CROCODILE SPECIALIST GROUP NEWSLETTER

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CROCODILE

SPECIALIST

GROUP

NEWSLETTER

VOLUME 31 Number 1
JANUARY 2012 - MARCH 2012

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CHAIRMAN:
Professor Grahame Webb
PO Box 530, Karama, NT 0813, Australia

EDITORIAL AND EXECUTIVE OFFICE:
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COVER PHOTOGRAPH: COVER PHOTOGRAPH: American Crocodile (*Crocodylus acutus*). Photograph: Juan Rafael Bolaños Montero.

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Editorial

The IUCN community and CSG are deeply saddened by the loss of its colleague and friend Dr. Susan Mainka. Sue passed away on 12 February 2012 after a courageous five-month battle with cancer. She made a huge contribution to the IUCN, to the Species Programme, and to maintaining the scientific rigor of IUCN's contribution. Sue worked very closely with the CSG, attended the CSG working meeting in Cuba (2000), played an important role in trying to rationalize IUCN's contribution to Cuba's sea turtle program, and was particularly supportive of all CSG activities at Conferences of the Parties to CITES. She will be sadly missed by many.

We were also saaddened to hear of the passing of Dr. John Loveridge last January. John had a diverse career, with a long involvement with crocodiles over many years (see page 4). An early participant in the CSG, James Powell Jr. passed away in January 2011, but details have also recently become available (see pages 4-5).

The second IUCN-Species Survival Commission Specialist Group Chairs' Meeting was held in Abu Dhabi, United Arab Emirates, on 23-27 February 2012. I attended the meeting as CSG Chairman, along with Tom Dacey (Executive Officer). Many of the presentations were about the work of the IUCN Species Program, particularly the Red List, and they can now be downloaded from: http://www.iucn.org/about/work/programmes/species/who_we_are/about_the_species_survival_commission_/ssc_members__area_/iucn_ssc_chairs_meeting_2012/. However, one of the main benefits of this meeting was the interchange between different Specialist Groups, which all operate in diverse ways to achieve the same ends - advancing conservation. The final report on the outcomes will be circulated.

SSC Chairman Simon Stuart presented the Species Survival Commission Chairs' Citation of Excellence to Grahame Webb, in recognition of his "leadership to crocodilian conservation worldwide, his long-term service as Chair of the IUCN-SSC Crocodile Specialist Group, and his thoughtful engagement with SSC on sustainable use" (see page 5).

A number of issues of relevance to the CSG were discussed at the 26th meeting of the CITES Animal Committee (Geneva, Switzerland, 15-20 March 2012). A workshop to evaluate the results of the monitoring program for *Crocodylus moreletii* in Mexico was held on 7-9 March 2012. An information paper on the "Monitoring Program of Morelet's Crocodile (*Crocodylus moreletii*) Mexico-Belize-Guatemala: Results of 2011 Season" was provided by Mexico to the Animals Committee, and the results of this monitoring work will also be presented at our next CSG Working Meeting in Manila. The Animals Committee Working Group on Nomenclatural Matters agreed with the change of the current CITES listing of the Australian Freshwater Crocodile from *Crocodylus johnsoni* to *Crocodylus johnstoni* by the Conference of the Parties. The same working group rejected the proposed split of *Crocodylus suchus* from *Crocodylus niloticus* at this time.

A letter of CSG support was sent to the US Fish and Wildlife Service in respect of the proposed: "Listing of 2 Distinct Population Segments of Broad-Snouted Caiman as Endangered or Threatened and a Special Rule". This relates to long outstanding Argentine proposal for the transfer of *Caiman latirostris* from "endangered" to "threatened" on the US Endangered Species Act.

A questionnaire has been sent to all CSG members to gather updated information on the membership for inclusion on the upgraded CSG website and in anticipation of a review of membership required after the IUCN World Congress, to be held in Jeju, Republic of Korea, 6-15 September 2012. The number of responses to the questionnaire to date has been poor, which is disturbing. Many CSG members are not requested to contribute a great deal to the CSG, and one truly wonders if they cannot answer a CSG questionnaire whether their positions as CSG members should be renewed. Members who have not filled in the questionnaires should contact Tom Dacey immediately.

On a more positive note, a final reminder that the 21st CSG Working Meeting (Manila, Philippines, 22-25 May 2012) is not far away, and it will be preceded by a meeting of the CSG Steering Committee (21 May). Full details of the venue, program, registration, accommodation, field trips, etc., can be found on the meeting website (www.csgmanila.com).

The 4th International Workshop on Crocodilian Genetics and Genomics will be held in Darwin, Australia, from 16-18 May 2012. Enquiries should be directed to Dr. Sally Isberg (sally@crocfarmsnt.com). The timing of this workshop was established to allow participants to attend the 21st CSG Working Meeting that will convene a few days later on 22-25 May 2012.

Professor Grahame Webb, CSG Chairman

Obituaries

John Loveridge

(3 March 1942 - 9 January 2012)

John Péri Loveridge was born in Rhodesia (now Zimbabwe) in 1942. He was a gentle man of many parts - naturalist, scientist, teacher, scout master, sportsman and a loving husband to Nan, father to Andrew and Morag, and grandfather of three.

John graduated in 1963 with Honours degrees in Botany and Zoology from the University College of Rhodesia and Nyasaland (now University of Zimbabwe). After graduating he went on to complete his doctorate, a physiological study of the water relations of locusts. His academic career began in 1967 as a junior lecturer in Zoology at the local university. After a sort stint as a senior lecturer in Zoology at the University of Cape Town, John returned to the University of Zimbabwe in 1980 as a senior lecturer. He was promoted to the post of Professor in Biological Sciences in1984, and then appointed Professor of Zoology in 1990.

John was a true naturalist with a deep and abiding interest and curiosity in plants and animals of all shapes and sizes, and he loved being outdoors and in the bush. His curiosity in nature remained with him all his life. A highlight of his life was an expedition as a student to the Ruwenzori Mountains on the borders of Uganda and the Congo where, in a frozen alpine lake, they found many new species, one of which was an alga that was later named after John. A current passion was his collection of cactii and aloes.

On a lighter note - at one time John's children had to share their evening bath with baby crocodiles - they were at one end of the bath, the little crocodiles at the other. As a research scientist John made outstanding contributions in the field of amphibian and reptile biology and physiology. His discovery that tree frogs secreted uric acid (something completely unexpected in frogs) was a major breakthrough. His first paper on the topic was initially rejected on the grounds that his observations were certainly wrong. The findings were then published in Nature. An invitation to spend a year at Duke University in North Carolina, working with one of the world's leading animal physiologists soon followed. John's research on crocodiles, and that of his students, contributed enormously to the development of crocodile farming and to the conservation of depleted populations of crocodiles. He was an advisor to the developing crocodile industry over many years.

John was a talented lecturer and teacher. He successfully supervised many postgraduate students and acted as an external examiner to several universities. His outstanding integrity also provided a moral compass in academia and elsewhere. Whilst being truly a gentle man he was always absolutely firm about what he thought was the right thing to do.

What more can one do but to salute a life well and fully lived by a talented man with a great capacity for friendship, loyalty and compassion, and great integrity.

Dr. David Cumming, *former Head of Research, Zimbabwe National Parks and Wildlife Department*.

James H. Powell Jr.

(1933-2011)

James Powell, an early participant in the CSG, passed away on 11 January 2011. He was an interested correspondent with IUCN, so when the SSC put together the first list of participants for the new Crocodile Specialist Group, James was included.

James was a dedicated amateur interested in conservation and the environment, but not a rigorous field biologist. If you read his presentations in the Proceedings of the 1st and 2nd CSG Working Meetings you will see they were primarily anecdotal observations drawn from his travels through Mexico and Texas and a few other sites, combined with comments from correspondents in Latin America and the Caribbean. James participated in the first two Working Meetings, but none of the later get-togethers, though he continued to correspond for several years before becoming quiescent.

While James was an enthusiastic supporter of crocodilian conservation, he was a fanatical, almost rabid, follower of the

'Ice Capades', the traveling troupe of professional ice skaters. When James was not talking about crocodiles, he would regale you with detailed verbal descriptions of the latest 'Ice Capades' show. He personally knew virtually every skater in the 'Ice Capades' and each year he would travel to dozens of cities across North America to see them perform.

Even though James died a year ago, the Plainview.com obituary was recently posted on 28 January 2012 (see http://www.myplainview.com/news/article_b3fa062a-4a1c-11e1-ab6a-001871e3ce6c.html).

Professor F. Wayne King, *Honorary CSG member and ex-CSG Chairman*.

CSG Student Research Assistance Scheme Update

The CSG Student Research Assistance Scheme has provided funding to one student so far in 2012:

1. Carol Bogezi, Makerere University, Uganda: "Distribution and status of crocodiles in Kidepo landscape in northeastern Uganda".

Tom Dacey, *CSG Executive Officer, csg@wmi.com.au*.

Citation of Excellence for CSG Chairman

At the second SSC Specialist Group Chair's Meeting held in Abu Dhabi, UAE, 23-27 February 2012, SSC Chairman Simon Stuart presented the Species Survival Commission Chairs' Citation of Excellence to CSG Chairman Professor Grahame Webb. It was in recognition of his "leadership to crocodilian conservation worldwide, his long-term service as Chair of the IUCN-SSC Crocodile Specialist Group, and his thoughtful engagement with SSC on sustainable use".

Grahame Webb (CSG Chair) receives the SSC's Citation of Excellence from Simon Stuart (SSC Chair). Photograph: Jean-Christophe Vié.

Regional Reports

Latin America and the Caribbean

Costa Rica

SURVEY OF AMERICAN CROCODILES IN TEMPISQUE GREAT WETLANDS, GUANACASTE, COSTA RICA. Studies on the status of *Crocodylus acutus* populations in Costa Rica have largely concentrated on the Pacific coast (Sasa and Chaves 1992; Bolaños *et al*. 1997; Piedra 2000; Porras-M 2004) and in particular the Tempesque River, considered to contain the most important *C. acutus* population in the country, and for which there exist data on size and sex distribution (Bolaños *et al*. 1997; Sánchez 2001). However, these studies have been largely undertaken in the main navigable channel of the Tempisque River, a length of approximately 50 km from its opening in the Gulf of Nicoya ((10°12' 43.96" N, 85°14' 04.79" W) to La Cutacha (10°25' 19.79" N, 85° 24' 08.19" W), around Hacienda El Pelón de la Bajura. This study updates comprehensively the knowledge on the status of the crocodile population of Tempisque's Great Wetlands (TGW), and allows some conclusions that smooth the way for decision-making on the conservation of the species in the zone.

The study area, termed the "Tempisque Greater Wetlands" (TGW), was quantified using information available in 1:50,000 scale maps of the National Geographic Institute, and supported by observations in Google Earth, verifications in the field, and previous knowledge of the zone and the crocodile population in the different rivers and wetlands of the Tempisque River. The TGW is approximately 150 km^2 in area and contains 224.9 km of surveyable habitat within 18 survey segments representing the different "environments". The study area was subdivided into three zones:

- Upper River Basin (64.1 km), with fast water obstacles, waters with minimum turbidity and stoney bottom;
- Lower River Basin (143.6 km), from the community of Guardia to the Gulf of Nicoya, with waters of slower circulation, wide and more mighty river, turbid waters and bottom of earth or mud; and,
- Zone of Marshes (17.2 km), that represents adjacent swamps, wetlands or water bodies in the Peninsula of Nicoya along the main course of the Tempisque River in the Lower River Basin.

Twenty-two field trips were undertaken between December 2008 and October 2010, averaging 3 nights per trip. Spotlight surveys were typically carried out from 1800 h onwards, and

during lunar phases where the amount of natural light was most reduced. Surveys of each segment could normally be undertaken in the one night, but where this was not possible surveys spanned consecutive nights. Most segments were surveyed at least twice, with the exception of Tempisquito and Irigaray-Guardia which were only surveyed once due to dangers along the route.

An inflatable "Avon" boat (3.5 m) 15HP "Yamaha" outboard motor was used to survey the navigable segments of the Tempisque River. In the Blanco River the same 3.5 m boat was used, but with a 2.5HP motor in the first section and rowing when water depth was too low. In the remaining segments, an inflatable "Air" boat (3.2 m) was used, due to rapids, low depth, rocks, etc. Where crocodiles could not be approached closely for observation or capture due to low water depth, I would proceed by foot in the water to get as close as possible to the crocodiles.

All efforts were made to maintain a standardized methodology in the navigable main channel of the Tempisque River which has been surveyed over the last 15 years. Specifically, the four segments were still recognised (A-D in Table 1), and surveys were undertaken at high tide to avoid getting grounded on sandbanks situated between Puerto Níspero y Puerto Humo. A "Rayovac" torch (6V, 10A) was used to spot crocodiles, and a "Garmin Etrex" GPS was used to track the survey routes. The total length of crocodiles was estimated in 0.5 m size categories [≤0.5 m TL (hatchlings), 0.5-1.0, etc.], and if an estimate of size was not possible animals were recorded as "eyes only" (King *et al*. 1990). The use of 0.5 m categories did not affect the ability to compare results with other studies (eg Bolaños *et al*. 1997; Porras 2004; Sánchez 2001), where counts were classified as hatchlings (<50 cm), recruits (50<100 cm), juveniles (100<150 cm), sub-adults (150<250 cm), adults (>250 cm) and "eyes-only" (Thorbjarnarson 1989).

The results of the surveys are in Table 1. A total of 1355 crocodiles were sighted in 176.8 km, representing 78.6% of the total surveyable area (47.7% of Zone of Marshes, 82.6% of Lower River Basin, 78.0% of Upper River Basin).

To derive a population estimate, two corrections were applied to the survey counts. The first corrected counts for the extent of surveyable habitat that was not surveyed (1355 sightings corrected to 2064). The second correction was applied to account for crocodiles not sighted during the survey (sighting

Table 1. Mean crocodile counts and population estimates (including hatchlings) in different survey segments of the Tempisque Great Wetland. Mean counts were corrected for habitat not surveyed within the surveyable sections ("Corrected for km") and then for visibility/sightability to derive population estimates ("Est. Pop.") for each survey segment. Rec.= recruits.

Size Class	Hatchlings	Rec.	Juveniles	- Sub-adults -		---------- Adults ----------				Eyes	Mean	Corrected	Est.
.Total Length (m)	<0.5	0.5-1.0	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	Only	Counts	for km	Pop.
Upper River Basin													
Rio Corobici	-	-	4	3	-	-	4	-	-	2	13	13	14
Rio Tempisquito	-	5	6	3	5	8	1	-	-	1	29	52	56
Rio Los Ahogados	10	6	2	6	7	1	-	-	-	-	32	56	60
Rio Colorado	4	4	5	2	4	3	1	-	-	-	23	23	25
Irigaray-Guardia	65	31	27	15	5	5				13	161	178	191
Sub-total	**79**	**46**	**44**	**29**	**21**	**17**	**6**	**-**	**-**	**16**	**258**	**323**	**347**
Lower River Basin													
Tempisque - Cauca Principal													
A: Níspero - Humo	15	33	8	8	18	10	18	2	2	9	123	123	140
B: Humo - Chamorro	6	21	8	10	5	1	11	1	-	2	65	65	74
C: Chamorro - Bolsón	22	18	14	16	38	24	33	4	4	5	178	178	202
D: Bolsón - Puente Pelón	25	13	3	3	12	13	18	8	3	11	109	109	124
Rio Bebedero	4	27	26	16	11	6	3	-	1	5	99	99	113
Rio Tenorio	5	6	7	6	4	5	10	-	-	4	47	47	53
Rio Blanco	-	8	-	-	2	1	1	-	-	2	14	30	34
Rio Cañas - Cañas	11	2	5	1	2	9	3	1	-	4	38	67	76
Palmira - Filadelfia	-	3	26	3	10	5	1	-	-	4	52	62	70
Las Bombas - Pelon	-	16	68	47	44	3	4	-	-	8	190	538	612
Sub-total	**88**	**147**	**165**	**110**	**146**	**77**	**102**	**16**	**10**	**54**	**915**	**1317**	**1497**
Zone of Marshes													
Lag. Mata Redonda	20	6	24	3	25	6	4	-	-	25	113	283	314
Rio Charco	3	3	4	2	3	2	2	-	-	2	21	21	23
Rio Bolsón	7	7	9	5	7	4	4	1	-	4	48	120	133
Sub-total	**30**	**16**	**37**	**10**	**35**	**12**	**10**	**1**	**-**	**31**	**182**	**424**	**471**
Totals	**197**	**209**	**246**	**149**	**202**	**106**	**118**	**17**	**10**	**101**	**1355**	**2064**	**2315**

fractions = 93% for Upper River Basin, 88% for Lower River Basin, 90% for Zone of Marshes), resulting in an estimated population of 2315 crocodiles, of which 1951 (84.3%) were considered to be non-hatchlings.

The majority of the non-hatchling population is estimated to be in the Lower River Basin (1262, 64.7%), followed by the Zone of Marshes (397, 20.4%) and the Upper River Basin (292, 15.0%). The overall density was 8.68 NH/km, but density varied greatly between the three zones (Zone of Marshes 23.08 NH/km, Lower River Basin 8.79 NH/km, Upper River Basin 4.56 NH/km).

The Zone of Marshes appears to be an important "refuge" for small-medium sized individuals (Sanchez 2001). Even some "rejected" adult crocodiles from the main channel visit during the reproductive season, and sometimes may remain there indefinitely. The size structure comprised hatchlings (15.7%), recruits (16.7%), juveniles (19.6%), sub-adults (28.0%) and adults (20.0%).

The crocodile population in the navigable main channel of the Tempisque River (A-D in Table 1) represents 23.0% of the total estimated population of the TGW. Comparison with past estimates of 138 and 544 crocodiles in 1993 and 2000 respectively (Sanchez 2001) suggest that the population may have stabilised following a rapid increase between 1993 and 2000 (reflecting mean rate of increase of around 20% per annum). The reasons for the population increase between 1993 and 2000 in this area are unclear, as it occurred despite factors such as habitat alteration (eg agricultural practices and urban encroachment) and human activities in the river that could be considered to reduce the crocodile population.

By way of comparison, Porras (2004) reported a density of 5.58 ind/km in the Tusubres River, on the central Pacific coast of Costa Rica, in the Playa Hermosa Wildlife Refuge, with important farming activity in the zone and constant vigilance of park guards. Rainwater and Platt (2009) reported a density of 0.49 ind/km for *C. acutus* in Blackbird and Calabash Keys, at Turneffe Atoll, Belize. Casas and Méndez (1992) reported a density of 12.3 ind/km in 1989 for *C. acutus* in the Cuitzmala River, Jalisco, Mexico.

In light of the increase in the TGW crocodile population, and its potential impact on human populations and their activities, it would be pertinent to develop and hasten the implementation of management policies to ensure the long-term conservation of the species whilst taking into account the security and needs of local communities.

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[Note: This article represents a summary extracted from a more detailed paper to be presented at the 21st CSG Working Meeting].

Juan Rafael Bolaños Montero, <*cocodrilo1@gmail.com*>.

Colombia

FIRST REPORT OF CAIMÁN AGUJA (*CROCODYLUS ACUTUS*) POPULATION IN THE TAYRONA NATIONAL NATURAL PARK, COLOMBIA. *Crocodylus acutus* is

distributed in 18 countries, ranging from the USA (Florida) in the north to Peru (Pacific coast) and Venezuela (Caribbean cost) in the south (Thorbjarnarson 2010). In Colombia, the Caimán aguja, as this species is named, shows a high cultural and social relevance for Caribbean communities (Ulloa-Delgado and Sierra-Díaz 2002; Balaguera-Reina 2007; Balaguera-Reina and González-Maya 2011), being part of legends (El hombre caiman), folk music (se va el caiman, Author: Cresencio Salcedo) and regional and local festivities (danza del caimán, Ciénaga municipality and carnaval de Barranquilla).

Trade in *C. acutus* skins at the end of the 19th and in the early 20th centuries reduced populations to critical levels in Colombia (Medem 1981), and Law 573 of 1969 was designed to indefinitely ban hunting of *C. acutus* to allow populations to recover. Currently *C. acutus* is listed as Critical Endangered at a national level (Rodriguez 2000) and Vulnerable at a global level (IUCN 2011).

Tayrona National Natural Park (TNNP) was founded in 1969, and is considered a major touristic place of the country, due to high biodiversity and variety of ecosystems (Brüggemann *et al*. 2002). It has an area of 15,000 ha, with both terrestrial and marine territories (Brüggemann *et al*. 2002). Since 2005, one part (Arrecifes and Cañaveral Bays) is a concession to a private company that offers touristic services (accommodation and food) to an significantly increasing number of visitors in this zone.

Until now *C. acutus* had not been reported in the TNNP (crocodilian census 1994 and 1996; Barahona *et al*. 1996; Rodriguez 2000; Parque Nacional Natural Tayrona 2006). The Dibuya Municipality (Guajira Department; Rodriguez 2000) and the Salamanca National Natural Park (Magdalena Department; Balaguera-Reina 2007; Balaguera-Reina and González-Maya 2008a,b) are the nearest zones with records of *C. acutus*.

Observations were made during monthly systematic walks along pre-determined tracks through all bays and beaches by park officials between 2006 to 2011. Opportunistic fauna sightings were recorded. Presence of species, geo-position, external morphology (eg individual identification markings) and observation area were recorded when crocodiles were sighted. This information was compiled within the data files of the park and analyzed using Arcgis 9.3 (Esri 2008) on the Land and Marine Ecosystem of Colombia (IDEAM, IGAC, IAvH, INVEMAR, I. SINCHI, e IIAP 2007) cartography.

The first sighting of *C. acutus* in TNNP was in 2006, in Arrecifes Bay. Since then numbers of sightings have increased, with a current total of 10 individuals greater than 1 m total length in zones such as Cañaveral, La Piscina and Los Naranjos Beaches, Cape San Juan, and Gayraca and Cinto Bays (Fig. 1), and covering both freshwater and marine habitats (Fig. 2). In October 2011, one individual was sighted by fishermen at Grande Beach, Taganga Bay (see Fig. 1), which is outside TNNP; according to local people *C. acutus* has not been sighted there before.

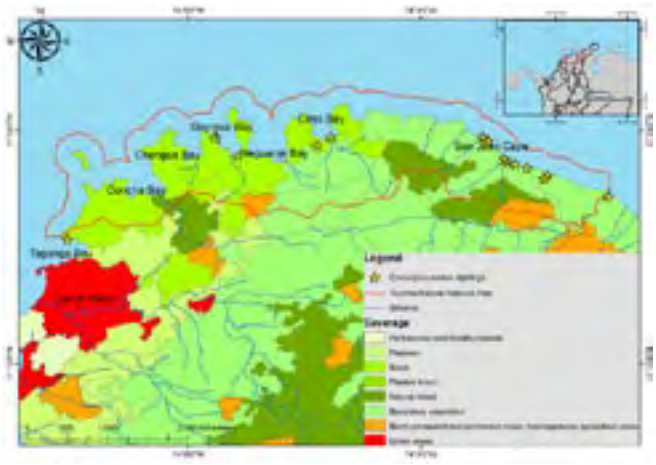

Figure 1. Locations of *Crocodylus acutus* sightings in Tayrona National Natural Park, 2006-2011.

Figure 2. *Crocodylus acutus* sighted at Escondida Beach (top), Cañaveral Swamp (middle) and Gayraca Bay (bottom), in TNNP.

It is important highlight that *C. acutus* has historically been recorded in all Colombian Caribbean, Andean (Magdalena River valley) and Chocó regions less than 500 m above sea level (Thorbjarnarson 2010). However, the few ecological studies on the species in this area (Abadía 1995; Ulloa-Delgado

and Sierra-Díaz 2002; Balaguera-Reina 2007; Balaguera-Reina and González-Maya 2008a,b; Ulloa-Delgado 2011) have shown a fragmented distribution and concentrations in areas of low human intervention.

The *C. acutus* population in TNNP should be given priority for research and conservation due to the lack of knowledge of its ecology and potentially high levels of threat. It is one of the few populations recorded in the Colombian Caribbean, and the TNNP is one of the three protected areas where it has been recorded (also Ciénaga Grande de Santa Marta Fauna and Flora Sanctuary and Salamanca National Natural Park).

The TNNP population of *C. acutus* also provides an opportunity to develop a monitoring program and to quantify the relationship with anthropogenic factors (eg tourists, fishermen and general public) and the reduction of potential human-crocodile conflict due to ignorance and/or fear.

Landscape modification, coastal urban development, the social myth about the species and habitat reduction for agriculture and livestock are the most probable causal factors for the low recovery process of *C. acutus* populations. The protection of wild populations in protected areas is a first step for the conservation of the species, due to the function of such areas as biodiversity sinks, allowing the recuperation and restocking of natural habitats.

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Sergio Alejandro Balaguera-Reina[1], Sandra Navarrete[2], Fabián Pescador[3] and Kelly Rodríguez[3]: *[1]Proyecto de Conservación de Aguas y Tierras ProCAT Colombia Calle 127 b #45-76, Bogotá, Colombia, sabalaguera@procat-conservation.org; [2]Parque Nacional Natural Tayrona, Unidad Administrativa Especial del Sistema de Parques Nacionales Naturales de Colombia, navarretesandra1@gmail.com; [3]Independent. carion83@hotmail.com.*

North America

USA-Canada

The Gladys Porter Zoo (GPZ) in Brownsville, Texas, USA, recently imported an adult pair of Orinoco crocodiles (*Crocodylus intermedius*). The animals originally arrived in Canada as hatchlings from Venezuela in 1987, and were housed at the Seaway Serpentarium, a privately-owned reptile facility in Welland, Ontario. Karel Fortyn, former owner of the facility, passed away suddenly in May 2011, leaving behind hundreds of animals, including the two crocodiles. Before his death, Fortyn had been planning to build them a new facility because they had outgrown their indoor tanks. But after his death, amidst a great deal of legal and interpersonal wrangling, many fans of "Blade" and "Suede" voiced concerns that they should be moved to a warmer climate where they could be kept outdoors.

With cooperation between the US Fish and Wildlife Service and Environment Canada, the relevant import/re-export permits were issued in late September 2011. Ten days later, a crew from the GPZ set off via moving truck on the 40-hour trip to Welland, and was joined in Canada by CSG members Lonnie McCaskill and Curt Harbsmeier, both from Florida. Paul Goulet of Lil' Ray's Reptile Zoo in Ottawa, Canada, served as the agent for Fortyn's estate and provided both logistic support and great entertainment for the US-based entourage. Together, this group made up an enthusiastic team of good "croc" men.

Lonnie McCaskill headed up the capture of the crocodiles from their cramped quarters, an exercise that threatened to be treacherous for both the animals and the team. Blade, the male, is around 4 m long, and Suede, the female around 3.5 m. Fortuitously for us, both crocodiles were quite docile. With a bit of direction from a broomstick wielded by McCaskill, both crocodiles freely walked into crates positioned in an exit door, requiring neither drugs nor tying up. Aside from the broomstick, the only equipment needed was a cutting torch to remove the metal frame holding the bulletproof glass the crocodiles had lived behind for years.

Fortyn and his crocodiles were well known in the little town of Welland. After his death, the six months of uncertainty over the crocodiles' future drew high levels of press. Accordingly, the Welland community was both saddened and energized with well wishes at the word of their departure.

For the GPZ team, rolling away from the US/Canada border and homeward was a fist-in-the-air moment. At the time of unloading at the GPZ, the scales on the crane used to lift the crocodiles and their crates into their new display revealed that the male weighed 365 kg and the female 183 kg.

Figure 1. Blade enters his new enclosure at GPZ.

Despite some cold winter days and colder nighttime temperatures, the animals now remain outdoors all of the time. A swimming pool heater keeps their water at the same temperature to which they are accustomed (27°C), and Blade and Suede are now basking and feeding, and appear to have settled in quite well. A video taken of the Suede's release into her Texas exhibit can be viewed at http://vimeo.com/30913805.

Figure 2. Blade enjoys a catfish.

Figure 3. Suede emerging from her new enclosure at GPZ.

The new Orinoco crocodiles at the GPZ join fewer than 10 wild-caught *C. intermedius* in captivity in North America. It is hoped that the pair will reproduce. At the Seaway Serpentarium the animals were observed copulating, and on at least one occasion Suede laid eggs in the water - there was no nesting area. However, because of territoriality issues, the animals were permanently separated by a wire partition, thus preventing any reproductive activity. Blood samples were collected for genetic analysis prior to release into their new exhibit in Brownsville. Thanks to this infusion of new blood into the North American captive Orinoco crocodile population, the AZA Crocodile Advisory Group has added this species to its growing list of Critically Endangered crocodilians that are managed via formal studbook or a Species Survival Plan.

Many thanks to all who were instrumental in getting these Critically Endangered crocodiles into the sun.

Colette H. Adams, *General Curator, Gladys Porter Zoo*.

CROC FEST 2011, BENEFITING THE CRITICALLY ENDANGERED PHILIPPINE CROCODILE. "Croc Fest 2011" was held on 10 December 2011 at Shawn Heflick's home and facility in Palm Bay, Florida. Proceeds from the event were earmarked for the Mabuwaya Foundation to benefit its work with Philippine crocodiles, *Crocodylus mindorensis*, in northern Luzon. The total amount raised was $US8800.

The BBQ event, which attracted over 100 attendees, was organized and sponsored by Shawn and Jen Heflick, Curt Harbsmeier, Flavio Morrissiey and Bruce Shwedick. Special guests included Colette Adams (North American Coordinator for Philippine Croc Conservation and the General Curator at Gladys Porter Zoo in Brownsville, Texas), Dr. Kent Vliet (Professor at University of Florida and Chair of the AZA's Crocodilian Advisory Group), and Joe Wasilewski (noted field biologist and frequent Nat Geo contributor).

Attendees were able to get "up close and personal" with "Pip," a 12-year-old Tomistoma and "Albi," a 17' albino Burmese python, courtesy of the Crocodilian Conservation Center of Florida and Reptile Discovery Programs. In addition, Gator Adventure Productions in Orlando provided the Gator Adventure Show (presented by Nathan Sweeting and Nick Wright). At the same time, and all through the afternoon, Shawn guided a steady flow of attendees through his reptile facility, showcasing his albino American alligators, African slender-snouted crocodiles, Morelet's crocodiles, and other species.

Jen Heflick, Cindy Moore, Rae Heflick, Megan Terry and Colette Adams helped with the silent auction and t-shirt sales tables throughout the day. Flavio, Joe and Colette performed splendidly as the evening's live auctioneers. The gala event lasted over 8 hours despite a persistent rain. Everyone enjoyed great food (grilled and prepared on site!) and camaraderie while bidding on some real bargains at the live auction.

Funds raised from this event will be routed to the Mabuwaya Foundation via the Gladys Porter Zoo. These funds will be added to the funds generated from the Summer BBQ for Crocs held in June 2011. Accordingly, the total funding raised by this group in 2011 for the Mabuwaya Foundation is just over $US13,000. Auction items were donated by businesses and individuals throughout Florida and other parts of the country. The largest single donation was provided by Gator Adventure Productions.

For additional information about attending, supporting or sponsoring Croc Fest 2012 or the Summer BBQ for Crocs, please contact any of the event organizers: Shawn Heflick (sheflick@aol.com), Curt Harbsmeier (charbsmeier@hdalaw.com), Flavio Morrissiey (flaviomorrissiey@gmail.com), Bruce Shwedick (bshwedick@aol.com).

Shawn Heflick (left), Bruce Shwedick (right), and Pip, a 12-year-old, captive-born Tomistoma. Photograph: The Crocodilian Conservation Center of Florida, Inc.

West and Central Africa

Gabon

REVISITING LAC DIVANGUI, GABON FURTHER SUPPORTS ITS IMPORTANCE FOR *MECISTOPS CATAPHRACTUS*. Lac Divangui is a small lake measuring

approximately 3.6 km in circumference, and at 80 m it is Gabon's deepest lake. Located within Shell's Rabi Oil Exploitation Concession and CBG's Mandji Forest Management Concession, Lac Divangui has been the focus of several biodiversity assessments previously (eg Lahm and Tezi 2006; Mamonekene *et al*. 2006). A series of such studies on the crocodiles of this lake have reported extraordinarily high densities of slender-snouted crocodiles (Barr 2004; Pauwels 2006; Pauwels *et al*. 2003, 2007). We conducted a brief survey of the lake and surrounding areas in August 2011 to assess the crocodile population, determine if it is increasing in response to recent changes in fishing activity in the lake, and collect samples to assess whether this population is genetically isolated from neighboring areas.

A preliminary survey was conducted on 3 August to familiarize ourselves with the area. On the night of 4 August we surveyed the lake from an ocean kayak moving at approximately 2 km/h at a distance 30 m from the shoreline. We spotted crocodiles with a 100/200,000 cp flood/spotlight and LED headlamps. All detected crocodiles were approached as closely as possible to confirm species and size class. The survey lasted nearly two hours and covered a distance of 3.68 km - the entire shoreline. We recorded 106 confirmed sightings of *M. cataphractus* and two Dwarf crocodiles - no Nile crocodiles were detected. The 38 eyeshines recorded were all attributed to *M. cataphractus* (Table 1).

Table 1. Results of survey for *M. cataphractus* in Lac Divangui in June 2003 (Barr 2004) and August 2011 (this study).

Year	---------- Size Class (m) ----------				Eyes	Total
	<0.5	0.5-1.0	1.0-2.0	>2.0	Only	
2003	9	13	24	6	4	56
2011	41	11	44	10	38	144

The resultant encounter rate was 28.8 Slender-snouted crocodiles/km, which is by far the highest encounter rate recorded for any population survey for the species throughout its range (eg Shirley *et al*. 2009 and references therein; Shirley, unpublished data). If eyeshines are included, the encounter rate would be 39.1 Slender-snouted crocodiles/km.

The Slender-snouted crocodiles ranged in size from hatchlings to ±2.5 m total length. A high proportion (73.6%) of individuals sighted were sufficiently approachable to classify, while the remainder submerged before they could be seen well. Despite their general approachability, few individuals allowed close enough approach for capture, and only 6 samples were collected.

Our results are relatively consistent with previously reported values in that an extraordinary density of Slender-snouted crocodiles is to be found at this site (Table 1). However, our count was almost three times higher than that reported by Barr (2004). There are several possibilities for this discrepancy. One possible explanation for the perceived population growth is that the population has in fact increased between 2003 and 2011. At the time of the 2003 surveys, fishing was practiced heavily at the lake. Crocodiles were clearly victims of this activity as evidenced by the dietary analysis of Pauwels *et al*. (2003) which relied on dead crocodiles found drowned in fishing nets. Net fishing has not been banned on the lake, however the closure of the CBG camp "Mongolila" in 2009 doubled the distance to the lake from the nearest permanent settlement of "Petit Village". Since this time it is believed that few people continue to fish the lake, though we discovered many signs of recent human presence (eg bait cups for cane pole fishing and fire pits for cooking/smoking fish) suggesting that the lake is still occasionally used. In general, utilization of the lake for fishing does not have to conflict with crocodile conservation and could be continued with strict regulations against net fishing; though this is only advisable in the event a regular monitoring program is implemented.

Another plausible explanation for the perceived population growth is a discrepancy in detection probability and/or occupancy between survey years. While both surveys were conducted during the dry season, Barr (2004) did not describe the water level conditions during his survey nor did he specify survey distance to verify water level. The lake water level was quite low during the 2011 survey with very few inundated areas and none that were unobservable during the survey. If the water level was higher during the 2003 survey, the most parsimonious explanation for the count discrepancy would not be an increased population, but rather reduced detectability of individuals and reduced lake occupancy due to increased habitat availability (eg the flooded forest and stream network). Indeed during our explorations of the surrounding area we encountered Slender-snouted crocodiles well into the forest streams away from the lake. Alternatively Barr (2004) survey employed a large fiberglass boat with outboard motor which may have resulted in increased crocodile submersion due to noise disturbance reducing detectability.

As remarked by Barr (2004), all observed and captured crocodiles appeared in good general condition. In addition, one nest site was found with its associated hatchling pod and what was likely the mother. A few individual hatchlings which were not clustered near the nest suggest the possibility of another nest site, though they could have also been members of the same clutch that simply dispersed a bit further. Laboratory work is currently underway to assess the degree to which this population is isolated and from where migrant individuals may arrive.

These results confirm that Lac Divangui is an incredibly unique site both in Gabon and throughout Africa. Slender-snouted crocodiles have recently been demonstrated to be in decline globally, with Gabon containing among the last significant populations (Shirley 2010, unpublished data). However, no site thus far in Gabon has been shown to support such high concentrations of Slender-snouted crocodiles. Because of this, and in light of its current status as a conservation easement in the Mandji concession, Lac Divangui should be considered a high priority site for crocodile conservation in Gabon. Further, the establishment of an annual monitoring program for the site would not only allow us to better understand

population growth in an undisturbed crocodile population, but would serve as a baseline set of data against which crocodile population growth, or decline, throughout the country could be assessed.

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I would like to thank the Smithsonian and Shell Gabon for their efforts in making this survey happen and their permission to do so. In particular, Marguerite Butler worked tirelessly to ensure the necessary administration and logistics were flawlessly executed. I thank my field companions Britt Burtner and Landry Tchignoumba for their assistance and enthusiasm in the field. Thank you to Jacqueline van de Pol for offering her support and the use of her canoe. Finally, we thank Wynand Viljoen for lending us the ocean kayak from which we were able to survey the lake.

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Matthew H. Shirley, *Department of Wildlife Ecology and Conservation, University of Florida, USA.*

South Asia and Iran

India

The annual census of Saltwater crocodiles, *Crocodylus porosus,* was conducted in river systems inside and outside of Bhitarkanika National Park of Orissa State from 28 December 2011 to 2 January 2012. A total 1646 crocodiles was counted, comprising 489 hatchlings, 320 yearlings, 423 juveniles, 154 sub-adults and 260 adults. Prior to the implementation of a "rear and release" program, the population census in 1976-77 reported 96 crocodiles (61 hatchlings/juveniles, 6 sub-adults and 29 adults). Relative density has increased from 0.87 in 1976-77 to 12.0 in 2011/12 - a 1279% increase over 35 years!

More than 2300 captive-reared crocodiles (approximately 1 m total length) from the Dangmal Crocodile Research Centre have been released into the river systems of the National Park in various phases since 1977 (the release program has been discontinued for over a decade as natural recruitment from about 65 wild nests now occurs). It should be noted that Bhitarkanika crocodile habitat represents around 6-7% of Indian Sundarban Saltwater crocodile habitat.

The rivers/creeks with the following characteristics have the highest concentrations of crocodiles:

a. Good mangrove cover/fringing mangrove vegetation.
b. Good network of creeks and creeklets.
c. Stretches of undisturbed mudbanks favoured as basking/resting spots.
d. Less human disturbance as there is little or no fishing activities.
e. Hypo-saline condition of water in the creeks, etc., the trend of which is more toward being fresh water than saline.
f. Depth of water is at a minimum of 1.5 m at the ebb-tide.

The results of this census confirm the success of the Saltwater crocodile "rear and release" program in Bhitarkanika SanctuaryNational Park that started in mid-1975.

Dr. Sudhakar Kar, <*kar.sudhakar@gmail.com*>.

SIGHTING OF MUGGER CROCODILE (*CROCODYLUS PALUSTRIS*) AT WADHAVANA RESERVOIR, DABHOI, VADODARA, GUJARAT. The Mugger crocodile (*Crocodylus palustris*) is most commonly and widely distributed threatened crocodilian in India (Whitaker and Andrews 2003). The species is legally protected as 'Schedule-I' species in the *Indian Wildlife (Protection) Act-1972* and categorized as 'Vulnerable' in the IUCN Red List (De Silva and Lenin 2010). The species was previously depleted throughout its range due to various threats, including illegal hunting, fishing,

pollution and habitat loss. However, recent evidence indicates that the Mugger population is flourishing as a result of legal protection and successful *ex-situ* programs (Singh 1999), and the same situation exists in Gujarat State (Vijay Kumar 1997; Vijaykumar *et al*. 1999a,b; Vyas 2008).

On 7 January 2012, we visited Wadhavana Reservoir to observe winter migratory bird species. We found various migratory birds flocking in good numbers - together with an an adult Mugger. The Mugger was basking on a small island, along with Comb Ducks (*Sarkidiornis melanotos*) and Grey Leg Geese (*Anser anser*) (Fig. 1). What astounded us was the fact that the Mugger was so close to these birds, without causing any apparent disturbance.

Figure 1. Mugger sighted basking amongst ducks and geese at Wadhavana Reservoir.

After the sighting of the Mugger, we carefully scanned the entire water body from all sides using binoculars (10 x 40). No other Muggers were sighted, but we recorded three species of aquatic reptile in notable numbers - two turtles (*Nilssonia gangeticus* and *Lissemys punctata*) and one snake (*Xenochrophis piscator*).

On 14 January 2012 we visited the reservoir again with the purpose of a more detailed investigation. After surveying the entire water body carefully, we gathered verbal data from the locals and forest staff about crocodiles. According to Mr. Raman Tadavi (Security Guard, Forest Department), he observed three Muggers in the reservoir since the last monsoon - all were estimated to be 1.5-2.0 m long.

The Wadhavan Reservoir (22°10'20.59"N; 73°29'03.68"E) is geographically situated in Dabhoi tehsil, Vadodara District, encompassing an area of 11.2 km^2. In 2004 it was declared as a Nationally Important Wetland by the Union Ministry of Environment and Forests and Forest Department, Gujarat. The reservoir is a century-old man-made earthen dam, constructed by Shrimant Maharaja Sir Sayajirao Gaekwad III of erstwhile State of Baroda in 1909-1910, and built with the purpose of providing water to agricultural fields. The area falls in Semi Arid Zone of central Gujarat and the average rainfall received by the area is comparatively less and fluctuating.

Vijay Kumar (1997) surveyed the entire State and published accounts of Mugger in each water body, but he did not record any Muggers from Wadhavan Reservoir. Therefore, this sighting represents the first record of Mugger from Wadhavan Reservoir, and raises the question as to how and from where this crocodile originated? There are three possibilities:

1. Forest Department, Government agencies and NGOs who work on wildlife rescue and conservation may have relocated the animal into the reservoir. This possibility is considered unlikely.

2. Ajwa Lake and Dev Dam contain a small population of Muggers (Vyas 2010). These areas are about 25 km away from the reservoir, and there is no direct connectivity between them. The chances of Mugger travelling between the two areas is considered low.

3. In the recent past, Wadhavana Reservoir was connected by Karjan-Amod branch canal through the main canals of Narmada Dam by the Sardar Sarover Narmada Nigam Limited (SSNNL) and State Irrigation Department, Gujarat, for excess water storage. Water canal is the one of best routes for migration of crocodiles, and thus the most likely scenarion is that the Mugger came through the Narmada Canals.

Vyas and Basu (2008) earlier emphasized and predicted the impact of Narmada Canal on Mugger population, stating that "It is difficult to say what the size of the mugger population will be in a few years of time, particularly in the large new network of canals and water bodies created by the Narmada Dam Project. Narmada canals and all connected water bodies may become one of the best habitats of muggers in the country". Narmada water inundation has a positive impact on the migratory birds, especially on the diving ducks, but has an adverse effect on the Marsh ducks and Dabbling (Padate *et al*. 2008).

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Raju Vyas *(505, Krishnadeep Tower, Mission Road, Fatehgunj, Vadodara, Gujarat-India, razoovyas@hotmail.com)*, Pritesh Patel *(Nr. Pramukh Hospital, Atladara, Vadodara, Gujarat)* and Kartik Upadhyay *(B 104 Premsagar Apartment, Nr. Rameshwar Temple, Ellora Park, Vadodara, Gujarat).*

East and Southeast Asia

Malaysia

NEW FIELD RECORD OF *TOMISTOMA SCHLEGELII* FOR PENINSULAR MALAYSIA AND CLARIFICATION OF A PREVIOUSLY PUBLISHED RECORD. *Tomistoma schlegelii* (IUCN Red List 'Endangered') was first recorded in Peninsular Malaysia in 1895 (Boulenger 1896) but since then few field records supported by specimens or other direct evidence have been published. In a review of the global distribution of *T. schlegelii* Stuebing *et al*. (2006) could locate only 9 confirmed records (comprising museum specimens and reliable sightings) for Peninsular Malaysia. This note presents a new field record of *T. schlegelii*, and clarifies the status of an existing record, both from Peninsular Malaysia.

A previously undocumented photograph taken by Graham Lenton (Fig. 1) in 1978 represents a new field record of *T. schlegelii* for Peninsular Malaysia (Location: Tasek Bera Ramsar Site, Pahang State (no geographic coordinates available; a general geo-reference for the park is: 3° 13'N, 102° 32'E). The photograph is held at the Museum of Zoology, University of Malaya (Kuala Lumpur), with the accompanying caption: "False Gharial *Tomistoma schlegelii* snared by orang asli at Tasek Bera in 1978. The gharial probably landed in the cooking pot. ©G. Lenton". The photograph displays a large (>3 m total length) adult *T. schlegelii*, and was clearly taken shortly after the specimen was caught. 'Orang asli' ('aboriginal people' in Malay language) refers to the local ethnic groups which live in this park. Graham Lenton, an ecologist, conducted research in Peninsular Malaysia in the late 1970s on the use of barn owls to control rats in oil palm plantations, and the photograph was apparently taken during an incidental visit to Tasek Bera. No other details are available and G. Lenton could not be located for the present note. The record is notable in that it appears to be the first photograph of a wild, live *T. schlegelii* from Peninsular Malaysia, as well as the third confirmed record of this species for Tasek Bera National Park (Simpson *et al*. 1998; Stuebing *et al*. 2006).

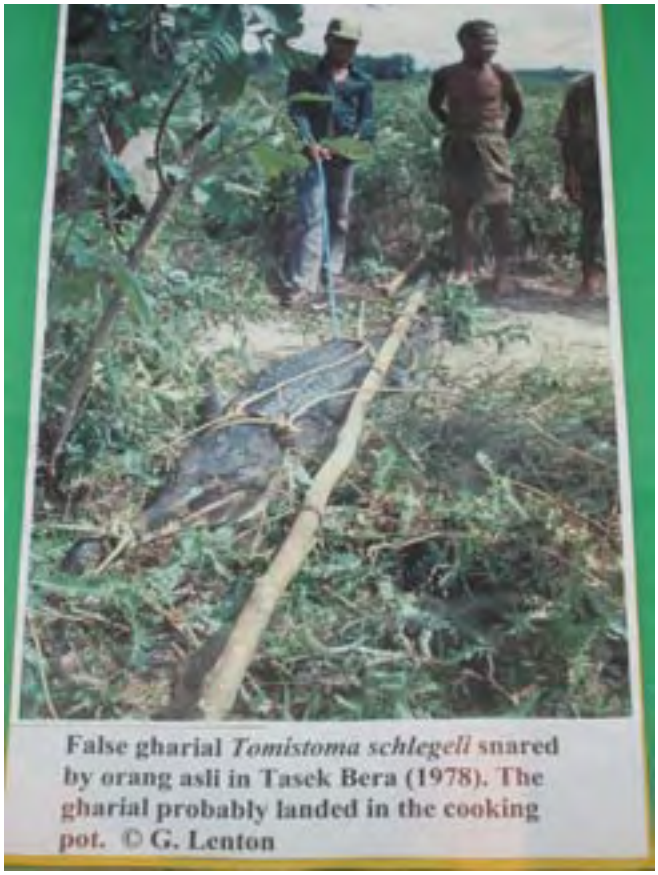


Figure 1. *Tomistoma schlegelii*, Tasek Bera National Park, Peninsular Malaysia. Photographer: Graham Lenton. Photograph held at the Museum of Zoology, University of Malaya (Kuala Lumpur).

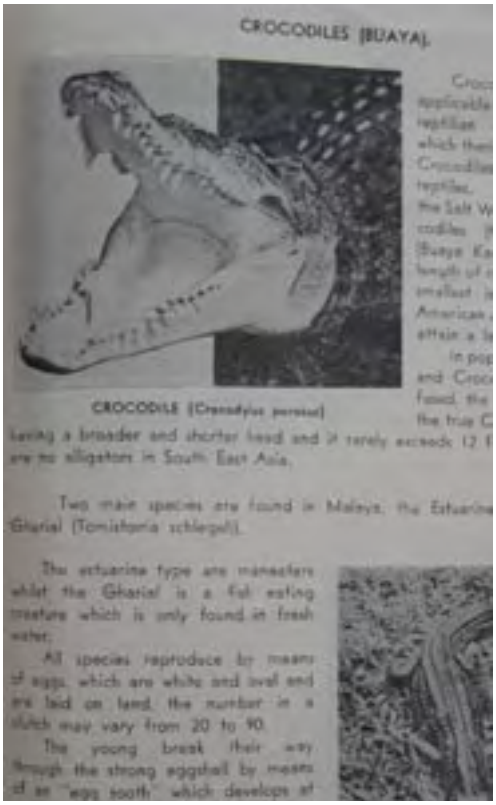
An existing record for Peninsular Malaysia is based on photographs taken by one of the authors, WG, of the dorsal and ventral views of a juvenile *T. schlegelii* (Fig. 2). These photographs were published in Chan-ard *et al*. (1999: 233), a pictorial guide to herpetofauna (now out of print), with the accompanying caption: '*Tomistoma schlegelii*. Sunda

Gavial/Sunda-Gavial. Juvenile specimen from Tasek Kenyir (lake), Terengganu, Malaysia'. No other details accompany the record. On the basis of this information, Stuebing *et al.* (2004, 2006) assigned this as the first confirmed record of the species for Terengganu State and provided a general geo-reference for the lake (5°55'N, 102°45'E), but did not contact WG. Although not stated by Stuebing *et al.* (2004, 2006), their implicit acceptance of the record accords it considerable geographic significance, as the first confirmed record of *T. schlegelii* from the eastern portion of Peninsular Malaysia. The photographs are in fact of a captive specimen taken at the facility of a wildlife trader on Penang Island (located off the north-west coast of Peninsular Malaysia), on 5 February 1997. The trader possessed two other *T. schlegelii* of the same size, and related to WG that all three individuals were purchased from a fisherman from Kenyir Lake. To reach Penang Island from Kenyir Lake would involve a drive of several hours across the peninsula. The claims of the trader regarding the capture locality of these specimens cannot be substantiated and this new information renders the record invalid.

Figure 2. *Tomistoma schlegelii*, captive, Penang Island, Peninsular Malaysia. Photographer: Wolfgang Grossmann. Reproduced from Chan-ard *et al.* (1999: 233).

Assuming that the three juveniles observed by WG originated locally, this confirms that at least until the late 1990s, breeding *T. schlegelii*, and successful recruitment, occurred in at least one (unknown) locality in the peninsula. Commercial trade in *T. schlegelii* occurred in the peninsula several decades previously (Simpson et al. 1998); the observations of WG suggest that some trade may still occur. For Kenyir Lake, the potential occurrence of *T. schlegelii* remains unknown. Brief opportunistic interviews with local residents about the occurrence of crocodiles, as well as frequent boat travel on the lake, both undertaken in the course of other research (between 2000 and 2010), did not detect any crocodile records (S.A.M. Sah, in litt.), although no systematic crocodile surveys of the lake have been conducted.

A photograph of a juvenile *T. schlegelii* (labeled 'Gharial') is given in Metcalfe and Lim (1959: 35), but the background indicates it is almost certainly a captive individual; no other details are provided. The publication is out of print and difficult to obtain, and their page on crocodiles, which also mentions the occurrence of *Crocodylus porosus* in Peninsular Malaysia, is reprinted here for general interest (Fig. 3).


CROCODILES (BUAYA).

CROCODILE (*Crocodylus porosus*)

having a broader and shorter head and it rarely exceeds 12 f
are no alligators in South East Asia.

Two main species are found in Malaya, the Estuarine
Gharial (*Tomistoma schlegeli*).

The estuarine type are maneaters
whilst the Gharial is a fish eating
creature which is only found in fresh
water.

All species reproduce by means
of eggs, which are white and oval and
are laid on land, the number in a
clutch may vary from 20 to 90.

The young break their way
through the strong eggshell by means
of an "egg tooth" which develops at

Figure 3. Page on crocodiles reproduced from Metcalfe and Lim (1959: 35).

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Stuebing, R.B., Bezuijen, M.R., Auliya, M. and Voris, H.K. (2006). The current and historic distribution of *Tomistoma schlegelii* (the False Gharial) (Müller 1838) (Crocodylia, Reptilia). The Raffles Bulletin of Zoology 54(1): 181-197.

Mark R. Bezuijen[1], Sasekumar Gapillay[2] and Wolfgang Grossmann[3]. *[1]P.O. Box 183, Ferny Creek, Victoria 3786, Australia <bezuijen@dodo.com.au>; [2]Institute of Biological Sciences, University of Malaya, Selangor 50603, Malaysia <sasekumarster@gmail.com>; [3]Wulfila-Ufer 33, 12105 Berlin, Germany <wg-gekko@t-online.de>.*

Science

Recent Publications

Axelsson, M. and Franklin, C.E. (2011). Elucidating the responses and role of the cardiovascular system in crocodilians during diving: fifty years on from the work of C.G. Wilber. Comp. Biochem. Physiol. A Mol. Integr. Physiol. 160(1): 1-8.

Abstract: In 1960, C.G. Wilber in a laboratory-based study described for the first time the changes in heart rate with submergence in the American alligator noting in particular the marked bradycardia that occurred during forced dives. This short review summarizes the major advances in our understanding of diving and the responses and role of the cardiovascular system of crocodilians during submergence in the 50 years since Wilber published his findings. These advances are attributable in part to the technological advances made in physiological monitoring devices and wildlife telemetry that have not only provided greater elucidation of the hemodynamics of the unique crocodilian cardiovascular system but also allowed the natural diving behaviors and heart rates in free-ranging crocodiles to be recorded. Of note, telemetric field-based studies have revealed that wild free-ranging crocodiles typically undertake only short dives, less than 20 min, yet crocodiles are also capable of dives of many hours in duration. In contrast to Wilber's study, dives recorded from free-ranging crocodiles were found to be accompanied by only a modest bradycardia, highlighting the often confounding effects associated with captive animals monitored under laboratory conditions. More recent studies have also documented the complex central flow and pressure patterns of crocodilians, including a pulmonary to systemic shunt that can be initiated by a unique intracardiac valve located in the subpulmonary conus. The role and significance of this cardiac shunt remains controversial and the focus of recent lab-based studies. We contend that elucidation of the role and significance of the cardiac shunt in crocodilians will only be achieved by monitoring telemetrically the central cardiovascular flows and pressures in non-captive animals that are undisturbed and free-ranging. This presents the challenge ahead in the next 50 years.

Moore, B.C., Mathavan, K. and Guillette Jr., L.J. (2011). Morphology and histochemistry of juvenile male American alligator (*Alligator mississippiensis*) phallus. Anat. Rec. (doi: 10.1002/ar.21521).

Abstract: Phalli of male crocodilians transfer sperm to female cloaca during sexual intercourse, resulting in internal fertilization. For over a century there have been scientific descriptions of crocodilian phallus morphologies; however, little work has presented detailed cellular-level analyses of these structures. Here we present a histological investigation of the complex functional anatomy of the juvenile male American alligator phallus, including fibrous and vascular erectile structures, a variety of secretory epithelium morphologies, and observed immune cells. Using 3D reconstruction software, we show the shape and location of vascular erectile tissues within the phallus. Histochemical staining detected mucin-rich secretory cells in glandular epithelial cells of the phallic shaft and also of the semen-conducting ventral sulcus. Lymphoid aggregates, lymphocytes, and epithelial mucin coats suggest an active immune system in the phallus defending from both the external and intracloacal environments. These results better characterize the complexity of the alligator phallus and predict later reproductive functions during adulthood

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Kang, J., Zhang, W., Song, W., Shen, D., Li, S., Tian, L., Shi, Y., Liang, G., Xiong, Y. and Chen, Q. (2011). Apoptosis mechanism of human cholangiocarcinoma cells induced by bile extract from crocodile. Applied Biochemistry and Biotechnology (doi: 10.1007/s12010-011-9482-x).

Abstract: Animal bile is popularly used as a traditional medicine in China, and bile acids are their major bioactive constituents. In the present study, effects of bile extract from crocodile gallbladder on QBC939 cell growth, cell cycle, and apoptosis were investigated by MTT assay, inverted microscopy, fluorescence microscopy, transmission electron microscopy, scanning electron microscopy, PI single- and FITC/PI double-staining flow cytometry, and western blotting. Our data have revealed that bile extract inhibited cells growth significantly, and the cell cycle was arrested in G1 phase. Bile extract induced QBC939 cell apoptosis, which was associated with collapse of the mitochondrial membrane potential and increase of ROS. In bile extract-treated cells, it was observed that the expression of bcl-2 decreased and cytochrome c released to cytosol, but the expression of bax remained unchanged. The data indicated that mitochondrial

pathway might play an important role in bile extract-induced apoptosis in QBC939 cells. These results provide significant insight into the anticarcinogenic action of bile extract on cholangiocarcinoma cells.

Roh, Y., Park, H., Cho, H., Cho, A., Islam, M.R., Cho, H., Lim, C.W. and Kim, B. (2011). *Aeromonas hydrophila*-associated septicemia in captive crocodiles (*Crocodylus johnstoni* and *Crocodylus porosus*). Journal of Zoo and Wildlife Medicine 42(4): 738-742.

Five 25-yr-old crocodiles (*Crocodylus johnstoni* and *C. porosus*) were diagnosed with *Aeromonas hydrophila*-associated septicemia accelerated by improper thermoregulation. At necropsy, pulmonary congestion and pleural effusion were the main lesions in the thorax. Necrotizing enteritis, intestinal hemorrhage, fibrinous serositis, hepatitis, and pancreatitis were observed in the abdominal cavities of all five crocodiles. *Aeromonas hydrophila* was identified in the pleural effusions and abdominal ascites of all necropsied crocodiles by using an API system 20NE. *Aeromonas hydrophila* infection and evaluation of virulence were confirmed by polymerase chain reaction targeting the 16S rRNA and extracellular hemolysin gene. The crocodiles in the present case were housed in an indoor facility at a private zoo that failed to optimize land and water portions of the enclosure, exposing the animals to impeded thermoregulation, and it is suggested that the pathogenesis was accelerated by the improper thermoregulation-induced stress. This is the first description of *A. hydrophila* pathogenicity associated with impeded thermoregulation in reptiles.

Zayas, M.A., Rodríguez, H.A., Galoppo, G.H., Stoker, C., Durando, M., Luque, E.H. and Muñoz de Toro, M. (2011). Hematology and blood biochemistry of young healthy Broad-snouted caimans (*Caiman latirostris*). Journal of Herpetology 45(4): 516-524.

Abstract: *Caiman latirostris* (Broad-Snouted Caiman) is widely distributed in wetlands and rivers of South America. Hematological and blood chemistry reference values are necessary for detecting the effects of environmental, infectious, parasitic, or toxicological stress on *C. latirostris* health. Peripheral blood samples were obtained from 24 healthy 6- to 18-month-old caimans. Blood cell dimensions and cytochemistry profiles were described; and reference intervals for hematological parameters, enzyme activities, and clinical analytes were established. Based on the caiman mass frequency distribution, two classes were distinguished: 125-900 g and 901-3100 g. Although an overlap in age ranges was observed, total length and snout-vent length range values from both mass classes differed. This finding is particularly useful because, in the wild, caiman age is unknown, whereas growth parameters can be easily recorded. Caiman blood cells exhibited morphological features similar to those of other reptiles, with lymphocytes being the most numerous type of leukocytes. Significant positive correlations between mass and hemoglobin concentration, hematocrit, red blood cell, and white blood cell counts were observed. Neither sex nor age was associated with differences in these parameters. Analysis of blood chemistry values found in this study was done by comparing with values reported for related species. Both similarities and discrepancies with values from other crocodiles are discussed. This study provides baseline information from healthy juvenile caimans to which subsequent measurements can be compared. These data will aid in the medical management of caiman farms, zoo conservation programs, and field studies.

Brochu, C.A. (2012). Phylogenetic relationships of *Necrosuchus ionensis* Simpson, 1937 and the early history of caimanines. Zoological Journal of the Linnean Society 163: S228-S25.

Abstract: Cranial fragments associated with the holotype of *Necrosuchus ionensis* reveal a dorsally shifted foramen aereum on the quadrate and a long, slender descending process of the exoccipital lateral to the basioccipital and approaching the basioccipital tubera. The former suggests that *Necrosuchus* is an alligatoroid and not a crocodylid, as first suggested; and the latter that it is a caiman. The scapulocoracoid shows evidence of early closure of the synchondrosis, further supporting a caiman affinity. Although we cannot yet pinpoint the phylogenetic placement of *Necrosuchus* amongst caimans, it nevertheless establishes a caimanine presence in South America by the Early Palaeocene. A review of other Palaeocene-Eocene caimans reveals a complex biogeographical history suggesting multiple dispersal events between North and South America, even if the modern caiman assemblage is monophyletic.

Brochu, C.A., Parris, D.C., Smith Grandstaff, B., Denton Jr., R.K. and Gallagher, W.B. (2012). A new species of *Borealosuchus* (Crocodyliformes, Eusuchia) from the Late Cretaceous-early Paleogene of New Jersey. Journal of Vertebrate Paleontology 32(1): 105-116.

Abstract: A lower jaw and associated postcranial remains from the Late Cretaceous-early Paleocene Hornerstown Formation of New Jersey form the basis of a new crocodyliform species, *Borealosuchus threeensis*. Although one of the oldest known species of *Borealosuchus*, phylogenetic analysis supports a closer relationship to *Borealosuchus* from the early Eocene than with other Late Cretaceous or early Paleocene forms. This is based on the shared presence of a short mandibular symphysis excluding the splenial, a small external mandibular fenestra, and ventral osteoderms composed of two sutured ossifications. It is also similar to Borealosuchus material from the Paleocene of western Texas, though conspecificity cannot be demonstrated at present. A close relationship with the basal alligatoroids *Leidyosuchus* or *Diplocynodontinae* is not supported. The distribution of lower jaws with very small slit-like external mandibular fenestrae, or no fenestrae at all, among basal crocodylian lineages (including *Borealosuchus*) and close crocodylian relatives suggests the fenestrae may have been ancestrally absent in Crocodylia and regained two or more times. Current phylogenetic hypotheses are consistent with dispersal of more-derived species of *Borealosuchus* to

the Western Interior during the Paleocene, and they indicate the presence of several unsampled lineages crossing the Cretaceous-Paleogene boundary.

Riff, D. and Kellner, A.W.A. (2011). Baurusuchid crocodyliforms as theropod mimics: clues from the skull and appendicular morphology of *Stratiotosuchus maxhechti* (Upper Cretaceous of Brazil). Zoological Journal of the Linnean Society 163: S37-S56.

Abstract: The Baurusuchidae crocodyliforms are usually interpreted as active terrestrial predators, but only some positive evidence of such habits has been described to date, mainly the relative position of external nares and orbits. Here we describe features that support this view in a complete specimen of the Baurusuchidae *Stratiotosuchus maxhechti*, and have executed a parsimony analysis to confirm their phylogenetic position. *S. maxhechti* exhibits theropodomorph features that have been previously recognized in skulls of the Baurusuchidae, as well as postcranial characteristics related to a parasagittal gait, showing that the similarities between the Baurusuchidae and theropods extend beyond the cranial morphology. These include a well-developed supracetabular crest, a relatively medially offset femoral head and a caudally orientated calcaneal tuber. The orientations of the surfaces for muscular attachments imply that the appendicular movements of S. maxhechti were mainly anteroposterior, with abduction significantly constrained. *S. maxhechti* presents features that mimic some present in theropods, including a 'fossa brevis' on the ilium and tubercles on the ischium and femur similar to the obturator process and accessory trochanter. The relative proportions of the femur, tibia, and longer metatarsal are more similar to those of *Postosuchus* than to other Crocodylomorpha. In the skull, besides the theropodomorph (ziphodont) dentition concentrated in the anterior half of the rostrum, the baurusuchids are remarkable by the fusion of the nasals, which can be related to a large resistance against feeding forces acting on a high-profile skull. The appendicular morphology of *S. maxhechti* strengthens the interpretation that the Baurusuchidae were active land-dwelling predators in the Upper Cretaceous of south-eastern Brazil, occuping ecological niches typical of small to medium-sized theropod dinosaurs.

Clark, J.M. (2011). A new shartegosuchid crocodyliform from the Upper Jurassic Morrison Formation of western Colorado. Zoological Journal of the Linnean Society 163: S152-S172.

Abstract: A small new basal crocodyliform, *Fruitachampsa callisoni* gen. nov., sp. nov., is represented by several partial skeletons from the Morrison Formation at the Fruita Paleontological Area near Grand Junction, Colorado. It is placed in the Family Shartegosuchidae Efimov, 1988, previously comprising three genera from the Late Jurassic locality of Shar Teeg in western Mongolia and possibly a fourth genus from the Early Cretaceous of Siberia. Shartegosuchids share a sculpted palatal surface of the pterygoids, the absence of a mandibular fenestra, and posterior maxillary teeth and post-caniniform dentary teeth with a flat and horizontal apical region and vertical crenulations extending basally from it. *Fruitachampsa* and *Shartegosuchus* form a clade supported by ventral half of the lacrimal tapering ventroposteriorly, sculpturing on palatines, and lower teeth absent anterior to caniniforms. The shartegosuchids are most parsimoniously considered to be outside of the mesoeucrocodylian clade and are possibly allied with the Asian taxa *Shantungosuchus*, *Sichuanosuchus*, and *Zosuchus*. *Fruitachampsa* is unusual in possessing a series of small protuberances along the occipital margin of the parietal and squamosal and procoelous vertebrae, and lacking an antorbital fenestra or fossa. This is the first occurrence of a shartegosuchid in North America, and the close relationship of *Fruitachampsa* with *Shartegosuchus* nested among other Asian taxa indicates it dispersed to North America from Asia.

Nascimento, P.M. and Zaher, H. (2011). The skull of the Upper Cretaceous baurusuchid crocodile *Baurusuchus albertoi* Nascimento & Zaher 2010, and its phylogenetic affinities. Zoological Journal of the Linnean Society 163: S116-S131.

Abstract: We here describe the cranial remains of *Baurusuchus albertoi* Nascimento & Zaher, 2010, a Baurusuchidae from the Upper Cretaceous of Brazil that is known from a partially complete and articulated skeleton. The cranial anatomy provided important new information that allowed a more accurate analysis of its phylogenetic affinities. Phylogenetic results suggest that *B. albertoi* is the sister-group of a clade formed by *Baurusuchus pachecoi* and *Baurusuchus salgadoensis*. Characters that place *B. albertoi* within the family Baurusuchidae are: antorbital portion of the jugal more than two times higher than the infratemporal part; rod-shaped infratemporal bar of the jugal; dorsal process of the quadratojugal extensively contacting the postorbital; posterolateral process of squamosal totally deflected ventrally; cervical neural spines anteroposteriorly large; spool-shaped vertebral centra; cranial table as wide as ventral portion. *Baurusuchus albertoi* differs from the remaining two species of the genus by having a more excavated triangular depression of the jugal suborbital portion, an area that is also more ventrally developed; a vertical and lateromedially thin retroarticular process; and descending expansion of the lateral edge of the squamosal anteriorly concave.

Fortier, D., Perea, D. and Schultz, C. (2011). Redescription and phylogenetic relationships of *Meridiosaurus vallisparadisi*, a pholidosaurid from the Late Jurassic of Uruguay. Zoological Journal of the Linnean Society 163: S257-S272.

Abstract: *Meridiosaurus vallisparadisi* Mones, 1980, a freshwater pholidosaurid from the Late Jurassic of Uruguay, is redescribed herein. It can be diagnosed by the possession of the following combination of features: (1) lateral constriction of the rostrum at premaxilla-maxilla contact, strong lateral expansion of the premaxilla with the fifth tooth placed in the widest portion; (2) sinusoidal premaxilla-maxilla suture in palatal view, posteromedially directed on its lateral half, and anteromedially directed along its medial region; (3) evaginated maxillary alveolar edges forming a discrete collar

at each alveolus, lateroventrally oriented; (4) greater number of maxillary teeth (at least 27) with respect to *Elosuchus* (less than 20 maxillary teeth); (5) nasals do not meet premaxilla dorsally; (6) strong sinusoidal lateral contour of snout in dorsal view, with respect to the similar condition of *Elosuchus*, forming two waves ('festooned'); and (7) third, fourth, and fifth alveoli are equally enlarged. A phylogenetic analysis was performed, including six pholidosaurids: *Elosuchus*, *Meridiosaurus*, *Oceanosuchus*, *Pholidosaurus*, *Sarcosuchus*, and *Terminonaris*. The analysis confirmed the monophyly of Pholidosauridae, and a new definition is proposed: a stem-based group name including *Pholidosaurus schaumburgensis* Meyer, 1841 and all taxa closer to it than to *Dyrosaurus phosphaticus* (Thomas, 1893) or *Pelagosaurus typus* Bronn, 1841. Pholidosauridae originated in Europe during the Middle Jurassic, dispersed to Africa, and North and South America, in several dispersal events, and completely disappeared in the Late Cretaceous.

Moraes-Santosi, H., Villanueva, J.B. and Toledo, P.M. (2011). New remains of a gavialoid crocodilian from the late Oligocene-early Miocene of the Pirabas Formation, Brazil. Zoological Journal of the Linnean Society 163: S132-S139.

Abstract: New specimens of gavialoids collected from the Pirabas Formation, Brazil, provide additional information about the evolutionary evolution of Gavialoidea during the late Oligocene-early Miocene. We describe a specimen that has a more gracile symphyseal mandible than any other South American gavialoid. This fossil represents an unusually diverse radiation of gavialoids that were probably ecologically differentiated from each other by size and dietary specialization.

Whiting, S.D. and Whiting, A.U. (2011). Predation by the saltwater crocodile (*Crocodylus porosus*) on sea turtle adults, eggs, and hatchlings. Chelonian Conservation and Biology 10(2):198-205.

Abstract: This paper describes predation tactics used by the saltwater crocodile (*Crocodylus porosus*) on flatback (*Natator depressus*) and olive ridley (*Lepidochelys olivacea*) sea turtles on nesting beaches in northern Australia. For adult turtles, crocodiles used both a sit-and-wait tactic in which they attacked a turtle at the water's edge after it completed nesting and an active hunting strategy in which crocodiles followed turtle tracks into the dunes to attack turtles at nest sites. Saltwater crocodiles also hunted sea turtle hatchlings in the dunes and excavated a sea turtle nest and consumed the eggs. The protection of saltwater crocodiles in Australia starting in the early 1970s has led to increased population sizes and a greater proportion of larger individuals. This likely has resulted in increased predation rates on sea turtles over several decades, which should be considered as an important mortality component for some tropical nesting aggregations.

Wilson, S.M., Zhu, T., Khanna, R. and Pritz, M.B. (2011). Quantitative RT-PCR analyses of five evolutionary conserved genes in Alligator brains during development. Translational Neuroscience 2(4): 339-343.

Abstract: Gene expression was investigated in the major brain subdivisions (telencephalon, diencephalon, midbrain and hindbrain) in a representative reptile, *Alligator mississipiensis*, during the later stages of embryonic development. The following genes were examined: voltage-gated sodium channel isoforms: NaV1.1 and NaV1.2; synaptic vesicle 2a (SV2a); synaptophysin; and calbindin 2. With the exception of synaptophysin, which was only expressed in the telencephalon, all genes were expressed in all brain regions sampled at the time periods examined. For NaV1.1, gene expression varied according to brain area sampled. When compared with NaV1.1, the pattern of NaV1.2 gene expression differed appreciably. The gene expression of SV2a was the most robust of any of the genes examined. Of the other genes examined, although differences were noted, no statistically significant changes were found either between brain part or time interval. Although limited, the present analysis is the first quantitative mRNA gene expression study in any reptile during development. Together with future experiments of a similar nature, the present gene expression results should determine which genes are expressed in major brain areas at which times during development in *Alligator*. When compared with other amniotes, these results will prove useful for determining how gene expression during development influences adult brain structure.

Gauthier, J.A., Nesbitt, S.J., Schachner, E.R., Bever, G.S. and Joyce, W.G. (2011). The bipedal stem crocodilian *Poposaurus gracilis*: inferring function in fossils and inovation in Archosaur locomotion. Bulletin of the Peabody Museum of Natural History 52(1): 107-126.

Abstract: We introduce a spectacular new specimen of a Late Triassic stem crocodilian identified as *Poposaurus gracilis*. It is part of a poorly known group, Poposauroidea, that, because of its striking similarities with contemporaneous stem avians ("dinosaurs"), has long puzzled archosaur paleontologists. Observed vertebrate locomotor behaviors, together with exceptional preservation of distinctive anatomical clues in this fossil, enable us to examine locomotor evolution in light of new advances in phylogenetic relationships among Triassic archosaurs. Because this stem crocodilian is unambiguously an archosaur, a diapsid, a tetrapod and a choanate sarcopterygian, we can safely infer major components of its locomotor behavior. These inferences, together with form-function constraints, suggest that *P. gracilis* was a fleet-footed, obligately erect-postured, striding biped. That behavior seems to have been superimposed on the ancestral archosaur's innovative locomotor repertoire, which includes the capacity to "high walk." These novelties persist in a recognizable form in archosaurs for at least 245 million years and are widely distributed across Earth's surface in diverse ecological settings. They thus qualify as evolutionary innovations regardless of significant differences in diversification rates among extant diapsid reptiles.

Beerama, S., Merchant, M.E. and Sneddon, J. (2011). Studies of metals in crocodilians by spectrochemical methods. Applied Spectroscopy Reviews (doi 10.1080/05704928.2011.634052).

Abstract: This review covers the results of metal determinations using various spectrochemical analytical techniques in crocodilians from various geographical regions. The most widely determined metal is mercury, both inorganic and organic. However, many other metals, including the known toxic metals of lead and cadmium, have been determined. In general, more elevated levels of metals have been determined in crocodilians from potentially-contaminated, as opposed to more pristine areas. Significant differences in concentrations for many metals have been demonstrated in captive versus wild alligators. The most widely-utilized part of crocodilians for food, tail or tailmeat, attracted the most interest but studies on kidney and liver as well as blood have been reported. Eggs and hatchings have also been examined for several metal concentrations.

Brazaitis, P. and Watkins-Colwell, G.J. (2011). A brief history of crocodilian science. Herpetological Review 42(4): 483-496.

St. John, J.A., Braun, E.L., Isberg, S.R., Miles, L.G., Chong, A.Y., Gongora, J., Dalzell, P., Moran, C., Bed'Hom, B., Abzhanov, A., Burgess, S.C., Cooksey, A.M., Castoe, T.A., Crawford, N.G., Densmore, L.D., Drew, J.C., Edwards, S.V., Faircloth, B.C., Fujita, M.K., Greenwold, M.J., Hoffmann, F.G., Howard, J.M., Iguchi, T., Janes, D.E., Khan, S.Y., Kohno, S., de Koning, A.P.J., Lance, S/L., McCarthy, F.M., McCormack, J.E., Merchant, M.E., Peterson, D.G., Pollock, D.D., Pourmand, N., Raney, B.J., Roessler, K.A., Sanford, J.R., Sawyer, R.H., Schmidt, C.J., Triplett, E.W., Tuberville, T.D., Venegas-Anaya, M., Howard, J.T., Jarvis, E.D., Guillette, L.J., Glenn, T.C., Green, R.E. and Ray, D.A. (2012). Sequencing three crocodilian genomes to illuminate the evolution of archosaurs and amniotes. Genome Biology 13: 415 (doi:10.1186/gb-2012-13-1-415).

Abstract: The International Crocodilian Genomes Working Group (ICGWG) will sequence and assemble the American alligator (*Alligator mississippiensis*), saltwater crocodile (*Crocodylus porosus*) and Indian gharial (*Gavialis gangeticus*) genomes. The status of these projects and our planned analyses are described.

Holliday, C.M. and Gardner, N.M. (2012). A new eusuchian crocodyliform with novel cranial integument and its significance for the origin and evolution of Crocodylia. PLoS ONE 7(1): e30471. doi:10.1371/journal.pone.0030471

Abstract: Crocodyliforms were one of the most successful groups of Mesozoic tetrapods, radiating into terrestrial, semiaquatic and marine environments, while occupying numerous trophic niches, including carnivorous, insectivorous, herbivorous, and piscivorous species. Among these taxa were the enigmatic, poorly represented flat-headed crocodyliforms from the late Cretaceous of northern Africa. Here we report a new, giant crocodyliform from the early Late Cretaceous (Cenomanian) Kem Kem Formation of Morocco. Represented by a partial braincase, the taxon has an extremely long, flat skull with large jaw and craniocervical muscles. The skull roof is ridged and ornamented with a broad, rough boss surrounded by significant vascular impressions, likely forming an integumentary structure unique among crocodyliforms. Size estimates using endocranial volume indicate the specimen was very large. The taxon possesses robust laterosphenoids with laterally oriented capitate processes and isolated epipterygoids, features allying it with derived eusuchians. Phylogenetic analysis finds the taxon to be a derived eusuchian and sister taxon to *Aegyptosuchus*, a poorly understood, early Late Cretaceous taxon from the Bahariya formation. This clade forms the sister clade of crown-group Crocodylia, making these taxa the earliest eusuchian crocodyliforms known from Africa. These results shift phylogenetic and biogeographical hypotheses on the origin of modern crocodylians towards the circum-Tethyean region and provide important new data on eusuchian morphology and evolution.

Dinets, V. (2011). *Crocodylus palustris* (Mugger Crocodile). Signaling behaviour. Herp. Review 42(3): 424.

Dinets, V. (2011). *Melanosuchus niger* (Black Caiman). Signaling behaviour. Herp. Review 42(3): 424.

Shirley, M.H., Dorazio, R.M., Abassery, E., Elhady, A.A., Mekki, M.S. and Asran, H.H. (2012). A sampling design and model for estimating abundance of Nile crocodiles while accounting for heterogeneity of detectability of multiple observers. The Journal of Wildlife Management (doi: 10.1002/jwmg.348).

Abstract: As part of the development of a management program for Nile crocodiles in Lake Nasser, Egypt, we used a dependent double-observer sampling protocol with multiple observers to compute estimates of population size. To analyze the data, we developed a hierarchical model that allowed us to assess variation in detection probabilities among observers and survey dates, as well as account for variation in crocodile abundance among sites and habitats. We conducted surveys from July 2008-June 2009 in 15 areas of Lake Nasser that were representative of 3 main habitat categories. During these surveys, we sampled 1086 km of lake shore wherein we detected 386 crocodiles. Analysis of the data revealed significant variability in both inter- and intra-observer detection probabilities. Our raw encounter rate was 0.355 crocodiles/km. When we accounted for observer effects and habitat, we estimated a surface population abundance of 2581 (2239-2987, 95% credible intervals) crocodiles in Lake Nasser. Our results underscore the importance of well-trained, experienced monitoring personnel in order to decrease heterogeneity in intra-observer detection probability and to better detect changes in the population based on survey indices. This study will assist the Egyptian government

establish a monitoring program as an integral part of future crocodile harvest activities in Lake Nasser.

Submitted Articles

CUTTING A TYPE INTO PIECES. The rules of zoological nomenclature stipulate that when a scientific name has a published figure cited as its basis, the specimen that was the subject of the illustration, not the picture itself, is the actual owner of the name. Thus, a preserved hatchling in Berlin, Germany, Berlin (ZMB-243) is the real *Paleosuchus trigonatus* (Schneider, 1801), while in contrast Seba's (1734) plate 105, figure 3, is merely an artist's representation of it. This is known informally as an iconotype, meaning that this illustration has traditionally represented the scientific name of the animal (in this case Schneider's smooth-fronted caiman) to the scientific public. However, if Seba's (1734) picture is found to be inaccurate, then the physical specimen (in this case Zoologisches Museum Berlin number 243 with "Sudamerika", collection of "Bloch" as its data) takes precedence as the type-specimen of the taxon.

Today there is no doubt about ZMB-243 being the subject of Seba's (1734) "male" illustration (Bauer and Günther, 2006), and it is confirmed that King and Burke (1989) and Magnusson (1992b) were correct in following the advice of Dr. Marinus Hoogmoed about it. Sometime soon after being killed in South America, this specimen developed a zone of physical damage in its intestinal gut region, which explains why Seba's picture looks so peculiar regarding the dorsal armor in its lumbar, lumbo-sacral and sacral transverse rows. We now know that this physically small specimen was preserved without cutting the belly open to allow the alcohol to enter the body cavity, and we can see that decomposition in its gut has softened the skin, including the dorsal scales in this zone where the outermost layer of the epidermis has been lost, exposing the still developing immature scales underneath. On the specimen, the normal mature skin is reddish brown and the scutes are strongly keeled, while within the damaged area the skin color is whitish gray and the scales are smoother and more two dimensional.

As indicated in Figure 1, the shape of this rotten zone on ZMB-243 exactly matches the region where Seba's artist invented dorsal scales and misrepresented transverse rows in the middle and lower back, and also the pelvic region. The picture is partly accurate (parts A & C in Fig. 1), and the now understood zone of inaccuracy (part B) physically identifies the unique individual specimen, and simultaneously explains why the picture looks wrong.

The biggest problem is that Seba's famous "male" was figured as having 4 longitudinal rows of keeled scales in the lumbo-sacral, sacral, and basicaudal region of the dorsal armor, resulting in an apparent count of 4 scales in each of the transverse rows located between the back legs. Hypothetically, if it were true that ZMB-243 has 4 dorsal scales across its pelvis, then it would key to *P. palpebrosus* today (see Magnusson 1992a Figs. 3-4); but, fortunately from a photograph it appears to us that ZMB-243 narrows its pelvic

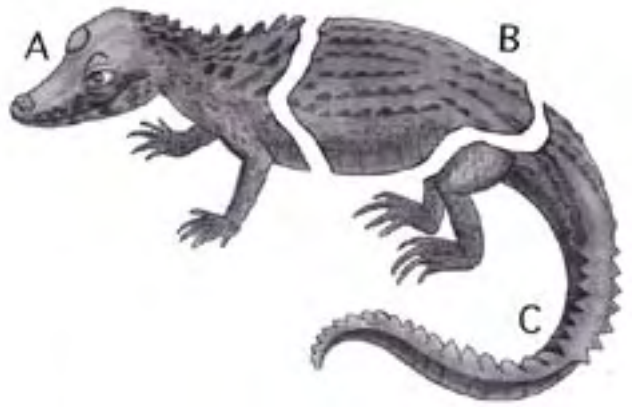

Figure 1. Illustration of ZMB-243. A= the dorsal armor on the neck and its adjacent thoracic zone is essentially accurate; B= the rotten gut and pelvic zone has stylized dorsal armor, and is misleading; C= the tail is generally accurate, but with a few extra whorls added.

dorsal armor to approximately 2 scales in a transverse row, and thus the specimen keys correctly to *P. trigonatus*. The sacral transverse rows of dorsal armor scutes are within the posterior end of the rotten area where Seba's artist generally invented scalation details.Other related problems with Seba's picture include the impression that there are 6 longitudinal rows of dorsal scales across the midregion of the body (the anterior end of piece B), creating 6 straightish and evenly disposed rows of keels. Indeed, 6 is the maximum number of contiguous scales in a transverse row across the midbody region, but the picture is misleading, because many of these transverse rows actually exhibit fewer than 6 scales in contiguity, and thus the regularity and the continuous nature of the longitudinal rows of keels in the picture are fiction. The midbody dorsal armor on the physical ZMB-243 specimen is more irregular, and is thus less heavily armored in comparison with the iconotype of its name.

Lastly, between the midbelly level and the sacral level, Seba's picture shows an unarmored gap of bare skin located among the dorsal scales directly overlying the long-axis midline that, if real, could be interpreted as a different kind of scalation irregularity that occurs infrequently but uniquely in *P. trigonatus* in almost exactly the same physical place on the body. However, the specimen proves the picture wrong, which is no surprise, because this unusual artistic invention is right in the middle of the physical specimen's gray rotten area. There is no gap, and the artist was merely attempting to connect 6 rows of midbody keels (fiction) with 4 rows of pelvic keels (also fiction), both of which are in the damaged region (zone B).

Outside of the fiction zone, Seba's picture is remarkably accurate about the shape of the head, and on the neck it shows the presence of one obvious transverse row of postoccipital scales. Further, the nuchal cluster is fairly narrow (2-3 scales across) and there is a single unpaired and strongly keeled midline scute located in the center of one of its middle transverse rows. Slightly less clear, the nuchal cluster (cervical shield) appears to be only very narrowly separated from the

thoracic dorsal armor, and the latter is somewhat irregular, and characterized by remarkably tall pointed keels (zone A). Back in 1969, when Marinus Hoogmoed counted the whorls on ZMB-243's tail as 11 DCCs and 16 SCCs (Magnusson 1992b), he functionally corrected Seba's picture (zone C).

Acknowledgements

We thank Prof. M.O. Rödel of Humboldt University for providing a series of color photos of ZMB-243. The history of this individual specimen in European museums and in the literature is documented in Bauer an Günther (2006), who, given the theoretical possibility that syntypes are involved, designated it as the lectotype. It was identified as the holotype of *Crocodilus trigonatus* Schneider, 1801, by specimen number in King and Burke (1989) and Magnusson (1992b).

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Franklin D. Ross, *NCB Naturalis, box 9517, Leiden 2300RA, the Netherlands*; Edio-Ernst Kischlat, *Rua Afonso Taunay 180/802, Porto Alegre 91520-540, Rio Grande do Sul, Brazil*; and Mark P.A. Van Tomme, *Rua Dr. José Lino 141/502, Fortaleza 60165-270, Ceará, Brazil*.

GEOFFROY (1809) IS BEFORE BORY (1824). Synonymy details are ordinarily beyond the concern of CITES listings, but by recognizing *Crocodylus niloticus suchus* (E. Geoffroy-Saint-Hilaire, 1807) and *C. niloticus chamses* (Bory de Saint-Vincent, 1824), the IUCN-SSC has gotten involved in an old French problem that is more complicated than it was formerly thought to be. All of the classic synonymies of the Nile crocodile indicate *Crocodilus marginatus*, *C. lacunosus* and *C. complanatus* as having been published later than *C. chamses*, but these authors (eg Duméril and Bibron, Gray, Boulenger, Werner, Loveridge, Wermuth and others) have overlooked the Étienne Geoffroy-Saint-Hilaire (1809) publication in which *C. marginatus*, *C. lacunosus* and *C. complanatus* became available.

We have discovered that at the time when *Crocodilus chamses* (Bory, 1824) was published, there were actually five French species-group names already available for Egyptian crocodiles; *C. vulgaris* (Cuvier, 1807), *C. suchus* (E. Geoffroy, 1807), *C. marginatus* (E. Geoffroy, 1809), *C. lacunosus* (E. Geoffroy, 1809), and *C. complanatus* (E. Geoffroy, 1809). In Geoffroy-Saint-Hilaire (1809), the taxonomic section titled "Des espèces de crocodiles qui vivent dans le Nil" is pages 243-263, and although not mentioned in its text, we believe that figures 1-2 in plate 2 (natural history) in the accompanying book of pictures (published in 1809) is part of Geoffroy's (1809) essay about the species of crocodiles which live in the Nile.

The taxonomic section in Geoffroy-Saint-Hilaire (1809) begins with discussion of his own 1807 species *Crocodilus suchus* (pages 243-257), followed by Cuvier's 1807 species *Crocodilus vulgaris* (pages 257-260). Then, Étienne Geoffroy's three new 1809 species were listed, with *Crocodilus marginatus* (pages 260-261), *C. lacunosus* (pages 261-262), and *C. complanatus* (page 263). This exact same pagination appears in at least one 1829 reprinting of E. Geoffroy St. Hilaire's essay, with the same pl. 2, figs. 1-2 picture. There are also other reprintings of this essay, including one from 1829, which are paginated differently. For a characterization of *C. chamses* (Bory, 1824), as an unnecessary nomenclatural act, and discussion about its type-locality being Egypt is in Ross (2006a,b).

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Geoffroy-Saint-Hilaire, É. (1809, in two parts). Description des crocodiles d'Égypte. Pp. 185-263 (text), in Description de l'Égypte, ou recueil des observations et des recherches qui ont été faites en Égypte pendant l'expédition de l'Armée Française, publié par les ordres de sa Majesté l'Empereur Napoléon le grand, ed. by Isidore Geoffroy-Saint-Hilaire and Jules-César Sivigny. Vol. 1 (Histoire naturelle); and, separately plate 2 (Hist. nat.) in Descr. de l'Égypte... Napoléon le grand, ed. by I. Geoffroy-Saint-Hilaire and J.-C. Savigny. Vol. 1 of plates ("Planches"), Imprimerie Impériale, Paris, France (also 1809).

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Ross, F.D. (2006b). Malagasy fossil is vulgar croc. Crocodile Specialist Group Newsletter 25(1): 24.

Franklin D. Ross, *NCB Naturalis, box 9517, Leiden 2300RA, the Netherlands*; Edio-Ernst Kischlat, *Rua Afonso Taunay 180/802, Porto Alegre 91520-540, Rio Grande do Sul, Brazil*; and Mark P.A. Van Tomme, *Rua Dr. José Lino 141/502, Fortaleza 60165-270, Ceará, Brazil*.

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Regional Chairmen, Europe: Dr. Jon Hutton, UNEP World Conservation Monitoring Centre, United Nations Environment Program, 219 Huntingdon Road, Cambridge CB3 0DL, UK, Tel: (44) 1223 277314, Fax: (44) 1223 277136, <Jon.Hutton@unep-wcmc.org>; Dr. Samuel Martin, La Ferme aux Crocodiles, Pierrelatte, France, <s.martin@lafermeauxcrocodiles.com>. **Regional Vice Chairman**: Ralf Sommerlad <crocodilians@web.de>.

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CSG IUCN Red List Authority: Dr. Perran Ross, Department of Wildlife Ecology and Conservation, P.O. Box 110430, University of Florida, Gainesville, FL 32611, USA, Tel: (1) 352 392 7137, <pross@ufl.edu>.

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