Zoos, aquaria and other “living” institutions are deeply involved in the conservation of endangered crocodilians. In recognition of the important roles that these institutions play in conservation, research and education, the IUCN-SSC Crocodile Specialist Group established a Zoos thematic group within its organizational structure. The group includes a few dozen members of the CSG experienced in captive management, zoo husbandry, captive breeding and reintroduction. Those seeking information or wishing to communicate with this group may contact the CSG Vice-chair of the Zoos group, Dr. Kent Vliet.

Exhibition of captive crocodilians brings these animals and their conservation dilemmas into the public conscience. Zoo specimens serve as ambassadors for their species in the wild. Through visitation to zoos and aquaria, zoo education and outreach programs have the ability to reach millions of people worldwide each year. While the majority of these visitors live in urban areas and regions of the world outside the native range of crocodilians, zoo interpretation and education programs can raise the awareness of the importance of crocodilians in the natural world and encourage support and participation in programs necessary for the long-term survival and conservation of crocodiles. People must be inspired and motivated to care about and understand the threats that animals face in the wild. Thus, the actions of zoos can direct public participation and financial support to conservation projects of endangered and critically endangered crocodilians. Access to captive animals by scientists facilitates research and expands our knowledge of the biology and behaviour of the group.

Although crocodilians have been held in captivity since at least ancient Roman times, historically, zoo collections were simply menageries of mixed species. It was only really in the late-1960s and 1970s when zoos first began keeping crocodilians in breeding pairs and captive reproduction was first recorded. Since that time, all living species of crocodilians have been reproduced under captive circumstances. Zoological collections in the USA include virtually all of the living crocodilian species, as do those in Europe.

Conservation programs in zoos extend far beyond promoting the preservation of endangered species through ex-situ captive breeding programs. There is growing awareness of the important role ex-situ conservation plays in overall conservation strategies (Pritchard et al. 2011). And, with an increasing rate of global extinctions, continued habitat loss and the, as yet not fully understood, impact of global climate change, this role is certain to become more important in the future.

Captive breeding populations in zoos may serve as assurance colonies or genetic reservoirs in case of an ultimate loss of the wild populations. There are relatively few, but highly significant, cases in which zoo animals have made enormous contributions to the initiation of recovery of critically depleted wild stocks. For instance, in the 1970s, an adult male Gharial (Gavialis gangeticus) from the Frankfurt Zoo, transported to India to assist an intensive captive breeding effort, became an important founder in the effort to head-start and reintroduce Gharial into wild sanctuaries.

Managed, cooperative breeding programs in zoos are designed to maintain the genetic diversity of small, captive breeding populations. This attention to heredity proves invaluable when captive populations are needed as a source for reintroduction programs. The Chinese alligator (Alligator sinensis) Species Survival Plan (SSP) in Association of Zoos and Aquaria (AZA) zoos in North America has managed a cooperative breeding program for this species for almost three decades. The known genetic pedigree of these animals made them attractive to wildlife officials in southern China and Chinese alligators from the SSP were imported into China for a reintroduction effort on Chongming Island, near Shanghai.

Within zoos, there is significant linking between in-situ and ex-situ conservation programs. The Cuban crocodile (Crocodylus rhombifer) faces the possibility of being genetically swamped in the wild due to hybridization with the sympatric populations of American crocodile (C. acutus). It is quite conceivable that no genetically pure C. rhombifer will remain in the wild in the next few decades. There has been a managed breeding program for the Cuban crocodile in AZA institutions in the USA for many years. European Association of Zoos and Aquaria (EAZA) institutions in Europe are initiating a similar...
program. These captive breeding programs, plus captive populations of genetically pure crocodiles in Cuba, may be the only long-term hope for continued existence of this beleaguered species.

The CSG includes several taxon-specific conservation programs that bring experts from academic institutions, wildlife authorities, zoos and aquaria, and other related professions to focus their talents on conservation problems of critically endangered crocodilian species. The CSG Tomistoma Task Force has drawn great support of expertise from the zoo community in its efforts to protect the Tomistoma (Tomistoma schlegelii) and its habitats. The Chinese Alligator Fund initially grew from the efforts of zoo professional and private individuals interested in helping the plight of this species. The CSG has a Chinese Alligator Working Group which focuses its efforts on identifying potential release sites of captive-bred alligators and helping to establish new reintroduced populations.

The World Association of Zoos and Aquariums (WAZA) consists of more than 250 zoos and aquarium as institutional members, and has advanced several conservation strategies to implement conceptual development of practices and strategies for zoos and aquaria to adopt. Conservation Strategies are published in multiple languages to communicate the message of the strategies and to facilitate promotion and adoption to a broader audience. Through a series of workshops organized by WAZA in 2000/2001 a strategy was developed to increase WAZA participation in in-situ conservation. The strategy involves the branding of conservation projects or programs by WAZA, after these projects have met sets of endorsement criteria. Since this time, WAZA branding of projects has taken on increasing clout within the conservation community. Branding of conservation priorities in the Mesangat wetlands of East Kalimantan were instrumental in the establishment of the EAZA/IUCN-SSC Southeast Asia Campaign mentioned below. The Mabuwaya Philippine Crocodile Conservation Program also has been WAZA-branded as proposed by Chris Banks (Melbourne Zoo). In partnership with the EAZA and the European section of the IUCN-SSC Conservation Breeding Specialist Group (CBSG), WAZA is establishing a World Zoo and Aquarium Conservation Database. This database currently catalogues more than 900 in-situ conservation projects supported by the international zoo community.

AZA is a professional organization of more than 6000 institutions, individuals and vendors from all over the world. Since 1924, rigorous accreditation standards ensure the professional conduct and standards of AZA institutions and partner organizations. AZA-accredited institutions provide support for research and conservation projects worldwide. In 2010 alone, AZA facilities provided $US130 million in support to conservation projects in more than 100 countries. Species Survival Plans (SSP) for many of the world's most threatened and endangered species provide coordinated captive breeding programs, in-situ conservation programs, habitat preservation and restoration, public education and research. SSPs for crocodilian species are managed by the AZA Crocodilian Advisory Group (CAG), the first Taxon Advisory Group within the AZA. The CAG maintains studbooks and SSP programs for the most endangered crocodilians species (Alligator sinensis, Crocodylus rhombifer, C. siamensis, C. mindorensis, C. intermedius, C. (Mecistops) cataphractus, Gavialis gangeticus, Tomistoma schlegelii).

The International Species Information System (ISIS) maintains an extensive database of animal species held in zoos and aquariums, and details of their zoo environments. This system, the Zoological Information Management Systems (ZIMS), links records from more than 800 member zoos and aquaria in at least 80 countries, and includes comprehensive data on more than 2.6 million captive animals of 10,000 species.

EAZA is a professional association of zoos and aquariums in Europe, with more than 345 member institutions from 41 countries. The EAZA manages cooperative breeding programs. The Endangered Species Program (ESP), similar to the SSP programs of the AZA, has intensive, cooperative, population management plans for individual species. Each has a coordinator and a species committee, which make pairing, breeding and transfer recommendations designed to promote and maintain the genetic diversity of the captive population. RRP's include only specimens kept in EAZA institutions. There is an EEP for C. mindorensis and one was previously maintained for A. sinensis.

European studbook (ESB) programs are less intensive management plans than the EEPs. A studbook keeper maintains records of all specimens in the program and all life events, including data on births, deaths, transfers, etc. ESBs exist for C. rhombifer and T. schlegelii, plus Osteolaemus tetraspis is being considered. ESBs may include specimens from non-EAZA institutions and from some highly qualified private collections. The EAZA has a single Taxon Advisory Group for all reptiles. Fabian Schmidt, Zoo Leipzig, oversees the crocodilian matters in this.
The Southeast Asia Campaign, a joint venture between the EAZA and IUCN-SSC, raises public awareness and funds for the conservation of biodiversity in Southeast Asia. One project in this campaign, the Conservation of the Mesangat Wetland in East Kalimantan, is of extreme importance to the conservation of two endangered species of crocodilians - *T. shlegelii* and *C. siamensis*. Both species occur in Mesangat Lake and the vast peat swamp forest surrounding it, an area salvaged from development from a local palm oil company and now proposed for permanent conservation by YASIWA - the Equatorial Conservation Foundation of Indonesia.

**International Zoo Educators Association** (IZE) members dedicate themselves to improving the impact of conservation education programs in zoos and aquariums.

The CBSG is a network of conservation professionals from around the world committed to developing science-based, cooperative conservation programs aimed at saving threatened species. The CBSG has developed workshops aimed at gathering essential data for the scientific analysis of conservation strategies directed at endangered species. These Population and Habitat Viability Assessment (PHVA) workshops bring together attendees with a range of knowledge on biology, ecology, habitat, reproduction, genetics, GIS and land use patterns. Computer models use data compiled from these sources to evaluate the potential impact of various management strategies on the risk of population decline or extinction of the species.

Other regional zoo associations exist, too numerous to list all:

- British & Irish Association of Zoos & Aquariums (BIAZA)
- Canadian Association of Zoos and Aquariums (CAZA)
- Mexican Association of Zoos & Aquariums (AZCARM)
- Pan African Association of Zoological Gardens, Aquaria & Botanical Gardens (PAAZAB)
- Sociedade de Zoologicos do Brasil (SZB)
- South Asian Zoo Association for Regional Cooperation (SAZARC)
- South East Asian Zoo Association (SEAZA)
- Zoo and Aquarium Association (ZAA)

**References**


