



## **CROCODILIAN ADVISORY GROUP**

# **North American Regional Collection Plan 2012**

**2nd Edition**

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# Introduction

The Crocodylian Advisory Group (CAG) is the Association of Zoos and Aquariums' oldest taxon advisory group, sanctioned by the WCMC in 1986. This document is the CAG's 2012 update of the North American Regional Collection Plan for crocodylians (the Crocodylia), including alligators and caiman, crocodiles, and gharials. Due largely to unregulated hunting of many of these animals for their hides, as well as unrelenting persecution of crocodylians as predators, many crocodylian species have faced possible extinction. In the 1970's and early 1980's, no less than 18 of the 23 recognized species were considered endangered or vulnerable to extinction. In the intervening years, however, the status of a large number of these species has brightened, improving from endangered to vulnerable or lesser risk. This improvement was due largely to the development of management programs, the application of sustainable utilization as a conservation strategy, and international regulation of trade in crocodylian products. However, not all species of crocodylians have benefited from these changes. Seven species of crocodylians are still endangered or critically endangered or have continued a long decline to critically endangered status. These seven include five Asian species: the Chinese alligator (*Alligator sinensis*), the Siamese crocodile (*Crocodylus siamensis*), the Philippine crocodile (*C. mindorensis*), and two species of gharial, the Indian gharial (*Gavialis gangeticus*) and the Tomistoma or Malay gharial (*Tomistoma schlegelii*). Additionally, two Neotropical crocodiles are also critically endangered: the Cuban crocodile (*Crocodylus rhombifer*), and the Orinoco crocodile (*C. intermedius*). Although the factors responsible for the precarious status of each of these species vary, generally these species are of low economic value and have not benefited from the sustainable utilization model that has worked with so many other crocodylians. Hunting of these animals for their hides is no longer the primary cause of their demise – habitat loss and degradation is the principle factor leading to the decline of most of these species.

Captive breeding of critically endangered species in managed propagation programs can be a powerful conservation strategy. Several endangered species of crocodylians can be assisted by captive breeding programs, including programs within our North American living institutions. The greatest challenge to date for the CAG has been the marshaling of the necessary space and resources for the captive management of imperiled crocodylian species. Generally, crocodylian programs have been given a relatively low priority for construction funds in most North American zoos. Unfortunately, in the case of crocodylians, there does not appear to be enough room in AZA institutions for us to develop programs for all of the endangered forms. This situation is made worse due to the large portion of current AZA space resources that is being utilized by non-targeted taxa. Relocating these non-targeted specimens out of AZA facilities can greatly increase the needed space for programs with endangered crocodylians. The CAG is cognizant of the impediments these space limitations impose and has redirected some of its attention to include more focus on education and the promotion of *in situ* conservation efforts.

Another critical difficulty that the CAG has encountered with our regional crocodylian programs has been a lack of zoo professionals with expertise in the management of this unique group of reptiles. The CAG's voting body consists of the Chair plus 15 steering committee members (Appendix 1). Historically, this comprised a significant part of the entire pool of individuals with expertise in crocodylians in AZA zoos. For this reason, the CAG, with the AZA Board of Regents, developed the Crocodylian Biology and Captive Management (CBCM) Training School. Over 200 individuals have been trained through this program over the last eleven years. CBCM appears to be achieving the results we hoped of it – increased interest in crocodylians in AZA institutions, increasing numbers of exhibits devoted to crocodylians, and the recruitment of new young professionals with an interest in crocodylians into the CAG. More than one quarter of the CAG steering committee is now made up of CBCM graduates.

The CAG has also taken a very proactive approach in the management of AZA crocodylian programs. Eight taxa are designated for SSP or Red studbook management. These taxa are reviewed yearly for appropriate pairings and placement by the CAG working members and an SPMAG representative in a population management plan. Again, if the limited amount of space in American zoos for crocodylians is considered, this proactive management approach by the CAG for all crocodylians is essential to guarantee that captive space is allocated efficiently for all AZA crocodylian programs.

Finally, we are making a plea for space and resource allocation in North American institutions for crocodylians. The Crocodylia represent the sole survivors of an ancient group. Some taxa are among the most endangered vertebrates in the world. Crocodylians make spectacular displays and draw great interest from the visiting public. Yet members of this group are often omitted from new zoo projects where they could be incorporated. Consideration must be given to more resource allocation for crocodylians if the AZA is going to make a long-term contribution to the conservation of these most endangered archosaurians.

A special thanks to Colette Adams for overseeing the revision of the species accounts herein and a modernization of the CAG Mission Statement, to Megan Terry for organizing, compiling and summarizing the results of our latest space survey, and to Chad Peeling for formulating our Sustainability Statement. Final revisions of the document were managed by an RCP review committee consisting of Colette Adams, Nate Nelson, Chad Peeling, Kevin Torregrosa, Bill Zeigler, and Kent Vliet.

This RCP has been posted on the AZA web site and made available to the institutional representatives of the CAG for a 30-day review period prior to publication.

## **CAG Mission Statement**

To promote conservation of the world's crocodylians and their habitats through species management, education, and research.

The objectives of the CAG are as follows:

- Develop, conduct, and support programs to further crocodylian conservation by
  - Monitoring the status of wild crocodylian species and recommending supportive AZA programs
  - Serving as a management advisory group for target species, developing studbooks and SSP programs where appropriate
  - Monitoring captive populations of crocodylians
  - Managing surplus captive crocodylians in accordance with AZA guidelines for sustainable exhibits and breeding populations
  - Analyzing data generated from monitoring wild and captive crocodylian populations and their supportive programs
  - Providing financial support for crocodylian conservation activities
  - Supporting engaging educational opportunities
- Facilitate cooperation and collaboration between zoos, the scientific community, government agencies, and the private sector
- Serve as a resource for information concerning crocodylian species management, education, and research
- Support the goals of the AZA



## CAG TAG Definition

There are generally recognized 23 living species of crocodylians. The extant Crocodylia consist of three families: the Alligatoridae, Crocodylidae, and Gavialidae. The alligatorids include alligators and caimans. *Alligator* includes not only our own familiar American alligator (*Alligator mississippiensis*) but the small, critically endangered Chinese alligator (*A. sinensis*) as well. The eight or so species of caiman are included in three genera – *Caiman*, *Melanosuchus*, and *Paleosuchus*. Living crocodylids, the true crocodiles, are organized into three genera. At present, 11 species of *Crocodylus* are recognized. New research in molecular systematics of crocodylians is revealing a greater diversity of forms than was previously recognized. As our understanding of this diversity improves, we will need to modify our programs in response. In some cases, this will require us to diagnose the specific identify of our existing specimens and re-evaluate our past reproductive events and current pairings and, ultimately, redirect our conservation breeding programs in light of these new revelations. The African crocodiles are a case in point. The genus *Osteolaemus*, the African dwarf crocodiles, has recently been considered to be a single species, with two subspecies. New evidence suggests that this genus may include at least three closely related species. Similarly, the Nile crocodile (*Crocodylus niloticus*) includes a second, cryptic West African form. There are zoogeographic reasons to suspect that more diversity may exist in the African slender-snouted crocodile (*Crocodylus cataphractus*) as well. Gavialids include the gharial. Often considered a monotypic family consisting only the Indian gharial (*Gavialis gangeticus*), recent molecular and biochemical studies strongly, almost overwhelmingly, suggest that the Malay gharial (*Tomistoma schlegelii*), is in fact a gharial and not a longirostrine crocodile as previously thought.

A complete list of the 23 currently recognized species of crocodylians, complete purview of the Crocodylian Advisory Group, is given below, including both common and scientific names. Species accounts for each of these species begin on page 19.

## Conservation Status of Taxa

The conservation status of each of the crocodylian taxa considered in this document is detailed in the Species Accounts section, beginning on page 19.



## CROCODYLIA

### ALLIGATORIDAE

American alligator	<i>Alligator mississippiensis</i>
Chinese alligator	<i>Alligator sinensis</i>
Common caiman	<i>Caiman crocodilus</i>
Broad-snouted caiman	<i>Caiman latirostris</i>
Yacare caiman	<i>Caiman yacare</i>
Black caiman	<i>Melanosuchus niger</i>
Dwarf caiman	<i>Paleosuchus palpebrosus</i>
Smooth-fronted caiman	<i>Paleosuchus trigonatus</i>

### CROCODYLIDAE

American crocodile	<i>Crocodylus acutus</i>
African slender-snouted crocodile	<i>Crocodylus cataphractus</i>
Orinoco crocodile	<i>Crocodylus intermedius</i>
Australian freshwater crocodile	<i>Crocodylus johnsoni</i>
Philippine crocodile	<i>Crocodylus mindorensis</i>
Morelet's crocodile	<i>Crocodylus moreletii</i>
Nile crocodile	<i>Crocodylus niloticus</i>
New Guinea crocodile	<i>Crocodylus novaeguineae</i>
Mugger crocodile	<i>Crocodylus palustris</i>
Saltwater crocodile	<i>Crocodylus porosus</i>
Cuban crocodile	<i>Crocodylus rhombifer</i>
Siamese crocodile	<i>Crocodylus siamensis</i>
African dwarf crocodile	<i>Osteolaemus tetraspis</i>

### GAVIALIDAE

Indian gharial	<i>Gavialis gangeticus</i>
Malay gharial	<i>Tomistoma schlegelii</i>



## Space Analysis

Available space estimations were made using an electronic space survey through the AZA institutional representative (IR) list server in summer 2010 and winter 2010-2011. This survey ultimately included responses from 122 of the 137 institutions with CAG IRs, representing >89% of all institutions that have CAG institutional representatives. This includes many institutions that do not currently hold crocodylians, or have only one or two specimens. More than 5% of the IRs on the list could not be contacted because of erroneous contact info. So, this survey represents the bulk of all AZA institutions with crocodylians. This IR list was used because it contains all institutions that have made their interest in crocodylian programs known to the CAG by designating an IR. These survey results represent a substantial increase in the number of institutions and number of crocodylian specimens reported over the space survey in the 2006 RCP. Also, a draft of this RCP was posted on the AZA website for final review and no AZA institution without a designated IR provided any response to the draft. This is another indication of the inclusiveness of crocodylian interests represented on the IR list server. The allocation numbers indicated in the tables below were made based on these 122 responding AZA institutions. The survey included both current and future holding capacities. Results of the space survey are tabulated in Appendix III. Other sources of data used to allocate space included ISIS, published studbooks and the individual expertise of the members of the CAG. Kent Vliet, CAG Chair, conducted the survey and produced the final tabulated results. The CAG acknowledges with much appreciation the work by Megan Terry, in tabulating and summarizing much of the current space survey.

Current census of data are provided for each species from studbooks, where available, or ISIS for non-studbook species.

## Self-Sustaining Managed Population Size

Crocodylians present unique potential among the vertebrates for long-term genetic management of captive populations. There are no existing studbook databases that include the entire lifespan of any crocodylian. To model this population potential, the Cuban crocodile studbook was used in ZooRisk to represent a generic crocodylian. These data were modified by increasing the life expectancy to 75 years, an adult probability of any adult female breeding at 10%, and increasing mortality rates to reflect that 5% of the animals will die per decade between 35 and 65 years of age. These animals are long lived (>75 years), have high fecundity, are reproductive to a late age (>65 years), lay eggs, and have temperature-dependent sex determination which allows the sex of the offspring to be predetermined during incubation. In ZooRisk, this generic crocodile was evaluated as at “low risk” in all categories except “reproduction in the last generation” where they are considered endangered because less than five pairs are expected to reproduce in each generation. This is not unexpected considering the longevity of these species in which they are reproductive for five plus decades. This issue was not considered a significant problem. In general, a target of 75 is the minimum carrying capacity assigned SSP species in this RCP. This was increased if there was substantial interest to maintain a taxon by AZA institutions (*e.g.*, Chinese alligators). Studbook programs may be managed with fewer animals (or greater if they are of interest to AZA institutions, *i.e.*, Nile crocodiles) and lower genetic goals. If a good unrelated founder base can be established (*i.e.*, minimum of 10 pairs), and the founders are maintained until they are no longer reproductive, 90% of gene diversity can be easily maintained for 100 years with a population size of less than 75 animals.





# Sustainability Statement

Sustainability in zoo and aquarium collections has become a topic of great concern, as we face the limitations—internal and external—imposed on our institutions. Sustainability has two meanings in this context: *conservation populations* and *exhibit populations*.

- Conservation sustainability implies adequate reproduction and genetic diversity for a captive population to maintain the unique character of its species, making it a viable reservoir for future re-introductions. Conservation populations are reserved for critically endangered taxa, where in-country assurance colonies are inadequate.
- Exhibit sustainability means continued availability of specimens to meet the exhibit and educational needs of our institutions. Exhibit populations are not necessarily endangered, but fill critical roles in our institutional missions. They require less intensive genetic management, and smaller population sizes may suffice.

Both categories of sustainability are threatened in the foreseeable future. It is self-evident that zoos and aquariums cannot maintain long-term viable conservation populations for more than a small fraction of species due to space constraints alone. The global decline in biodiversity has made the gap between conservation needs and our ability to serve as “arks” poignant. We are simply outgunned on a tremendous scale.

We also face an ever-more-restrictive regulatory environment. Moving ESA and CITES I species internationally has become extremely difficult, effectively isolating US zoos from the opportunity to exchange genetically valuable animals with foreign zoos, further shrinking an already small pool of resources. Many AZA institutions set additional self-imposed constraints on disposition of surplus animals and culling, making population management challenging.

Given these limitations, difficult choices must be made to ensure sustainable captive populations of a few species at the expense of the vast majority of others. The CAG’s role is to maximize the contributions of captive crocodylian populations to conservation, to science, and to meeting the exhibit and educational missions of our institutions. The CAG is addressing population sustainability in the following ways:

- Continued intensive management of *conservation populations* for a few critically endangered species, and work to address weaknesses within these programs—particularly advocacy for importation permits to bring in needed genetic stock.
- Evaluation of potential managed *exhibit populations* to ensure availability of species widely used/needed in exhibits and educational programs. Our most recent space survey (Appendix III) indicates far more space for small crocodylian species in AZA institutions than was previously recognized. Since our conservation populations consist primarily of larger species, we see an opportunity for one or more small species being managed as exhibit populations.
- Continued communication with AZA members via an informative RCP and access to crocodylian experts.
- Grooming the next generation of crocodylian professionals in our field through the ongoing AZA Crocodylian Biology and Captive Management School.

Crocodylians in AZA institutions have existed as relatively closed populations for decades. Few importations of wild specimens or genetic exchanges with foreign zoos have been possible. This, coupled with spotty reproduction in some species, has led to steady declines in some of the conservation populations identified in the RCP.

Sustainability is not a subject that may be written away with a few paragraphs of hyperbole. It is a challenge that will occupy the attention of zoo and aquarium professionals into the distant future. While AZA is refining its policies on sustainability, we have maintained this RCP in its original format. The CAG is actively engaged in sustainability planning, however, and we view the RCP as an evolving document, subject to change and re-evaluation.



## Non-member Participation

As indicated in the Introduction to this document, the lack of sufficient captive space is a significant factor affecting the development of captive breeding programs for crocodylians in North American collections. In light of this trend, and in addition to utilizing all space made available to crocodylian programs in AZA institutions, the CAG has recruited space in the private sector to hold and, in some cases, to breed animals for AZA conservation programs. These private facilities also provide critical space to hold less important specimens that would otherwise take valuable zoo space away from targeted species. For many years, a few private and non-commercial facilities, including non-AZA participants, have cooperated and collaborated with the CAG and its programs, offering expertise, advise, captive specimens and space resources for our programs. These individuals and facilities are keenly aware of AZA policies and procedures and are committed to the conservation of these animals and the programs the CAG and AZA have established to further these goals. In the past, two facilities have been actively involved in CAG SSP programs. These two private non-member participants have been registered and inspected by CAG members to comply with AZA standards for non-member participants, and both of these non-member participants are involved with our two current Yellow SSPs (Chinese alligator and Cuban crocodile). Other non-member participants currently hold other specimens of SSP animals (Chinese alligators). As this is a Yellow SSP program, these animals can remain with these participants based on the current WCMC policies for non-member participation. Non-member participants do contribute to other (*i.e.*, non-SSP) programs as well. Most importantly, these private collaborators offer space resources most AZA institutions cannot or have not made available for crocodylians. The additional space made available by non-member participants allows non-targeted species, surplus specimens, and excess progeny from breeding programs to be moved out of AZA exhibits and holding spaces, relieving some AZA crocodylian space limitations and allowing the CAG to expand certain programs within AZA institutions.

## Species Selection Criteria

The Crocodylian Advisory Group (CAG) has prioritized species for inclusion in North American collections based on several factors. First, endangered taxa that do not have adequate *in situ* protection and recovery programs were given highest priority. Second, the probability of successfully contributing to the conservation of an endangered taxon was factored in (*e.g.*, availability of founders for captive propagation, the prospects of aiding the conservation of the species in the wild, existing husbandry expertise, etc.). Third, consideration was given to the biological uniqueness of each taxon to produce a regional collection plan that will represent the diversity of the Crocodylia. In some cases when several closely related taxa fell into the same categories, the CAG has initiated and supported *in situ* conservation efforts (*e.g.*, Morelet's crocodile, *Crocodylus moreletii*) while recommending that these animals not be maintained in AZA institutions. Fourth, consideration was given to ongoing and future proposed research projects for crocodylians in zoos. There is still a great deal that can be learned about these animals and, in many cases, can be learned more easily in captive situations (*e.g.*, social and parental behavior, temperature-dependent sex determination). Finally, the CAG recognizes that there are many reasons why an institution might consider exhibiting species other than those specified in this document as program species. Zoogeographic exhibits, space requirements, husbandry requirements, and popularity all come into play. Specific geographical considerations and individual institutional needs must be considered in the allocation of crocodylian space.



These considerations might necessitate displaying the American alligator (*Alligator mississippiensis*), rather than more valuable program species. Whenever possible, however, the CAG strongly encourages a reduction in numbers of these non-program species in North American zoos to best use limited space resources toward more endangered taxa.

To further this process, a decision tree was developed to categorize crocodylian species by level of management (page 9). WCMC Program selection criteria questions (page 10) were also used to classify species as to the type of management deemed necessary in AZA institutions. A summary of the CAG steering committee's responses to those criteria questions for species targeted for conservation programs is also provided in Table 1 (page 11).

To aid collection managers at individual institutions in the selection of species, a recommendation matrix is also provided (page 12). This matrix can be used in the decision process in the development of an Institutional Collection Plan. Both targeted and untargeted taxa are present in this matrix. It is strongly suggested that institutions dedicate resources for the targeted species but, when this is not possible because of zoogeographic or space limitations, alternatives are suggested to meet the institution's goals.

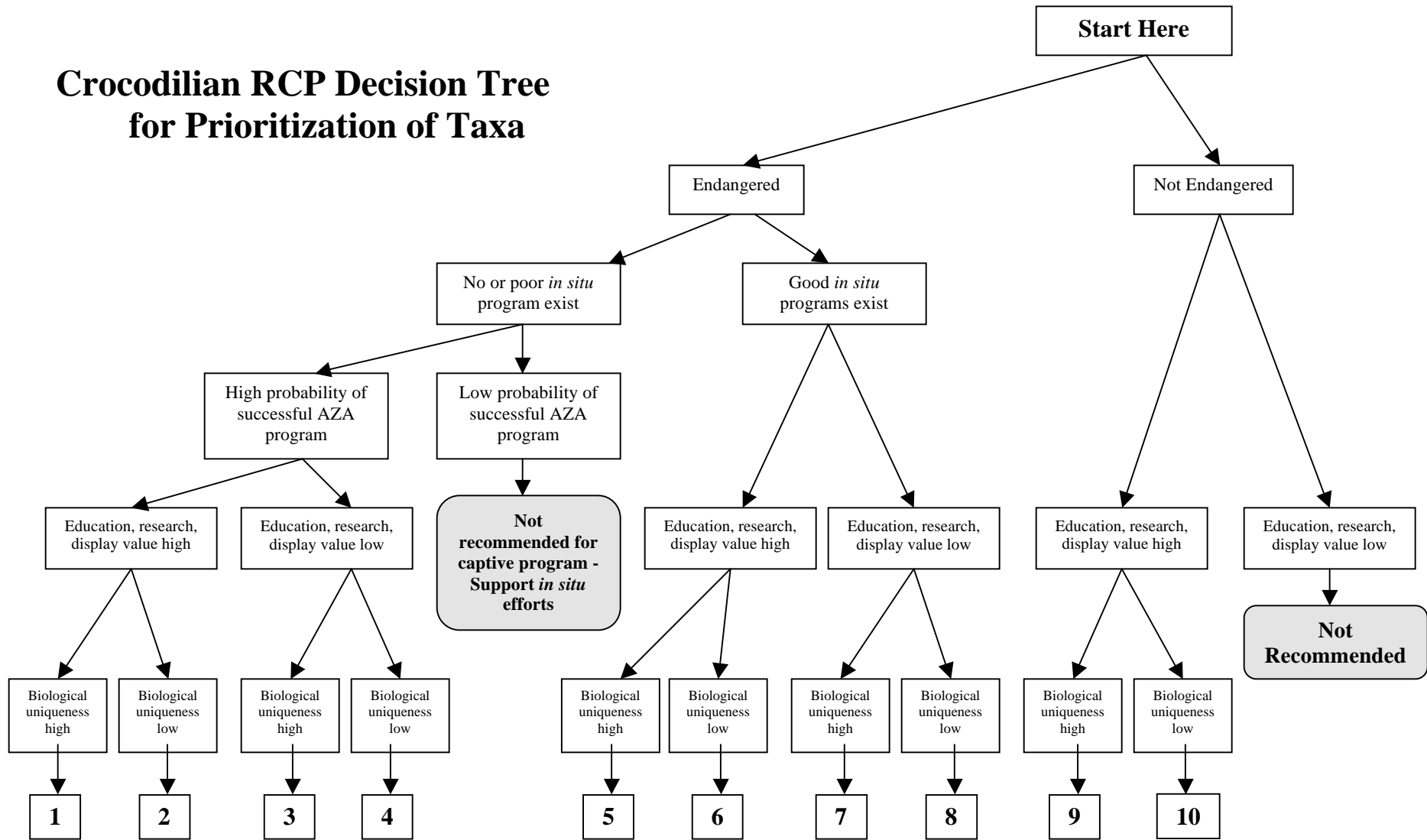
## **TAG Recommendations: Categories**

The following is a list of CAG recommendation categories used in this regional Collection Plan:

- **SSP Population**
  - Intense management
  - Studbook necessary
  - Maintain 90% genetic diversity for 100 years or 10 generations
  - Participating institutions sign MOP
  - Compliance by participating institutions expected
  - Make breeding recommendations and develop Masterplan Management Group
- **Studbook Population**
  - Moderate management
  - Long-term objective to maintain population
  - Studbook necessary
  - No MOP
  - Encourage institutional compliance
  - Breeding recommendations offered
  - Masterplan not required
  - No Management Group
- **DERP: Display/Education/Research Population**
  - No studbook
  - Long-term genetic/demographic management not required
- **Phase Out Population**
  - Moratorium on breeding and acquisition
  - Species champion monitors phase-out through ISIS
- **Phase In Population**
  - Species not currently in AZA institutions
  - TAG hopes or plans to import founders
  - Once in North America Population will be reassigned to another category



# Crocodilian RCP Decision Tree for Prioritization of Taxa



← **INCREASING PRIORITY FOR AZA EFFORTS**



# Management Criteria

1. What is the availability of the species/taxon in AZA collections?
2. What is the availability of the species/taxon outside AZA collections?
3. What is the extinction risk for the species/taxon within AZA collections if it is not managed?
4. In what direction does the extinction risk within AZA collections move if it is?
5. What is the demand for the species/taxon within AZA collections (from survey)?
6. What is the institutional commitment to the species/taxon within AZA membership (from survey)?
7. How easy is it to breed the species/taxon?
8. What is the extinction risk for the species/taxon in the wild?
9. What are the program operating costs for this species/taxon?
10. Is there an international conservation/management program for this species/taxon?
11. What type of link would a management program have to conservation of this species/taxon in the wild (outlined in species account)?



**Table 1. Responses to the WCMC Program selection criteria questions by the CAG steering committee and the resulting decisions on level of management for targeted species, including both traditional and new Sustainability levels.**

Taxon	Availability AZA	Availability Non-AZA	Extinction Risk – Not managed	Extinction Risk – Managed	Demand in AZA	AZA Institutional Commitment	Ease of Breeding	Extinction Risk in Wild	Program Operating Costs	International Conservation Programs	Link to Management Program	Level of Management
<i>Alligator sinensis</i> Chinese alligator	Moderate	Low	Very high	Much lower	High	Very high	Moderate	Critically endangered	Moderate	Yes	Direct support, reintroduction	Yellow SSP
<i>Crocodylus cataphractus</i> Slender-snouted crocodile	Moderate	Low	Moderate	Stable	High	Moderate	High	Vulnerable	Moderate	No	No	Red Studbook
<i>Crocodylus intermedius</i> Orinoco crocodile	Extremely low	Low	Moderate	Decreases	Moderate	High	Moderate	Critically endangered	Moderate	Yes	Direct support, reintroduction	Red Studbook
<i>Crocodylus mindorensis</i> Philippine crocodile	Extremely low	Low	Very high	Decreases	Moderate	High	Low	Critically endangered	Moderate	Yes	Yes	Red Studbook (future)
<i>Crocodylus rhombifer</i> Cuban crocodile	Moderate	Low	Critical	Decreases	Moderate	High	Moderate	Critically endangered	Moderate	Yes	Yes	Yellow SSP
<i>Crocodylus siamensis</i> Siamese crocodile	High	Moderate	Moderate	Stable	Moderate	Moderate	High	Critically endangered	Moderate	Yes	Yes	Red Studbook
<i>Gavialis gangeticus</i> Indian gharial	Low	Very low	Critical	Decreases	High	High	Moderate/low	Critically endangered	High	Yes	Yes	Red Studbook
<i>Tomistoma schlegelii</i> Malay gharial	Low	Very low	Very high	Decreases/stable	High	High	Very low	Endangered	High	Yes, a few	Yes	Red Studbook



# Species Recommendation Matrix

The CAG designed this matrix to assist institutions in species selection decision. The following decision matrix can be used to aid the selection of crocodilian species for an individual institution to meet specific needs and limitations. Selections of species indicated in dark boxes are strongly encouraged and targeted for cooperative programs by the Crocodilian Advisory Group. If space requirements limit selection to a small species of crocodilian, and if zoogeographic restraints prevent selection of a targeted Asian species, species indicated in bold text are suggested. Species indicated in light text are discouraged by the CAG but are provided as suggestions if specimen size or zoogeographic requirements prevent selection of targeted species.

		<b>GEOGRAPHIC REGION</b>			
		<b>AFRICA</b>	<b>ASIA</b>	<b>AUSTRALIA</b>	<b>AMERICAS</b>
<b>SIZE</b>	<b>SMALL</b>	<i>Osteolaemus tetraspis</i> (African dwarf crocodile)	<i>Alligator sinensis</i> (Chinese alligator)	<i>Crocodylus johnsoni</i> (Australian freshwater crocodile)	<i>Paleosuchus palpebrosus</i> or <i>P. trigonatus</i> (Dwarf caimans) or <i>Caiman latirostris</i> (Broad-snouted caiman)
	<b>MEDIUM</b>	<i>Crocodylus cataphractus</i> (Slender-snouted crocodile)	<i>Crocodylus mindorensis</i> (Philippine crocodile) (highest priority) or <i>Crocodylus siamensis</i> (Siamese crocodile) (lower priority)	<i>Crocodylus johnsoni</i> (Australian freshwater crocodile)	<i>Crocodylus rhombifer</i> (Cuban crocodile)
	<b>LARGE</b>	<i>Crocodylus niloticus</i> (Nile crocodile)	<i>Tomistoma schlegelii</i> (Malay gharial) or <i>Gavialis gangeticus</i> (Indian gharial)	<i>Crocodylus porosus</i> (Saltwater crocodile)	<i>Crocodylus intermedius</i> (Orinoco crocodile) or <i>Crocodylus acutus</i> (American crocodile)



# Summary Tables

*The next pages contain tables that summarize assessments for all crocodilian species and those used in the selection of taxa, the recommendations for AZA institutions, the programs themselves, and contact information:*





**Table 2. Assessment of Captive Propagation Programs for Crocodylian Species and Need for Captive Programs. Reintroduction potential, existence and viability of captive populations, and scientific and research potential categories are restricted to North American zoological institutions.**

Taxon	Conservation Status	Reintroduction Potential	Existence and Viability of Captive Populations	Scientific and Research Potential	Other Regional Captive Propagation grams	Exhibit Value	Husbandry Expertise
<i>Alligator mississippiensis</i> American alligator	IUCN-Low Risk	Not needed	Yes Hundreds	High - Large research base	Extensive farming and ranching in United States	High	Excellent
<i>Alligator sinensis</i> Chinese alligator	IUCN- Critical	Poor/No Habitat	Yes, Yellow SSP 35.40.3	Conservation program with China	Large captive breeding programs in China - Some animals in Europe	High	Good
<i>Caiman crocodilus</i> Common caiman	IUCN-Low Risk	Not needed	Yes 7.9.10	Minor	Farmed extensively in South American	Low	Very good
<i>Caiman latirostris</i> Broad-snouted caiman	IUCN-Low Risk	Not needed	Yes 7.3.5	Minor	Breeding programs in Brazil, Paraguay, Uruguay and Argentina	Moderate	Very good
<i>Caiman yacare</i> Yacare caiman	IUCN-Low Risk	Not needed	Probable 2.13.1	Some taxonomic questions remain	Farming and ranching in Brazil	Low	Very good
<i>Melanosuchus niger</i> Black caiman	IUCN-Endangered	None at present	No-too few animals, 0.2.3	Husbandry research	Ranching in Ecuador	High	Low
<i>Paleosuchus palpebrosus</i> Dwarf caiman	IUCN-Low Risk	None	Yes 32.40.26	Minor	None	Moderate	Good
<i>Paleosuchus trigonatus</i> Smooth-fronted caiman	IUCN-Low Risk	None	Uncertain but probable 4.8.1	Minor	None	Moderate	Good
<i>Crocodylus acutus</i> American crocodile	IUCN-Vulnerable	Low	Yes 7.9.6	Good	Central America/South America	High	Moderate
<i>Crocodylus cataphractus</i> Slender-snouted crocodile	Indeterminate- Prob. Endangered	Not at present Surveys needed	Yes, Red Studbook 12.11.15	Yes, biology unknown, Surveys needed	A few in captive collection, e.g., St. Lucia, South Africa	High	Moderate
<i>Crocodylus intermedius</i> Orinoco crocodile	IUCN-Critical	High	Developing, Red Studbook 9.61.35	Field research, reintroductions	Established captive breeding programs in Venezuela , Columbia	High	Moderate
<i>Crocodylus johnsoni</i> Australian freshwater crocodile	IUCN-Low Risk	Low	Moderate 6.8.7	Minor	Raised on numerous farms in Australia	Moderate	Moderate
<i>Crocodylus mindorensis</i> Philippine crocodile	IUCN-Critical	Not at present But <i>in situ</i> exchange	Developing, future studbook 3.10.18	Husbandry research	Programs exist for farming & research	Moderate	Moderate
<i>Crocodylus moreletii</i> Morelet's crocodile	Indeterminate- Possibly Low Risk	Low	No 0.4.3	Minor	Large populations in Mexican institutions	Low	High
<i>Crocodylus niloticus</i> Nile crocodile	IUCN-Low Risk	Not needed	Yes 38.18.4	Minor	Extensive farming program in Africa	High	High
<i>Crocodylus novaeguineae</i> New Guinea crocodile	IUCN-Low Risk	Low	No 4.2.0	Minor	Ranching and farming programs in Papua New Guinea	Moderate	Moderate
<i>Crocodylus palustris</i> Mugger crocodile	IUCN-Vulnerable	Low	No 1.1.0	Minor	Numerous government and private breeding facilities in India	Moderate	High
<i>Crocodylus porosus</i> Saltwater crocodile	IUCN-Low Risk	Low	Improbable 4.5.6	Minor	Extensive programs in Australia, PNG, India, Indonesia, etc.	High	Moderate
<i>Crocodylus rhombifer</i> Cuban crocodile	IUCN-Critical	Moderate	Yes, Yellow SSP 9.23.1	Cooperate with <i>in situ</i> programs	Large captive population in Cuba	High	High
<i>Crocodylus siamensis</i> Siamese crocodile	IUCN-Critical	Low	Yes, Red Studbook 4.15.18	Minor	Large captive population in Asian institutions	Moderate	Excellent
<i>Osteolaemus tetraspis</i> African dwarf crocodile	IUCN-Vulnerable	Not at present	Yes 15.24.24	Taxonomic questions	Abidjan Zoo, Ivory coast, St. Lucia, South Africa	Moderate	Excellent
<i>Gavialis gangeticus</i> Indian gharial	IUCN-Critical	Low	Good, Red Studbook 4.13.0	Husbandry research	Numerous government and private breeding facilities in India/ Nepal	High	Moderate
<i>Tomistoma schlegelii</i> Malay gharial	Indeterminate- Prob. Endangered	Low	Low, need for founders, Red Studbook 9.10.4	Strong need for husbandry research	Held in several institutions in Asia	High	Low



**Table 3. Assessment of relevant factors and Crocodylian Advisory Group recommendations for management categories of crocodylian species held in North American zoological collections.**

Taxon	Education Value	Availability of potential founders	Taxonomic and/or Morphological Uniqueness	Potential for <i>in situ</i> conservation of this species	Decision tree rating	Management Category
<i>Alligator mississippiensis</i> American alligator	High	High	Only alligatorid from United States	High Established management programs	10	DERP
<i>Alligator sinensis</i> Chinese alligator	High	Good	Only Asian alligatorid	Captive propagation programs New potential for reintroduction	2	Yellow SSP
<i>Caiman crocodilus</i> Common caiman	Low	High	Low	Moderate – sustainable harvest Established management programs	NR	Phase out
<i>Caiman latirostris</i> Broad-snouted caiman	Moderate	Moderate	Low – broadest snout	Good On going research	9	DERP
<i>Caiman yacare</i> Yacare caiman	Low	Good	Taxonomic position unclear at this point	Yes But extensive harvest	NR	Phase out
<i>Melanosuchus niger</i> Black caiman	Moderate	Poor	Largest tropical alligatorid Taxonomy under investigation	Yes	1	DERP
<i>Paleosuchus palpebrosus</i> Dwarf caiman	Low	High	Smallest crocodylian	Poor	9	DERP
<i>Paleosuchus trigonatus</i> Smooth-fronted caiman	Low	High	Low	Poor	9	DERP
<i>Crocodylus acutus</i> American crocodile	High	High	Low	High in Florida population	6	DERP
<i>Crocodylus cataphractus</i> Slender-snouted crocodile	High	Good	Monotypic genus	Yes Great need for surveys and research	1	Red Studbook
<i>Crocodylus intermedius</i> Orinoco crocodile	High	Moderate	Low-moderate	High – reintroduction programs have been established	2	Red studbook
<i>Crocodylus johnsoni</i> Australian freshwater crocodile	Low	Low	Narrow snout	High- large number of captive breeders Established management programs	9	DERP
<i>Crocodylus mindorensis</i> Philippine crocodile	High	Possible in future	Low	Low Strong need for captive propagation	1	Red Studbook (future)
<i>Crocodylus moreletii</i> Morelet's crocodile	Low	High	Low	Good, ranching in Mexico	8	Phase out
<i>Crocodylus niloticus</i> Nile crocodile	Moderate	High	Low	High Established management programs	10	DERP
<i>Crocodylus novaeguineae</i> New Guinea crocodile	Moderate	Poor	Possibility of sibling species	High, value added conservation	10	Phase out
<i>Crocodylus palustris</i> Mugger crocodile	Low	Good	Low	High Established management programs	4	Phase out
<i>Crocodylus porosus</i> Saltwater crocodile	Good	Moderate	Widest ranging crocodylian taxon Largest species	Excellent Established management programs	10	DERP
<i>Crocodylus rhombifer</i> Cuban crocodile	High	Good	Low	High and ongoing	1	Yellow SSP
<i>Crocodylus siamensis</i> Siamese crocodile	Moderate	High	Low	Low, but new surveys expanding known distribution	4	Red Studbook
<i>Osteolaemus tetraspis</i> African dwarf crocodile	Moderate	High	Taxonomy in need of investigation Monotypic genus	Uncertain Need for surveys and research	9	DERP
<i>Gavialis gangeticus</i> Indian gharial	High	Good	Monotypic genus Narrowest snout	High Established management programs	1	Red Studbook
<i>Tomistoma schlegelii</i> Malay gharial	High	Low	Monotypic genus, Familial affiliation uncertain	Low, Need for regional conservation programs	1	Red Studbook



**Table 4. Crocodylian Advisory Group recommendations for captive management of crocodylian species held in North American zoological collections and AZA contact person for each species. Contact information is provided in Appendix II.**

Taxon	Primary Role and Purpose of Taxon Recommended for Captive Management	Target Pop. Size	Basis for listing and comments	Recommendations	AZA Contact(s) (See Appendix II)
<i>Alligator mississippiensis</i> American alligator	Regional education programs Conservation education	427	North American dominant crocodylian species	Do not breed. Use for education or regional exhibits	Kent Vliet
<i>Alligator sinensis</i> Chinese alligator	Genetic reservoir	120	One of the most critically endangered crocodylian species	Maintain SSP Identify and track new potential founders	Kevin Torregrosa Bill Orrico, Melanie Litton
<i>Caiman crocodilus</i> Common caiman	Phase out	0	Space limitations	Phase out	Peter Brazaitis
<i>Caiman latirostris</i> Broad-snouted caiman	Education Small South American taxon	15	Education	Maintain only for education	Bruce Shwedick
<i>Caiman yacare</i> Yacare caiman	Phase out	0	Space limitations	Phase out	Peter Brazaitis
<i>Melanosuchus niger</i> Black caiman	Research population and captive husbandry research	13	Research for captive husbandry	Work out captive husbandry. Support in situ projects	Bruce Shwedick
<i>Paleosuchus palpebrosus</i> Dwarf caiman	Only if you must display small American species	83	Theme exhibits	Education	John Brueggen
<i>Paleosuchus trigonatus</i> Smooth-fronted caiman	Education Small South American taxon	0	Education Zoogeographic representative	Education	John Brueggen
<i>Crocodylus acutus</i> American crocodile	Education	42	United State's only crocodile	Education, <i>in situ</i> research in FL	Steve Conners
<i>Crocodylus cataphractus</i> Slender-snouted crocodile	Need for management research	50	Unique morphologically, endangered status	Continue studbook, Support <i>in situ</i> efforts, develop and complete survey	John Groves
<i>Crocodylus intermedius</i> Orinoco crocodile	Genetic reservoir, captive propagation	28	Critically Endangered status Theme exhibits	Explore management efforts <i>in situ</i>	Luis Sigler
<i>Crocodylus johnsoni</i> Australian freshwater crocodile	DERP	32	No conservation value in North America.	Do not breed	Jessi Krebs
<i>Crocodylus mindorensis</i> Philippine crocodile	Genetic reservoir, captive propagation	75	Most endangered crocodile, IUCN recommends captive program	Acquire additional founders	Colette Adams
<i>Crocodylus moreletii</i> Morelet's crocodile	Phase out	0	Little exhibit or conservation value	Do not breed	John Brueggen
<i>Crocodylus niloticus</i> Nile crocodile	DERP	100	No conservation value in North America.	Phase out	Rick Hudson
<i>Crocodylus novaeguineae</i> New Guinea crocodile	Phase out	0	Extensive farming/ranching programs <i>in situ</i>	Do not breed	John Brueggen
<i>Crocodylus palustris</i> Mugger crocodile	Phase out	0	Limited space, large captive population in India	Phase out	Bruce Shwedick
<i>Crocodylus porosus</i> Saltwater crocodile	Only if you must display large Australian species	33	Extensive farming/ranching programs <i>in situ</i> , Space limitations	Do not breed	John Brueggen
<i>Crocodylus rhombifer</i> Cuban crocodile	Genetic reservoir	75	Limited geographic distribution	SSP Integrate program with Cuba	Bill McMahan Steve Conners
<i>Crocodylus siamensis</i> Siamese crocodile	Genetic reservoir	75	Critically endangered in the wild	Maintain self-sustaining population	Lonnie McCaskill
<i>Osteolaemus tetraspis</i> African dwarf crocodile	Only if you must display small African species	75	Theme exhibit	Do not breed	R. Andrew Odum
<i>Gavialis gangeticus</i> Indian gharial	Conservation education, uniqueness	75	Taxonomically unique, distinct	Import potential founders, reproduce	Kent Vliet
<i>Tomistoma schlegelii</i> Malay gharial	Genetic reservoir, research husbandry techniques	92	Unique, need to conserve genetic diversity	Importation of founders, pairing of potential founders, reproduction	Scott Pfaff



**Table 5. Summary of Crocodylian Advisory Group recommendations, program leaders and studbook keepers for managed taxa.**

<b>Common Name</b>	<b>Scientific Name</b>	<b>Recommendation</b>	<b>Program Leaders</b>
Chinese alligator	<i>Alligator sinensis</i>	Yellow SSP	SSP Coordinator: Kevin Torregrosa, St. Augustine Alligator Farm 904-824-3337, ext. 6, <a href="mailto:KevinT@alligatorfarm.com">KevinT@alligatorfarm.com</a> SSP Vice-coordinator: Bill Orrico, Bronx Zoo 716-220-5042, <a href="mailto:worrico@wcs.org">worrico@wcs.org</a> Studbook Keeper: Melanie Litton, Audubon Zoo 504-212-5343, <a href="mailto:reptiles@auduboninstitute.org">reptiles@auduboninstitute.org</a>
Slender-snouted crocodile	<i>Crocodylus cataphractus</i>	Red Studbook	Studbook Keeper: John Groves, North Carolina Zoo 336-879-7620, <a href="mailto:john.groves@nczoo.org">john.groves@nczoo.org</a>
Orinoco crocodile	<i>Crocodylus intermedius</i>	Red Studbook	Studbook Keeper: Luis Sigler, Dallas World Aquarium 214-720-2224, <a href="mailto:cocodriloblanco@yahoo.com">cocodriloblanco@yahoo.com</a>
Philippine crocodile	<i>Crocodylus mindorensis</i>	Red Studbook (future)	Species Contact: Colette Adams, Gladys Porter Zoo 956-546-9431, <a href="mailto:cadams@gpz.org">cadams@gpz.org</a>
Cuban crocodile	<i>Crocodylus rhombifer</i>	Yellow Studbook	SSP Coordinator: Bill McMahan, Louisville Zoological Gardens 502-459-2181, <a href="mailto:bill.mcmahan@louisvilleky.gov">bill.mcmahan@louisvilleky.gov</a> Studbook Keeper: Steve Conners, Miami MetroZoo 305-251-0401, <a href="mailto:sconner@miamidade.gov">sconner@miamidade.gov</a>
Siamese crocodile	<i>Crocodylus siamensis</i>	Red Studbook	Studbook Keeper: Lonnie McCaskill, Disney's Animal Kingdom 407-938-2805, <a href="mailto:Lonnie.McCaskill@disney.com">Lonnie.McCaskill@disney.com</a>
Indian gharial	<i>Gavialis gangeticus</i>	Red Studbook	Studbook Keeper: Kent Vliet, St. Augustine Alligator Farm 352-392-8130, <a href="mailto:kvliet@ufl.edu">kvliet@ufl.edu</a>
Malay gharial	<i>Tomistoma schlegelii</i>	Red Studbook	Studbook Keeper: Scott Pfaff, Riverbanks Zoological Park 803-779-8717 x1119, <a href="mailto:spfaff@riverbanks.org">spfaff@riverbanks.org</a>



**Table 6. Crocodylian Advisory Group program status summary for managed taxa.**

<b>Program</b>	<b>Date Program Initiated</b>	<b>Current Program Leader</b>	<b>Date Leadership Assumed</b>	<b>Date of last studbook update</b>	<b>Date of last PMP publication</b>	<b>Date of last master plan publication</b>
Chinese alligator <i>Alligator sinensis</i> Yellow SSP	12/31/1982	<u>SSP Coordinator:</u> Kevin Torregrosa, St. Augustine <u>Vice- Coordinator:</u> Bill Orrico, Bronx Zoo <u>Studbook Keeper:</u> Melanie Litton, Audubon Zoo	05/16/2012	6/30/1998		02/04/2010
Cuban crocodile <i>Crocodylus rhombifer</i> Yellow SSP	12/17/1993	<u>SSP Coordinator:</u> Bill McMahan, Louisville Zoological Gardens <u>Vice- Coordinator:</u> Mike Davenport, National Zoological Park (2/27/2008) <u>Studbook Keeper:</u> Steve Conners, Miami Metro Zoo	12/17/1993	10/09/2007		04/28/2011
Slender-snouted crocodile <i>Crocodylus cataphractus</i> Red Studbook	1/27/1997	<u>Studbook Keeper:</u> John Groves, North Carolina Zoo	1/27/1997	02/07/2012	01/2009	
Orinoco crocodile <i>Crocodylus intermedius</i> Red studbook	11/10/2011	<u>Studbook Keeper:</u> Luis Sigler, Dallas World Aquarium	11/10/2011	not published		
Philippine crocodile <i>Crocodylus mindorensis</i> Red Studbook (future)	future program	<u>Species Contact:</u> Colette Adams, Gladys Porter Zoo	future program	not published		
Siamese crocodile <i>Crocodylus siamensis</i> Red Studbook	4/13/1989	<u>Studbook Keeper:</u> Lonnie McCaskill, Disney's Animal Kingdom	05/15/2010	11/18/2007	08/13/2008	
Indian gharial <i>Gavialis gangeticus</i> Red Studbook	3/26/1992	<u>Studbook Keeper:</u> Kent Vliet, St. Augustine Alligator Farm	2/7/2000	08/09/2010	not published	
Malay gharial <i>Tomistoma schlegelii</i> Red Studbook	12/31/1995	<u>Studbook Keeper:</u> Scott Pfaff, Riverbanks Zoological Park	7/8/1996	06/15/11	06/15/11	



# CROCODILIAN SPECIES ACCOUNTS

The Crocodilian Advisory Group gratefully acknowledges the extensive editorial work performed by Colette Adams, Gladys Porter Zoo, on these crocodilian species accounts. Colette assembled the accounts, configured them into a common format, edited their content, and inserted current ISIS numbers for each species.



## American alligator, *Alligator mississippiensis*

STATUS: IUCN - Lower Risk, least concern  
CITES - Appendix II  
ESA - Similarity of Appearance

The American alligator is among the most temperate of crocodylians with a wide distribution in the southeastern United States. Although the maximum size of this species rarely exceeds 4.5 meters, records of much larger specimens exist. The alligator is principally a palustrine species, inhabiting swamps and marshes, though they may be found in virtually any freshwater and many brackish water habitats. Many alligators spend the winter months in dens dug into the banks. Females are known to allow hatchlings to over winter in these sites. In the northern portions of its range, the alligator may survive short periods of freezing weather with their snouts frozen in the surface ice, allowing them to breathe.

Both males and females attain sexual maturity at about 1.8 meters in length. Courtship occurs in the early spring months, typically April and May. Females build mound nests of soil and vegetation in which they lay 35-45 eggs. Nesting is highly synchronized in a population with almost all nests being laid within a two-week period in June. Incubation typically takes 65-68 days.

American alligators were very heavily exploited by humans in the 1800s and first half of the 1900s and were considered endangered by many in the 1950s and 1960s. They were listed as an endangered species in the U.S. Endangered Species Act in the early 1970s. Populations responded well to this protection and recovered rapidly. The American alligator has been reclassified as Threatened by Similarity of Appearance throughout its entire range. The current population of American alligators is large and may be more than 1.5 million. Several southern states have sustainable management plans involving harvest of adults, farming and ranching.

The North American captive population currently consists of 1,511 (315.330.866) in 127 institutions. This number has is up from 1,012 five years ago. The CAG will assist any institution trying to do so in placing these animals. Replace with targeted taxa.

### **RECOMMENDATIONS:**

#### **DERP – Display/Education/Research. Do Not Breed**

No cooperative captive management plan for this species is recommended. The CAG recommends that this species should be held only for education (e.g., to display an endemic species of crocodylian or as an example of a successful conservation program) or for other special reasons, such as collections with a zoogeographic theme. **Whenever possible, display and holding space should be reallocated to endangered species of crocodylians. Do not breed.**



## **Chinese alligator, *Alligator sinensis***

STATUS: IUCN - Critically Endangered  
CITES - Appendix I; Appendix II Captive bred population in China  
ESA - Endangered

This is a relatively small species, reaching lengths of about 2 meters. It is one of the world's most endangered crocodylians. Although they were once widely distributed in China's lower Yangzi River basin, individuals are now restricted to the southeastern Anhui Province. Wild populations have experienced severe declines, and there may be fewer than 125 adults left in the wild.

The Chinese alligator inhabits the area of climatic transition between subtropical and temperate regions of eastern China. They are inactive from late October through mid-April in subterranean dens dug into the edges of ponds, marshes, or rice paddies. Wetlands they formerly occupied have been lost to agriculture. The few remaining adults have little opportunity to reproduce. In 1999, only four females nested in the wild. Eggs were collected and taken to the Anhui Research Center for *Chinese Alligator* Reproduction (ARCCAR), a breeding center established in 1979. Adults continue to be persecuted. In recent times animals have been shot and poisoned or displaced from their last refuges by drought and floods.

Captive reproduction has proven very successful at ARCCAR, with 500 - 900 hatchlings produced some years. This species has also reproduced well in captive situations outside of China. The Bronx Zoo, Houston Zoo, St. Augustine Alligator Farm, and the Rockefeller Wildlife Refuge in the U.S. have produced hatchlings. This species was designated an SSP species in 1982. Kevin Torregrosa (St. Augustine Alligator Farm) serves as SSP Coordinator, C. Bill Orrico (Wildlife Conservation Society - Bronx Zoo) serves as SSP Vice-Coordinator, and Melanie Litton (Audubon Zoo) serves as Studbook Keeper.

The North American captive population currently consists of 78 (35.40.3) in 23 institutions.

### **RECOMMENDATIONS: SUSTAINABILITY LEVEL: YELLOW SSP**

Manage as SSP with long-term goals to preserve genetic diversity. There is a need for additional holding and exhibit space. This taxon should be considered as a high priority for space in American institutions.





## **Common caiman, *Caiman crocodilus***

STATUS: IUCN - Lower Risk  
CITES - Appendix II, except *C. c. apaporiensis*, Appendix I  
ESA - Not Listed, except *C. c. apaporiensis*, which is listed as Endangered

The taxonomy of the *Caiman crocodilus* complex remains unclear, based largely on geographic variation. *Caiman c. crocodilus* is the common form. The validity of *C. c. apaporiensis* is questioned by most authorities. *Caiman c. fuscus* and *C. c. chiapasius* may not be distinct from one another, but may, in fact, be a different species from *C. crocodilus*. *Caiman* species reach a maximum length of 2.8 meters in males, and are considered a small to medium-sized crocodylian. Female *Caiman* reach sexual maturity at just over a meter in length. They lay 20-40 eggs in a mound nest during the wet season.

The North American captive population currently consists of 26 (7.9.10) in 12 institutions.

**RECOMMENDATIONS:**  
**Phase Out. Do Not Breed**



## **Broad-snouted caiman, *Caiman latirostris***

STATUS: IUCN - Not Listed, lower risk  
CITES - Appendix I, except in Argentina, where it is Appendix II  
(ranching)  
ESA - Endangered

*Caiman latirostris* may include *Caiman l. chocoensis* from northern Argentina.

The broad-snouted caiman has proportionately the widest snout and robust body of any crocodylian. It is a medium-sized crocodylian, capable of attaining lengths of 3.5 meters, but it is rare to find an animal in the wild in excess of 2 meters. It ranges from northeast Argentina, through southern Bolivia, Paraguay and Uruguay. It inhabits Atlantic coast drainages from the eastern Brazil to northeast Uruguay. It is found in upland coastal regions as well as lowland wetlands, quiet waters, but has been known to colonize isolated cattle stock ponds.

The skin of this species is considered better for manufacturing goods than the other species of *Caiman*. Commercial hunting originally depleted wild populations. Currently, because of improved protection and the availability of legal skins becoming more attractive to traders, illegal hunting is no longer a major problem for this species. Habitat destruction and pollution currently pose the greatest threats to wild populations.

Sustainable use programs have been developed in Argentina and Brazil. This species has reproduced at several North American facilities.

Broad-snouted caiman are mound nesters, and 18 - 50 eggs are laid during the wet season.

The North American captive population currently consists of 15 (7.3.5) in 5 institutions.

### **RECOMMENDATIONS:**

**DERP – Display of small South American species.**



## **Yacare caiman, *Caiman yacare***

STATUS: IUCN - Lower Risk, least concern  
CITES - Appendix II  
ESA - Threatened

The Yacare caiman is a small to medium-sized crocodylian that reaches 2.8 meters in length. It is native to southern Brazil and Bolivia, through the Paraguay and Parana River systems of Paraguay and northern Argentina. This was previously considered a subspecies of *Caiman crocodilus*. Further work is needed to sort out the *Caiman crocodilus* complex. Because of the Yacare's distinct geographic range and unique role in the skin trade, the USFWS has classified it as Threatened due to similarity of appearance, unlike other populations of the *Caiman crocodilus* complex.

Yacare were depleted in all four countries due to illegal hunting in the 1970s and 1980s, but the species appears to have recovered sufficiently to be declassified from Endangered. Commercially oriented programs are in place in 3 of the 4 countries they inhabit. There is continued need for regulation and control of the captive breeding and harvest programs in range countries.

Yacare caiman are mound nesters and egg laying usually peaks in the middle of the wet season. Clutch size is usually 25-35 eggs.

The North American population currently consists of 16 (2.13.1) in 5 institutions.

**RECOMMENDATIONS:**  
**Phase Out. Do Not Breed.**



## **Black caiman, *Melanosuchus niger***

STATUS: IUCN – Endangered  
CITES - Appendix I, except in Ecuador, where Appendix II  
ESA - Endangered.

Restricted to the Amazon river basin and its lowland tributaries. Black caiman grow to be very large – over 4 meters in length for males. Populations have been greatly reduced over the years due to over-hunting, and continue to be reduced by poaching. It is considered severely depleted in four of the seven South American countries in which it occurs; it is considered depleted in the remaining three with an estimated total decline of greater than 50% in the last 3 generations. Although legislation is in place to protect the black caiman throughout its range, in many areas it is ineffective in stopping illegal trade in skins. Human food consumption and habitat loss are additional factors. Despite populations being highly fractionated, good populations in some local areas have encouraged down-listing the Brazilian population for purposes of commercial skin trade. Black caiman skin simulates the appearance of quality American alligator skin.

Female black caiman reach sexual maturity at 2.8 meters in length. They are mound nesters, and the average clutch size is about 40 eggs.

The North American population currently consists of 5 (0.2.3) in 3 institutions.

### **RECOMMENDATIONS:**

#### **DERP - Husbandry Research Population**

This animal cannot be easily obtained for North American collections, and there has been a history of difficulties in maintaining this species in captivity using husbandry practices that are effective for other species of crocodylians. Support *in situ* conservation efforts if possible.



**Dwarf caiman, *Paleosuchus palpebrosus*  
(Cuvier's dwarf caiman)**

STATUS: IUCN -Lower Risk, least concern  
CITES – Appendix II  
ESA – not listed

This species is widespread in open waters of the Amazon and Orinoco river drainages, and the upper Paraguay River drainages, not including black-water forest streams. Dwarf caiman prefer the shallow water of riverbanks under the cover of low hanging branches. They may occur in streams at slightly higher elevations, too cold for *Caiman*. Overland movements may be extensive to reach ephemeral wetlands. Dwarf caiman are present in both large rivers and small streams in Bolivia, usually along stretches of shore frequently in association with dead trees.

This is the smallest species of crocodylian, with the maximum length for males reported to be about 1.6 meters. Female caiman are known to be mound nesters, laying 10-15 eggs.

*Paleosuchus* have well-developed osteoderms present over most of the body. This, as well as the small size, makes their hide virtually worthless for commercial purposes and has resulted in minimum pressure from hide hunting. However it is utilized for human consumption.

The North American captive population currently consists of 98 (32.40.26) in 34 institutions.

**RECOMMENDATIONS:**

**DERP – Display of small South American species.**



**Smooth-fronted caiman, *Paleosuchus trigonatus***  
**(Schneider's smooth-fronted caiman)**

STATUS: IUCN - Lower Risk, least concern  
CITES - Appendix II  
ESA – not listed

The smooth-fronted caiman is somewhat larger than the dwarf caiman. Maximum male length is 2.3 meters.

The distribution of this species is restricted to the black-water Amazon river basin and its forest tributaries, and the Guyana shield in Venezuela, and has been reported at elevations of up to 1300 meters. Studies of this species reveal that the diet is mostly comprised of terrestrial vertebrates.

Environmental pollution and habitat destruction associated with gold mining is having an adverse affect on the entire ecosystem. This in turn has a negative impact upon the wild populations of *P. trigonatus*. Because of this species' small size and ventral ossification, the commercial value of the hide is extremely low.

This species may have the longest incubation period of any crocodylian, which may last in excess of 100 days. Smooth-fronted caiman are mound nesters and typically build nests adjacent to or on top of termite mounds, which maintain elevated nest temperatures. Egg laying generally begins at the end of the dry season.

The North American captive population currently consists of 13 (4.8.1) in 4 institutions.

**RECOMMENDATIONS:**

**DERP – Display of small South American species.**

*Paleosuchus palpebrosus* has been recommended as the target *Paleosuchus* species for North American collections. Barring zoogeographical restrictions, the space available should be used for other small crocodylians (see matrix, page 10).



## American crocodile, *Crocodylus acutus*

STATUS: IUCN – Vulnerable  
CITES - Appendix I  
ESA - Threatened

The American crocodile is a large species, with males reaching maximum lengths of 5 - 6 meters. It is primarily an estuarine form, inhabiting the New World mangrove swamps of southern Florida, Cuba, Haiti, Dominican Republic, Jamaica, Central America and northern South America. It is a morphologically variable species, particularly where it may come into contact with congeners. It is an ecologically adaptable nester, utilizing marl, earth, and even crushed shell substrates in both hole and mound nests. During the dry season, a female will typically lay 30 - 60 eggs, although clutches as small as 20 eggs have been reported.

Extensive commercial hunting in the 1930s through the 1960s for the skin industry is largely responsible for the present population status throughout its range. While protected status has been provided throughout most of its range, enforcement is often difficult to non-existent. Currently, habitat destruction for beach development is a concern, as females often use communal nesting sites much smaller than a hectare in size. These sites, specially chosen by the female crocodiles for optimum drainage, sun, etc., need enforceable protection. Its populations are recovering gradually in the U.S., but in Central and South America, limited survey data indicate that some populations may be declining.

The North American captive population currently consists of 22 (7.9.6) in 15 institutions.

### **RECOMMENDATIONS:**

**DERP – Display/Education. Do Not Breed.**

This is the only crocodile found in the continental United States (Florida). Because of the geographically wide distribution of this species and the large housing requirements of this taxon, it is recommended that *in situ* projects be supported.



## **African slender-snouted crocodile, *Crocodylus cataphractus***

STATUS: IUCN - Data Deficient, possibly Endangered or Vulnerable  
CITES - Appendix I  
ESA - Endangered

This medium-sized African species of crocodile is considered to be one of the most morphologically unique crocodile species. In fact, it has been suggested that this species should be placed in its own genus (*Mecistops*). It has a narrow snout, and reaches a maximum length of 4 meters. This species is believed to be declining throughout its range, but surveys are needed to determine its current status. Of the 24 countries that this species inhabits, only four countries have basic survey data on their populations. Regulated hunting of this crocodile is permitted in Chad, Sierra Leone, Togo, Cameroon and Zaire, but there are no management plans associated with these activities. Habitat destruction and degradation of the rivers in which it lives are the most serious threats to this species. Hide trading, although not considered a serious threat to its populations at this time, may have a greater impact on this species as its populations decline due to continued habitat destruction.

Females build mound nests, in which they lay approximately 16 relatively large eggs at the beginning of the wet season.

The North American captive population currently contains 38 (12.11.15) at 10 institutions. However, progeny of only five wild-caught specimens are currently represented in the captive population. John Groves (North Carolina Zoological Park) maintains the regional studbook for this crocodile.

### **RECOMMENDATIONS:**

### **SUSTAINABILITY LEVEL: RED STUDBOOK**

**The African slender-snouted crocodile is recommended for exhibit and educational programs where a large to moderate sized African species is needed.** A stable, well-managed captive population of this species is the goal of this program. Space will be needed to allow the current population to grow to the 75 specimens needed to maintain genetic diversity in zoological institutions. Unpaired founder specimens need to be matched for additional breeding and incubation of the eggs must be managed for control of sex and number of offspring. Field surveys and educational programs in the 24 countries where this crocodile occurs are urgently needed to help manage this species in the wild to ensure its future.





## **Orinoco crocodile, *Crocodylus intermedius***

STATUS: IUCN - Critically Endangered  
CITES - Appendix I  
ESA – Endangered

The Orinoco crocodile is a large crocodile native to the mid and lower reaches of the Orinoco River in Venezuela and Colombia. Historical records exist of animals reaching lengths of over 7 meters, but it is more likely that today large males only reach lengths of 5 meters. It is the most critically endangered New World crocodylian, and has suffered a population decline of over 80 percent within the last 3 generations. There may be less than 250 individuals left in the wild. This species is legally protected in both Venezuela and Colombia, but the protection has had little effect in Colombia in the past. Nothing is known about the status of this crocodile in Colombia, while significant research and conservation activities have taken place in Venezuela.

This species is a hole nester, laying 40 - 70 eggs in exposed sandbars and riverbanks during the dry season. Hatching is correlated with the onset of the wet season and the natural rise in water levels.

The Dallas World Aquarium (DWA) has been involved for more than ten years with the conservation of this crocodile. As of July 2010, 10 Orinoco crocodiles have been sent to some AZA institutions: Miami Metro Zoo (2006), San Antonio Zoo (2007) and Saint Augustine Alligator farm (2009). All of our crocodiles hatched at DWA in 2006 and 2007 (total 53) were sent to Venezuela on December 2008 and released into the wild as part of the loan agreement DWA made with the Venezuelan government when they gave them their pair for exhibit in 1998.

The North American captive population currently consists of 5 and their offspring (9.61.35) in 5 institutions.

### **RECOMMENDATIONS: SUSTAINABILITY LEVEL: RED STUDBOOK**

Work towards the establishment of a stable, genetically diverse captive population in North America by working with Venezuelan contacts to obtain unrelated stock. With additional founders, future formation of an SSP is warranted.



## **Australian freshwater crocodile, *Crocodylus johnsoni***

STATUS: IUCN - Lower Risk, least concern  
CITES - Appendix II  
ESA -Endangered

This freshwater crocodile is native to tropical northern Australia. It is a small to medium-sized crocodile, and is readily identified by its elongated, narrow snout. Males grow to a length of nearly 3 meters.

There may be as many as 50,000 to 100,000 freshwater crocodiles in the Northern Territory; because their habitats are intact and their skins are of low value, they seem relatively secure in the wild.

Females dig hole nests during the dry season, and clutch size averages about 13 eggs.

The North American captive population currently consists of 21 (6.8.7) in 5 institutions.

### **RECOMMENDATIONS:**

**DERP – Display of small to medium Australian species.**

Replace with targeted taxon where possible.



## **Philippine crocodile, *Crocodylus mindorensis***

STATUS: IUCN - Critically Endangered  
CITES - Appendix I  
ESA - Endangered

This is a relatively small freshwater crocodylian that has been eliminated from most of its historic range. It now occurs only in very small populations in northeastern Luzon and Mindanao in the Philippines. Males of the species seldom attain lengths over 3 meters. The wild population has declined more than 80% in 3 generations, initially due to commercial overexploitation and currently due to habitat loss and killing by local people. There may be fewer than 100 adults left in the wild.

Worldwide interest in contributing to the conservation of this species has resulted in agreements (MOA's) with the Philippine government, who retains ownership of all the known individuals in captivity. Through these MOAs, the transfer of crocodiles to several zoos has taken place, including to the Gladys Porter Zoo in Brownsville, Texas. These agreements provide the foundation for captive breeding, fundraising and promotion of conservation for the species in the Philippines. The Gladys Porter Zoo has been the sole U.S. signatory to a MOA, and by its terms produced and loaned young Philippine crocodiles to other U.S. facilities. However, all offspring in the U.S. are closely related. With the recent genetic questions about whether populations of Philippine crocs hailing from different islands should be managed separately answered at the genetics lab at Omaha's Henry Doorly Zoo, it is now essential to both bring in new bloodlines and to make space for multiple breeding pairs in U.S. zoos. This will not only create the genetic reservoir needed as a hedge against extinction, but will also raise visibility for the need to support *in situ* conservation initiatives for this imperiled little crocodile.

The North American population currently consists of 31 (3.10.18) at 6 institutions. There has been high juvenile mortality due to intra-specific aggression.

### **RECOMMENDATIONS:**

#### **SUSTAINABILITY LEVEL: RED STUDBOOK (Future)**

Renew currently expired MOA with the DENR-PAWB in the Philippines, thereby allowing the importation of unrelated animals for breeding. Establish a stable, genetically diverse captive population in North America by obtaining select, unrelated stock from CFI in the Philippines. As young captive Philippine crocodiles are extremely territorial in low densities, they should be reared individually until close to breeding age. With additional founders, future formation of an SSP is warranted.



## **Morelet's crocodile, *Crocodylus moreletii***

STATUS: IUCN – Low Risk, Conservation Dependent  
CITES - Appendix I  
Some subpopulations in Mexico and Belize – Appendix II  
ESA - Endangered

This broad-snouted species rarely exceeds 3 meters in length. It is primarily a freshwater species, but has been known to inhabit brackish waters. Its range extends from the Atlantic coast of Mexico down to northern Central America. In the southernmost portion of its range, it overlaps with *C. acutus*.

Morelet's crocodile suffered from uncontrolled hide hunting in the 1940s and 1950s. Currently, continued illegal killing for skins and habitat destruction is causing a gradual decline throughout its range, particularly in Mexico. There are stable populations at Cox Lagoon and other locations in Belize and Mexico, but the status of the species in Guatemala remains unknown. Commercial farming is currently being conducted; sustainable use programs are currently being considered in Guatemala and Belize. Escapes from farms in Mexico that are outside of its natural range are threatening native populations of *C. acutus*.

This species is exclusively a mound nester, with clutches consisting of 20 - 40 eggs deposited prior to the rainy season.

The North American captive population currently consists of 7 (0.4.3) in 4 institutions.

**RECOMMENDATIONS:**  
**Phase out. Do Not Breed.**



## Nile crocodile, *Crocodylus niloticus*

STATUS: IUCN - Lower Risk, least concern  
CITES - Appendix I in all countries except Madagascar, and Uganda (Appendix II, subject to export quotas), Botswana, Ethiopia, Kenya, Malawi, Mozambique, South Africa, Zambia, Zimbabwe, and Tanzania (Appendix II, subject to ranching provisions).  
ESA - Threatened

This crocodile is among the largest and most-studied of the crocodylians. The average size is approximately 5 meters, but very large males can reach lengths of 6 meters. Niles in the cooler regions of South Africa achieve smaller adult sizes, and there are two known populations of dwarf Niles living along the fringe of the range for the species; these only average 2 to 3 meters in length.

Although it is widely distributed in Africa, some populations appear to be declining. Unfortunately, reliable survey data is available for only a few countries in its extensive range. The primary factors contributing to its apparent decline in the wild are habitat destruction, degradation of the rivers in which it lives and hunting for food and hides. This species is, however, being farmed and is a good candidate for sustainable use management.

Recent molecular studies of Nile crocodile populations throughout Africa have revealed that populations in West Africa are, in all likelihood, a separate, previously unrecognized species. As our understanding of this taxonomic diversity increases, we will have to classify all of our captive Nile crocodiles as to their specific identity. Population distributions, densities, and conservation status of these western populations is poorly known at this time. It is likely that this new species of crocodile may be in need of additional protection. If warranted, we may need to change our recommendations for this species and develop cooperative breeding efforts within AZA institutions for this West African Nile crocodile.

Females are hole nesters and lay 40 to 60 eggs during the dry season.

The North American captive population currently contains 60 (38.18.4) specimens at 14 institutions with many additional unrecorded specimens being held at private facilities.

### **RECOMMENDATIONS:**

#### **DERP – Display of large African species – Do not Breed.**

Replace this species with *Crocodylus cataphractus* for exhibit and educational purposes where possible.



## **New Guinea crocodile, *Crocodylus novaeguineae***

STATUS: IUCN - Low Risk, Least Concern  
CITES - Appendix II  
ESA - Endangered

The New Guinea crocodile is a medium-sized crocodile that inhabits the island of New Guinea. Males attain lengths of 3.5 meters. Recent studies reflect major differences, both in morphology and breeding habits, between northern and southern (Papua) populations. Wild populations are currently secure, with effective sustainable use programs in effect.

New Guinea crocodiles are mound nesters, and females reach sexual maturity at lengths of 1.5 to 2 meters. Northern populations have a tendency to lay larger clutches of smaller eggs than the populations in the south.

The North American captive population currently consists of 6 (4.2.0) in 1 institution.

### **RECOMMENDATIONS: Phase out. Do Not Breed.**

Replace wherever possible, with other targeted species of Asian crocodiles (see matrix, page 10).



**Mugger crocodile, *Crocodylus palustris***  
**(Marsh crocodile)**

STATUS: IUCN - Vulnerable  
CITES - Appendix I  
ESA - Endangered

The mugger is the once common freshwater crocodile of India, Sri Lanka and Nepal. It also inhabits Pakistan and Iran. It is thought to be extinct in Bangladesh and Myanmar. The mugger inhabits a variety of freshwater and coastal habitats and has invaded man-made reservoirs and canals. It is a medium to large species with an adult size of 4 to 5 meters; it has a wide alligator-like head. Populations were decimated in India during the 1950s and 1960s due to the trade in skins, but today the species is primarily threatened due to the loss of its natural habitat, egg collecting, illegal hunting, and conflicts with fisherman.

Muggers have been extirpated in many parts of their range, leaving an estimated 3,000-5,000 in isolated populations scattered across India, with a population of about 2,000 in Sri Lanka. Nepal and Iran are believed to have small but stable populations. A head-start recovery program is being considered in Pakistan. Captive breeding and collection of eggs from wild nests have resulted in a captive population of over 12,000 in India, where large numbers of these crocodiles have been released into National Parks and other sanctuaries. A lack of suitable habitat and local public support has hindered restocking efforts.

Females mature at 1.8 to 2 meters in length and lay 25 - 30 eggs in a hole nest during the dry season.

The North American captive population currently consists of 2 (1.1.0) in 1 institution.

**RECOMMENDATIONS:**  
**Phase out. Do Not Breed.**

Replace with targeted species where possible. Support *in situ* efforts in India.



**Saltwater crocodile, *Crocodylus porosus***  
**(Indo-Pacific crocodile, estuarine crocodile)**

STATUS: IUCN - Low Risk, Least Concern  
CITES - Appendix II in Australia and Papua, New Guinea, and Appendix II in Indonesia, which has an annual quota for ranching.  
Appendix I in all other countries  
ESA - Endangered

The saltwater crocodile is the world's largest crocodilian, attaining lengths of up to 6 meters (and reports of individuals attaining lengths of up to 7 meters). This species is the most widely distributed crocodilian, ranging from southern India throughout Southeast Asia to the Philippines, Palau and the Solomon Islands, as well as New Guinea and northern Australia. Severely depleted through most of its range from the 1940s to the 1970s, it has made an incredible comeback in Australia and New Guinea, where sustainable use programs are in effect. It is becoming rare, however, through most of the rest of its range, due to habitat loss and persecution by local people.

Females reach maturity at lengths over 2 meters, and build mound nests during the rainy season. Clutch size ranges from 40 - 60 eggs.

The North American captive population currently consists of 15 (4.5.6.) in 7 institutions. Additionally, there are 3.3.0 hybrids listed at 2 institutions.

**RECOMMENDATIONS:**

**DERP – Display of large Australian species – Do not breed.**





## Cuban crocodile, *Crocodylus rhombifer*

STATUS: IUCN – Critically Endangered  
CITES - Appendix I  
ESA - Endangered

The Cuban crocodile is Critically Endangered and the most threatened crocodylian in the New World. This animal had a much wider distribution across Cuba in the past, and subfossil material indicates its former range also included the Bahamas and Cayman Islands. This species is currently confined to a core area of freshwater marsh of approximately 300 square kilometers inside the Zapata Peninsula in Cuba, and has been reintroduced into about 100 square kilometers of the Lanier Swamp on Cuba's Isla de la Juventud. Its entire current range would fit inside Florida's Lake Okeechobee five times.

Hybridization with the abundant American crocodile in Cuba is rapidly destroying the genetic integrity of this unique organism. The Cuban crocodile has also been intentionally hybridized with several other *Crocodylus* species in captivity - *C. acutus*, *siamensis*, *niloticus*, *porosus* and *palustris* - which poses a grave threat to captive stocks and this crocodile's ex-situ persistence. Poaching is another serious problem for the Cuban crocodile in Cuba, as is the introduction of a flourishing, exotic crocodylian (*Caiman crocodilus*) on Isla de la Juventud. As a result of all of these factors, the prospects for the Cuban crocodile's survival appear increasingly bleak.

Usually not exceeding 3.5 meters in length, this animal possesses a beautiful yellow and black speckled pattern, and is heavily armored. This species is widely regarded for its ability to jump, its alert and active behavior, and strong feeding response - all qualities that make it popular with the public.

Females build mound nests, and clutch size is typically 20 - 30 eggs. It has been bred at several facilities in Cuba and the United States.

The Cuban Crocodile SSP has a strong *in situ* component and is working closely with Cuban conservation authorities. Bill McMahan (Louisville Zoo) is the Species Coordinator and Steve Connors (Miami Metro Zoo) is the studbook keeper.

The North American captive population currently consists of 33 (9.23.1) in 11 institutions.

### **RECOMMENDATIONS: SUSTAINABILITY LEVEL: YELLOW SSP**

Breed male 17 and female 4 at the Smithsonian National Zoo

Breed male 25 and female 9 at the Gladys Porter Zoo

Breed male 55 and female 78 at the Louisville Zoo

Recruit new institutions into the SSP with the goal of developing a Yellow SSP. The European Association of Zoos and Aquaria is working on a studbook for this species



## Siamese crocodile, *Crocodylus siamensis*

STATUS: IUCN - Critical  
CITES - Appendix I  
ESA - Endangered

This is a medium-sized crocodile that reaches up to 4 meters in length, although most individuals rarely exceed 3 meters. Its historical range includes Thailand, Cambodia, Vietnam, Indonesia, Lao PDR, and Malaysia. Viable populations occur only in the Mekong River basin in Cambodia and Lao PDR; even these populations are fragmented and depleted. Recently there has been a sizeable population found in Mesangat Indonesia that seems to have little pressure from hunting.

Very little is actually known about their natural history. However, since 1999 Flora and Fauna International (FFI) have done intensive survey work in Cambodia to identify existing populations and research on their natural history there. Sixty-nine Siamese crocodiles have been confiscated throughout Cambodia over the last several years and are being held at the Phnom Tamao Wildlife Rescue Centre. DNA work recently completed on 15 adults and 54 young has revealed that 35 of the crocodiles were indeed purebred Siamese crocodiles. Other individual animals in this group appear to be a mixture of hybrid Siamese x saltwater or Siamese x Cuban crocodiles. The purebred individual animals will make up the nucleus of a captive breeding group targeted for a reintroduction program in Cambodia. Through the survey work conducted over the years by FFI, areas have already been identified as possible release site with community support. To-date there has never been a documented account of a wild Siamese crocodile attack on a human in Cambodia, where this species is highly regarded as sacred over much of its range. Even with the secure areas, some of the current areas where Siamese crocodiles are found are at risk due to the construction of hydroelectric dams. They are currently considered critically endangered, with greater than 80% decline in wild populations in three generations.

There are thousands of pure *C. siamensis* in many of farms in Thailand and Cambodia. Unfortunately there have been efforts at many farms to hybridize *C. siamensis* with *C. porosus* in an effort to produce a faster growing animal with more marketable hide. If pressures, such as human disturbance and habitat loss can be controlled or reversed, there are enough wild crocodiles left for the species to recover in many areas where it has been severely depleted.

Females construct mound nests during the wet season and lay clutches of 20 - 50 eggs. All of the information available on reproduction has come from captive specimens.

The North American population currently consists of 37 (4.15.18) at 8 institutions. Lonnie McCaskill of Disney's Animal Kingdom has taken over the duties of maintaining the North American Regional Studbook and will also be traveling to Cambodia to assist with the captive breeding efforts for reintroduction.

### **RECOMMENDATIONS: SUSTAINABILITY LEVEL: RED STUDBOOK**

Establish a self-sustaining population of 75 animals in North American institutions. Assist and partner with *in-situ* conservation efforts through fundraising or educational opportunities for awareness or ranger training.



## **African dwarf crocodile, *Osteolaemus tetraspis***

STATUS: IUCN - Vulnerable  
CITES - Appendix I  
ESA - Endangered

The smallest species of crocodile, the African dwarf crocodile attains a maximum length of only 2 meters. In recent times, this species has been considered to contain two subspecies: *O. t. tetraspis* and *O. t. osborni*. The former is known as the West African dwarf crocodile and the latter is known as the Congo dwarf crocodile. The population status of this species is currently unknown from most countries it inhabits, but five of the 20 countries in its wide range have listed it as depleted or severely depleted. Field surveys have been conducted in only four of the countries in its range. The primary threats to the continued survival of this crocodile in the wild are illegal hunting for food and habitat destruction. The hide produces a relatively poor quality leather product.

Recent molecular studies of *Osteolaemus* populations in Africa have revealed greater taxonomic diversity within this genus than was previously appreciated. The genus appears to include at least three separate, but closely related species – *O. tetraspis* in the Ogooué River drainage of Gabon in west central Africa, *O. osborni* in the Congo Basin, and a third species, morphologically very similar to *O. tetraspis* in the West Africa. No known *O. osborni* currently exist in AZA facilities. However, West African and Ogooué drainage specimens are difficult to distinguish from one another by morphological means. As a result, we must work to determine the specific identity of all captive dwarf crocodiles in AZA institutions. If warranted, we may need to change our recommendations for this species and develop cooperative breeding efforts within AZA institutions for this West African dwarf crocodile.

The North American captive population contains 63 (15.24.24) *O. t. tetraspis* at 24 institutions. No reporting institutions list *O. t. osborni* in their collections.

### **RECOMMENDATIONS:**

#### **DERP – Display of small African species.**

The African dwarf crocodile is recommended for exhibit only when enclosure space is a limiting factor and a small African species or a small crocodile is necessary. Where an African species is not necessary, space should be made available for another small crocodilian species that is currently being managed.



## Indian gharial, *Gavialis gangeticus* (Gavial)

STATUS: IUCN Critically Endangered  
CITES - Appendix I  
ESA - Endangered

This is a very large, distinctive crocodylian from India, Nepal, Pakistan and Bangladesh. Known to inhabit four river systems of the northern Indian subcontinent - the Ganges, the Mahanadi, the Brahmaputra and the Indus. The species has probably been extirpated in Bangladesh. Preferred habitat is deeper pools of flowing rivers characterized by high sand banks and healthy stocks of fish. Survival in reservoirs needs to be ascertained as a possible way to ensure long-term survival as rivers become increasingly inhospitable

The gharial is generally considered to be the only living member of the family Gavialidae, although recent molecular evidence suggests that *Tomistoma* may be closely related. Indian gharial are distinguished by extremely long slender snouts. Adult males grow a large bulbous swelling around the external nares known as a 'ghara.' The species is highly aquatic, with short, flattened legs. Indian gharial may well be the longest living crocodylian, with males attaining lengths of 6 - 7 meters.

Gharial are primarily piscivorous, but are known to take other vertebrate prey. They nest on large high sand banks. Gharial lay the largest eggs of any crocodylian, about 160 grams on average. Thirty to 50 eggs are laid in hole nests. Females mature at a length of 3 meters; males at almost 4 meters.

Current threats include massive dam and irrigation projects that change river courses and drastically reduce river flow as well as irregular water releases from dams that flood nests and flush juvenile gharial downstream. Illegal fishing in Protected Areas, resulting in entanglement (hooks and nets), drowning, de-beaking and beheading of gharial caught in nets, is a leading cause of mortality. Already marginal habitats are rapidly becoming uninhabitable for gharial due to dams, canals, siltation, sand mining, water removal for agriculture, riverbed cultivation, livestock and human disturbance at basking and nesting beaches. Over 80% of known gharial habitat has already been lost.

The gharial is a critically endangered species. At present there are an estimated 200 breeding adult gharial left in the wild. There are three places in India where a total of 88 nests were recorded and one location in Nepal where 6 nests were recorded in 2006. The gharial is now considered the most endangered large animal on the Subcontinent. In spite of high fecundity and a massive egg collection/head-starting/release program (12,000+ eggs collected, 5,000+ young gharial released) initiated in India in 1975, the gharial is still in serious trouble. Compared to the many reserves that have been set aside for the tiger, breeding populations of the gharial survive in only three reserves in India, namely, Katarniaghat, Chambal and the Son, and one in Nepal at Chitawan. Despite these recovery efforts – once championed as one of the world's great conservation success stories - the gharial still faces a high probability of extinction in the wild. Apart from a period in the early phases of the Chambal Project, when population increases created the false impression that its survival had been secured, the status of gharial will likely swing between critically endangered and 'conservation dependent', and relict populations are probably the best that can be hoped for. Reports began surfacing in 2005 indicating that human



pressures had increased significantly in recent years and that enforcement to protect the sanctuaries was marginal and ineffective. The tri-state National Chambal Sanctuary has become increasingly lawless, with sand mining and turtle and fishing activities now being largely mafia controlled with little or no governmental enforcement. Until the Indian government steps up to address this problem, wild populations are at risk. Captive populations must be expanded accordingly.

The North American captive population currently consists of 14 (3.11.0) in 7 institutions. Of these, about 60% are of Nepalese origin. No reproduction has occurred in North American collections due to the immaturity of the population. Studbook first established in 1989 and is maintained by Kent Vliet (St. Augustine Alligator Farm).

**RECOMMENDATIONS:**  
**SUSTAINABILITY LEVEL: RED STUDBOOK**

The gharial is highly recommended for exhibit and educational programs due to its endangered status, distinct appearance, taxonomic position, and conservation history.



**Malay gharial, *Tomistoma schlegelii***  
**(Tomistoma, Sunda gharial)**

STATUS: IUCN – Endangered – Critical 1  
CITES - Appendix I  
ESA - Endangered

The Malay gharial belongs to a monotypic genus of crocodylian that is taxonomically distinct. The vernacular for this species has recently been changed from false gharial to the preferred Malay gharial, or Tomistoma. It is currently listed by the IUCN as endangered but probably warrants critically endangered status. The historical range of the species includes the Malay Peninsula, Sumatra, Borneo, Java and possibly Vietnam and Sulawesi. Today the range is restricted to low density, scattered populations in eastern Sumatra, Sarawak and Kalimantan on the island of Borneo and small remnant populations in peninsular Malaysia and western Java. Preferred habitat appears to be restricted to peat swamp forest and shaded, slow moving water. The size of the remaining wild population is largely unknown, but is small, of low density, and highly fragmented.

This is one of the largest species of crocodylians with males attaining sizes of up to 6 meters in length. Females build mound nests, and lay 20 - 60 large eggs. Sexual maturity in females is reached at approximate lengths of 2.5 to 3 meters.

The current North American population is 23 (9.10.4) in 9 institutions. The North American Regional Studbook is maintained by Scott Pfaff of the Riverbanks Zoo.

**RECOMMENDATIONS:**  
**SUSTAINABILITY LEVEL: RED STUDBOOK**

The Malay gharial population in North America is currently managed as a studbook. Successful managed reproduction of *Tomistoma* has proven to be problematic. In the past 40 years, there have only been five successful breeding events in North America. Egg fertility has been very low and consequently only 17 offspring have been produced. Intensive management to optimize reproductive potential is necessary to maintain this species in North American institutions. Given the lack of reproduction of *Tomistoma* in captivity, ascertaining the reasons for breeding failures must be a high priority. When reproductive issues have been overcome, the RCP recommends the development of an SSP program



# Appendix I

## Current CAG Officers and Steering Committee

### Chairs (Vote of Confidence 2009)

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Chair

John Groves, North Carolina Zoo, [john.groves@nczoo.org](mailto:john.groves@nczoo.org)

Vice-chair

### Ends 2013 (Election 2014):

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## Appendix II

### CAG Species Contacts

Contact information for persons identified in Table 4 as an AZA contact for crocodylian species.

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## Appendix III

### Results of the 2011 CAG Space Survey

**Table 7. Space currently allocated to crocodylians and potential additional space that could be devoted to crocodylians in 122 institutions responding to the CAG space survey. The survey was conducted by Kent Vliet and compiled and organized with the assistance of Megan Terry.**

2011 CAG Space Survey	CURRENT HOLDING						POTENTIAL ADDITIONAL HOLDING						TOTAL
	ADULTS			JUVENILES			ADULTS			JUVENILES			
SPECIES	Male	Female	UNK	Male	Female	UNK	Male	Female	UNK	Male	Female	UNK	
<i>Alligator mississippiensis</i> American alligator	55	76	273	7	26	586	15	11	36	0	0	16	1023/78
<i>Alligator sinensis</i> Chinese alligator	11	19	42	0	1	0	1	2	12	0	0	50	73/65
<i>Caiman crocodilus</i> Common caiman	1	2	20	0	0	20	0	0	0	0	0	0	43/0
<i>Caiman latirostris</i> Broad-snouted caiman	1	1	9	0	0	0	0	0	2	0	0	8	11/10
<i>Caiman yacare</i> Yacare caiman	2	5	8	0	0	0	0	0	0	0	0	0	15/0
<i>Melanosuchus niger</i> Black caiman	0	1	2	0	0	0	0	0	5	0	0	0	3/5
<i>Paleosuchus palpebrosus</i> Dwarf caiman	13	14	37	1	2	8	2	3	10	0	0	28	75/43
<i>Paleosuchus trigonatus</i> Smooth-fronted caiman	1	5	7	0	0	0	0	0	2	0	0	10	13/12
<i>Crocodylus acutus</i> American crocodile	3	22	7	0	2	2	1	0	1	0	1	1	36/4
<i>Crocodylus cataphractus</i> Slender-snouted crocodile	4	4	10	0	0	5	3	3	2	0	0	36	23/44
<i>Crocodylus intermedius</i> Orinoco crocodile	1	1	4	2	0	31	1	2	0	0	0	15	39/18
<i>Crocodylus johnsoni</i> Australian freshwater crocodile	3	4	3	0	0	4	0	0	1	0	0	10	14/11
<i>Crocodylus mindorensis</i> Philippine crocodile	2	6	1	0	0	21	0	0	1	0	0	1	30/2
<i>Crocodylus moreletii</i> Morelet's crocodile	0	3	0	1	0	2	0	0	2	0	0	0	6/2



2011 CAG Space Survey	CURRENT HOLDING						POTENTIAL ADDITIONAL HOLDING						TOTAL
	ADULTS			JUVENILES			ADULTS			JUVENILES			
	Male	Female	UNK	Male	Female	UNK	Male	Female	UNK	Male	Female	UNK	
<i>Crocodylus niloticus</i> Nile crocodile	32	9	10	0	0	2	0	0	17	0	0	0	53/17
<i>Crocodylus novaeguineae</i> New Guinea freshwater crocodile	0	0	1	0	0	5	0	0	1	0	0	0	6/1
<i>Crocodylus palustris</i> Mugger crocodile	0	0	2	0	0	0	0	0	2	0	0	0	2/2
<i>Crocodylus porosus</i> Saltwater crocodile	1	1	2	0	0	11	1	1	0	0	0	0	15/2
<i>Crocodylus porosus</i> Saltwater crocodile hybrids	1	1	0	0	0	0	0	0	0	0	0	0	2/0
<i>Crocodylus rhombifer</i> Cuban crocodile	5	15	5	0	1	6	1	1	8	3	3	16	32/32
<i>Crocodylus siamensis</i> Siamese crocodile	4	6	2	0	0	20	2	2	0	0	0	3	32/7
<i>Osteolaemus tetraspis</i> African Dwarf crocodile	4	6	2	0	0	20	2	2	0	0	0	3	42/19
<i>Gavialis gangeticus</i> Indian gharial	3	14	0	0	0	0	3	3	0	0	0	20	17/26
<i>Tomistoma schlegelii</i> Malay gharial	4	5	8	0	0	10	0	0	3	1	1	29	27/34
<b>TOTAL</b>													1632/434



**Table 8. Potential future crocodylian exhibit space, tabulated by size and zoogeographic categories, indicated by 122 institutions responding to the CAG space survey. The survey was conducted Kent Vliet and compiled and organized by Megan Terry.**

2011 CAG Space Survey	POTENTIAL ADDITIONAL HOLDING						
	ADULTS			JUVENILES			
SPECIES	<i>Male</i>	<i>Female</i>	UNK	<i>Male</i>	<i>Female</i>	UNK	TOTAL
North America	1	1	14	0	0	6	22
Asian Small Species	4	5	3	0	0	10	22
Asian Large Species	6	7	6	0	0	10	29
Australian Large Species	1	2	1	0	0	0	4
Australian Small	1	1	13	0	0	1	16
Large African	2	3	15	0	0	0	20
Small African	2	4	1	0	0	0	7
Caribbean Large	1	1	2	0	0	0	4
Caribbean Small	0	0	2	0	0	0	2
Large South American	0	0	3	0	0	0	3
Small South American	1	2	8	0	0	2	13
Generic Large Crocodile Species	1	1	0	0	0	2	4
Generic Small Crocodile Species	0	0	2	0	0	2	4
Generic Large Alligatorid	0	0	0	0	0	0	0
Generic Small Alligatorid	0	0	0	1	2	0	3
Slender Snouted Species	5	8	0	0	0	0	13
<b>TOTAL</b>							<b>166</b>

