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The Crocodile Museum at Zoológico Regional Miguel Álvarez del Toro (ZooMAT), Mexico: 'How to exhibit a bullfrog' put into reality

L. SIGLER*

Conservation Biologist, The Dallas World Aquarium, 1801 North Griffin Street, Dallas, Texas 75202, USA

E-mail: luis@dwazoo.com

Staff at the Zoológico Regional Miguel Álvarez del Toro (ZooMAT), Mexico, have acquired over several decades extensive background knowledge about various aspects of the biology and conservation of the three species of crocodilians inhabiting Chiapas; the Chiapas' caiman *Caiman crocodilus chiapasius*, American crocodile *Crocodylus acutus* and Morelet's crocodile *Crocodylus moreletii*. This knowledge was put into practice when designing a new exhibit to provide visitors with a better understanding of crocodilians. In 2003, an initiative by the government of Chiapas State to support ZooMAT with new projects and renovations, resulted in the adaptation of an unfinished building, originally constructed as an aquarium, into a Crocodile Museum, which opened in 2004. The public enters via the open jaws of a scale model of an American crocodile, and inside visitors can view graphics and displays describing the natural history and ecology of the three species in a national and international context. Murals, dioramas with mounted animals, aqua-terrariums with living crocodiles and caimans, tanks containing animals that are part of the crocodilian food chain and the skeletons of specimens of diverse sizes are all on display. Outside the building there is a contact area where guides talk to the public and provide information, and visitors are allowed to touch materials laid out on a table. There is also an amphitheatre where formal lectures are given and visitors can view the enclosures containing breeding crocodilians. From here the visitors are able to access the remaining living collection of ZooMAT.

Key-words: Crocodile Museum; crocodilian; design; education; exhibit; Mexico; ZooMAT.

RESUMEN

Personal del Zoológico Regional Miguel Álvarez del Toro (ZooMAT), adquirió durante varias décadas suficiente

conocimiento en aspectos de biología y conservación de las tres especies de cocodrilianos que viven en Chiapas; el Caiman de Chiapas *Caiman crocodilus chiapasius*, el Cocodrilo americano *Crocodylus acutus* y el de Morelet *Crocodylus moreletii*. Este conocimiento fue puesto en práctica cuando se diseñó una nueva exhibición para que el público visitante entendiera mejor a los cocodrilianos. En 2003 hubo una iniciativa del gobierno del estado de Chiapas para apoyar al ZooMAT con nuevos proyectos y remodelaciones, lo que favoreció que un edificio inconcluso diseñado como acuario, fuera adaptado para el Museo del Cocodrilo, el cual se inauguró en 2004. El público entra a través de las mandíbulas abiertas de un cocodrilo americano, y adentro encuentra información sobre la historia natural y la ecología de las tres especies, en un contexto nacional e internacional. Se muestran murales, dioramas con animales disecados, acuaterarios con animales vivos de las tres especies, tanques con animales que forman parte de la cadena alimenticia de los cocodrilianos y esqueletos de ejemplares de diversos tamaños. Afuera existe un área de contacto en la que se da atención al público y se le permite tocar el material. También hay un anfiteatro en el que se imparten charlas para posteriormente continuar con las exhibiciones de los cocodrilianos reproductores y tener acceso al resto de la colección de ejemplares del zoológico.

INTRODUCTION

Zoológico Regional Miguel Álvarez del Toro (ZooMAT) is considered a pioneer zoo in Latin America and further afield, because Miguel Álvarez del Toro, the founder and director for 54 years, decided to maintain only fauna from the state of Chiapas (Mittermeier, 1979), which is the second

*Former curator (1992–2004) of the Crocodile Museum at Zoológico Regional Miguel Álvarez del Toro (ZooMAT), Mexico.

richest state for biodiversity in Mexico (Álvarez del Toro *et al.*, 1993). In 1980, after almost 40 years, the Tuxtla Gutiérrez Zoo was relocated from the city to the El Zapotal reserve. The Zoo changed its name to ZooMAT, to honour the remarkable work of Álvarez del Toro in the conservation of the natural resources of Chiapas.

While curator at ZooMAT, I was inspired by William G. Conway's (1973) article 'How to exhibit a bullfrog: a bed-time story for zoo men'. In this article Conway presents the argument that it should be possible to display even the most common and often unnoticed animal, such as the American bullfrog *Lithobates catesbeianus*, in a way that allows every facet of its morphology, behaviour and ecology to be explored in a range of exciting modes using graphics, live exhibits and preserved specimens. Few zoos have fully taken up this challenge, although Conway's article is still as novel and exciting today as it was 40 years ago. Given the extensive knowledge that staff at ZooMAT had gained over many years about the husbandry, breeding and conservation of crocodilians, the aim was to see whether Conway's bullfrog vision could be brought into reality using crocodilians.

MUSEUM DEVELOPMENT

In 1980, when ZooMAT was constructed in El Zapotal reserve, a round building with multiple tanks and a peripheral walkway for visitors was built as an aquarium. Because water from the natural springs in El Zapotal is hard (alkaline with a high mineral content), the aquarium was not developed because the budget to maintain it was too expensive for a public zoo. In 1992 the author was asked to oversee the crocodilian collection, the never-opened aquarium building and the Nocturnal House (nocturnal mammals) at ZooMAT.

Taxonomic focus

The crocodilian area at ZooMAT included three large exhibits for the three species found in Chiapas: Chiapas' caiman *Caiman crocodilus chiapasius*, American crocodile

Crocodylus acutus and Morelet's crocodile *Crocodylus moreletii*. The International Union for Conservation of Nature (IUCN) has Red Listed the American crocodile as Vulnerable, while the Chiapas' caiman (as the Spectacled caiman *Caiman crocodilus*, rather than *C. c. chiapasius*) and Morelet's crocodile are listed as Least Concern, although these designations probably need to be updated (IUCN, 2014).

These three species have differing distributions. Morelet's crocodile has a limited distribution in the Atlantic lowlands of the Gulf of Mexico (Mexico) and the Yucatan Peninsula (Mexico, Belize and Guatemala) (Platt *et al.*, 2010). The American crocodile ranges from the state of Sinaloa in Mexico, to Tumbes in Peru on the Pacific coast. On the Atlantic coast the American crocodile is distributed from the southern tip of Florida, USA, to the northern tip of Venezuela, including some Caribbean islands, such as Cuba, Jamaica, Hispaniola, the Dominican Republic and Haiti (IUCN, 2014). The IUCN listing for the Spectacled caiman does not distinguish the Chiapas' caiman, although studies by Medem [1983, cited in Escobedo-Galván *et al.* (2011)] suggest that the subspecies occurs 'from México, through Central America, . . . to the Pacific lowlands of Colombia and Ecuador'.

The distribution of the three species of crocodilian that inhabit Chiapas is related to the tropical lowlands. The Chiapas' caiman and American crocodile are present across the whole Pacific coast. The American crocodile is also found in the centre of the state along the Grijalva River and some of its tributaries, from the east at the frontier with Guatemala to the north-west into the state of Tabasco. Morelet's crocodile inhabits the lowlands of the north of Chiapas in the Gulf of Mexico's coastal plain, and the north-east region of Selva Lacandona and Marqués de Comillas (Álvarez del Toro & Sigler, 2001).

Exhibit design

In 2002 the Chiapas government offered economic support for ZooMAT; new projects

were developed and existing exhibits were renovated. A new public entrance to the Zoo was planned, to be located at the side of the old aquarium building. This development provided the opportunity to ‘present an educational exhibit of a fascinating creature who lives in your own back yard’ as suggested by Conway (1973). A volunteer architect drew up designs that used the aquarium niches to relate different aspects of the natural history of the crocodilians in Chiapas, in order to inspire visitors by explaining all aspects of the biology, natural history and conservation of crocodilians in the state, and their relationship with human culture. The volunteer architect’s blueprints were given to the official government architects. Within 2 days final designs were presented to the government and the project was approved.

The engineers arrived almost a week later and work started on creating a Crocodile Museum that the residents of Chiapas could be proud of. The entrance was designed in the form of an anatomically correct head of an American crocodile (Plate 1).

In the interior of the Crocodile Museum, the natural history of the three crocodilians found in Chiapas is explained, starting with

their life cycles. Nesting and hatching are presented using a replica of a nest of an American crocodile in the entrance, and a diorama where the public can view a mounted skin of a Morelet’s crocodile building her nest and laying eggs (Plate 2), and a mounted skin of a female Chiapas’ caiman assisting her hatchlings in the nest and taking them to the water’s edge (Plate 3). Further detailed signage describes the structure of an egg and the development of an embryo. During the incubation season fertile eggs are placed in incubators, where visitors can observe them. In this area visitors may see American crocodile eggs hatching in May–June, Morelet’s crocodile eggs hatching in August and Chiapas’ caiman eggs hatching in September. These displays go some way towards depicting ‘the ecology and life history . . . from egg to death, through . . . growth and development’ described by Conway (1973).

ZooMAT (formerly Tuxtla Gutiérrez Zoo) has a long tradition of successful captive breeding of crocodiles. In 1966 Tuxtla Gutiérrez Zoo was the first zoo in Mexico to breed the Chiapas’ caiman in captivity (Álvarez del Toro, 1969). ZooMAT was



Plate 1. The entrance to the Crocodile Museum at ZooMAT, Chiapas, Mexico, is in the shape of the head of an American crocodile *Crocodylus acutus*, with anatomically correct teeth. Luis Sigler, former Curator of the Crocodile Museum ZooMAT, Chiapas, Mexico.



Plate 2. A mounted skin of Morelet's crocodile *Crocodylus moreletii* laying eggs in an exhibit in the Crocodile Museum. Luis Sigler, former Curator of the Crocodile Museum ZooMAT, Chiapas, Mexico.



Plate 3. A mounted skin of a Chiapas' caiman *Caiman crocodilus chiapasius* helping her hatchlings in an exhibit in the Crocodile Museum. Luis Sigler, former Curator of the Crocodile Museum ZooMAT, Chiapas, Mexico.

also the first to breed the Chiapas' caiman (1992) and the American crocodile (1993), following artificial incubation of eggs (Sigler, 1994a,b, 1996). Álvarez del Toro achieved international recognition for breeding Morelet's crocodile in captivity in 1969 (Álvarez del Toro & Sigler, 2001). This considerable knowledge and expertise about crocodilians from Chiapas, and the research projects that have been carried out, could all be utilized when developing the new

Crocodile Museum at ZooMAT. Three enclosures were built outside the Museum to house the breeding pairs of Mexican crocodilians that were already located at the Tuxtla Gutiérrez Zoo and on which Álvarez del Toro carried out his research for his book *Los Crocodylia de Mexico* (Álvarez del Toro, 1974).

Visitors can inspect several tanks that contain aquatic animals that are the main prey of the crocodilians, such as aquatic

insects, fish, frogs and turtles, and read graphics that explain the link between prey and hunter (Plate 4), in a similar way to that described for the bullfrog – highlighting the ‘relation to other animals . . . as a predator’ (Conway, 1973).

At the centre of the Museum the public discover an aqua–terrarium that exhibits juveniles of the three crocodilian species together. Here visitors can try to identify and differentiate between the species using the guides on the walls. There are also small tanks containing individuals of each species of crocodilian to remind visitors of their specific characteristics, especially when they are young and easy to confuse. This layout provides displays that broach ‘the subject of speciation and adaptation’ (Conway, 1973).

A beautiful mural, painted by local artist José Guadalupe Monzón, illustrates the evolution of the three species of crocodilians on display, comparing them with other reptiles that coexisted with the crocodilians through the same geological time but that are now extinct. As suggested by Conway (1973), graphics should show ‘the evolution . . . from a common ancestor’. The mural moves from the Triassic, passing into the Jurassic (the era of the dinosaurs and other large reptiles), the Cretaceous, the Tertiary, and ending in the current era, the Quaternary. This information helps visitors to understand the importance

of the crocodilians through time, and especially how they have adapted to environmentally changing conditions and how they continue to help keep the ecosystems they occupy in balance, positioning the crocodilians ‘clearly in relation to the biosphere: its earth, air and water’ (Conway, 1973).

Cultural significance

The entrance, which is in the shape of a head of an American crocodile, resembles a crocodile vessel from the Mayan culture of Izapa, located on the coast of Chiapas. Visitors enter this crocodile through its open mouth and inside they learn more about this group of reptiles, which the Mayans believe are guardians of the underworld with the known world built by the gods on their backs.

The interior of the Crocodile Museum is enhanced with information that shows visitors the global distribution of living crocodilian species and habitats. For example, there is a map at the entrance identifying all 23 species of living crocodilian. Further on, near the enclosures for the living crocodilians, there is a detailed map indicating the distribution of these species within Mexico. However, the Museum addresses not only the biological aspects of these reptiles but also shows the importance of these crocodilians in ancient Mexican cultures and the

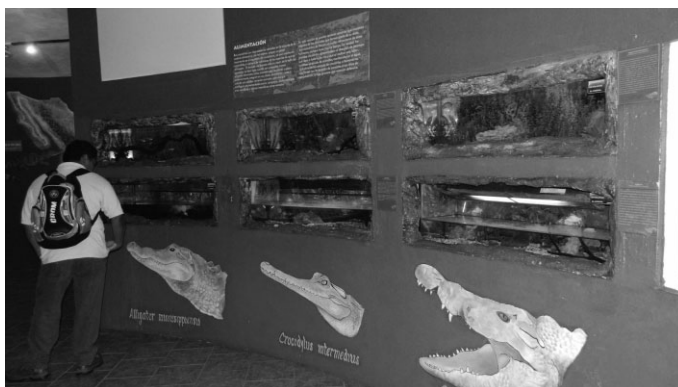


Plate 4. The trophic chain is demonstrated by tanks of aquatic animals that are prey items for the crocodilians of Chiapas. Luis Sigler, former Curator of the Crocodile Museum ZooMAT, Chiapas, Mexico.

unsustainable exploitation of crocodilians today. The exhibits are located on both sides of the public pathway but never one in front of the other; this gives the visitors a feeling of meandering as they walk through the Museum (Plate 5). Conway (1973) said of the hall in the mythical bullfrog exhibit that ‘Exhibits were confined . . . to one side of the exhibit hall; there was no need to backtrack to see the displays in a logical fashion’, and the staggered layout of the displays in the Crocodile Museum was designed to emulate this. There are painted murals showing habitats, the heads of the 23 living crocodilians, and demonstrating human–crocodile conflicts and how to prevent the sorts of accidents that occur when people go into crocodile habitat without understanding the risks of entering the water or disturbing nesting/hatchery areas. Various other artefacts can be seen around the Crocodile Museum, including mounted skins of crocodiles that were found dead during research studies in the field and some skeletons. A copy of a fossilized crocodilian from the clade Gavialoidea, which was found in Chiapas, is also on display with all the information that is available for this recently discovered species (Carbot-Chanona *et al.*, 2013). This is similar to the ‘several fine bronzes of giant amphibians from prehistoric times’ cited in Conway (1973).

Towards the end of the tour there is a naturalistic exhibit displaying juvenile American crocodiles from the Sumidero Canyon National Park programme, which pays tribute to over 20 years of conservation work on this Vulnerable species carried out by ZooMAT in this iconic region of Mexico (Sigler, 2010). Providing a variety of views and perspectives is important in such educational displays, as described in detail for ‘The World of Bullfrogs’ (Conway, 1973); for example, the juvenile American crocodiles can also be viewed through an underwater viewing window (Plate 6).

At the end of the tour around the Crocodile Museum there are two exhibits for aquatic animals that have some similarities to the crocodilians and that the people of Chiapas think of as ‘relatives’ to these reptiles: the Crocodile turtle *Chelydra serpentina* and the Tropical garfish *Atractosteus tropicus*.

Visitor experience

The Crocodile Museum is positioned to the right of the main entrance to the Zoo. Visitors do not have to go through the Museum but because of its innovative design almost everyone enters that way. Feedback from visitors confirms that the American crocodile-head entrance is inviting, and the contrast between the surrounding forest landscape



Plate 5. Dioramas and murals throughout the Crocodile Museum illustrate various aspects of the natural history of the crocodilians that inhabit the state of Chiapas. Luis Sigler, former Curator of the Crocodile Museum ZooMAT, Chiapas, Mexico.



Plate 6. The Sumidero Canyon American crocodile *Crocodylus acutus* exhibit in the Crocodile Museum at ZooMAT, Chiapas, Mexico. Young crocodilians are presented individually so visitors can see the differences between the species. Luis Sigler, former Curator of the Crocodile Museum ZooMAT, Chiapas, Mexico.

and the open ‘toothy jaws’ promises something very exciting. Visitors have also reported that they enjoy the mounted representations of the crocodilians because they are so real and illustrate the natural history of the animals clearly. For example, being able to observe the mounted skins of either a nesting Morelet’s crocodile or a Chiapas’ caiman helping its hatchlings out of the nest. Visitors also like viewing the mounted skin of a huge American crocodile rescued from the Pacific coast of Chiapas. There are numerous captivated visitors on days when live hatchings occur, even though these are only single-day events.

Outside the Museum building, visitors can touch crocodilian artefacts that are placed on a table, and guides provide information and talk informally to the public (Plate 7). There is also a small amphitheatre with a 50-person capacity, where timetabled formal talks are given, providing visitors with the opportunity to see at close hand and touch a juvenile crocodilian.

The breeding ponds for Chiapas’ caiman, Morelet’s crocodiles and American crocodiles are all located outside at the end of the Crocodile Museum tour (Plate 8), and these lead the visitors into the rest of ZooMAT’s

living collection. Special guided tours can be arranged for school groups to visit the crocodilian holding areas, the nursery for the hatchlings that are produced every year and various crocodilians that are kept off show, including: huge rescued American crocodiles that are kept transiently before being relocated for release, breeding or display purposes to other institutions; or a Chiapas’ caiman that hatched without tail in 2003; or the famous ‘Gasparín’ (Casper), an American crocodile hatched at Sumidero Canyon National Park in 2003 with atypical skin pigmentation. Gasparín’s coloration is pale grey with completely black eyes and this individual and its siblings generated the urban legend of ‘the blue crocodiles of Chiapas’.

By the time the visitors leave the Museum they report that they have a better understanding of the basic natural history of crocodilians, especially those species inhabiting Chiapas. Visitors have often seen crocodilians in the local communities in which they live or in other places around the state, so it is reassuring to hear about their previous experiences and the myths that have been dispelled by their visit to the Crocodile Museum.



Plate 7. When visitors leave the Crocodile Museum, there is an education area outside, including a contact zone where they can handle crocodilian artefacts and guides are available to provide information. *Luis Sigler, former Curator of the Crocodile Museum ZooMAT, Chiapas, Mexico.*



Plate 8. Outdoor breeding ponds for Chiapas' caiman *Caiman crocodilus chiapasius*, Morelet's crocodile *Crocodylus moreletii* and American crocodile *Crocodylus acutus* complete the Crocodile Museum tour and visitors can then move into ZooMAT to see the other animals in the living collection. *Luis Sigler, former Curator of the Crocodile Museum ZooMAT, Chiapas, Mexico.*

It is 10 years since the Crocodile Museum opened to the public, and staff report that the dioramas have been very successful and only need occasional maintenance. However, the murals behind the aqua-terrariums that contain live crocodilians are in constant need of repair. Sometimes equipment, such as filters, heating elements and ultraviolet lights, breaks down, and it has been both difficult and expensive to locate replacements for these items in Tuxtla Gutiérrez. In recent years, as the city continues to grow, the actual amount of water available to supply the Crocodile Museum has been diminishing. Various adaptations could be made to the Museum to enhance the visitor experience, such as improved filtration and lighting, and a new sound system to immerse the visitors fully into the habitats, surrounding them with a variety of vocalizations: crocodilians are the most vocal of the Reptilia (Vergne *et al.*, 2012). Furthermore, some of the aqua-terrariums are square, which is the way they were built for the old aquarium project. The appearance of the Museum would be greatly improved if these displays had rounded and irregular corners, making them more naturalistic.

The Crocodile Museum was opened on 2 August 2004, in commemoration of the

eighth anniversary of the death of Miguel Álvarez del Toro. Every 23 August since 2002, the date of Álvarez del Toro's birthday, the 'Crocodile and Crocodile-Men Day' is celebrated in Mexico.

CONCLUSION

The Crocodile Museum at ZooMAT is the first of its kind in Latin America, with an estimated annual attendance of more than 700 000 visitors per year and all for a modest budget of US\$120 000, which was used to remodel and equip the old aquarium building. It is successful because it offers uniquely an in-depth and immersive experience, where visitors can learn about almost every aspect of the lives of the crocodilians of Chiapas.

Conway has said 'My paper was a dissection of the potentials of zoo exhibition . . . [and] I used the bullfrog as a zoological mannikin and draped it with a discussion of ways to convey bullfrogness to zoo-goers' (W. G. Conway, pers. comm.). His vision of how to display animals in immersive educational exhibits is as relevant today as it was 40 years ago, and yet few zoos have fully engaged in his approach. 'A poor display can destroy the wonder of the rarest most marvellous creature', Conway (1973) proclaims. At ZooMAT we are proud of utilizing many years of shared expertise and knowledge about the crocodilians of Chiapas to bring to reality Conway's vision (Sigler, 2003). Chiapas is the only state in Mexico where Chiapas' caiman, American crocodile and Morelet's crocodile are all found, and so it is vital that ZooMAT conveys effectively the ecological and conservation importance of these magnificent reptiles to the widest audiences, both in Mexico and overseas. In this regard we believe the Crocodile Museum has been an outstanding success.

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