zoo (renamed the Jacksonville Zoological Park in 1966) fell on hard financial times by the 1960s. In 1971, the decision was made to transfer management and oversight of the zoo from the city's Department of Recreation and Public Affairs to a newly formed not-for-profit organization, the Jacksonville Zoological Society. This privatization and restructuring, which also took place at many other zoos in the United States around the same period (Kisling 2001), enabled the zoo to become more effectively managed and eventually rebound from its financial woes. As part of this transition, there was an unfortunate loss of many institutional records and paperwork, particularly those documenting the zoo's animal collection and staffing prior to 1971.

Since the early 1990s, the zoo has undergone extensive capital improvements, including the modernization and

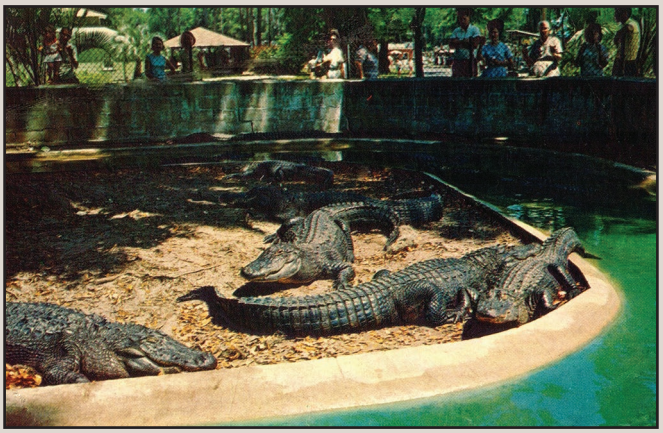

Fig. 1. An early *Alligator mississippiensis* exhibit at the Jacksonville Zoo and Gardens. Undated postcard, ca. 1975.

ROBERT W. MENDYK*
Department of Herpetology, Jacksonville Zoo and Gardens, 370 Zoo Parkway, Jacksonville, Florida 32218, USA; Department of Herpetology, Smithsonian National Zoological Park, 3001 Connecticut Avenue NW, Washington, D.C. 20008, USA
ALAN F. ROST
Registrar, Jacksonville Zoo and Gardens, 370 Zoo Parkway Jacksonville, Florida 32218, USA; e-mail: rosta@jacksonvillezoo.org

**Current address: Department of Herpetology, Audubon Zoo 6500 Magazine Street, New Orleans, Louisiana 70118, USA e-mail: rmendyk@audubooninstitute.org*

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FIG. 2. The Jacksonville Zoo and Gardens' first building dedicated to exhibiting herpetofauna, ca. 1971–1972.

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FIG. 3. Reptile curator Peter Sachs receives an "adopt an animal" check in front of the zoo's original reptile building in the early 1970s. An Amazon Basin Emerald Tree Boa (*Corallus batesi*) can be seen on display in background.

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FIG. 4. Interior service corridor of the zoo's first building dedicated to displaying reptiles. Early 1970s.

construction of many new exhibits, buildings, and gardens. The zoo changed its moniker to the Jacksonville Zoological Gardens in 1993 and then once again in 2003 to the Jacksonville Zoo and Gardens (hereafter JZG), and was officially recognized by the city as a botanical garden the following year. The zoo's current footprint is ca. 117 acres (47.3 ha), of which 29 acres (11.7 ha) remain undeveloped, and as of 1 November 2017, the animal collection comprised a total of 1705 specimens representing 257 species. Over the last decade, JZG has become the most popular and heavily visited attraction in northern Florida, now seeing an annual attendance of around one million visitors.

Herpetology at the Jacksonville Zoo and Gardens

Due to the paucity of available records, it is unclear when an official herpetology department was established at JZG; however, an earlier incarnation of the department around 1970 was known as the "reptile project" (P. Sachs, pers. comm.). There appears to have been six official herpetology curators to date: Peter S. Sachs (1971–1976), Ralph Williams (1980–1981, 1985–1986), David Collins (1982–1985), Jack Meyer (1986–1991), Greg Lepera (1994–2007), and Dino Ferri (2007–2013). Early on, reptile department staff sometimes consisted of just a single person, who performed both keeper and curatorial duties (Anonymous 1979; D. Collins, pers. comm.). In 2014, the herpetology curator position was merged with that of the bird and ambassador animal collections, and is currently held by Mike Taylor. In addition to managing the reptile and amphibian collection, the herpetology department also oversees the zoo's marine and freshwater fishes and invertebrates. Seven full-time keepers (including three aquarists) and a supervisor currently comprise the herpetology department.

Exhibits.—Although an outdoor alligator exhibit has existed in one form or another since the zoo's inception (e.g., Fig. 1.), the first official building dedicated specifically to the keeping of herpetofauna was a free-standing structure that had been constructed on a slab under a covered picnic area on the southwestern side of the zoo in 1957 following the donation of a large private collection of snakes (Figs. 2, 3). This building featured around 30 exhibits with viewing windows encircling its perimeter, a central service corridor (Fig. 4), and retractable roofing panels (P. Sachs, pers. comm.). It was here that most of the zoo's reptile breeding took place during the 1970s to early 90s (see below), until it was finally decommissioned, razed, and replaced by more modern reptile and amphibian buildings throughout the zoo (see below). During the early 1980s, there were also several reptile enclosures scattered throughout the zoo, including an off-exhibit building, a small barn with multiple tortoise pens, a crocodile pool, and a lizard pit (D. Collins, pers. comm.).

Today, JZG is unique among most zoos in that instead of a single, centralized reptile house, its herpetological collection is distributed throughout the zoo in four reptile and amphibian-specific buildings and one mixed-collection building displaying reptiles, amphibians, freshwater fishes, and small mammals. Most of these buildings have a particular biogeographic focus.

The first of the zoo's current herpetology buildings to open was the African Reptile House in 1998, which houses a variety of African taxa in 13 exhibits ranging in size from smaller cubicle-style terraria to a large room-sized exhibit. Although no longer a fixture in the building, Naked Mole Rats (*Heterocephalus glaber*) were previously displayed here alongside African Mole Snakes (*Pseudaspis cana*).

The Wild Florida Reptile House opened three years later in 2001, and displays native Floridian species along with some

introduced exotic species in a series of 17 indoor exhibits; the two largest exhibits also feature outdoor components. Adjacent to this building is a large outdoor exhibit for American Alligators (*Alligator mississippiensis*) as well as an Alligator Snapping Turtle (*Macroclemys temminckii*) exhibit.

Range of the Jaguar, a large exhibit complex featuring both indoor and outdoor displays of Central and South American taxa (and a few Caribbean species) opened in 2004, and includes a large walk-through aviary with a 150,000-liter pool housing several neotropical turtle and fish species, several large outdoor mammal exhibits, and a Mayan temple-themed building with 11 indoor reptile and amphibian exhibits (Fig. 5) and a few small mammal exhibits.

Repurposed from a building that formerly housed koalas, and was used as a nursery for newborn animals before that, the zoo's Amphibian Conservation Center (originally named "Save the Frogs") opened in 2007 to coincide with and celebrate the Amphibian Ark's "Year of the Frog" conservation campaign (Grow and Allard 2008; Pavajeau et al. 2008). This building features two independent laboratories dedicated to the ex-situ conservation breeding of threatened amphibian taxa (see below), as well as a central display area showcasing several additional amphibian species. All three rooms are located behind large viewing windows, offering visitors a glimpse into the daily husbandry and conservation work carried out by the zoo's herpetology staff (Fig. 6).

The most recent reptile building to be constructed at JZG is the Komodo Dragon (*Varanus komodoensis*) facility, which opened in 2009 as part of the initial phase of the zoo's Asian exhibits expansion. Architecturally themed as an Indonesian fishing village within Komodo National Park, this facility features both indoor and outdoor exhibits as well as a series of off-exhibit indoor enclosures and an outdoor holding yard.

A temporary exhibition highlighting the prehistoric mega-snake *Titanoboa* was developed by the zoo and held from March to September 2015 in the zoo's Discovery Center. It featured a larger-than-life-sized model of *Titanoboa*, osteological mounts of extant snake taxa, and several exhibits displaying living representatives of some of the largest native Floridian (*Crotalus adamanteus*, *Drymarchon couperi*) and exotic (*Python bivittatus*, *Eunectes murinus*) snake species alive today.

Living Collection and Captive Breeding.—Significant efforts have been made by one of the authors (AFR) to historically reconstruct records documenting JZG's living collection since the zoo's inception. Although these efforts are ongoing, from records that could be retrieved, at least 321 species of reptiles and 78 species of amphibians have been maintained by the zoo over its history. The first reptile species to be kept by the zoo was *Alligator mississippiensis*, in 1914. The Gopher Tortoise (*Gopherus polyphemus*) was also an early captive displayed by the zoo, with records dating back to at least 1938; however, given the species' ubiquitous occurrence in the area, including on zoo grounds, it is likely the species was kept even earlier. Additional reptiles documented in an inventory record from 1938 included 24 *A. mississippiensis*, a Common Snapping Turtle (*Cheyldra serpentina*), and several unspecified snake species, including one rattlesnake (*Crotalus* sp.). While most of the herpetofauna maintained during the zoo's early history appears to have been native Floridian species, the collection began to grow and diversify to include non-native taxa in the late 1950s, coinciding with the opening of the zoo's first official reptile building, the emergence of several prominent reptile dealers in Florida such as

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FIG. 5. Interior view of reptile exhibits in the Range of the Jaguar Temple building, 2017.

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FIG. 6. Public view of one of the two bio-secure conservation breeding laboratories in the zoo's Amphibian Conservation Center, 2017.

Ross Allen's Reptile Institute that periodically supplied JZG with specimens, and the 1957 donation of a large private collection of snakes to the zoo.

Successful reproduction has occurred in at least 53 reptile and 13 amphibian species at JZG (Tables 1, 2). However, it is difficult to ascertain, particularly in older records, whether some of these records represented true captive breeding events or offspring produced by wild-caught females that arrived at the zoo gravid. The earliest documented reptile births at the zoo were of the Sidewinder (*Crotalus cerastes*) and West African Gaboon Viper (*Bitis rhinoceros*) in 1970; the earliest record of amphibian reproduction occurred in the African Clawed Frog (*Xenopus laevis*) in 1979. Many reptiles and amphibians have reached significant ages at JZG (e.g., Mendyk and Smith 2016); noteworthy records of longevity are presented in Table 3.

At least 83 lizard species have been kept by the zoo. Noteworthy taxa have included the Sungazer (*Smaug giganteus*), Fiji Banded Iguana (*Brachylophus fasciatus*), Ricord's Ground Iguana (*Cyclura ricordi*), and the Bahamian Rock Iguana (*C. rileyi*). A locally collected amelanistic Eastern Glass Lizard (*Ophisaurus ventralis*) was displayed in the early 1970s (P. Sachs,

TABLE 1. Breakdown of reptile taxa successfully reproduced at the Jacksonville Zoo and Gardens 1970–2017. *Asterisked entries represent captive birth (from a recently acquired gravid female) rather than true captive breeding.

Order	Family	Species	Common name	Earliest known reproductive event
Testudines	Emydidae	*Pseudemys concinna peninsularis*	Peninsular Cooter	1989
		Terrapene carolina bauri	Florida Box Turtle	2013
	Geomydidae	*Heosemys annandalii*	Yellow-headed Temple Turtle	2013
		Rhinoclemmys pulcherrima incisa	Painted Wood Turtle	1985
	Kinosternidae	*Kinosternon odoratum*	Common Musk Turtle	unknown
	Testudinidae	*Aldabrachelys gigantea*	Aldabra Tortoise	1984
		Chelonoidis carbonaria	Red-foot Tortoise	1986
		Geochelone elegans	Indian Star Tortoise	1987
		Geochelone sulcata	African Spur-thighed Tortoise	1990
		Gopherus polyphemus	Gopher Tortoise	1984
		Kinixys belliana nogueyi	Bell's Hinged-back Tortoise	2000
		Malacochersus tornieri	Pancake Tortoise	2013
		Stigmochelys pardalis babcocki	Leopard Tortoise	1985
	Chelidae	*Chelodina novaeguineae*	New Guinea Snakeneck Turtle	1983
	Pelomedusidae	*Pelusios subniger subniger*	East African Black Mud Turtle	2000
Squamata – Sauria	Agamidae	*Pogona vitticeps*	Bearded Dragon	1999
		Xenagama taylori	Taylor's Shield-tailed Agama	2017
	Anguidae	*Ophisaurus ventralis*	Eastern Glass Lizard	2013
	Cordylidae	*Smaug warreni*	Warren's Girdled Lizard	2015
	Eublepharidae	*Eublepharis macularius*	Leopard Gecko	1979
	Gekkonidae	*Hemidactylus turcicus*	Mediterranean House Gecko	1978
		Thecadactylus rapicaudus	Turnip-tailed Gecko	1990
	Iguanidae	*Iguana iguana*	Common Iguana	unknown
Squamata – Serpentes	Boidae	*Boa constrictor constrictor*	Red-tailed Boa Constrictor	1972
		Chilabothrus angulifer	Cuban Boa	1980
		Chilabothrus chrysogaster	Turks Island Boa	1974*
		Chilabothrus fordi	Haitian Ground Boa	1980
		Chilabothrus inornatus	Puerto Rican Boa	1975
		Chilabothrus strigilatus fosteri	Bimini Boa	1972
		Chilabothrus s. strigulatus	Bahamian Boa	1976
		Chilabothrus subflavus	Jamaican Boa	1976
		Corallus hortulanus hortulanus	Amazon Tree Boa	1982
		Epicrates alvarezi	Argentinian Rainbow Boa	1988
	Pythonidae	*Python regius*	Ball Python	1997
		Python sebae	Northern African Rock Python	2012
	Colubridae	*Drymarchon couperi*	Eastern Indigo Snake	1984
		Hydrodynastes gigas	False Water Cobra	1972
		Lampropeltis triangulum hondurensis	Honduran Milksnake	1984
		Nerodia clarkii compressicauda	Mangrove Salt Marsh Snake	2002
		Orthriophis taeniurus	Taiwan Beauty Snake	1971
		Pantherophis alleghaniensis	Eastern RatSnake	1977
		Pantherophis guttatus	Red Ratsnake	1976
		Pituophis melanoleucus mugitus	Florida Pinesnake	1985
		Pituophis ruthveni	Louisiana Pinesnake	2015
	Viperidae	*Atheris chloroechis*	Western Bush Viper	2000
		Bitis rhinoceros	West African Gaboon Viper	1970
		Bothriechis schlegelii	Eyelash Viper	1986
		Crotalus atrox	Western Diamond-backed Rattlesnake	1984
		Crotalus cerastes laterorepens	Sidewinder	1970
		Lachesis muta muta	South American Bushmaster	2007
		Atropoides occiduus	Jumping Pitviper	1992
		Sistrurus miliarius barbouri	Dusky Pygmy Rattlesnake	1987
Crocodylia	Crocodylidae	*Crocodylus niloticus*	Nile Crocodile	1983
		Osteolaemus tetraspis tetraspis	West African Dwarf Crocodile	1980
	Alligatoridae	*Alligator mississippiensis*	American Alligator	unknown

Table 2. Breakdown of amphibian taxa successfully reproduced at the Jacksonville Zoo and gardens 1979–2017.

Order	Family	Species	Common name	Earliest known reproductive event
Caudata	Ambystomatidae	*Ambystoma mexicanum*	Axolotl	1997
	Proteidae	*Necturus beyeri*	Gulf Coast Waterdog	2016
	Salamandridae	*Neurergus kaiseri*	Kaiser's Newt	2010
		Notophthalmus perstriatus	Striped Newt	2008
		Notophthalmus viridescens dorsalis	Broken-striped Newt	1995
		Notophthalmus viridiscens piaropicola	Peninsular Newt	2001
Anura	Bufonidae	*Atelopus zeteki*	Panamanian Golden Frog	2008
		Peltophryne lemur	Puerto Rican Crested Toad	2011
	Dendrobatidae	*Dendrobates auratus*	Green and Black Poison Dart Frog	1989
		Dendrobates tinctorius	Dying Poison Dart Frog	2008
	Bombinatoridae	*Bombina orientalis*	Oriental Fire-bellied Toad	1982
	Hylidae	*Agalychnis callidryas*	Red-eyed Treefrog	2009
	Pipidae	*Xenopus laevis*	African Clawed Frog	1979
		Pipa parva	Sabana Suriname Toad	2016

Table 3. Selected longevity records for reptiles and amphibians kept by the Jacksonville Zoo and Gardens as of 1 November 2017. Longevity is represented in years. Note that many wild-caught reptiles and amphibians were acquired as adults; therefore, their true ages may be far greater than the values reported here which represent the total number of years lived in captivity. Abbreviations: CB = captive-bred; CH = captive-hatched; WC = wild-caught; UNK = unknown. Sexes are represented as Male.Female.Unknown. *Asterisked values represent specimens that are still living in the collection.

Class	Order	Species	Common name	Origin	Sex	Longevity
Reptilia	Squamata – Sauria	*Dracaena guianensis*	Caiman Lizard	WC	0.1	18.1
		Eublepharis macularius	Leopard Gecko	WC	1.0	24.3
		Heloderma horridum horridum	Mexican Beaded Lizard	CB	1.0	31.6*
		Tupinambis rufescens	Red Tegu	UNK	1.0	23.7
	Squamata – Serpentes	*Acrantophis dumerilii*	Dumeril's Boa	CB	1.0	35.1*
		Agkistrodon contortrix contortrix	Southern Copperhead	CB	0.1	17.6
		Atheris chlorechis	West African Bush Viper	WC	0.1	17.9
		Bothreichis schlegelii	Eyelash Viper	CB	0.1	19.8
		Crotalus adamanteus	Eastern Diamondback Rattlesnake	WC	1.0	20.8
		Dendroaspis viridis	West African Green Mamba	CB	0.2	19.9*
		Epicrates cenchria cenchria	Brazilian Rainbow Boa	CB	1.0	22.3
		Naja haje haje	Egyptian Cobra	WC	1.0	20.4*
		Pituophis melanoleucus mugitus	Florida Pinesnake	CB	1.0	22.2*
		Proatheris superciliaris	Lowland Swamp Viper	WC	1.0	15.8
		Pseudaspis cana	Mole Viper	WC	0.1	13.6
		Sistrurus miliarius barbouri	Dusky Pygmy Rattlesnake	WC	1.0	20.9
	Testudines	*Chelus fimbriatus*	Mata Mata	WC	1.0	35.5*
		Chelus fimbriatus	Mata Mata	WC	0.1	32.6*
		Dermatemys mawii	Central American River Turtle	WC	1.0	37.2*
		Dermatemys mawii	Central American River Turtle	WC	0.1	24.3*
		Dermatemys mawii	Central American River Turtle	CH	0.1	23.8*
		Terrapene coahuila	Coahuilan Box Turtle	CB	1.0	28.2*
Amphibia	Anura	*Rhaebo guttatus*	Smooth-sided Toad	WC	0.0.1	19.5
	Caudata	*Notophthalmus viridescens dorsalis*	Broken-striped Newt	WC	0.1	20
		Notophthalmus viridescens piaropicola	Peninsular Newt	WC	0.1	13.5
		Siren intermedia intermedia	Eastern Lesser Siren	WC	0.0.1	15.4
		Siren lacertina	Greater Siren	WC	1.0	13.6
	Gymnophiona	*Typhlonectes natans*	Rio Cauca Caecelian	WC	1.0	14.0*

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FIG. 7. An amelanistic gopher snake (*Pituophis* sp.) at JZG, early 1970s.

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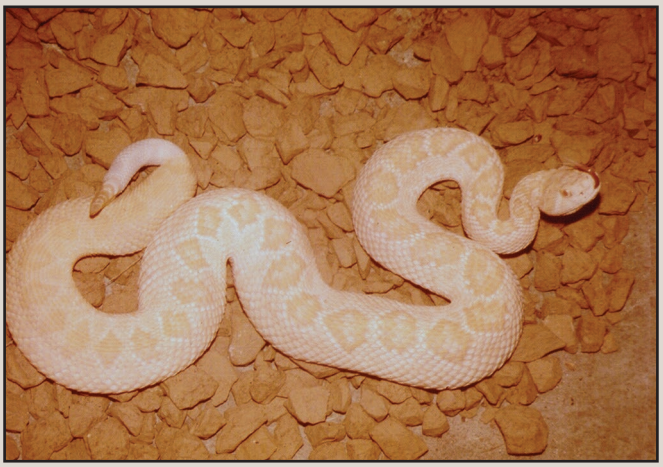

FIG. 8. An amelanistic *Crotalus atrox* displayed at JZG, early 1970s.

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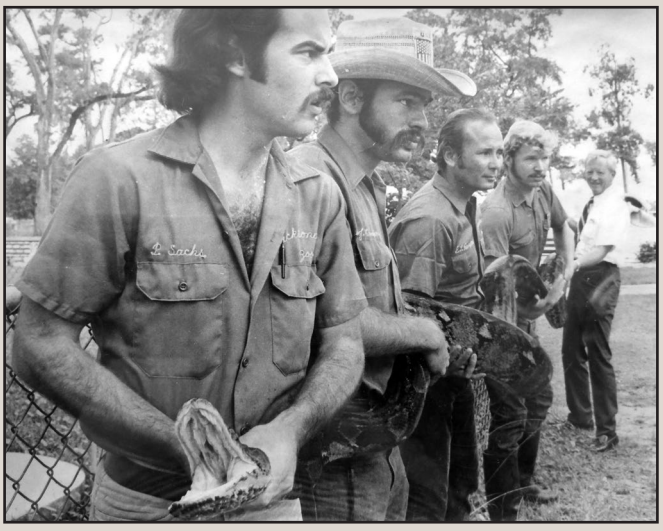

FIG. 9. Peter Sachs (left) and colleagues (from left to right: Jeffery Crocker, Leonardo Runyan, and Tim Krause) restrain a ~7-m long *Malayopython reticulaus* acquired in 1971.

pers. comm.). Florida's only native amphisbaenid, the Florida Worm Lizard (*Rhineura floridana*), has also been kept. *Varanus komodoensis* was added to the collection in 2007. Besides commonly bred species such as the Inland Bearded Dragon (*Pogona vitticeps*) and Leopard Gecko (*Eublepharus macularius*), lizard reproduction at JZG has been limited. Warren's Girdled Lizard (*Smaug warreni*) was successfully reproduced for the first time at the zoo in 2015, although the offspring did not survive past a few months. Taylor's Shield-tailed Agama (*Xenagama taylori*) was successfully reproduced in 2017.

About 165 species of snakes have been maintained by JZG, with venomous taxa making up an important component of the zoo's snake collection over the past several decades. From the mid-1990s to mid-2000s, there was a strong focus on African bush vipers of the genus *Atheris*, with five species kept: *A. ceratophorus, A. chloroechis, A. desaixi, A. squamiger,* and *A. superciliaris*. Some of the more obscure venomous taxa kept have included the Cape Coral Snake (*Aspidelaps lubricus*), Peringuey's Adder (*Bitis peringueyi*), Leaf-nosed Viper (*Eristicophis macmahoni*), and the Desert Black Snake (*Walterinnesia aegyptia*). As many as ten species belonging to the neotropical boid genera *Chilabothrus* and *Epicrates* were kept throughout the 1970s and 1980s; additional noteworthy snake taxa included the Indian Python (*Python molurus*), Bahamian Pygmy Boa (*Tropidophis canus*), and the Ratonel (*Pseudoboa neuwiedii*). Now a common fixture in the reptile hobby, JZG may have been the first zoo to display an amelanistic Red Rat Snake (*Pantherophis guttatus*) in 1971, acquired from noted breeder and originator of this color mutation, H. Bernard Bechtel (P. Sachs, pers. comm.). Around this time, the zoo displayed a few other amelanistic snakes including a gopher snake (*Pituophis* sp.) (Fig. 7) and Western Diamondback Rattlesnake (*Crotalus atrox*) (Fig. 8), as well as a 7-m-long Reticulated Python (*Malayopython reticulatus*) (Fig. 9). During the 1970s and 80s, the zoo successfully birthed at least six species of *Chilabothrus* (formerly assigned to *Epicrates*): *C. angulifer*, *C. chrysogaster*, *C. inornatus, C. striatus fosteri* (Fig. 10), *C. s. strigulatus, C. subflavus,* and *C. fordi*. Some of these may have represented world's first breeding events; however, at least one birth reported for *C. chrysogaster* (Anonymous 1975) appears to have been a case of a gravid female giving birth shortly after arriving at the zoo (see Huff 1978; Smith 2011). JZG may have been the first zoo to successfully reproduce the False Water Cobra (*Hydrodynastes gigas*) in 1972 (Fig. 11). The South American Bushmaster (*Lachesis muta*) was reproduced on several occasions in the late 2000s (Eisele 2009).

Fifty-nine chelonian species are known to have been kept, including such notable taxa as the Central American River Turtle (*Dermatemys mawii*), Flat-backed Spider Tortoise (*Pyxis planicauda*), North American Wood Turtle (*Glyptemys insculpta*), Blanding's Turtle (*Emydoidea blandingii*), and Aldabra Tortoise (*Aldabrachelys gigantea*). Throughout the 1980s, JZG hatched at least seven species of tortoise, which included the first captive breeding of *A. gigantea* in the western hemisphere (Collins 1984; Fig. 12). Additional noteworthy chelonians bred at the zoo include the Indian Star Tortoise (*Geochelone elegans*), Pancake Tortoise (*Malacochersus tournieri*), and Yellow-headed Temple Turtle (*Heosemys annandalii*).

At least 14 species of crocodilian have been kept, including the Sunda Gharial (*Tomistoma schlegelii*), Orinoco Crocodile (*Crocodylus intermedius*), Cuban Crocodile (*C. rhombifer*), West African Crocodile (*C. suchus*), Dwarf Crocodile (*Osteolaemus tetraspis*), and Slender-snouted Crocodile (*Mecistops cataphractus*). Despite the temperate climate of northern Florida (where nighttime temperatures in winter may drop as low as -9°C) and the zoo's lack of indoor holding space for colder winter months, two species of crocodile, the Nile Crocodile (*C. niloticus*) and *O. tetraspis* were successfully reproduced in the 1980s.

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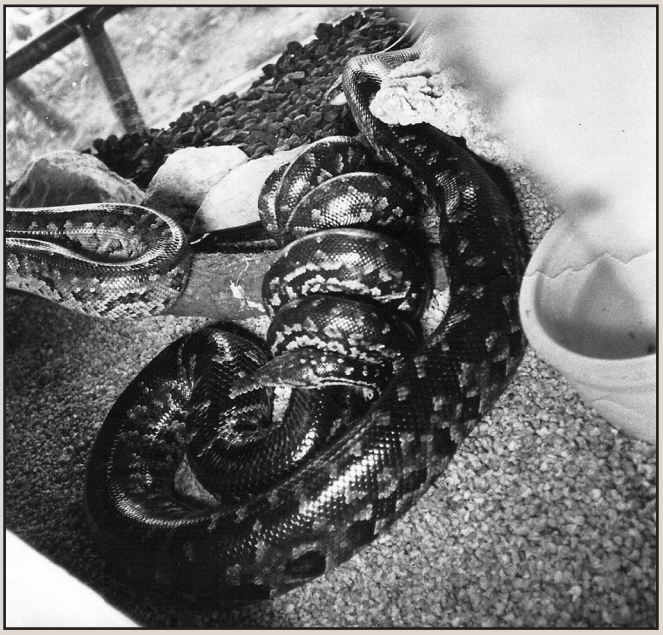

FIG. 10. Copulation in Bimini Island Boas (*Chilabothrus striatus fosteri*) at JZG, around 1973–1974.

PHOTO COURTESY OF PETER SACHS

FIG. 11. Copulation in *Hydronastes gigas* ca. 1973–1974.

PHOTOS COURTESY OF DAVID COLLINS

FIG. 12. Captive breeding of *Aldabrachelys gigantea* at JZG, 1980s.

Since 1946, at least 77 species of amphibians have been kept, including 55 anurans, 21 caudates, and one gymnophionan. Several poison dart frogs (*Dendrobates* sp.) were imported from Costa Rica and kept by the zoo in the early 1970s, but were never officially displayed for the public (P. Sachs, pers. comm.). Following the establishment of the zoo's Amphibian Conservation Center in 2008, several noteworthy reproductive events have taken place at JZG. Caudates have been a strong focus. Most notably, the Striped Newt (*Notophthalmus perstriatus*) has been produced since 2008 over multiple generations (see below); additional newt species bred include the Eastern Newt (*N. viridescens dorsalis* and *N. v. piaropicola*) and Kaiser's Newt (*Neuerergus kaiseri*). Although captive breeding success with the Gulf Coast Waterdog (*Necturus beyeri*) was first achieved by the Cincinnati Zoo in 2013 (Stoops et al. 2014), JZG appears to have been the first facility to successfully reproduce this species in captivity without the use of assisted reproductive technologies in 2016, and then building upon this success again in 2017.

Several noteworthy importations of reptiles were spearheaded by the zoo. A group of *Pseudaspis cana*, the first to be displayed at JZG, was acquired from the Pretoria Zoo in South Africa in 1999. In 2011, a group of 17 Jamaican Boas (*Chilabothrus subflavus*) was imported from Europe to diversify and bolster the AZA-managed North American captive population. In 2010, the zoo assisted with processing a large confiscated group of *Heosemys annandalii* that had been seized in Hong Kong and imported by the Turtle Survival Alliance (TSA) (Hagen 2011). A few dozen adult individuals arrived at JZG, where they were processed and then shipped out to other facilities in the United States; six of these individuals were retained by JZG for breeding purposes. At least two *Alligator mississippiensis* were exported from JZG to the Riyadh Zoo in Saudi Arabia in 1988.

As of November 2017, the herpetology department's living collection was comprised of 58 species of reptiles and 20 species of amphibians. On account of the biogeographic scope of most of the zoo's reptile and amphibian buildings, the collection is heavily focused on African, Central and South American, and Floridian taxa, although some Asian species such as *Varanus komodoensis* and *Heosemys annandalii* are kept as well. The snake collection continues to have a strong emphasis on venomous taxa (15 species) including all native Floridian species (6 species), with a venomous to non-venomous taxon ratio of 1.07 (N = 31).The zoo currently maintains 12 species of reptiles and one amphibian whose captive populations are managed by AZA Species Survival Plans (SSP), representing 20.7% and 5.0% of each collection, respectively. Of the 15 SSP-managed species that have been kept by JZG over its history, six have successfully been

TABLE 4. Reptile and amphibian species found on grounds at the Jacksonville Zoo and Gardens. *Single asterisks denote species previously reported, but have not been recorded in 10+ years; **double asterisks denote a species involved in the zoo's long-term snake mark-recapture study. "General abundance" is a qualitative assessment using a scale of Abundant–>Common–>Uncommon–>Rare.

Class	Order	Family	Taxon	Common Name	Status	General abundance
Amphibia	Anura	Bufonidae	*Anaxyrus terrestris*	Southern Toad	Native	Abundant
		Eleutherodactylidae	*Eleutherodactylus planirostris*	Greenhouse Frog	Exotic	Abundant
		Hylidae	*Hyla cinerea*	Green Treefrog	Native	Abundant
			Hyla squirella	Squirrel Treefrog	Native	Abundant
			Osteopilus septentrionalis	Cuban Treefrog	Exotic	Abundant
		Microhylidae	*Gastrophryne carolinensis*	Narrow-mouth Toad	Native	Uncommon
		Ranidae	*Rana catesbeiana*	American Bullfrog	Native	Abundant
			Rana sphenocephala	Southern Leopard Frog	Native	Common
		Scaphiopodidae	*Scaphiopus holbrookii*	Eastern Spadefoot Toad	Native	Uncommon
	Caudata	Sirenidae	*Siren lacertina*	Greater Siren	Native	Unknown
		Amphiumidae	*Amphiuma means*	Two-toed Amphiuma	Native	Unknown
Reptilia	Crocodylia	Alligatoridae	*Alligator mississippiensis*	American Alligator	Native	Common
	Squamata – Sauria	Dactyloidae	*Anolis carolinensis*	Green Anole	Native	Common
			Norops sagrei	Brown Anole	Exotic	Abundant
		Scincidae	*Plestiodon fasciatus*	Five-lined Skink	Native	Common
			Plestiodon laticeps	Broad-headed Skink	Native	Common
			Scincella lateralis	Ground Skink	Native	Common
		Anguidae	*Ophisaurus ventralis*	Eastern Glass Lizard	Native	Uncommon
		Gekkonidae	*Hemidactylus turcicus*	Mediterranean Gecko	Exotic	Abundant
	Squamata – Serpentes	Colubridae	*Coluber constrictor***	Black Racer	Native	Abundant
			*Farancia abacura***	Mud Snake	Native	Rare
			*Opheodrys aestivus***	Rough Green snake	Native	Common
			*Nerodia fasciata***	Banded Water snake	Native	Abundant
			*Pantherophis alleghaniensis***	Yellow Ratsnake	Native	Abundant
			*Pantherophis guttatus***	Red Ratsnake	Native	Common
			*Regina allent**	Striped Crayfish Snake	Native	Unknown
			Rhadinaea flavilata	Pinewoods Snake	Native	Uncommon
			*Thamnophis sirtalis***	Eastern Garter Snake	Native	Abundant
			*Thamnophis sauritus***	Eastern Ribbon Snake	Native	Common
		Elapidae	*Micrurus fulvius**	Eastern Coral Snake	Native	Unknown
		Typhlopidae	*Ramphotyphlops braminus*	Brahminy Blind Snake	Exotic	Rare
		Viperidae	*Crotalus adamanteus***	Eastern Diamond-backed Rattlesnake	Native	Uncommon
			*Sistrurus miliarius**	Pygmy Rattlesnake	Native	Unknown
	Testudines	Chelydridae	*Cheyldra serpentina osceola*	Florida Snapping Turtle	Native	Abundant
		Emydidae	*Malaclemys terrapin*	Diamondback Terrapin	Native	Rare
			Pseudemys rubriventris	Red-bellied Cooter	Native	Common
			Terrapene carolina bauri	Florida Box Turtle	Native	Common
			Trachemys scripta elegans	Red-eared Slider	Exotic	Common
			Trachemys scripta scripta	Yellow-bellied Slider	Native	Common
		Kinosternidae	*Kinosternon baurii*	Striped Mud Turtle	Native	Common
			Sternotherus odoratus	Common Musk Turtle	Native	Abundant
		Testudinae	*Gopherus polyphemus*	Gopher Tortoise	Native	Common
		Trionychidae	*Apalone ferox*	Florida Softshell Turtle	Native	Abundant

reproduced: the Puerto Rican Crested Toad (*Peltophryne lemur*), Panamanian Golden Frog (*Atelopus zeteki*), Louisiana Pine Snake (*Pituophis ruthveni*), *Lachesis muta*, *Heosemys annandalii*, and *Malacochersus tournieri*. Several clutches of eggs have also been received from *Dermatemys mawii* over successive years, but have not yet proven to be viable.

In addition to the herpetology department's collection, 11 reptile and six amphibian species are presently maintained by the zoo's education department for educational outreach.

Wild Herpetofauna on Zoo Grounds.—Many zoological parks in the United States and Europe are located within urban centers and subsequently lack an abundance of free-ranging wildlife on their grounds, particularly reptiles and amphibians. In contrast, given its geographical location along the Trout River and the extensive wetlands, wooded areas, and planted gardens that occur throughout its grounds, JZG is presently home to at least 28 species of reptiles (four of which are non-native) including one venomous species, the Eastern Diamond-backed Rattlesnake (*Crotalus adamanteus)*, and 11 species of amphibians (two of which are non-native) (Table 4; Fig. 13). Three additional snake species, the Eastern Coral Snake (*Micrurus fulvius*), Pygmy Rattlesnake (*Sistrurus miliarius*), and Striped Crayfish Snake

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FIG. 13. Herpetology keeper Sean Wallace (left) and senior herpetology keeper Emily Fyfe (right) safely restrain a large *Crotalus adamanteus* captured on zoo grounds in 2013.

PHOTO BY ROBERT W. MENDYK

FIG. 14. A wild *Pantherophis alleghaniensis* retrieved after ingesting several plaster-filled "dummy eggs" in one of the zoo's aviaries. Surgical excision of the eggs was required after attempts to manually palpate and eject the eggs were unsuccessful.

(*Regina alleni*) have previously been recorded on grounds (D. Collins and G. Lepera, pers. comm.), but have not been observed in over a decade. Snakes that are opportunistically captured on zoo grounds by herpetology staff and deemed large enough for PIT tag implantation are monitored as part of a long-term mark-recapture study on their ecology (see below).

Some species of wild herpetofauna present noteworthy challenges in terms of safeguarding JZG collection animals. Wild alligators are a persistent threat to collection animals, particularly smaller wading birds and waterfowl maintained in the zoo's open, outdoor exhibits. Hatchling and juvenile alligators periodically enter wetland areas on zoo grounds from the adjacent Trout River or through drainage culverts when small, and then quickly grow to formidable sizes feeding on an abundant supply of wild amphibians, insects and fishes. Nuisance alligators retrieved from exhibit areas are usually relocated to the Trout River.

Florida Snapping Turtles (*Chelydra serpentina osceola*) are also abundant on zoo grounds, and on several occasions have bitten and seriously injured the feet of wading birds and waterfowl in the collection. On one occasion, a Southern Pudu (*Pudu puda*) fawn was grabbed and pulled underwater by a snapping turtle, but was able to escape without injury. Problematic individuals are relocated to other wetland sites on the property or the Trout River. Interestingly, two wild snapping turtles living in a natural wetland area inside a mixed bird and hoofstock exhibit had learned to leave the water to opportunistically feed on pelleted crane food from food bowls up on land.

Ratsnakes of the genus *Pantherophis* are notorious raiders of bird nests and chicken coups (e.g., Medsger 1920) and are common throughout JZG. Yellow Ratsnakes (*Pantherophis alleghaniensis*) and Red Ratsnakes (*P. guttatus*) are frequently encountered attempting to enter the zoo's aviaries to feed on collection birds' eggs and their young. On several occasions, these snakes have inadvertently consumed "dummy" or "nest eggs"—sand or plaster-filled eggshells placed in nests as substitutes for the actual eggs. Unable to digest or pass these replica eggs (Fig. 14), surgical intervention by the zoo's veterinary staff has been required for multiple individuals after manual palpation and ejection of the eggs proved unsuccessful. Once captured and removed from aviaries, these snakes are PIT-tagged and released away from the aviary in another part of the zoo. Some of these snakes end up returning to their original capture sites, and "repeat offenders" that continue to target aviaries are relocated off-grounds or accessioned into the zoo's living collection.

The introduced Cuban Treefrog (*Osteopilus septentrionalis*) has been established in southern Florida since the 1920s (Barbour 1931), but has only reached northeastern Florida in recent years. It is substantially larger than all of Florida's native treefrog species, and is known to occupy the same refuge sites and predate indigenous species such as the Green Treefrog (*Hyla cinerea*) (Wyatt and Forys 2004; Glorioso et al. 2012). Although not necessarily a threat to JZG's collection animals, its presence does jeopardize indigenous treefrog populations on grounds. After several years of casual sightings on zoo grounds, which

most likely represented individual specimens transported up from southern Florida with tropical plant shipments, the number of *O. septentrionalis* opportunistically collected in 2016 exploded to more than 100 individuals, with breeding adults, tadpoles, and juveniles now appearing throughout the zoo. Efforts to remove opportunistically collected individuals over the past several years have failed to prevent the establishment of this species on zoo grounds.

The Greenhouse Frog (*Eleutherodactylus planirostris*) is another introduced anuran that is now established throughout the state of Florida. On zoo grounds, they are frequently encountered beneath rocks, logs, and other objects, and occasionally enter animal buildings and exhibits. Several individuals, which were probably inadvertently transported with live plants or mulch, were found living inside the zoo's bushmaster and poison dart frog exhibit. In addition to successfully reproducing in the exhibit undetected (this species deposits its eggs terrestrially and has direct development with no tadpole stage), male *E. planirostris* have been observed attempting to mate with Green and Black (*Dendrobates auratus*) and Golfodulcean (*Phyllobates vittatus*) Poison Dart Frogs in the exhibit (B. Eisele and M. Beshel, pers. comm.).

Conservation

Ex-situ Conservation Breeding and Repatriation.—JZG is currently engaged in three ex-situ conservation breeding and repatriation programs where captive-bred offspring produced at the zoo are released into the wild in an effort to help restore extirpated populations or bolster declining wild populations. In 2008, the zoo joined the *Peltophryne lemur* SSP and recovery program, a conservation initiative led by the United States Fish and Wildlife Service in partnership with Puerto Rico's Department of Natural and Environmental Resources and several AZA-accredited zoos. The program carefully oversees the captive management and breeding of *P. lemur* in zoos and the subsequent release of captive-bred tadpoles into selected wetland sites in Puerto Rico (see Johnson 1990). As of November 2017, more than 8000 *P. lemur* tadpoles have been produced by JZG at its Amphibian Conservation Center and delivered to Puerto Rico for release.

In response to rapidly declining wild populations of *Notophthalmus perstriatus* throughout its range in Florida and Georgia, a multifaceted recovery project was initiated in 2010 by the Coastal Plains Institute, in collaboration with the Florida Fish and Wildlife Conservation Commission and the United States Forestry Service, to protect, conserve, and study the decline of the species. Recovery work for this species focuses on the Apalachicola National Forest (ANF) in the Florida panhandle, the species' last reported stronghold in the state (Means et al. 2013). In 2011, JZG joined the project to help establish ex-situ assurance colonies of *N. perstriatus* together with the Memphis Zoo, and to produce captive-bred offspring for repatriation into recipient wetlands within the ANF (Means et al. 2012). As of November 2017, JZG has released more than 1000 *N. perstriatus* into the wild, and together with the Memphis Zoo and most recently the Central Florida Zoo's Orianne Center for Indigo Conservation, more than 1300 individuals have been repatriated since the project's inception (Means et al. 2016; Fig. 15). Offspring produced at JZG have been sent to other AZA-accredited facilities in Florida to establish additional ex situ breeding colonies. Conservation support grants received from the American Association of Zoo Keepers (2015) and the Foundation for the Conservation of Salamanders (2017) have enabled JZG to expand on this project by increasing the zoo's holding capacity for rearing larval newts.

PHOTO BY ROBERT W. MENDYK

Fig. 15. Captive-bred *Notophthalmus perstriatus* produced at JZG in preparation for release in the Apalachicola National Forest, Florida.

Since 2011, JZG has participated in conservation and recovery efforts for *Pituophis ruthveni*, an imperiled colubrid native to western Louisiana and eastern Texas (Rudolph et al. 2006). Captive-bred offspring produced by zoos participating in the *P. ruthveni* SSP, including JZG, are released into the wild in an attempt to bolster current populations (e.g., Himes and Hardy 2006). Although some setbacks were experienced prior to 2014, JZG produced its first three captive-bred *P. ruthveni* offspring in 2015, followed by additional offspring in 2016 and 2017.

Although currently listed as a species of least concern by the IUCN, JZG is working to reproduce *Necturus beyeri*, an aquatic salamander that naturally occurs from western Florida to eastern Texas. By maintaining *N. beyeri* as an analog species, JZG seeks to develop husbandry and breeding techniques for this species that can then be applied to the closely related and endangered Alabama Waterdog (*N. alabamensis*) for future conservation breeding and repatriation efforts. Reproductive success with *N. beyeri* was first achieved at JZG in 2016 (three live offspring) and repeated again in 2017 (35 offspring), and we hope that these initial successes can be refined to produce consistent and repeatable techniques that can soon be applied to *N. alabamensis*.

Capacity Building.—In addition to directly participating in several herpetological conservation and recovery projects, JZG is also committed to supporting a wide range of conservation projects and initiatives led by other organizations and institutions throughout the globe. Through its Conservation Awards, Research and Events (CARE) committee, JZG has provided financial and logistical support to numerous projects worldwide, with more than US $73,000 in funding support allocated specifically to herpetology-related projects since 2013. This has also included providing support to graduate students studying local herpetological conservation issues in Florida and the southeastern United States, and equipment support for radiotelemetry field studies on *Chilabothrus subflavus*.

In 2015, JZG, in collaboration with the TSA and the Belize Foundation for Research and Environmental Education (BFREE), sponsored the 2nd Hicatee Conservation Workshop and Forum in southern Belize, which brought together a consortium

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Fig. 16. JZG herpetology staff (senior keepers Brian Eisele and Emily Fyfe) measure a wild *Coluber constrictor priapus* with zoo visitors as part of the department's long-term mark-recapture snake study, in 2011.

of stakeholders involved in the conservation of *Dermatemys mawii* across its range to discuss current conservation efforts and future actions for the species (Barrett et al. 2016). Additional funding support from JZG has been earmarked for supporting the Hicatee Conservation and Research Center (HCRC) at BFREE as well as the design and construction of a new educational exhibit in Belize which will highlight *D. mawii* and its conservation challenges. JZG herpetology and hospital staff members routinely travel to Belize to assist with reproductive health assessments of the HCRC's captive assurance population.

Research

In recent years, JZG's herpetology department has initiated several in-situ, ex-situ, and database-driven research projects focusing on various subjects including ecology, physiology, behavior, captive management, and life expectancy. Ethological investigations are currently focused on the behavioral repertoire and courtship of the poorly-known *Dermatemys mawii* (e.g., Mendyk and Eisele 2016), with hopes that this research can help inform husbandry and reproductive management practices for this critically endangered species. Herpetology staff members are also studying the life expectancy and longevity of various reptile groups in captivity through analysis of life history data obtained from published studbooks and animal record keeping databases such as the Zoological Information Management System (ZIMS) (e.g., Mendyk 2015), with a study on the life expectancies and longevities of rattlesnakes (*Crotalus* and *Sistrurus*) in captivity currently underway. Building upon earlier studies on thermal husbandry in captive reptiles (Mendyk et al. 2014, 2016), JZG seeks to study the thermoregulatory behaviors and thermal preferences of species within its collection, which can have strong implications for improving captive management practices in zoos.

In addition to husbandry-based studies, JZG is engaged in field research on reptile and amphibian ecology. Similar to studies carried out by other zoos with wild reptile and amphibian populations on grounds (e.g., Roberts and Mitchell 1998; Hartdegen 2004; D. Smith, pers. comm.; C. Baker, pers. comm.), JZG has been conducting a long-term mark-recapture study of free-ranging snakes since 2008. Over the course of this study, herpetology staff have collected important ecological data that will shed light on the diversity and relative abundances, sex ratios, seasonal activity patterns, habitat associations, home range sizes, growth rates, injuries and other health issues of the native snake species found on zoo grounds. Specimens opportunistically encountered are captured, measured and weighed, probed for sex determination, and PIT-tagged before being released. With the exception of venomous snakes (*Crotalus adamanteus*) which are relocated to undeveloped areas of the zoo due to public safety concerns, non-venomous species are usually released at or near the site of their capture. To maximize this project's educational impact, herpetology staff will usually process captured snakes out in public areas of the zoo to encourage questions from visitors and provide them with opportunities to see local snake species up close and in person (Fig. 16). To date, more than 400 individual snakes of nine species (Table 4) have been PIT-tagged and continue to be monitored on zoo grounds.

Citizen Science and Educational Outreach

In 2015, JZG joined FrogWatch USA, a citizen science-based initiative led by the AZA to collect important field data and monitor changes in anuran populations and communities throughout North America (Inkley 2006). Through its Northeast Florida FrogWatch Chapter, JZG hosts annual training sessions and workshops for local citizen scientists interested in participating in the program and leads occasional nighttime field outings with FrogWatch participants and zoo volunteers.

Like most zoos, JZG features a separate education department that focuses exclusively on educational outreach; however, visitor engagement and education are also significant activities of the zoo's herpetology department. Each year, herpetology staff engages thousands of visitors on herpetological matters through a combination of scheduled keeper chats, public feedings and other demonstrations (e.g., processing wild snakes in the mark-recapture study), and behind the scenes tours, with the goal of educating and fostering appreciation and respect for reptiles and amphibians. Further educational outreach is carried out off-grounds through public lectures and presentations given by JZG herpetology staff and through participation at various conservation events (e.g., Claxton Rattlesnake Festival; see Morell 2017).

Staff Publications

Since the 1970s, JZG staff has contributed numerous publications on various aspects of herpetology and captive management. Many of these works have focused on the husbandry and reproduction of species at the zoo. For instance, Collins (1984) described the husbandry and first successful breeding of *Aldabrachelys gigantea* in the Western Hemisphere. Williams (1986a,b), Meyer (1987), and Meyer et al. (1989) described in detail the husbandry and breeding of several tortoise species in the collection. Lepera (2004b) outlined some of JZG's safety protocols for working with venomous taxa which are still in use today. Eisele (2009) documented the zoo's repeated reproductive success with *Lachesis muta*. Beshel (2014a,b) discussed current ex-situ amphibian conservation initiatives at the zoo, whereas Means et al. (2014, 2015, 2016), and Mendyk and Beshel (2017) described husbandry and breeding parameters for *Notophthalmus perstriatus* at JZG. Scent enrichment for several reptiles in the collection was described by Burr (1997), and Mikus

(2014) outlined an operant conditioning program for behaviorally managing a group of adult *Alligator mississippiensis*. As part of a training manual on crocodilian captive management, Carter and Lepera (2001) discussed techniques used for identifying individual animals, Pastika and Lepera (2001) provided an overview of transportation methods, and Rost (2001a) discussed record keeping. Ferri (2012a) prepared and published the AZA North American regional studbook for *Chilabothrus subflavus*.

Additional works have focused on broader management topics, such as identifying problematic areas of husbandry in zoos and offering potential solutions for their remedy. Mendyk et al. (2014) described the thermal husbandry of monitor lizards; as a follow-up to this study, Mendyk et al. (2016b) quantified and characterized differences in thermal husbandry practices between zoos and private herpetoculturists, and highlighted the importance of communication between these two groups. Mendyk (2015a) assessed the life expectancy and longevity of monitor lizards in North American zoos and discussed factors that may be affecting long-term keeping and breeding success. Annotated bibliographies on the captive management and reproduction of monitor lizards were provided by Mendyk (2015c, 2016c, 2017). Mendyk (2018) discussed folklore reptile husbandry in zoos, highlighting outdated or inappropriate keeping practices that may be affecting the success of captive management programs.

Several published works have focused on historical aspects of zoo herpetology. For example, Mendyk (2015d) reported on the history of a troubled reptile zoo in New York, whereas Mendyk et al. (2015) described the history, husbandry, and behavior of a Bornean Earless Monitor (*Lanthanotus borneensis*) maintained by the Bronx Zoo during the 1960s and 70s. Mendyk and Smith (2016) briefly discussed the history of *Dermatemys mawii* in zoos, and presented new captive longevity records for the species.

Some publications have focused on the natural history, ecology, and behavior of reptiles. Groves and Sachs (1973) provided descriptions of the eggs and offspring of the Scarlet Kingsnake (*Lampropeltis elapsoides*) in Florida. Wilson and Meyer's (1985) book, *The Snakes of Honduras*, provided a comprehensive overview of the natural history and distribution of Honduran snakes. Mendyk and Adragna (2014) reported on the discovery, status, and distribution of two new introduced populations of the Italian Wall Lizard (*Podarcis siculus*) in New York. Mendyk et al. (2016a) studied the reproductive biology of invasive female Northern African Rock Pythons (*Python sebae*) collected from southern Florida. Mendyk and Eisele (2016) described caudal prehensility in *Dermatemys mawii*. Ferri (2012b) briefly discussed collecting water samples for amphibian eDNA testing. Taylor and Mendyk (2017) described a case of kyphosis in a Florida Softshell Turtle *Apalone ferox*, and Wood et al. (2017) studied foraging behavior in Hawksbill Sea Turtles (*Eretmochelys imbricata*) in southern Florida. Mendyk et al. (2018) described the resiliency of a wild clutch of Southern Black Racer (*Coluber constrictor priapus*) eggs that hatched after experiencing extensive flooding and total submersion after a direct hurricane strike.

Jacksonville Zoo and Gardens staff have also contributed various works on the veterinary management and surgery of reptiles in captivity. Page (1985) described soft tissue celiotomy in an *Aldabrachelys gigantea*, and reviewed anesthesia techniques in reptiles (Page 1993). Page et al. (1988, 1991) described pharmacokinetics in *Gopherus polyphemus*, and Mautino and Page (1993) discussed various aspects of the biology and medical management of captive chelonians. Page et al. (1986) described the medical management of a debilitated Leopard Tortoise (*Stigmochelys pardalis*). Mendyk (2015b) described the use of predatory soil mites for treating parasitic mite infestations in lizards and discussed the potential role of biological control agents as an alternative to chemical therapeutics.

Finally, a number of brief, miscellaneous herpetological notes were published in the Jacksonville Zoo and Gardens' newsletter *Kitabu* (Anonymous 1979, 1997b; Williams 1986b; Meyer 1987; Moore 1988, 1989, 1991, 1992, 1999; Lepera 1997, 2001, 2004a,b,c; Rost 1997, 2001b; Tomlinson 1999; Pastika 2000; Kapustin 2004) and *Wild* (Mendyk 2015e, 2016a,b), which it later changed its name to in 2005.

Additional Activities and Miscellany

Several staff members of JZG's herpetology department have served in various capacities for national and international conservation organizations and committees and have served as instructors for several courses and professional workshops. Dino Ferri served as chair of the AZA Snake Taxon Advisory Group, vice chair of the AZA Wildlife Conservation Management Committee, and as a steering committee member of the AZA Chelonian Taxon Advisory Group. Former herpetology supervisor Steve Gott served as a trustee on the board of the World Chelonian Trust. Former herpetology supervisor Robert Mendyk was a founding member of the IUCN Species Survival Commission's (SSC) Monitor Lizard Specialist Group, and served on steering committees of the AZA Lizard Taxon Advisory and Komodo Dragon Taxon Advisory Groups. Greg Lepera served as an instructor for the AZA Crocodilian Biology and Captive Management course over several years and senior herpetology keeper Mark Beshel has been an instructor for the Amphibian Ark's Biology, Management and Conservation of North American Salamanders Training Course since its inception in 2016.

While at JZG, Robert Mendyk served as herpetoculture section editor for the journal *Herpetological Review* (published by the Society for the Study of Amphibians and Reptiles) and editor-in-chief of *Biawak*: *Journal of Varanid Biology and Husbandry* (published by the International Varanid Interest Group).

In recognition of their contributions to the field of herpetology, Greg Lepera and Robert Mendyk were presented with the International Herpetological Symposium's Joseph Laszlo Memorial Award in 2000 and 2017, respectively.

Outlook

The herpetological history outlined here documents one aspect of the Jacksonville Zoo and Gardens' maturation into a modern zoological park—a facility that serves both the public interest and the scientific community as an important center for conservation, education, and research. Reptiles and amphibians have played a crucial role in shaping the zoo's growth and transformation over the past several decades, and will likely continue to be a driving force behind its continued evolution. Much is planned for the future of the herpetology department in terms of its collection and conservation and research activities.

Working within the biogeographic framework of its herpetology collection, JZG seeks to increase its role and participation in AZA-managed SSP programs. Additionally, since maintaining sustainable captive populations continues to be a major challenge for zoo herpetology departments (e.g., Ziegler

et al. 2016), JZG also plans to focus on reproducing rare and threatened species that are not managed by SSPs but are still in much need of captive breeding (e.g., Ziegler et al. 2016, 2017). Along similar lines of sustainability, it will also be important for the zoo to focus on breeding common species that are of educational or display value, particularly native taxa. Currently in Florida zoos, many indigenous reptile and amphibian species are rarely reproduced because of their perceived commonness and widespread availability as wild-caught specimens. As stewards of wildlife conservation, zoos should be distancing themselves from the practice of field-collecting (or purchasing wild-caught) reptiles and amphibians if more responsible options are available. To achieve this, a concerted effort will be needed among Florida zoos to produce sustainable captive-bred populations of important native species. JZG has recognized this need as it seeks to establish captive-bred lineages of several indigenous species, and welcomes collaboration, participation, and feedback from other institutions on these efforts.

The Jacksonville Zoo and Gardens' ideal location in northeastern Florida affords many opportunities for the zoo to support and contribute to local reptile and amphibian conservation efforts and field research. Moreover, with several nearby universities and AZA-accredited zoological facilities, there are many opportunities to forge collaborative partnerships with these institutions as well as local, state and federal wildlife agencies. Expanding upon its current conservation projects, JZG seeks to add additional species to its ex situ captive breeding and repatriation efforts. The zoo also plans to continue providing financial and logistical support to external conservation and research projects, with a particular emphasis on biodiversity hotspots such Guyana, Democratic Republic of Congo, Indonesia, and Florida.

As highlighted by several authors discussing the importance of zoo-academic herpetological collaborations, zoos have unique opportunities to work together with outside researchers on a variety of research topics (Murphy and Chiszar 1989; Chiszar et al. 1993; Pough 1993; Chiszar and Smith 2005) yet may not be reaching their potential in this regard (Pough 1993; Card et al. 1998). To maximize its scientific contributions to the fields of herpetology and herpetological husbandry, JZG is taking several steps to increase its research activities. In addition to increasing the size of its reptile and amphibian collection by including more individuals of species that would facilitate larger sample sizes for biological investigations, JZG is soliciting partnerships with academic institutions and promoting the zoo as a living research laboratory and source for biological materials to outside researchers. In addition to the archetypal studies conducted on reptile and amphibian behavior, physiology, and veterinary management in zoos (Chiszar et al. 1993; Chiszar and Smith 2005), a new animal wellness initiative at JZG (see Maple 2016) offers opportunities to study the behavior of captive reptiles and amphibians and evaluate the appropriateness and success of captive husbandry regimes.

Finally, the various conservation, research, and publishing activities of JZG's herpetology staff, coupled with the many contributions made by other zoos over the past century (e.g., Murphy 2007), exemplify the value and importance of herpetology departments in zoos. Today, as zoos face increasing scrutiny from animal rights groups and other critics, it is imperative now more than ever, that zoos demonstrate their value and importance to society through their educational and scientific endeavors. The vast body of herpetological research and conservation programs carried out by zoos offers many opportunities for zoos to boast and publicize these activities and contributions. Retrospective historical accounts such as the present article can also be valuable for illustrating the significance of zoos. Additionally, in an era where some zoos are moving away from taxonomic specialization among their staffing by restructuring traditional taxonomically defined departments (e.g., herpetology, ornithology, mammalogy) to those defined by biogeography (e.g., Asia, Neotropics, Australia, etc.) or zones within the zoo, this is likely to have a negative impact on the scientific output and contributions of zoological parks, particularly those herpetological in nature. It is doubtful that JZG could have achieved all that it has over the past 40 years in terms of herpetological husbandry and breeding, conservation, and research if it did not have specialized herpetology staff. Therefore, it is our hope that in addition to contributing a further chapter to the annals of zoo history, this article illustrates the importance and necessity of maintaining taxonomic specialization in zoological parks, particularly formal herpetology departments.

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