# CROCODILE SPECIALIST GROUP NEWSLETTER

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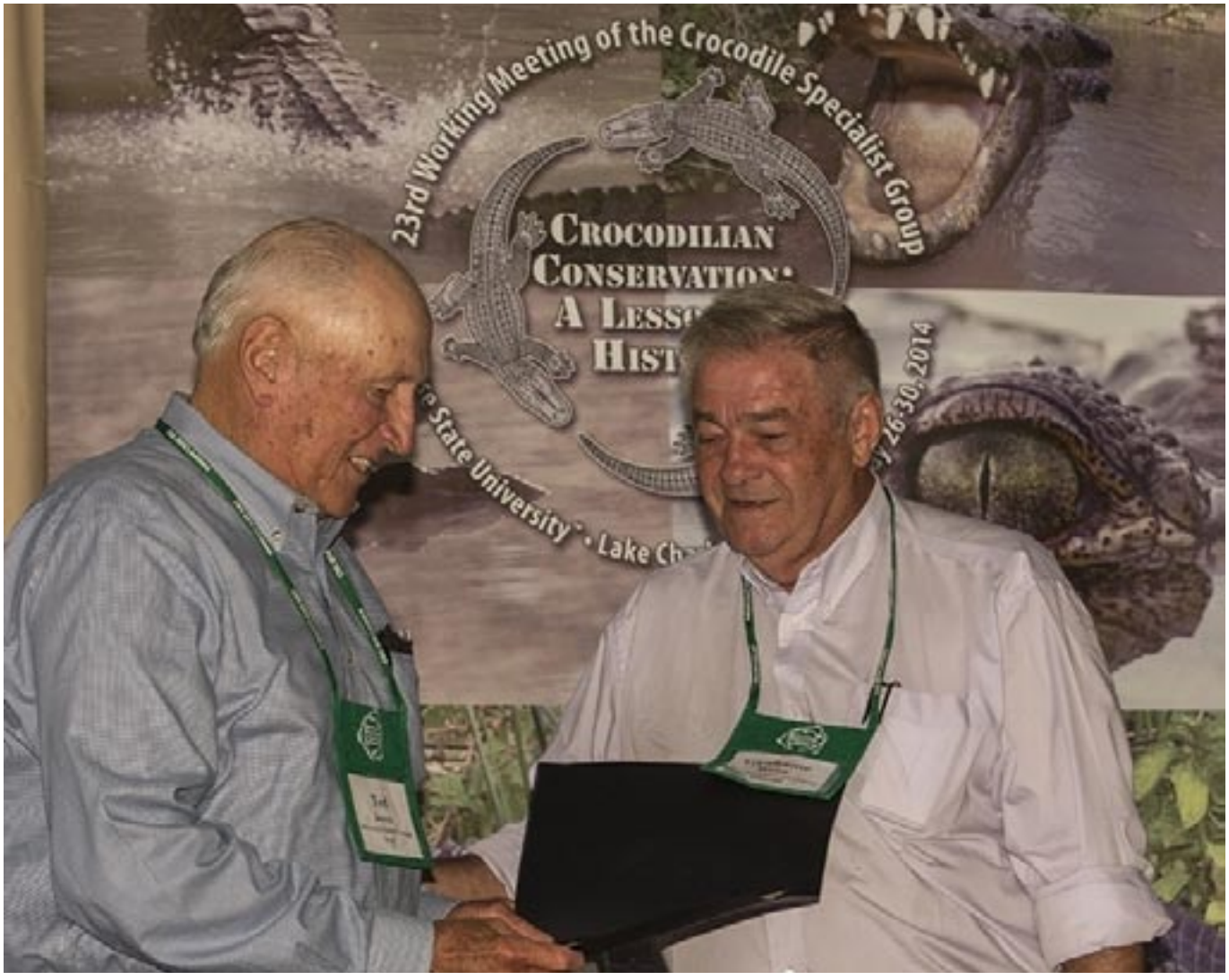


IUCN • Species Survival Commission

# CROCODILE

# SPECIALIST

# GROUP

# NEWSLETTER

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COVER PHOTOGRAPH: Ted Joanen (left) was recognised for his significant contribution to crocodilian research and management at the 23rd CSG Working Meeting. Ted is pictured here with CSG Chairman Grahame Webb (right). Photograph: Phil Wilkinson.

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The CSG Newsletter provides information on the conservation, status, news and current events concerning crocodilians, and on the activities of the CSG. The Newsletter is distributed to CSG members and to other interested individuals and organizations. All Newsletter recipients are asked to contribute news and other materials.

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Zoo Leipzig, Leipzig, Germany.
Zoo Miami, Florida, USA.

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Crocodile Park, Malaga, Spain.
Vic Mercado, Microlab, Philippines.
The Ebey family, New Mexico, USA.
Marco Schultz, Germany.

# Editorial

In April, Tom Dacey (CSG Executive Officer) and I participated in a "Siamese Crocodile Conservation and Husbandry Meeting" and a "Siamese Crocodile Task Force Meeting" at Mahidol University, Bangkok, Thailand, hosted by Parntep Ratanakorn. The meeting addressed a number of regional issues, including progress with capacity building, development of training materials for regional training and workshops and the proposed reintroduction of wild populations in Cambodia and Thailand in 2014. One of the outcomes of the meeting was a later visit by Paolo Martelli and Cathy Shilton (CSG Veterinary Science Group) to help plan a way through which the Veterinary Department at Mahidol, with its very good resources, could increase the role it plays as a regional centre for crocodilian health issues.

The 27th meeting of the CITES Animals Committee was held in Veracruz, Mexico, on 28 April-3 May 2014. CSG Deputy Chairman Alejandro Larriera represented the CSG at the meeting, but numerous CSG members attended in varying capacities. TRAFFIC's assessment of the situation in Colombia was agreed by participants at AC27, and representatives from Colombian Ministry and farming industry raised no objections at the meeting. This issue was further discussed at the CSG Working Meeting in Louisiana (see comments below).

The Ethiopia Review, a long time in planning, was finally undertaken (28 April-7 May 2014), by CSG members Matthew Shirley and Ludwig Siege. A preliminary report was tabled at the recent CSG Steering Committee meeting (25 May 2014), and a final report will be available soon. See page 9 for more details.

The 23rd Working Meeting of the CSG was held at McNeese University, Lake Charles, Louisiana, USA, 26-30 May 2014, with some 363 participants from 38 countries attending. It was a wonderful meeting and Mark Merchant and his support staff are to be congratulated for their splendid efforts. Highlights of the meeting included Ted Joanen being honoured with two awards (page 14), 10-year-old Karin Ebey being made the CSG's youngest member (page 12), and a record amount of funding being raised through the auction (page 12). Ashley & Associates and other donors also pledged to contribute $50,000 ($10,000/year for 5 years) to establish a CSG Conservation Education Fund (CEF), to better tell the "Marsh to Market" story of alligators and other crocodilians in trade (page 15). A report on the Working Meeting is on pages 11-14.

Don Ashley (left) and Ted Joanen (right).

The Working Meeting was preceded by meetings of the CSG Executive on 23 May and the full CSG Steering Committee meeting on 25 May, attended by 107 participants (35 SC Members and 72 Observers). A wide range of issues were discussed (pages 4-11), but some of the most important were:

(a) Ongoing concerns about *Caiman c. fuscus* farming in Colombia, where wild caught skins are traded with a CITES Source Code "C", implying they are captive bred. Meetings with representatives of the Colombian CITES Management Authority and the Colombian farming industry discussed the issue in depth. I subsequently wrote to the CITES Secretary General, the Colombian Authorities and industry members in an attempt to assist Colombia in its efforts to ensure all trade in caiman skins complies with Colombian legislation and thus CITES, and is legal, sustainable and verifiable. The matter is scheduled for further consideration at the 66th meeting of the CITES Standing Committee (date/venue tbc).

(b) For much the same reason (lack of compliance) trade in Nile crocodile skins from Madagascar was banned by CITES (2010), and this ban continues 4 years later while Malagasy authorities complete their compliance with recommendations (CITES Notification 2010/015 of 17 June 2010). The matter is scheduled for further consideration at SC65 (July 2014).

Charlie Manolis (CSG Regional Chairman Australia-Oceania) and I attended the "Borneo Crocodile Forum 2014 - Human-Crocodile Co-existence - Roadmap to Sustainability" held in Sibu, Sarawak, Malaysia, 10-12 June 2014. The meeting

is the third in a series of meetings addressing human-crocodile conflict in Malaysia, and may result in a proposal to CITES to have the Sarawak population of *Crocodylus porosus* downlisted to Appendix II so that more innovative management measures can be implemented.

In June 2014 the California Senate passed Bill AB2075 for an extension of a 5-year sunset clause to allow the sale of alligator/crocodile products in California. It will now go to the Assembly for concurrence and then on to the Governor's desk. It is hoped to complete legislative passage of AB2075 before the July summer break. Don Ashley is thanked for his tireless work on this issue.

Planning is well advanced on the proposed CSG fact-finding mission to Indonesia, 23 August-3 September 2014. I will participate in discussions with industry (ICFA) and the Government management (PHKA) and scientific (LIPI) authorities, in Jakarta, regarding Indonesia's current crocodile management program. Ranching has spread beyond the areas originally intended and a new proposal to CITES may be needed to ensure compliance problems with source codes do not occur. This will be followed by a CSG delegation going to East Kalimantan, to finally take some action on Lake Messangat, a refuge area for Indonesian populations of Siamese crocodiles (*C. siamensis*) and Tomistoma (*Tomistoma schlegelii*). The mission will have discussions with Provincial Government officers and representatives from the oil palm industry, to examine practical options for the long-term protection of these important wetlands.

The "1st International Course Specializing in Management of Crocodilians" will be held in Colombia on 16-21 November 2014. The course will have specialist instructors from Argentina, Mexico and Colombia, and will involve both theoretical and practical sessions. The course will be limited to 40 people. For further details, contact the organisors at: 1ercursocrocodylia@gmail.com.

The "2nd Symposium on Colombian Crocodilians", with the theme of "Crocodilian Conservation - An Opportunity for Communities" will be held on 2 December 2014, under the auspices of the "5th Colombian Congress of Zoology" (1-5 December 2014), in Cartagena, Colombia. An invitation can be downloaded from the homepage of the CSG website (www.iucncsg.org). People can contact the symposium organisors (simposiococodrilos@gmail.com) for details.

Cambodia have been given approval to arrange a CSG East & South East Asia regional meeting in Siam Reap in May 2015, subject to early confirmation that all the necessary arrangements and funding are in place.

The 24th CSG Working Meeting CSG is scheduled to be held in Skukuza Rest Camp, Kruger National Park, South Africa, sometime in May 2016. SANParks have until the end of August 2014 to confirm all the necessary arrangements and funding are in place.

Professor Grahame Webb, *CSG Chairman*

# CSG Steering Committee Meeting

(Lake Charles, Louisiana, USA, 25 May 2014)

1. Opening

The Chairman, Grahame Webb, opened the meeting at 9 am and welcomed participants to the meeting.

Steering Committee members present: Grahame Webb, Alejandro Larriera, Tom Dacey, Charlie Manolis, Samuel Martin, Christine Lippai, Lonnie McCaskill, Nao Thuok, Eric Langelet, Carlos Piña, Alvaro Velasco, Hesiquio Benitez Diaz, Luis Bassetti, Sergio Medrano-Bitar, Manuel Alfonso Tabet, Marisa Tellez, Ralf Sommerlad, Ruth Elsey, Allan Woodward, Noel Kinler, Thomas Rainwater, Don Ashley, Yoichi Takehara, Enrico Chiesa, Jerome Caraguel, Simone Comparini, Bernardo Ortiz, John Caldwell, Paolo Martelli, Kent Vliet, Val Lance, James Perran Ross, Bruce Shwedick, Ted Joanen, Phil Wilkinson.

Observers present: Gabriela Lopez S., Rafael Crespo, Tanya Sturman, Mario Alecoa, Joe Wasilewski, Byron Wilson, Soledad Moleon, Pamela Leiva, Jazmin Bauso, Alba Imhof, Robinson Botero-Aries, Maria de la Paz Lopez Vasquez, Manuel Muñiz, Avishka Godahewa, Helen Crowley, Silke Pfitzer, Ian Colenbrander, Luis Angel Velasquez, Hector Ragusa Villegas, Andres Leonardo Rodriguez, Godfrid Solmu, Luis Sigler, Robert Godshalk, Weber Girardi, Simon Pooley, Adam Britton, Serge Castagno, Adieu Fanget, Gabriel Brull, Nairen Alonso Jimenez, Roberto Ramos Targarona, Mark Merchant, Ashley Pearcy, Juan Fernando Martinez, Maria Alejandra Camargo, Luis Felipe Martinez, Hernando Zambrano, Akira Matsuda, Noboru Ishii, Vicente P. Mercado, Mitsuko Takehara, Freddy Webb, Giovanna Webb, Soham Mukherjee, Dhiraj Gopinath, Gowri Mallapur, Jeff Lang, Robby McLeod, Frank Garcia R., William Belo, Careen Bello, Rainier Manalo, Brian Sibongga, Szu-Lung Chen, Li-Jen Chang, Chris Banks, Jennifer Andringa, Rio Throm, Shawn Heflick, Patrick Delaney, Brian Jeffery, Michael Cherkiss, Steve Gorzula, Theresa Aquino, Colette Adams, Curt Harbsmeier, Antoine Soler, Heng Sovannara, Sally Isberg, Matthew Shirley, Fernando Cuadra.

Apologies (Steering Committee members): Dietrich Jelden, Alison Leslie, Howard Kelly, Tomme Young, Kevin van Jaarsveldt, Jiang Hongxing, Alfonso Llobet, Clara Lucia Sierra Diaz.

Apologies (other CSG members): Patrick Aust, Matt Brien, Ruan Xiangdong

1.1. Chairman's Report

The Chairman drew attention to the activities of the CSG over the past year and the forthcoming years, highlighting:

- Five CSG members had passed away since the last working meeting - Keiran McNamara and Peter

McInnes (Australia), Thierry Bordat (France), Robert Chabreck (USA) and Fritz Huchzermeyer (South Africa).

- Changes to the Steering Committee, including appointment of Howard Kelly as Regional Vice Chairman for Southern & East Africa, Lonnie McCaskill as Regional Chairman for East & Southeast Asia, Myrna Canilan-Cureg as Vice Chair for Public Education and Community Participation, and Curt Harbsmeier as Vice Chair for Legal Affairs.
- The current status of trade in Madagascar, where CITES has maintained a trade suspension recommended by the CITES Standing Committee. The matter is being scheduled for further consideration of the CITES Standing Committee meeting (SC65) in July 2014.
- An overview of the current situation in Colombia. An out of session meeting with members of the Colombian industry and a Government representative was scheduled for later in the working meeting.
- Meetings attended - Siamese Crocodile Task (Thailand, 24-25 April 2014) and 27th CITES Animals Committee meeting (Mexico, 28 April-3 May 2014).
- Reviews: Ethiopia review undertaken 28 April-7 May 2014. Preliminary report being provided by Matthew Shirley, later during the meeting. Proposed Fact Finding Mission to Indonesia on the conservation of the crocodile habitat for *T. schlegelii* and *C. siamensis* in Lake Mesangat, East Kalimantan, possibly in September 2014, also to possibly include CITES issues.
- The involvement of the Responsible Ecosystems Sourcing Platform (RESP) involvement in the snake trade issue, which has been expanded to include all reptiles, including crocodilians, is a matter of some concern.
- Proposed CSG Leadership Program, which envisages the selection of about six younger CSG members and to mentor and train them in the various outside bio-political activities undertaken by the CSG (eg CITES, including its Standing and Animals Committees and IUCN).
- Nominations to host the next CSG Working Meeting were received from Argentina, South Africa and Cambodia. These were to be further considered by the Executive Committee and the decision reported back during the course of the meeting.

The report was noted.

1.2. Minutes and Actions from CSG SC Meeting, Negombo, Sri Lanka (May 2013)

Executive Officer, Tom Dacey, advised that all outstanding actions from the Negombo meeting were either reported in the minutes of the meeting or addressed as separate agenda items in the papers for the CSG Working Meeting. The report was noted.

1.3. Executive Officer's Report

The Executive Officer highlighted:

- CSG currently has 502 members from 62 countries;
- The CSG has continued to fund in a modest way the regional offices in Latin America & the Caribbean, South Asia & Iran and Southern & East Africa; and,
- Since 2009 the Student Research Assistance Scheme (SRAS) has approved 72 projects, for which 51 reports for completed projects have been received. All details are available on the CSG website.

The report was noted.

1.4. Financial Report

Tom Dacey introduced the financial report, which highlighted a current balance of $AUD621,660 (around $US576,665) at 31 March 2014, including $US25,400 for CSG-TTF and $US7000 in the Chinese Alligator fund. Around $AUD522,376 is invested in a short-term deposit account earning interest, which provides an income sufficient to sustain the minimum CSG executive support needed. The report was noted.

1.5. International Association of Crocodile Specialists

The audited financial statement for 30 June 2013 was tabled. The Annual General Meeting was held on 11 November 2013. The report was noted

2. Regional Reports

2.1. Southern and East Africa

The Regional Chair for Southern and East Africa, Christine Lippai, presented the report, highlighting recent activities:

- Angola - surveys in the Okavango catchment area confirms adult crocodiles are nesting and breeding there. Human-crocodile conflicts also occur within the region;
- Botswana - ongoing mark-recapture program being carried out by the Okavango Crocodile Monitoring Programme (OCMP). Projects planned for 2014 include (a) Human-Crocodile Conflict study and (b) mother-to-young acoustic communication;
- Egypt - a crocodile management plan is being drafted and an advisory council established with the local Aswan Government and Lake Nasser

authorities. CSG member Mohamed Ezat has recently undertaken a learning visit to Zimbabwe to enhance his knowledge in order to assist him with the creation of a Crocodile Management Unit in Egypt;
- Ethiopia - review undertaken, 28 April-8 May 2014. Matt Shirley to provide a preliminary report later during the meeting;
- Madagascar - the CITES Animals Committee's Working Group met informally at AC27 to discuss progress to date. Apparently the report submitted by Madagascar was still with the CITES Secretariat and has still to be formally considered .The trade suspension will be retained and considered again at the CITES Standing Committee meeting (July 2014);
- Namibia - a study on "Nile Crocodile Genetic Diversity and Population Structure, within the Kunene and Kavango Rivers, Northern Namibia" commenced in March 2014;
- South Africa - the South African Department of Trade and Industry approved the launch of the National Exotic Leather Cluster (NELC), aimed at establishing a sustainable, world class exotic leather industry in South Africa; and,
- Uganda - monthly crocodile surveys continue along the Victoria Nile in the Murchison Falls National Park.

The report was noted.

2.2. West and Central Africa Regional Report

Samuel Martin addressed the report, highlighting:

- Crocodile monitoring in the Sitatunga Valley (CREDI-NGO project) confirmed the presence of Dwarf crocodile (*Osteolaemus tetraspis*) and the West African crocodile (*Crocodylus suchus*).
- SOS Crocodiles of La Ferme aux Crocodiles (France) continue to be involved in the funding of several projects.
- Scientific research has focused on human-crocodile interaction around agro-pastoral dams.
- Continuing to collect data on crocodile distribution and movement in Benin in order to design a local and regional action plan for crocodile conservation and management.
- Monitoring of the *C. suchus* population is continuing.

A report was provided by Matt Shirley on the work he has been undertaking in:

- Ivory Coast. West African slender-snouted crocodile captive breeding and reintroduction project being undertaken in collaboration with the Abidjan National Zoo, Ivorian National Parks Service (OIPR) and the University of Nangui-Abroguoua (UNA).
- 3rd Regional Meeting proposed to be held in Abidjan, Ivory Coast, in late November 2014.
- Gabon. Work with the Smithsonian Institute continues slowly.
- The Burkina Faso Government has recently begun enforcing wildlife legislation regarding crocodiles, on a multitude of extractive industry groups.
- The Gambian Government is exploring the possibility of establishing a limited crocodile trophy hunting initiative in response to apparently increasing human-crocodile conflict in some coastal areas.

The report was noted.

2.3. East and Southeast Asia Regional Report

The report collated by the CSG Executive Officer from various sources highlighted:

- Chinese Alligator project. Assessment of an earlier reintroduction of captive-breed Chinese alligators in Dongtan Wetland Park on Chongming Island at the mouth of the Yangtze River, indicates that the alligators are established and reproducing in the Park.
- Lao PDR. The WCS head-starting project progresses well, however, donor funding will run out at the end of 2014 and casts some doubt on the future of this successful project.
- Philippines.
  - Government is undertaking a review to develop a "National Conservation Management Plan for the Crocodiles in the Philippines, 2014-2020".
  - CPPI, in partnership with the Silliman University Angelo King Centre for Research and Environmental Management (SUAKCREM), has initiated a 10-month research project on "Crocodiles and their Contribution to the Productivity of Wetland Ecosystems in the Philippines".
  - The 36 juvenile *C. mindorensis* reintroduced into Paghongawan Marsh, Siargao Island, appear to be surviving well (only 2 reported deaths to date).
  - North Luzon Island (Mabuwaya Foundation): quarterly surveys during 2012 and mid-2013 recorded just over 100 wild C. mindorensis; 5 nests were located in 2012 and 2 in 2013; a further 29 head-started *C. mindorensis* were released, 2012-2014; and, the Mabuwaya Foundation continues its program of collaboration with local communities, and municipal and provincial governments in Northern Luzon to enhance conservation of *C. mindorensis* in the region.
- Singapore. Consistent sightings of *C. porosus* in Sungei Buloh Wetlands and nearby Kranji Reservoir are beginning to attract tourists and

local visitors.
- Vietnam. There are now 9 CITES-registered captive breeding farms for *C. siamensis*. These are supplemented by some 2500 domestic contract farms.
- Sarawak, Malaysia. "Borneo Crocodile Forum 2014 - Human-Crocodile Co-existence - Roadmap to Sustainability", to be held in Sibu, 10-12 June 2014, to discuss the possible downlisting of *C. porosus*.
- Thailand. The "1st Siamese Crocodile Conservation and Husbandry Meeting" and the "Siamese Crocodile Task Force Meeting" were held at Mahidol University, Nakhon Pathon, Thailand, 24-25 April 2014. Report at SC.6.2.

The report was noted.

2.4. North America Regional Report

The report, provided by the Regional Chairs Ruth Elsey and Allan Woodward, highlighted:

- Report on American crocodile (*C. acutus*) by Mike Cherkiss and Frank Mazzotti.
- Alabama will offer a limited alligator hunt for 2014 (9th consecutive year).
- Florida population of alligators has been relatively stable over the past 25 years. Florida has three alligator harvest programs (nuisance, private lands and statewide public lands).
- Louisiana. Improvements in worlwide economics has lead to improved prices for wild and farm-raised alligators. Increased alligator egg and wild harvests in 2011, 2012 and 2013.
- US Fish and Wildlife Service have no petitions pending for reclassification of crocodilians under the Endangered Species Act (ESA).

The report was noted.

2.5. South Asia and Iran Regional Report

The report was provided by Anslem de Silva, with input from the various Vice Chairs, highlighting:

- Iran. To improve legal protection, the Department of Environment has increased fines for illegal killing of Mugger crocodiles and undertaken some public awareness activities with local participation.
- India. The Tri-state National Chambal Sanctuary Management Plan has been prepared and a trans-boundary critically endangered species management programme is being planned (India and Nepal).
- Sri Lanka. Human-Crocodile Conflict continues to be a problem. Translocation of "problem crocodiles" continues, however, Crocodile Exclusion Enclosures (CEEs) are gaining popularity.
- Pakistan. 2013-2014 has seen a marked increase in the establishment of private sector, domestic Mugger (*C. palustris*) breeding facilities in Sindh Province.

The report was noted.

2.6. Australia and Oceania Report

The report by Regional Chairman Charlie Manolis highlighted:

- Northern Territory. Recent attempt to integrate a trial hunting component into the *C. porosus* management program was rejected by the Federal Minister for the Environment (March 2014). The effect of the cane toad on the freshwater crocodile population continues.
- Queensland Department of Environment and Heritage Protection has developed a new crocodile management policy, aimed at an improved balance between community safety and crocodile conservation. A trial wild *C. porosus* egg harvest is in its second year.
- Western Australia. Two commercial crocodile farms have largely ceased operations.
- Papua New Guinea. Biennial nest counts surveys for *C. novaeguineae* were carried out in October 2013, indicating stable-increasing trend. Surveys for *C. porosus* nests were carried out in March 2014, but data have yet to be analysed.
- Timor Leste. In April 2014, the government of Timor Leste was seeking a consultant to develop a management plan for *C. porosus*.
- Solomon Islands - HCC continues to be a major issue with increasing political pressure on government to address the problem.
- Grahame Webb has recently released his new book, "Wildlife Conservation: In the Belly of the Beast".

The report was noted.

2.7. Europe

The Regional Chairman Samuel Martin presented the paper, highlighting:

- Zoo community activities.
- *In-situ* conservation programs supported by European institutions.

The report was noted.

2.8. Latin America and the Caribbean Regional Report

The report was presented by Deputy Chairman Alejandro Larriera, who thanked all representatives from LAC region for their inputs into the regional

report and offered an apology for all those who were unable to attend the meeting. Issues highlighted:

- Argentina. Currently there are 7 registered ranching programs in the country, producing 18,481 skins in 2013.
- Bolivia. *Caiman yacare* wild harvest program and the associated development and review of management plans.
- Brazil. The status of the 6 Brazilian crocodilian species were published in Revista Biodiversidade Brazileira 2013 (Portuguese). The first caiman slaughterhouse is almost completed.
- Belize. Public awareness and education increases throughout the country, but senseless killing and poaching also continues. Loss of habitat is a major threat.
- Guatemala. Surveys of Morelet's crocodile populations will commence in the fall of 2014, as well as heavy metal analysis.
- El Salvador. American crocodiles are starting to repopulate habitats where they were once extirpated.
- Nicaragua. Survey of crocodilians in the San Juan and Bartola Rivers have been undertaken. Students are working on the data for publication.
- Costa Rica. Marisa Tellez has been collaborating with the La Selva Biological Station in Puerto Viejo, on establishing crocodilian research and courses for students and volunteers.
- Colombia. CITES Decisions 16.63-16.66 on the Implementation of the Convention relating to captive-bred and ranched specimens, directly affects Colombia - "evaluate concerns identified in the examples in Annex to Document SC62 Doc26 – which includes Item 13: *Caiman* (*C.c.f*) skins from Colombia traded using as source code "C" (exports of approximately 1.2 million skins were reported as exports from Colombia during the review period). Colombia has long been exporting wild harvested caimans using the wrong source codes. It was agreed that the Executive and other SC members would meet with the Colombian Ministry representative and industry representatives during the course of the meeting.
- Cuba. In November 2013, WCS was able to co-organise a Crocodile Workshop within the IX International Wetland Symposium held at the Zapata Swamp. The workshop was considered to have been extremely successful, covering key topics relevant to future of crocodilians in Cuba.
- Mexico. The following were highlighted: reports on 9 current projects being undertaken by CSG members in Mexico; 2 PhD, 2 Masters and 3 undergraduate theses reported; a number of management and conservation actions have been instigated; production and trade; and, numerous publications.
- Paraguay is working on a draft National Program for *Caiman yacare*. Researchers are seeking funding for the Scientific Authority to implement a population monitoring program, based in local Universities.
- Peru. The report addressed the institutions maintaining breeding *C. acutus* populations, the *Melanosuchus niger* situation and other crocodilian species.
- Venezuela. The report addressed: *Caiman c. crocodilus* wild harvest; *C. intermedius* conservation program; and, the First Symposium on Ecology and Conservation of Crocodiles in Venezuela.

The report was noted.

2.8.1. Crocodile Conservation in Jamaica

Perran Ross presented the paper and the issues discussed at the *C. acutus* meeting held in Miami on 15 February 2013.

- The Jamaican Crocodile Working Group has been formed.
- Independent group of crocodile supporters (many of whom are CSG members) organised two functions, raising some $US26,000 which is dedicated to supporting crocodile conservation in Jamaica.
- Unfortunately, the situation for *C. acutus* in Jamaica remains extremely grim. There is no specific wildlife agency in Jamaica and responsibility rests with Government Development Organisations.

The report was noted.

3. Review Updates

3.1. Cambodia: Update on Implementation of Recommendations

The detailed report from Fisheries Administration of Cambodia on implementation of the Recommendations of the 2005 CSG review was included in the agenda papers.

Recommendations 1-7, 9, 12, 19, 21-23 and 25-27 were considered to have been completed. Recommendations 8, 11, 13, 18, 20, 24 and 28-31 were considered to have been partly completed and ongoing. Recommendations 10 and 14-17 were considered to be ongoing. Cambodia government has agreed to proceed with the registration of a further 16 captive breeding farms. A Cambodian Crocodile Farmers Association was established to assist with the proposed reintroduction of *C. siamensis* into the wild, a project being undertaken in co-operation with NGOs. The report was noted.

3.2. Ethiopia Review

CSG undertook a review of crocodile management in Ethiopia, 28 April-7 May 2014, utilising the services of CSG members Matthew Shirley and Ludwig Siege. Matthew Shirley presented a preliminary report on the outcomes of the review:

- Trophy Hunting. There is a healthy population of *C. niloticus* in Lake Chamo with abundant juvenile, sub-adult and adults.
- Human-Crocodile Conflict does not appear to be a big issue with local people, however, it warrants further investigation.
- The "ranching" does not appear to be running very well, although the farming facilities look good and the skin quality is very good. There appears to be a definite potential for the "ranching" program, however, there are bureaucratic difficulties hampering progress.
- Non-Detriment Finding. There is just a total lack of documentation. Therefore, there is no basis for a non-detriment submission. The Federal Government delegates responsibility to the State Governments.
- The final report will become available at the end of June 2014.

The report was noted.

4. Thematic Group Reports

4.1. CITES

The report was briefly introduced by Tom Dacey/ Grahame Webb, highlighting:

- Madagascar. The trade ban continues until further consideration by the CITES Standing Committee (SC65) in July 2014.
- Colombia. The Executive and Steering Committee members familiar with the situation would hold separate meetings with the industry members from Colombia to discuss problem issues, and undertake such other meetings as may be needed throughout the CSG Working Meeting, particularly with a representative of the Colombian Management Authority when she arrived, to try and resolve the ongoing laundering of wild caimans through farms, and the misuse of source codes on the CITES certificates to achieve this.

The report was noted.

4.2. Industry Report

Vice Chair Don Ashley addressed the report highlighting:

- The need to continue CSG presence at CITES meetings.
- California Assembly Bill AB2075 to extend the sunset clause, allowing the legal sale of alligator and crocodile products, through to 1 January 2025 now has to go through the Senate on 10 June 2014.
- CITES Animals Committee Meeting, Veracruz, Mexico, 28 April-2 May 2014: Working Group on Captive Bred and Ranched Specimens continues to review and provide input on ways to better ensure CITES requirements for captive breeding and ranched specimens are in compliance; and, Snake Trade and Conservation issues.
- Animal Welfare and Humane Slaughter issues. The work of the Expert Panel on the Humane Killing (slaughter) of Reptiles was completed in 2013 and is currently under review of the World Health Organisation (WHO) to be considered as international standards. Report was circulated.
- Best Management Practices for crocodilian programs is becoming increasingly important in many countries.
- Conservation Education and Marsh to Market Story. Need for dedicated efforts to better tell Conservation and Community stories to Governments, legislatures, industry, retail trade and the general public.

The report was noted.

4.3. Trade Monitoring

John Caldwell presented the report, highlighting: the source of the trade data; outstanding CITES reports. Currently, Malawi, Nicaragua and the Phillipines are 3 years in arrears and in danger of having trade restrictions imposed upon them by the CITES Standing Committee under Resolution Conf. 11.17 (Rev. CoP16). The report was noted.

4.4. Veterinary Science

Paolo Martelli presented the report, highlighting:

- Passing of Fritz Huchzermeyer.
- Dr. Cathy Shilton has accepted an invitation to be Co-Chair for the Veterinary Science Group.
- Website updates include step-by-step guide and necropsy form for crocodilians, a literature compilation on crocodilian anaesthesia, a manual for parasite collection and preservation and a link to a Spectrum Web viewer histopathology reference, together with other important documents.
- Dr. Silke Pfitzer completed her MSc entitled "Physiological Parameters of Farmed Nile Crocodiles (*Crocodylus niloticus*) Captured Manually by Electricial Immobilisation".

The report was noted.

4.5. Zoos

Vice Chair Kent Vliet presented the report, highlighting:

- Dedicated session on "The Impact of Zoos on Crocodilian Conservation and Biology" will be held during the Working Meeting.
- Requests to Zoos to accept and house confiscated crocodilians.
- *In-situ* conservation programs.
- Activities in North American Zoos [eg The Association of Zoos ad Aquariums (AZA), Crocodile Advisory Group (CAG)]. Annual training course "Crocodilian Biology and Captive Management". Studbooks and cooperative breeding programs. Fund-raising activities have been extremely active.
- Activities in Latin America.
- Activities in Europe. Imports to the Czech Republic.
- Activities Asia, where communications are getting better.
- Working Meeting session related to cryptic species and the number of living species of crocodilians.

The report was noted

4.6. Public Education and Community Participation

Vice Chair, Clara Lucia Sierra Diaz was unable to attend the meeting. The report was noted.

4.7. General Research

Vice Chair Val Lance presented his report, highlighting the high number of recent papers dealing with crocodilians and listing a number of specific relevant papers. The report was noted.

5. IUCN Red List Authority

Perran Ross advised that:

- Red List Assessments for *C. palustris*, *Tomistoma schlegelii* and *Mecistops* are complete and *C. mindorensis* is in final draft.
- IUCN assessments are updated in June and November each year, however, there is usually a 6 month delay from the time the CSG finalises assessments to when they actually get listed by the IUCN.
- IUCN announced the 50th anniversary of the Red List this year and will feature special announcements and publicity.
- Current list for crocodilian assessments, in priority order is as follows:
  - *Crocodylus intermedius* - CR
  - *Alligator sinensis* - CR
  - *Melanosuchus niger* - EN
  - *Crocodylus niloticus* - (eastern clade)
  - *Crocodylus suchus* - (western clade)
  - *Osteolaemus tetraspis* - VU
  - *Crocodylus johnstoni* - LR
- The remaining unassessed species are currently LR and not likely to change.
- The need to identify possible team leaders and people to assist with the Red List assessments.

The report was noted.

6. Task Force/Working Group Reports

6.1. Tomistoma Task Force

The report was presented by TTF Chair Bruce Shwedick, highlighting:

- Boyd Simpson has completed surveys in Peninsular Malaysia (North Selangor Swamp Forest in Selangor State and the South-East Pahang Peat Swamp Forest in Pahang). Report still awaited.
- Funding is coming in on a regular basis and has been provided for following projects: $US12,410 to the Peoples Resource and Conservation Foundation for Phase 1 of project "Focused Conservation of *Tomistoma schlegelii* in the Landscape of Danau Sentarum National Park (DSNP)". Report on the first three surveys received; and, $US4500 to Kyle Shaney, PhD student, University of Texas, for Phase 1 of project "Assessing Abundance and Population Genetic Structure of the Endangered False Gharial (T*omistomia schlegelii*) in Sumatra".
- Proposed participants (Bruce Shwedick, Lonnie McCaskill and Rob Stuebing) to undertake the fact finding mission re: Lake Mesangat, East Kalimantan, Indonesia, will meet with CSG Executive members in Louisiana to draft Terms of Reference for the Mission.
- Colin Stevenson is working on the new TTF webpage to be incorporated into the CSG website.

The report was noted.

6.2. Human-Crocodile Conflict

HCC Working Group Chairman Allan Woodward presented the report, highlighting that a special HCC session will be held during the Working Meeting, devoted to presentations of HCC case studies. The report was noted.

6.3. Siamese Crocodile Task Force (SCTF)

SCTF Chairman Parntep Ratanakorn was unable to attend the meeting but provided a written report

outlining progress from the recent meetings held at the Mahidol University, Nakhon Pathom, Thailand (24-25 May 2014), including: capacity building development of training materials for regional training and workshops; reintroductions of wild populations in Cambodia and Thailand in 2014; and, country updates from Cambodia, Lao PDR, Thailand and Vietnam. CSG Chairman, Grahame Webb, advised that the status of *C. siamensis* in the wild is now worse that what it was 40 years ago. There is pressure on Cambodia because they still have a remnant wild population. The CSG is also encouraging Thailand to get reintroductions underway. The report was noted.

6.4. Capacity Building Manual Working Group

Verbal report presented by Charlie Manolis, highlighting:

- That all submissions received to date have been placed onto the website.
- Perran Ross has agreed to complete the project but will need help from others who are able to provide future sections for the Manual.
- There is a need for a sunset clause for completion of the Manual.

7. General Business

7.1. International Working Group on Reptile Skins.

CSG Chairman Grahame Webb provided a summary on the background on the issue and the reaction from the fashion houses and the impact it caused on the snake trade. This then spilled over to the crocodilian trade when it shifted from the snake trade to the reptile trade (which includes crocodiles).

He warned that there will be a need to approach the issue with a great deal of caution as the ultimate cost will be borne by the producer and not the other players in the system. Top end companies are now starting to recognise the impacts of the issue. Perran Ross, Hesiquio Benitez and Chris Banks offered further comments on the issue. The report was noted.

8. Next CSG Working Meeting

The CSG had received three applications to host the 24th CSG Working Meeting in 2016: Proyecto Yacare, Argentina; South African National Parks, South Africa; and, Cambodian Ministry of Fisheries, Cambodia.
The CSG Chairman advised that the 24th CSG Working Meeting will be held in South Africa in 2016, but SANParks will be given until the end of August 2014 to confirm all the necessary arrangements and funding. If South Africa cannot meet this deadline, then the Working Meeting will transfer to Argentina.

Cambodia has been requested to amend its offer and arrange to hold a CSG Regional Meeting in Siem Reap, Cambodia, in May 2015. It also will have to confirm all the necessary arrangements and funding are in place.

The meeting closed at 1600 h.

Figure 1. Steering Committee members were treated to a classic Cajun pig roast (coshon de lait), but first CSG Chairman Grahame Webb delivered a toast with “Apple Pie”, a favourite local drink. Mark Merchant looks on.

Figure 2. from left: Christine Lippai, Ted Joanen and Pamela Ashley continue discussions over lunch.

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

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## CSG Meeting (26-30 May 2014)

The 23rd Working Meeting of the IUCN-SSC Crocodile Specialist Group (CSG) was held on the campus of McNeese State University, Lake Charles, Louisiana, USA, on 26-30 May 2014. Attended by 363 participants representing 38 countries, the theme of the meeting was “Crocodilian Conservation: A Lesson in History”. Participants with interests in farming and

ranching, trade, ecology, conservation, physiology, genetics and biochemistry gathered to discuss a wide array of topics.

The Working Meeting was preceded by a meeting of the CSG Steering Committee on 25 May, which was attended by more than 106 committee members and observers (see pages 4-11). During the meeting, we bid farewell to CSG members who had passed away during the past year, announced various changes to the Steering Committee. Proposals to host the next Working Meeting (in 2016) were obtained from Argentina, South Africa and Cambodia.

A Welcome Social was held on Sunday in the Grand Art Gallery, which featured the amazingly detailed crocodilian scratchboard art of special guest John Agnew. Lake Charles Mayor Randy Roach was present to welcome guests to Lake Charles. together with with Conference Director Mark Merchant, McNeese State University Provost Dr. Jeanne Daboval and President Phillip Williams.

A packed house filled the Memorial Gym at McNeese State University over the five days of the meeting. A broad spectrum of topics was discussed, including special sessions on current industry issues, human-crocodile conflict, contribution of zoos to crocodilian conservation and crocodilian reproduction. A special session concerning the possibilities of splitting some current crocodilian species into multiples based on emerging genetic data.

During the first day of the meeting, the Industry thematic group, chaired by Don Ashley, made a special presentation to Ted Joanen for his ground-breaking work in the 1960s and 1970s, during which he studied the natural history, feeding and nesting ecology of the American alligator. His studies served as the basis for the development of the world's first crocodilian management program based on sustainable use. Today, Louisiana unarguably serves as a key leader in the area of crocodilian sustained use and management. Dr. Christopher Beachy, Chair of the Department of Biological Sciences at Southeastern Louisiana University in Hammond, Louisiana, was present to announce the establishment of the "Ted Joanen Endowed Professorship", which will be presented each year in Ted's name. See page 14 for more details.

Figure 1. left to right: Mark Merchant, Phil Wilkinson, Ted Joanen and Grahame Webb, following announcement of the "Ted Joanen Endowed Professorship".

A special presentation was made to 10-year-old student Karin Ebey (Fig. 2) during the welcome ceremony on the first day. Karin has, for the past three years, asked friends and family not to give her birthday gifts, but give money that they would have spent on gifts. She has then sent the money to the CSG to be used for crocodilian conservation. What an incredible act of conservation from a remarkable young lady!

Figure 2. Karin Ebey (left) with Charlie Manolis.

Special guest Dr. Peter Brazaitis delivered a presentation on the history of the CSG, entitled "An anecdotal history of the CSG: The early years", and Ted Joanen spoke about the "History of Alligator Conservation in Louisiana".

The 2014 CSG auction was held on Thursday night. With nearly 200 items donated by CSG participants, the auction raised a record $US14,743, which the Executive Committee decided will be applied to crocodilian conservation in the West and Central Africa region. Many thanks to auctioneers Joe Wasilewski and Carlos Piña for their added entertainment value and for prising so much money from the meeting participants (Fig. 3). A record sum of $US14,743 was generated from the auction, to be used for crocodilian conservation in West and Central Africa.

Figure 3. Auctioneers Joe Wasilewski and Carlos Piña managed to extract a record amount from the auction.

The Castillo Award was presented to Steve Platt (Fig. 4) for his many years of tireless work with Siamese crocodiles (*Crocodylus siamensis*) in southeast Asia, Morelet's and American crocodiles (*C. moreletii*, *C. acutus*) in the Yucatan region, and Chinese alligators (*A. sinensis*) in China. It is fitting that Steve is from Baton Rouge, Louisiana.

Figure 4. 2014 Castillo Award winner Steve Platt (second from left) with Phil Wilkinson (left), Grahame Webb and Thomas Rainwater (far left).

Very early on Wednesday morning, everyone was awakened by the thunder, lightning, wind and heavy rains that resulted in approximately 8 cm of rain in 3 hours. However, the 830 am session started on time …. the show must go on!

Every night, after the social functions and hospitality suites closed at the meeting, the assembly moved down the street to "Coolers", which quickly became the iconic watering hole for the late night CSG parties (Fig. 5). We filled the bar every night, to the delight of owner Cody Cahanin.

Figure 5. Participants dance the night away at "Coolers".

The CSG contributed prize money to the best student posters and oral presentations. Given the high quality of posters and presentations, the judges found it difficult to pick three winners, and in the end first places were awarded to James Nihong and Adam Rosenblatt, second places to Thiago Portelinha and Amanda Carr, and third places to Agustina Latorre, Nicole Smolensky and Derek Newberger (Fig. 6).

Figure 6. Winners of student awards with CSG Chairman Grahame Webb; from left, Agustina Latorre, Derek Newberger, Nicole Smolensky, Thiago Portelinha, James Nifong (not present; Adam Rosenblatt, Amanda Carr).

On Saturday (31 May) 100 international guests were treated to a field trip to the historical Rockefeller Refuge in Grand Chenier, Louisiana. Tremendous thanks are owed to the dedicated Louisiana Department of Wildlife and Fisheries staff, and other volunteers, of Rockefeller Refuge for providing this fantastic opportunities for our CSG guests. See pages 15-16 for more details.

Mark Merchant, *McNeese University, Lake Charles, Louisiana, USA (mmerchant@mcneese.edu).*

# Ted Joanen's Contribution to Crocodilian Research and Management Recognised with Awards

Ted Joanen, pioneer researcher and retired administrator of Louisiana's Rockefeller Refuge, was recognized with two outstanding Research Awards in Sustainable Use Management during the CSG Working Meeting in Lake Charles, Louisiana.

Ted's batchelor's degree *alma mater*, Southeastern Louisiana University (SELU), presented him with an endowed Professorship to further studies in sustainable marsh management and conservation of wetlands. Dr. Chris Beachy, head of the SELU's Biology Department presented the $US100,000 award on behalf of the university and benefactors (Figs. 1 and 2).

Figure 1. left to right: Don and Pamela Ashley, Dr. Chris Beachy, Ted Joanen, Benny Cenac and Guillaume Dromel.

Figure 2. left to right: Chad Courville, Nathan Walls, Tim Allen, Gerald Savoie, Ed Froehlich, Ted Joanen, Grahame Webb, Alejandro Larriera, Pam and Don Ashley.

A proclamation from Louisiana State University (LSU), where Ted completed his Master's degree, established the "Ted Joanen Outstanding Research Award in Sustainable Marsh Management". LSU students will be eligible for annual grants to further studies and research focussing on marsh and sustainable use management. A founding grant of $US30,000 was donated to the graduate studies program.

CSG Chairman Grahame Webb said, "This was extraordinary recognition by Louisiana and the Trade of Ted Joanen's four decades of pioneer work to help protect Louisiana's wetlands through the sustainable use of the alligator and other renewable natural resources." He added, "Ted was a CSG pioneer as well from the very beginning. He shared his Rockefeller research findings with all who knew him to encourage the concepts of sustained use management and, as Ted always said, find ways to keep the marsh wet and wild".

Some of the contributors to the Ted Joanen special recognition awards also helped create a "**CSG Conservation Education Fund**" (CEF) during the meeting, to better tell the "Marsh to Market" story of alligators and other crocodilians in trade. A founding contribution of $US50,000 ($US10,000 per year for 5 years) established the CEF with four primary goals:

1. Better tell the Marsh to Market story about crocodilian sustainable use benefits to commerce (economic incentives), conservation (wetlands and natural habitats) and communities (local people and cultures).
2. Reduce negative, misleading or incorrect media references, displays (ie confiscated products) and other exhibits that misinform policymakers as well as the public.
3. Create more positive, balanced and factual media stories, displays (airports, etc.) and exhibits (ie museums, zoos and aquaria) that focus policymakers and public attention on sustainable use benefits to local pople, cutlures, natural habitats (wetlands) and economic incentives to conserve renewable natural resources.
4. Retain 50% of annual CEF contributions in an endowed fund to help ensure CSG is also sustainable to protect and conserve crocodilians and their wetland habitats as well as benefit local people and cultures.

Contributions to the CSG Conservation Education Fund will be tax-deductible and can be made to the CSG through the International Association of Crocodile Specialists (IACS; csg@wmi.com.au). Don Ashley, Vice Chairman of the CSG Industry thematic group, announced the CEF fund to meeting participants and encouraged all to help find ways to better tell the "Marsh to Market" story to policymakers and public. "We must increase our efforts to explain the benefits of sustainable use to wetlands, local people and cultures," he said. Like Ted says, "it's local people and cultures who have the best chance to keep the marsh "wet and wild".

Figure 3. A Turner bronze alligator hatchling emerging from the egg was presented to Ted Joanen by Don Ashley and CSG Chair Grahame Webb in recognition of the CSG Conservation Education Fund.

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

# Rockefeller Refuge Hosts 2014 CSG Working Meeting Field Trip

After a very successful 23rd Working Meeting of the CSG in Lake Charles Louisiana, the Louisiana Department of Wildlife and Fisheries hosted one of the post-meeting field trips at Rockefeller Wildlife Refuge in Grand Chenier, Louisiana, on the afternoon of 31 May. Participants travelled to Rockefeller and enjoyed sandwiches and beverages organized by Mark Merchant and colleagues from McNeese State University on the drive south to the refuge. On arrival, participants were welcomed by Ruth Elsey, Phillip "Scooter" Trosclair and numerous other LDWF employees. Mrs. JoAnn Nunez and Ms. Katie Little had gift bags from the Cameron Parish Tourist Commission for guests.

Guests participated in a variety of activities, including measuring, tagging, notching and determining the sex of young alligators, and releasing the marked juvenile alligators to the wild while on airboat tours through marshes adjacent to the refuge headquarters (Fig. 1). Tours also included viewing of alligator holding facilities where the initial research on alligator culture and husbandry was conducted by Ted Joanen and Larry McNease in the 1970s and 1980s. Geoff McClure participated fully by voluntarily tasting the commercial alligator pelletized food and deeming it quite palatable.

A "leucistic"/white alligator was available for viewing, and some guests also took a boat ride in our 27' skiff to see alligator habitat winding through the refuge all the way to the Gulf of Mexico. Despite inclement weather in the Belle Chasse area, a helicopter from Jesuit Bend Helicopters, LLC (near New Orleans), was able to get to Rockefeller and guests took brief aerial overview flights of the alligator habitat.

We thank all field trip participants for making time in their busy work schedules to travel to Rockefeller Refuge for a brief introduction to the alligator habitat and ongoing alligator work being undertaken here.

Prior to the Working Meeting, we were pleased to have the CSG Chairman Grahame Webb, Giovanna Webb and Freddy Webb (Fig. 2) visit Rockefeller for a few days. Grahame recalled his first overseas trip back in 1980, which included visiting Rockefeller Refuge. During their visit, we needed to catch adult alligators to have a range of sizes available for research to be conducted by Dr. Brandon Moore and Dr. Diane Kelly on the Monday following the CSG meeting. It took Freddy about 5 minutes to catch the first alligator, a nice 1.85 m adult, and the next afternoon (after morning airboat trips into the marsh) he caught an even larger adult (Fig. 3). We also were very pleased to have Karin Ebey and dad Peter Ebey visit (Figs. 4-6). Since a very young age, Karin has shown a keen interest in crocodilians, and we were able to give her some hands-on experience with alligators at Rockefeller Refuge.

Ruth Elsey, *Louisiana Department of Wildlife and Fisheries, Rockefeller Refuge, Louisiana, USA.*

Figure 1. Participants enjoying various activities arranged at Rockefeller Refuge.

Figure 2. Jeb Linscombe (LDWF) takes Webb family on airboat tour.

Figure 3. Ryan King (LDWF) and Freddy Webb with adult alligator.

Figure 4 (right). Karin Ebey on arrival at Rockefeller Refuge.

Figure 5. Karin Ebey releases a marked alligator into the wild.

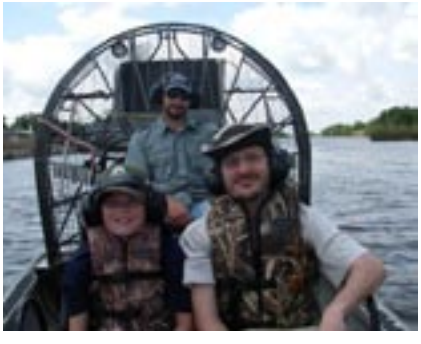

Figure 6. Karin (left) and Peter Ebey (right) enjoy an airboat ride.

### CSG Student Research Assistance Scheme Update

The CSG Student Research Assistance Scheme (SRAS; http://www.iucncsg.org/pages/General-Information.html) provided funding to 5 students in the April-June 2014 quarter. Two further applications are under review.

1. Natalia A. Rossi (USA): Conserving American crocodiles (*Crocodylus acutus*) in a Key Cuban Wetscape

2. Ilassa Ouedraog (Burkina Faso): Diversity, abundance, conservation measures endogenous, human-crocodile and the environment in Burkina Faso.

3. Nohora Cristina Mora Rivera (Colombia): Population status, distribution and habitat assessment for establishing aspects of management for babilla (*Caiman crocodilus fuscus*) in the Prado River Hydroelectric Dam in Tolima Department, Colombia.

4. Gerardo Jesus Soria Ortiz (Mexico): Variation in the diet of *Caiman crocodilus chiapasius* (Crocodylia: Alligatoridae) in Encrucijada, Chiapas, Mexico.

5. Sean Williamson (Australia): Why are crocodiles unable to sustain embryonic development *in utero*?

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

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# Regional Reports

## East and Southeast Asia

### China

PRELIMINARY RESULTS OF A CHINESE ALLIGATOR SURVEY IN DONGTAN WETLAND PARK, SHANGHAI PROVINCE, CHINA. The Chinese alligator (*Alligator sinensis*) is regarded as one of the most critically endangered crocodilians in the world (Xing 2010). Fewer than 150 Chinese alligators survive in the wild, and these occur in small populations at widely scattered sites; the largest population at any particular site numbers no more than 20 individuals and contains <10 adults (Thorbjarnarson and Wang 1999; Thorbjarnarson *et al*. 2002; Thorbjarnarson and Wang 2010). Sites occupied by wild Chinese alligators are typically patches of marginal habitat embedded within an agricultural landscape. Importantly, the agricultural lands surrounding occupied sites effectively block the dispersal of alligators, thereby precluding genetic exchange between wild populations. Furthermore, the limited areal extent of most occupied habitats prevents any significant increase in the size of wild populations (Thorbjarnarson and Wang 2010).

In contrast to the tenuous conservation status of wild populations, *ex-situ* propagation has proven remarkably successful and thousands of alligators (ca. 13,000 in 2014; Lu Shunqing, unpubl. data) are now maintained at two government-operated conservation-breeding centers in China (Thorbjarnarson and Wang 2010; Platt 2012). An action plan prepared in 2001 by Chinese and international scientists strongly recommended that new wild populations be established by releasing captive-bred, head-started *A. sinensis* into suitable, but unoccupied habitat (Jiang *et al*. 2006). To this end, a trial release of 6 adult Chinese alligators was conducted at Dongtan Wetland Park (DWP) on Chongming Island in June 2007 (Thorbjarnarson and Wang 2010). Chongming Island is a large alluvial island (1267 $km^2$) at the mouth of the Yangtze River near Shanghai, and within the known historic distribution of *A. sinensis* (Platt 2012). DWP is a popular outdoor recreation area and consists of 860 ha of freshwater marsh dominated by *Phragmites australis*. These marshlands host an abundance of potential prey such as aquatic insects, mollusks, fish, snails, crustaceans (including the invasive *Procambarus clarki*), snakes, and frogs, and as such is considered excellent alligator habitat (Thorbjarnarson and Wang 2010). Thorbjarnarson and Wang (2010) suggested DWP could ultimately support as many as 300 adult *A. sinensis* and considered it the most important site for alligator conservation in China.

The original group of alligators released at DWP consisted of 3 adults (1:2) from a breeding center in Zheijiang Province, China, and three adults (1:2) imported from institutions in the USA; the latter were part of breeding programs in the AZA Species Survival Plan. Each alligator was fitted with a telemetry collar and monitored for about 1.5 years until battery power was exhausted. Two adult alligators (1:1) drowned shortly after being released when they became entrapped in submerged crab nets set in a deep canal along the perimeter of DWP (Fig. 1). Subsequent to this incident nets were banned from DWP and park staff removed those that remained. Another adult female was recaptured by park staff after dispersing >20 km from the release site. This animal was held in captivity at DWP for one year before succumbing to unknown causes in late autumn of 2009.

Post-release monitoring was discontinued in early 2009 when transmitters ceased emitting signals, and the fate of the remaining three alligators is unclear. Nesting was confirmed in 2008 when DWP staff and one of us (LS) found a recently constructed nest mound containing four eggshell membranes on a levee adjacent to the perimeter canal (Fig. 2). The nest was built in dense grass about 4 m from the water. Sixteen hatchlings were observed nearby and probing revealed the submerged entrance to a burrow, presumably that of the nesting female, about 3 m from the nest mound. Although no other nests have been found, a group of at least 20 hatchlings

was observed by DWP staff and volunteers in 2012, indicating that additional population recruitment has occurred within the park.

Figure 1. Crab traps removed from a canal by Dongtan Wetland Park staff. Two adult Chinese alligators drowned in these nets shortly after being released in 2007. The use of crab traps and fishing nets is now prohibited within the park to safeguard alligators.

Figure 2. Dried eggshell membranes found in a nest mound in October 2008. These eggshells and subsequent a sighting of 16 hatchlings confirm that reproduction among reintroduced Chinese alligators has occurred at Dongtan Wetland Park.

While these observations suggest an increasing population of Chinese alligators now inhabits DWP, an assessment of the reintroduction has never been conducted (Thorbjarnarson and Wang 2010), despite being accorded priority by the Crocodile Specialist Group (Xing 2010). This is particularly lamentable because reintroduction has been identified as the key strategy for restoring viable alligator populations to landscapes in the Yangtze River floodplain (Jiang *et al*. 2006; Xing 2010). However, without rigorously evaluating previous attempts there is no way to determine if reintroduction is indeed a conservation tool likely to prove successful with Chinese alligators. To address this need, we initiated a project with the objectives of: 1) estimating the number of Chinese alligators now inhabiting DWP; 2) determining the size-class structure of the alligator population; and, 3) providing management recommendations to DWP managers based on our findings. Our ultimate goal is to establish a viable population of Chinese alligators in DWP as part of the larger "conservation metapopulation" envisioned by Thorbjarnarson and Wang (2010).

We used a combination of diurnal pedestrian surveys and nocturnal spotlight counts to determine the population status of Chinese alligators in DWP. Fieldwork was conducted from 27 April through 1 May 2014, a period selected to maximize the likelihood of encountering basking alligators. Basking frequency is highest during the early spring, shortly after alligators emerge from hibernation (Thorbjarnarson and Wang 2010). At this time, air temperatures exceed water temperatures, and alligators raise their body temperature by leaving the water to bask on land. Diurnal surveys were conducted by walking slowly along the trail network that provides access to much of DWP, and searching for alligators in the surrounding wetlands with binoculars (8 x 42 and 10 x 50). We conducted nocturnal spotlight counts using battery powered flashlights and headlamps to search for the reflective eye-shines of alligators. Spotlight counts were conducted either by walking along the trail network or paddling a small boat along the shoreline of waterbodies where alligators had been previously observed during diurnal surveys. We classified each alligator based on estimated total length (TL) as a small juvenile (<50 cm TL), large juvenile (50-100 cm TL), sub-adult (101-120 cm TL), or adult (>120 cm TL). Alligators that could not be approached closely enough during spotlight counts to estimate size were classified as "eye-shine only". The location of each alligator was recorded with a hand-held GPS Unit and plotted on a map of DWP. We also searched likely nesting habitat (eg islands, former nesting sites, and elevated canal banks) for evidence of old nest mounds. In addition to our field survey, we also reviewed records of incidental observations of alligators maintained by DWP staff.

We observed 9 Chinese alligators during our survey including three adults, two sub-adults, and four large juveniles (Fig. 3). Despite searching most of DWP, alligator sightings were restricted to an area of about 1 $km^2$ in the south-central section of the park. An adult male and female, and a sub-adult (TL ca. 100 cm) alligator were observed in Swan Lake; the male (TL ca. 200 cm) was distinguished from the female (TL ca. 150 cm) by its large body size. Swan Lake (ca. 1.5 ha) is surrounded by a large mesh-net fence that confines a small collection of ornamental waterfowl. However, a shallow concrete channel connecting the lake to a canal network is incompletely blocked by the netting, permitting the ingress and egress of alligators. We also observed a female (TL ca. 150 cm), one sub-adult (TL ca. 100 cm), and three large juvenile (TL ca. 70 cm) alligators in Pine Island Lake, a 3 ha waterbody containing a large island where three burrow entrances were found. The burrow openings were located just behind stands of *Phragmites* that fringe the island, in an area where we repeatedly observed alligators. Finally, we observed a large juvenile alligator (TL ca. 80 cm) swimming in a densely vegetated canal near the DWP Research Station. This alligator is regularly observed by DWP staff and said to

inhabit a burrow in a deep pool adjacent to the Earthquake Exhibit, approximately 100 m south of where we observed it.

Figure 3. Female Chinese alligator photographed in Swan Lake at Dongtan Wetland Park in late April 2014. This individual is one of two surviving female alligators from the original release of 6 alligators in June 2007.

The three adult alligators we observed during this survey are undoubtedly the surviving members of the original group released in 2007, while the sub-adults and juveniles are progeny from post-release reproductive events. Based on the size range of smaller alligators, it appears that at least two cohorts of offspring are now present in the park, most likely from nesting that occurred in 2008 and again in 2012. We found nothing to indicate reproduction occurred during the 2013 season; no small juveniles were observed and our search of likely nesting habitat (island in Pine Island Lake and a densely vegetated berm at Swan Lake) found no old nest mounds. This is unsurprising considering the size of the reproductive population (2 females) and the fact that female alligators usually nest biennially or two years out of three owing to energy constraints that limit reproduction (Thorbjarnarson and Wang 2010). Of course, we cannot rule out the possibility that hatchlings produced in 2013 had yet to emerge from the burrow at the time of our survey.

Assuming 50 eggs were produced during two reproductive events (clutch size is generally 20-30 eggs; Thorbjarnarson and Wang 2010), the 6 juvenile and sub-adult alligators that now inhabit DWP represent a survival rate of 12%, which is comparable to survival rates reported for young *A. mississippiensis* (Ouchley 2013). Most mortality among hatchling and juvenile alligators probably results from predation by wading birds, which are common at DWP and the adjacent wetlands. Wading birds are considered significant predators of hatchling *A. mississippiensis* (Neill 1971). A juvenile alligator is also known to have drowned after becoming entrapped in a net barrier placed across a canal linking Swan Lake to Pine Island Lake (DWP, unpubl. data). Other young alligators may have emigrated into the surrounding agricultural lands; in 2011 an area farmer found a small alligator (TL ca. 90 cm) in a drainage canal about 15 km from DWP. The alligator was recaptured, returned to the park, and later released. The extensive network of linear drainage canals on Chongming Island probably facilitates the dispersal of alligators from DWP. Whether or not dispersing alligators can survive in the wetland-agroecosystem matrix adjacent to DWP remains unclear.

At this time our sole recommendation to DWP managers is to remove the net barriers placed across canals draining into Swan Lake. Alligators that become entangled in these nets are likely to drown, and because the nets have a large mesh size, even adult alligators could be at risk. Given the small number of alligators now inhabiting DWP, the loss of even a single adult could have serious demographic consequences for population recovery. Not only do the nets constitute a hazard for alligators, but they may also be hindering the movement potential prey (eg fish and crustaceans) into Swan Lake. We recommend these nets be replaced by heavy gauge wire-mesh barriers that extend 10-20 cm below the water surface. Wire-mesh barriers will contain ornamental waterfowl within Swan Lake, while at the same time allow alligators to pass safely beneath the fence without risk of entanglement and drowning. Additional population surveys and an investigation of alligator reproduction are planned for July-September of 2014. Upon completion of this work a set of formal recommendations will be provided to DWP managers. Finally, the preliminary results of our survey, as well as other studies (Wang *et al*. 2011), suggest that reintroduction is a feasible management tool for restoring wild populations of Chinese alligators.

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## Myanmar

AN ESTUARINE CROCODILE POPULATION ON THE COAST OF SOUTHERN MYANMAR. The Estuarine crocodile (*Crocodylus porosus*) was historically widespread and abundant in Myanmar, with a largely coastal distribution that extended from Rakhine State, throughout the lower Ayeyarwady Delta, and southwards into Mon State and Tanintharyi Region (formerly "Division") (Thorbjarnarson *et al*. 2000, 2006). Although populations are now thought to be seriously depleted as the result of unregulated commercial skin hunting, collection to stock crocodile farms in Myanmar and neighboring countries, wanton destruction where perceived as a threat to humans and livestock, and habitat loss (Thorbjarnarson *et al*. 2006), recent assessments are lacking and there is little information available on the current distribution and conservation status of *C. porosus* in Myanmar (Webb *et al*. 2010). Scattered crocodiles may persist in the mangrove swamps of coastal Rakhine State (Platt 2000; Platt and Khin Myo Myo 2009) and a small but apparently viable population inhabits Meinmahla Kyun Wildlife Sanctuary and the adjacent Reserved Forests of the Ayeyarwady Delta (Thorbjarnarson *et al*. 2000, 2006; Onishi 2009). In southern Myanmar, a small population is found in the Tanintharyi River (Platt *et al*. 2012), and reports of occasional attacks suggest at least a few crocodiles survive in the Myeik Archipelago (Platt *et al*. 2012; www.crocodile-attack.info). Here we document the occurrence of a hitherto unreported population of Estuarine crocodiles on the coast of southern Myanmar, and provide additional information gleaned from interviews of area fishermen.

We learned of this crocodile population from local informants while conducting fieldwork in southern Myanmar during December 2013 (Platt *et al*. 2014). According to these informants, large crocodiles could readily be observed in Ban Pone Chaung (= creek), a coastal waterway in Boke Pyin Township, approximately 80 km north of Boke Pyin Town in Tanintharyi Region. On 21 December 2013 we traveled to Ywa Thit (11°32'06" N, 98°45'25.0" E; India-Bangladesh datum), a coastal fishing village at the mouth of Ban Pone Chaung to investigate these reports. Ban Pone Chaung is fed by a network of smaller tributaries (Shwe, San, Tadakee and Kyauk Nyet Creeks) that drain an extensive mangrove swamp. After conferring with villagers, we conducted a boat-borne reconnaissance along 8.5 km of Ban Pone Chaung upstream from Ywa Thit (1430-1600 h) and encountered two adult *C. porosus*. The first crocodile (TL ca. 300 cm) was observed (1450 h) basking on the shore among mangrove (*Rhizophora* spp.) prop roots (Fig. 1). The crocodile appeared accustomed to human activity and allowed our boat to approach closely before it entered the water, swam a short distance, and then submerged. The second crocodile was encountered (1530 h) as it swam across the main channel of Ban Pone Chaung, a short distance upstream from Ywa Thit. Although only its head was visible above the surface, this animal appeared to be as large, or slightly larger than the first crocodile (TL ca. 300-325 cm). Tidal conditions and shallow water precluded a more extensive survey of the creek system. We then returned to Ywa Thit and interviewed a group of about 20 resident fishermen concerning the local occurrence of crocodiles.

Figure 1. One of two adult estuarine crocodiles observed during a reconnaissance of Ban Pone Chaung in southern Tanintharyi Region, Myanmar. Photograph: Me Me Soe.

According to the fishermen, crocodiles are regularly encountered in the area, often in close proximity to Ywa Thit. Fishermen stated that at least 20 large adult crocodiles inhabit Ban Pone Chaung and its tributaries, some of which are said to be as "long as a fishing boat" (TL ca. 450 cm). Given that most people experience difficulty when attempting to accurately estimate the size of crocodilians (Magnusson 1983; Platt *et al*. 2009), these purported lengths are probably somewhat exaggerated. However, *C. porosus* of similar size are known to occur in the lower Ayeyarwady Delta (Thorbjarnarson *et al*. 1999). Regardless, our observations confirm that large adult crocodiles are indeed present in the Ban Pone Chaung wetlands.

Crocodile eggs are reportedly collected for domestic

consumption by some inhabitants of Ywa Thit, although this practice is by no means universal among village households. In light of this information, it is probable that little if any recruitment is now occurring in the Ban Pone Chaung population. To our knowledge, human consumption of crocodile eggs has not previously been documented in Myanmar, although crocodile meat is on occasion eaten as food (Platt *et al*. 2012). Fishermen described finding large mound-type nests constructed in thickets of leather fern (*Acrostichum* spp.) adjacent to tidal waterways. Similar microsites are used by nesting female *C. porosus* in coastal Rakhine State (Platt 2000), on islands in the Ayeyarwady Delta (Thorbjarnarson *et al*. 2006), and along the Tanintharyi River (Platt *et al*. 2012). In northern Australia, Magnusson (1980) found that female *C. porosus* selected nest sites in freshwater swamps where leather fern was a significant component of the understory. The availability of herbaceous vegetation suitable for constructing nest mounds is apparently a major determinant of nest site selection for *C. porosus* and probably other mound-nesting crocodilians as well (Fukuda and Cuff 2013).

Crocodile nests along Ban Pone Chaung are said to contain as many as 60 eggs. While comparably large clutches have been reported for *C. porosus* in Australia and New Guinea (Webb *et al*. 2010), the mean (±1 SD) clutch size found in a limited sample of 8 nests from the Ayeyarwady Delta was somewhat smaller (39.6 ± 11.0; range= 24-51 eggs; Thorbjarnarson *et al*. 2006). Interestingly, fishermen appeared to recognize a relationship between female body size and clutch size in *C. porosus*. According to our informants, a 38 cm (15") increase in the TL of an adult female translates into an additional 10 eggs. Our informants also stated that female crocodiles often excavate wallows adjacent to the nest and remain in attendance throughout the incubation period, a behaviour well documented among other populations of *C. porosus* (Webb and Manolis 1989).

Until recently the attitude of the Ywa Thit populace towards crocodiles was probably best described as "benign neglect" (ie crocodiles were tolerated because there had been no serious incidents involving humans or livestock). Killing or capturing the resident crocodiles was not viewed as a worthwhile endeavor owing to the considerable effort involved and the lack of any financial reward. However, in late 2013 a 9-year-old girl was killed and consumed by a crocodile while tending crab traps near the village. Given that large adult crocodiles often venture close to Ywa Thit, and most of the population is engaged in fishing, crabbing, and other activities carried out in small boats or at the water's edge, the fact that only a single attack has occurred in recent years is somewhat surprising. Should additional attacks occur, villagers stated that crocodiles would be killed out of concerns for human safety.

Our informants indicated that few crocodiles are to be found in coastal swamps south of Ywa Thit, which is consistent with our previous investigations in the region (Platt *et al*. 2012). However, crocodiles are frequently encountered in tidal rivers and coastal wetlands from Ywa Thit northwards to Myeik. Fishermen stated that crocodiles are particularly abundant in Anyin Sore Ywa and Wha Kote Chaung. Given that few extant *C. porosus* populations are known in Myanmar, these reports certainly warrant further investigation. Because *C. porosus* is extirpated, or nearly so on the western coast of Thailand and little is known regarding populations in western Peninsular Malaysia (Webb *et al*. 2010), it is possible that southern Tanintharyi Region could harbor crocodile populations of regional conservation significance.

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## Lao PDR

COMMUNITY-BASED SIAMESE CROCODILE CONSERVATION IN LAO PDR. The Siamese crocodile (*Crocodylus siamensis*) is regarded as one of the most critically endangered crocodilians in the world (Simpson and Bezuijen 2010). During the past 50 years, wild populations of *C. siamensis* throughout Southeast Asia have been decimated by illegal hunting for skins and meat, wanton killing, government sponsored extermination programs, habitat loss, and over-collecting to stock commercial crocodile farms (Platt and Tri 2000; Platt *et al*. 2004; Simpson *et al*. 2006; Simpson and Bezuijen 2010; Kanwatanakid-Savini *et al*. 2012; Guérin 2013). Furthermore, although hundreds of thousands of *C. siamensis* are now held on commercial crocodile farms in Southeast Asia, the genetic integrity of this burgeoning captive population has been compromised by widespread hybridization with saltwater crocodiles (*C. porosus*) (Fitzsimmons *et al*. 2002; Starr *et al*. 2009).

In Lao PDR (hereafter referred to as Laos), potentially viable, albeit fragmented populations of wild *C. siamensis* are confined to wetlands in Attapu, Salavan and Savannakhet Provinces (Stuart and Platt 2000; Thorbjarnarson *et al*. 2004; Bezuijen *et al*. 2013). Despite being legally protected as a "Prohibited Category I Species" (hunting and trade is strictly prohibited) in Laos, Siamese crocodiles are threatened by deliberate killing for food and to protect people and livestock, collection of eggs for domestic consumption and medicinal purposes, incidental take in fishing gear, and habitat loss (Simpson and Bezuijen 2010; Platt 2012; Bezuijen *et al*. 2013). The latter threat is particularly acute in Savannakhet Province, which not only harbors some of the largest remaining crocodile populations, but also supports the greatest rural population density in Laos (Bezuijen *et al*. 2013).

Recognizing that *C. siamensis* faced near-certain extinction in Laos unless immediate action was undertaken, the Wildlife Conservation Society-Lao Program working in collaboration with the Lao Government designed and implemented a long-term crocodile recovery plan in 2008 (Hedemark *et al*. 2009). Surveys first identified a number of small *C. siamensis* populations in Savannakhet Province that would likely benefit from conservation efforts (Bezuijen *et al*. 2006). Most of these populations already received some degree of de facto protection from the local belief that crocodiles embody the spirits of dead ancestors (Platt 2012; Bezuijen *et al*. 2013). Six wetlands known to harbour crocodiles in the Champhone (Kout Kaen, Xelat Kadan, Nong Maehang, and the Kout Mark Peo-Phai Cheo Reservoir Complex) and Xangxoy (Kout Kouang and Kout Koke) River systems were then selected for inclusion in a community-based conservation project. These wetlands are thought to contain elements of a single interacting crocodile metapopulation linked by riverine corridors (Platt 2012). Project sites are described in greater detail elsewhere (Hedemark *et al*. 2009; Platt 2012; Bezuijen *et al*. 2013), but most are heavily vegetated alluvial wetlands subject to overbank flooding during the annual wet season (June-September). An additional wetland near Ban Nauneua Village was later incorporated into the project. This non-alluvial site is an expansive marsh where crocodiles and other wildlife have long been protected by local animist beliefs (Baird 2001).

Village-level discussions were held in area communities during 2008-09 to solicit local input for site-specific management plans designed to insure crocodile recovery, protect critical wetland habitats, and establish conservation zones with accompanying regulations (Hedemark *et al*. 2009). More recently (2010-present) efforts have focused on developing wetland management guidelines (especially critical during the dry season when farmers require large quantities of water for irrigation), designing crocodile-friendly fishing regulations, and conducting conservation awareness programs in key communities.

In 2010-11, Village Crocodile Conservation Committees (VCCC) were organized in rural communities adjacent to project wetlands (Fig. 1). VCCC cadres attended training workshops held during November-December 2011 where they learned basic monitoring and patrolling techniques, and each was issued a Lao-language edition of Simpson (2006). Cadres are now tasked with monitoring crocodile populations, enforcing conservation regulations, and searching for crocodile nests (see below), and receive a small monthly stipend for their participation in the project. In addition to monitoring wild populations, WCS in collaboration with the Lao Zoo and area villages has initiated head-starting and conservation-breeding programs to provide crocodiles for eventual release into protected wetlands. Below we provide an over-view of on-going population monitoring, head-starting, and conservation-breeding programs for Siamese crocodiles in Laos.

Figure 1. Village Crocodile Conservation Committees were established in communities adjacent to wetlands harboring Siamese crocodiles. Cadres are tasked with monitoring crocodile populations, enforcing local conservation regulations, and searching for crocodile nests. Here a team of VCCC cadres assist with collecting crocodile eggs as part of the head-starting program.

Population monitoring

WCS biologists and VCCC cadres monitor crocodile populations at each project wetland using a combination of nocturnal spotlight counts, camera trapping, track and sign surveys, and nest counts (Simpson 2006). Monitoring is conducted during the latter half of the dry season (December-May) when sites are accessible and crocodiles become concentrated by low water levels. Nocturnal spotlight counts have proven largely ineffective because crocodiles are extremely difficult to detect among the thick emergent vegetation that characterizes most sites. Bezuijen *et al*. (2013) likewise concluded this methodology was ill-suited for detecting crocodiles in Laos, particularly in densely vegetated wetlands where population densities are low. Camera trapping was also found to be an ineffective method for population monitoring; 19 camera traps (baited with chicken carcasses) deployed for a total of 1294 trap nights during the late dry season (February-May 2012) failed to obtain a single photo-record of a crocodile. Although *C. siamensis* are known to respond to bait (Bezuijen *et al*. 2013), Merchant *et al*. (2012) demonstrated that without technical modification motion-sensitive infrared cameras often fail to detect crocodilians. Camera trapping has since been discontinued at project sites.

Track and sign surveys delivered somewhat better results; two sets of measureable quality rear-foot tracks and 41 scats were found at four wetlands. However, because track and sign surveys are affected by poorly understood factors such as substrate condition, water levels, and social interactions between crocodiles these results are difficult to interpret. Although no doubt useful for determining presence/absence, at best, track and sign surveys can provide a crude estimate of the minimum number of crocodiles present at a site. Nest searches are conducted by VCCC teams in the late dry and early wet seasons (May-July) when female *C. siamensis* in Laos deposit eggs. Nest searches began in May 2011, and to date (April 2014) 8 nests have been found in four wetlands. Only three nests contained clutches of viable eggs; the remaining clutches were either destroyed by predators (N= 1) or contained intact, but non-viable eggs (N= 4). The underlying cause of the latter is unknown, but is possibly due to a paucity of sexually mature males in the metapopulation. Given the limitations of nocturnal spotlight counts, camera trapping, and track and sign surveys, nest counts appear to be the most appropriate method for monitoring long-term population trends and evaluating the success of this conservation project.

Head-starting Program

Because crocodile populations in Laos contain very few sexually mature adults, it was recognized early on that natural recovery in the absence of some form of augmentation could only be accomplished over a period of many years. Therefore, a head-starting program was initiated in June 2011 to bolster recruitment and increase the trajectory of population recovery. The first clutch of 28 *C. siamensis* eggs was collected in mid-June 2011 and transported to the Lao Zoo for incubation. Eggs were artificially incubated in Styrofoam boxes kept in a walk-in incubator at 32-33°C. Twenty-seven of the 28 eggs proved viable, and 20 (70.3%) hatched on 18 August 2011 (mean hatchling TL= 29.2 cm). Each neonate was weighed and measured, assigned a unique number, and permanently marked by clipping a unique combination of single and double caudal scutes. Neonates were housed in brooding chambers, fed *ad libitum* on living food (small fish, freshwater shrimp, and frogs) placed in the water, and growth is monitored each month by zoo staff. One neonate succumbed to unknown causes, and the remainder was transferred to two larger grow-out pens in October 2011. Each pen measured 3.1 x 2.2 m with an interior surface area that had an approximate land to water ratio of 1:1. Floating aquatic plants provided the neonates with concealment and naturalistic foraging opportunities when small fish and frogs were released into the enclosures.

On 19 March 2013 the 19 young crocodiles (mean TL= 78.6 cm) were transferred to a “sort-release” holding pen constructed in Phai Cheo Reservoir, an irrigation impoundment

that is part of the larger wetland complex where the eggs were originally collected. The pen (ca. 6 x 6 m) was constructed in shallow water, encompassed a patch of floating marsh and emergent plants, and consisted of a perimeter fence of closely spaced poles, the interior of which was lined with fine-mesh plastic screen (Fig. 2). The base of the screen was buried in the substrate to prevent crocodiles from escaping prematurely by burrowing beneath the fence. A small bamboo raft and floating peat mats provided basking sites. Village fishermen supplied food (fish, eels, and crushed apple snails) throughout the penning period.

The original plan was to hold the crocodiles in the pen for several months to engender site fidelity that in turn would dampen post-release dispersal. Self-release would occur at the onset of the wet season when rising floodwaters over-topped the perimeter fence, allowing the crocodiles to disperse into the surrounding wetlands. However, escapes began about a month after the crocodiles were transferred to the pen. By early June only three crocodiles could be found in the pen and these self-released when floodwaters inundated the enclosure later that month. After escaping, crocodiles stayed in the vicinity of the pen for varying periods before dispersing into the larger wetland complex. A continuous stream of sightings by village fishermen suggests most of the head-started crocodiles remain in the wetland.

Figure 2. Pre-release holding pen constructed in Phai Cheo Reservoir. Head-started Siamese crocodiles were held in the pen for several months prior to release. Most of the juvenile crocodiles managed to burrow beneath the fine mesh screen lining the interior of the pen and escape prior to the intended release period.

To further engage local communities and instill a sense of ownership in the resource, in 2012 it was decided to conduct incubation and head-starting operations in a village setting. Thirty-three viable eggs were collected from a nest at Kout Mark Peo on 6 June 2012; five of these eggs were placed in an artificial incubation chamber in Tan Soun Village, while the remainder (28) were taken to the Lao Zoo. The artificial incubation chamber consisted of a wooden frame (ca. 1 m x 1m x 1m) covered with fine-mesh wire netting and fitted with a hinged top; a floor of wooden slats allowed ample drainage (Fig. 3).

Figure 3. Improvised incubation chamber used to successfully hatch Siamese crocodile eggs in Tan Soun Village. Dried bamboo leaves serve as incubation media. Bamboo fence surrounding the chamber excludes free-ranging livestock.

The incubation media consisted of dried bamboo leaves and other vegetative detritus, which was kept moist (either by rainfall or supplemental watering) but not wet. The incubation chamber was placed in an exposed location with no overhead cover to mimic the natural nest environment, and monitored daily by VCCC cadres. Four of five eggs (80.0%) incubated at Tan Soun, and 17 of 28 (60.7%) eggs incubated at the Lao Zoo (60.7%) hatched on 6 and 11 August 2012, respectively.

Shortly after hatching, neonates at Tan Soun were placed in a brooding chamber, similar in design but somewhat larger than those used at the Lao Zoo. An electric light suspended in the brooder provided supplemental heat during the cooler winter months. Neonates were fed primarily small fish and eels, with lesser numbers of frogs and apple snails, on a daily basis. Because of unexpectedly rapid growth rates, the juveniles quickly outgrew the brooding chamber, and in August 2013 were transferred to four larger concrete grow-out pens (2 m x 3 m x 1.1 m high) constructed on the grounds of the village monastery (Fig. 4). The 2012 cohort is slated for repatriation to Phai Cheo Reservoir in mid-2014.

In 2013, a nest containing 37 eggs (35 viable; 2 non-viable) was found at Kout Mark Peo in late May. Because of the earlier success in rearing crocodiles at Tan Soun, it was decided to continue this practice in 2013. The 35 viable eggs were incubated as described earlier, neonates began vocalizing from within the egg on 15 August, and 17 (45.9%) hatchlings emerged the following day. Ants infesting the incubation media killed one neonate shortly after hatching, and another succumbed to unknown causes in October. The 15 surviving juveniles are being reared in the concrete grow-out pens and will be released at Phai Cheo Reservoir in mid-2015.

Conservation-breeding Program

Given the small wild population and limited number of nests available for collection each year, conservation-breeding was deemed a necessary element of the recovery efforts for *C.*

Figure 4. Concrete grow-out pen for head-starting juvenile crocodiles set amidst stupas on the grounds of a monastery in Tan Soun Village (above). Heavily vegetated interior of the pen (below).

*siamensis* in Laos. Conservation-breeding offers a means to rapidly produce large numbers of juveniles for head-starting and eventual release, and like head-starting has the potential to dramatically increase recovery trajectories. Genetic heterozygosity can be maintained by carefully managing the pool of breeding adults, an especially important consideration in Laos where both wild and captive populations of *C. siamensis* are small and inbreeding depression is a potential long-term concern.

*Ex-situ* conservation efforts began in 2009 when a group of 26 adult crocodiles of a phenotype consistent with *C. siamensis* were selected from among >100 crocodiles being held by the Lao Zoo. The provenance of the selected crocodiles could not be determined with any degree of certainty; some probably originated from wild populations in Laos, but others no doubt came from commercial farms in Thailand. Blood samples collected from each crocodile were analyzed by Dr. Evon Hekkala (Fordham University, Bronx, New York) to identify hybrid individuals. Based on these results, 10 (7 females, 3 males) crocodiles were determined to be genetically-pure *C. siamensis* and incorporated into a conservation-breeding group.

Prior to the beginning of the 2013 reproductive season, the genetically-pure Siamese crocodiles were segregated into three subgroups, each consisting of a single male and 2-3 females. Subgroups were housed in separate enclosures, and well-supplied with herbaceous material for nest construction. Three of the 7 females deposited 59 eggs during May 2013. Of these eggs, 21 were viable while 38 proved non-viable or were consumed by conspecifics. Poor egg viability may be due in part to past husbandry practices at the zoo, where until recently crocodiles were fed a diet consisting wholly of fish. Fish-based diets have been demonstrated to depress reproductive success among both female and male crocodilians in captivity (Hunt 1980; Joanen and McNease 1987). The viable eggs were artificially incubated and 12 (57%) hatched in mid-July. The hatchlings are being reared in small outdoor concrete pens, each containing a shallow pool with abundant aquatic vegetation. Heat is supplied with electric lamps during the cooler months, and a diet of small fish, frogs, and snails is fed *ad libitum*. These young crocodiles will be released upon attaining a length of 0.75-1.0 m. Nesting among the breeding group has not yet occurred in 2014.

## Future directions

The ultimate objective of this project is to restore a functioning metapopulation (Hanski and Simberloff 1997) of Siamese crocodiles in the Champhone River Basin. To this end, the existing network of locally protected conservation areas must be expanded to include additional wetlands known to harbor crocodiles and critical habitat that provides linkages between occupied sites. Long-term monitoring of crocodile populations must also continue so that conservation actions can be rigorously evaluated and revised if necessary. Finally, a significant expansion of the conservation-breeding program at the Lao Zoo is warranted, but great care must be taken to insure that only genetically-pure *C. siamensis* are incorporated into breeding groups. Unfortunately, an unexpected cancellation of donor funding in early 2014 casts doubt on the future of this project. Unless alternate funding sources can be secured, what is proving to be a highly successful community-based conservation project for a critically endangered crocodilian is unlikely to continue.

## Acknowledgements

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# Latin America and the Caribbean

## Paraguay

After the CSG Working Meeting in Lake Charles, Louisiana (26-30 May 2014), I met with the Paraguayan Authorities in Asunción, Lic. María Cristina Morales Palarea (Secretary of Environment) and Lic. Martha Motte (Director of Wildlife) (Fig. 1). We had a friendly discussion about the possibilities and advantages of establishing a management plan for *Caiman yacare* in the country, since the Government is receiving interest from the private sector on the sustainable use of the recovered populations. To the degree possible, the CSG is willing to assist Paraguay in this process. The private sector is planning a meeting/seminar to discuss the sustainable use of wildlife, and specifically crocodilians, but no date has been confirmed as yet. The authorities are aware that the CSG is keen to see Paraguay develop a management plan, and they will contact CSG before sending a formal request to CITES in relation to this issue.

Figure 1. Carlos Piña (right), with Paraguayan authorities; Martha Motte (left) and Maria Cristina Morales Palarea (centre).

Carlos Piña, *Regional Chairman for Latin America and the Caribbean, Argentina, <cidcarlos@infoaire.com.ar>.*

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## Mexico

PROGRAM FOR MANAGEMENT AND CONSERVATION OF CROCODILES IN THE NICHUPTE LAGOON SYSTEM, CANCUN, QUINTANA ROO, MEXICO. Over the last 22 years there have been 35 crocodile attacks in Quintana Roo State, 22 of which were occurred in Cancun. Nine of these attacks involved international tourists. Two species of crocodile, *Crocodylus acutus* and *C. moreletii*, occur in Cancun, the largest Mexican tourist destination, with more than 10 million tourists annually. A large tourist/hotel industry is located on the eastern barrier beach, and the local township of Benito Juarez, located adjacent to the hotel area, is where local people reside. The Nichupte Lagoon System is a saline wetland that lies between Benito Juarez and the coastal hotel located along the eastern beach.

In the last year we have taken steps to establish a program to coordinate different institutions for the benefit of the inhabitants of the town of Benito Juarez and the conservation of crocodiles in Cancun. The program is based on a planning document outlining the understanding of the problem and the organization, funding and coordination of actions to reach the following objectives: increased safety of local people; use by visitors; and, conservation of crocodiles. For this reason the program is a dynamic and flexible tool that can adapt to local conditions in the short-, medium- and long-term. The program establishes a permanent "Crocodile Program in the Nichupte Lagoon System" with a solid scientific base, developed and operated by specialists with the participation of all interested sectors. We hope to reduce crocodile mortality and maintain a viable crocodile population while improving the security of local people, resource users and visitors.

Specific objectives of the program are to: understand the dynamics of the crocodile population; inform visitors of the presence of crocodiles and what to do and not do to avoid negative encounters with them; disseminate information to local people on the importance of crocodiles and what actions are possible; manage dangerous and problem crocodiles; maintain permanent zones of tolerance and exclusion; and, understand the health of the crocodiles and attend to risk factors, injured and dead crocodiles. The program is organized into 5 sub-programs: population monitoring; environmental education; information distribution; conflict management; and, ecosystem health. In addition to government agencies the program involves local inhabitants and representatives of the hotel industry who have a large responsibility and interest and are developing strategies for participation at different scales.

In 2012, after two attacks occurred in the hotel zone of Cancun, the crocodile program was initiated for the first time to develop education, conflict management, monitoring and capacity building among diverse authorities. Unfortunately the program was terminated by withdrawal of government funding. In 2013 we started a plan and strategy to reactivate the program seeking economic sustainability and involving all the interested local players, by holding meetings of residents and authorities. Meetings were held on 9 September 2013 to establish an accord with the NGO Onca Maya, on 8 October 2013 to establish additional complementary sources of funding, and on 22 February 2014, where all the interested parties were brought together. With federal, state and municipal authorities, delegates from PROFEPA, SEMARNAT, the director of Ecology, the Director of FONATUR and ZOFEMAT, as well as directors from CONANP. These meetings have established agreement on a basic proposal with all the necessary components for successful development.

Results of the program to date include the establishment of the 5 sub-programs, a partnership agreement with Onca Maya, a pledge of funding $M446,000 (around $US34,000) from CONANP, coordination among the listed agencies, establishment of tax deductible status for donations to the project and development of a strategy to include local hotels in the program.

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NEW HUMAN-CROCODILE CONFLICT INCIDENTS IN OAXACA, MEXICO. The frequency of HCC continues to increase in Oaxaca State. One of the problems in acquiring an accurate interpretation of these events is the difficulty in obtaining detailed information. However, a significant effort has been invested to gather and report information opportunistically on the circumstances surrounding cases of HCC (eg García-Grajales and Buenrostro-Silva 2013).

Recently this conflict has become noticeable again due to the concerns that this kind of predator generates in the general public, and in most cases confronting the situation involves government participation due to public safety (García-Grajales 2013). However, it is fundamental to know in detail the circumstances for each incident in order to elaborate a more in depthanalysis of the proximal causes of these events, and then be able to develop a more robust mitigation strategy for this important issue.

In this study we report three new non-fatal incidents (Fig. 1) that took place on the coast of Oaxaca early this year, with the aim of increasing the amount of detailed information for a better understanding of this conflict in the state. The regions in the coast are based on that proposed by García-Grajales and Buenrostro-Silva (2013).

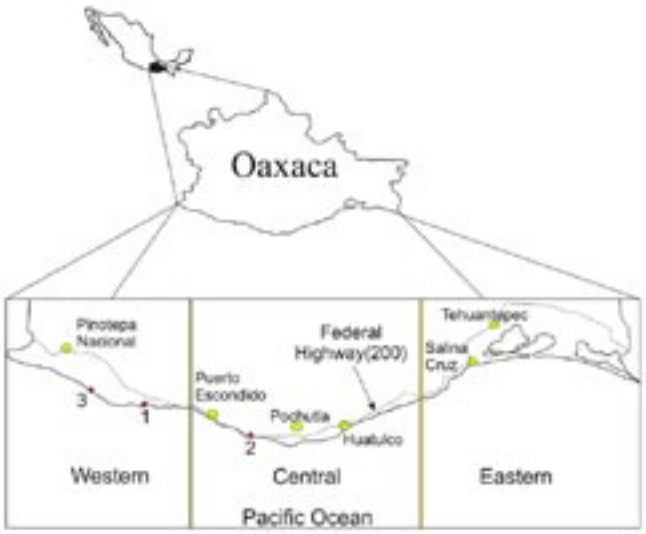


Figure 1. Sites of new HCC incidents in Oaxaca State, Mexico. 1= Case Zapotalito, 2= Case La Escobilla, 3= Case La Boquilla.

Incident 1: Zapotalito, Parque Nacional Lagunas de Chacahua (Western Region)

On 20 February 2014, at around 1700 h, Martín Canseco (40), a fisherman from the village of El Zapotalito was fishing in Laguna La Pastoría, within the Parque Nacional Lagunas de Chacahua (Fig. 1). While snorkeling, Martín had previously observed a crocodile of around 2 m length resting at the bottom, approximately 20 m from land. After a couple of minutes of fishing the man was taken by surprise by the crocodile. It attacked from behind, biting him on the calf of his left leg. Fortunately, Mr. Conseco was able to fight and get free from the crocodile and reach the shore where he asked other fishermen for help, and who swiftly transported him to the regional hospital in Río Grande. Mr. Conseco commented that he made the mistake of carrying his captured fish at his waist, and therefore, it was very likely that the crocodile had directed its attack at the fish, a key prey item of the species. Fishermen in the region face serious economic problems, and in order to feed their families most of them don't have other alternatives than fishing in areas where crocodiles occur. This increases the likelihood of interaction between fishermen and crocodiles.

Incident 2: Estero La Escobilla (Central Region)

On 24 February 2014, at around 1100 h, an adult male, around 35 years of age (person decided not to provide his personal information), was fishing on the shores of the La Escobilla estuary (Fig. 1) with two other fishermen. The man had been working near the shore using a cast net for almost two hours when he was attacked by a crocodile, approximately 1.6 m long. The crocodile bit him on the inner portion of his right thigh. Fortunately, his friends realized what was happening and reacted immediately by helping to release the injured fisherman from the jaws of the crocodile. The fisherman was taken and treated in the Hospital Regional de Pochutla, and the man recovered without major side effects.

There are three possible motives for this attack: 1) nesting in this region begins in early February, and reproductive females become territorial and protective of nest sites (Cedillo-Leal *et al*. 2013); 2) It is possible that the fisherman could have stepped on the resting crocodile and the latter reacted; and, 3) the crocodile may have attacked the fisherman due to the fish resource, similar to the previous case.

Incident 3: La Boquilla, Chicometepec (Western Region)

On 28 April 2014, at around 1000 h, Mr. Isidro Santiago Toscano Cruz (25) from Ranchería La Boquilla (Cangrejera), municipality of Santa María Huazolotitlán, was fishing with his cast net in one of the extensions of La Boquilla estuary when his net became entangled deep in the water. As he tried to disentangle the net a crocodile, approximately 1.8 m long, suddenly bit his right arm. The man quickly freed himself from the animal, sustaining only a few lesions. The fisherman reached the municipal health clinic on his own, and was taken to the Hospital Regional de Pinotepa Nacional.

Fishing is a common activity in many areas of coastal Oaxaca. Unfortunately, this makes it dangerous for fishermen as it means they are within the crocodile's environment, and in some instances this has resulted in the loss of human lives in the state (García-Grajales *et al*. 2008, 2013).

These three accounts were described to the first author via telephone, and the fishermen were notified that information would be used to develop a regional evaluation regarding these interactions. It is important to generate and channel efforts to establish and implement a national protocol to specifically address HCC, without the exclusion of previous recommendations (García-Grajales 2013). We strongly suggest that the resulting protocol contains a specific section addressing funding for these types of incidents. These funds should be created nationwide through a national department, and should cover fuel, lodging and food expenses for the victims of HCC. On the other hand, we suggest the creation of a special committee in every state where these accidents are more frequent; thus, they will be able to address these incidents in a timely manner.

In the state of Oaxaca, these conflicts have acquired politico-ecological dimensions due to the general discontent of local residents, since they are the ones who are interacting more frequently with the crocodiles. These social pressures have generated isolated actions from governmental sectors trying to reduce this crisis, such as the use of different improvised economic sources without reaching an efficient solution (García-Grajales 2014). Additionally, it is important to ensure the participation of the different academic groups from universities, research institutes, and the different government sectors to implement action plans that reduce and control the frequency of these accidents.

Finally, we reiterate that the removal of "suspect crocodiles" and their subsequent relocation to other areas or specific facilities without an appropriate investigation is no longer acceptable. Furthermore, institutional coordination is needed to channel state and federal economic resources toward clear and unified objectives instead of being isolated as has been the case in previous years and with different understandings of the problem.

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## Belize

DETAILS OF A FATAL ATTACK ON A HUMAN BY A MORELET'S CROCODILE (*CROCODYLUS MORELETII*) IN BELIZE. Morelet's crocodile (*Crocodylus moreletii*) is a medium-sized species (maximum size 4.5 m) native to Belize, Guatemala and Mexico (gulf coast to northern Tamaulipas State). It is generally viewed as preferring freshwater habitat (swamps, rivers, lagoons, etc.) but is also found in some saline coastal habitats. Morelet's crocodile is sympatric with the larger American crocodile (*C. acutus*) throughout much of its coastal range (Platt *et al*. 2010).

Amongst the South American crocodilian species, Morelet's crocodile is less commonly implicated in attacks on humans than *C. acutus* and the Black caiman (*Melanosuchus niger*), but nonetheless non-fatal attacks are reported every year. Anecdotal and unconfirmed records of man-eating Morelet's crocodiles exist for Belize and Guatemala (Marlin et al. 1995), but reports of fatal attacks by Morelet's crocodile are very rare in modern times - of the 31 attacks recorded since 2006, only four have been fatal and only one of these involved consumption of the victim. Two of the fatalities occurred in southern Tamaulipas State of Mexico in 2008, one occurred within the Chisec municipality of Alta Verapaz in Guatemala in 2006, and the most recent in the Ladyville region of Belize in 2014; here we present details of this recent Belizean attack.

Attacks on humans by crocodiles in Belize have previously been documented (Marlin *et al*. 1995; Garel *et al*. 2005); in both fatal cases Morelet's crocodile was either identified as

the culprit or was the most likely culprit. Prior to this 2014 attack, the last fatal attack reported for Belize occurred in August 2001 in the Balema Phase I community of Belize City; the culprit was identified as a Morelet's crocodile and an American crocodile in conflicting reports.

On 7 April 2014, at approximately 1430 h, Carl Michael Diaz (47) from Benque Viejo in Cayo district, was killed by a large crocodile while fishing in a marshy pond at the Green Estate compound in the Lord's Bank area of Ladyville, Belize district. According to local news media, at the time of the attack a nearby fisherman heard the victim's cry and responded to the scene to witness Diaz being dragged through the water by the crocodile. The fisherman made noise that caused the crocodile to release Diaz's body and flee the location. When Diaz's body was recovered it was found that injuries inflicted included his right foot being nearly completely removed, a large wound on his right leg, 3 puncture (bite) wounds on his left leg, and injuries to his face. It is believed the victim was fishing, as a small sack containing 9 fish was found along the shore of the pond. According to the victim's brother, Diaz and local residents were aware of large crocodiles being present in the area and that they were frequently seen (Bodden 2014a).

On 10 April 2014 the crocodile believed to be responsible was captured at the site of the attack by Vince Rose of the American Crocodile Education Sanctuary (ACES), and transported to the organization's Ladyville facility, where it was humanely euthanazed under the direction of the Belize Forest Department. The crocodile measured 2.9 m in length but had a substantial portion of its tail missing (around 0.6 m), and so its total length would have been 3.5 m; it weighed 249.5 kg. It was deemed responsible for the attack on Diaz due to it being the only crocodile sighted in the area during two nights of spotlight surveys and that it displayed unprovoked aggressive behavior towards Mr. Rose as he surveyed the attack site.

On 8 April 2014 a non-fatal attack, attributed to a Morelet's crocodile, occurred at Almond Hill Lagoon at Mile 9 of the Western Highway in Belize District. This incident involved two victims - a 13-year-old boy and his adult brother-in-law, both of whom were diving for fish at the lagoon when they were attacked. They were treated for their injuries at Belize City Hospital (Bodden 2014b).

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# Science

## Recent Publications

Kohno, S., Parrott, B.B., Yatsu, R., Miyagawa, S., Moore, B.C., Iguchi, T. and Guillette, Jr., L.J. (2014). Gonadal differentiation in reptiles exhibiting environmental sex determination. Sex. Dev. (doi: 10.1159/000358892).

Abstract: As temperature-dependent sex determination (TSD) and homozygote or heterozygote genetic sex determination (GSD) exist in multiple reptilian taxa, they represent sex determination systems that have emerged de novo. Current investigations have revealed that the genetic mechanisms used by various reptilian species are similar to those used by other vertebrates. However, the recent completion or near completion of various reptilian genome projects suggests that new studies examining related species with and without TSD could begin to provide additional insight into the evolution of TSD and GSD in vertebrate ancestors. Major questions still remain concerning germ cell migration and specification, the differentiation of gonadal accessory cells, such as the Sertoli cells and granulosa cells of the developing testis and ovary, respectively, and the mechanisms by which gene expression is regulated during TSD events. Further, reptilian sentinels and their mechanisms of gonadogenesis will likely remain important indicator species for environmental health. Thus, ongoing and new investigations need to tie molecular information to gonadal morphogenesis and function in reptiles. Such data will not only provide important information for an understanding of the evolution of these phenomena in vertebrates, but could also provide an important understanding of the health of the environment around us.

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Sweetman, S.C., Pedreira-Segade, U. and Vidovic, S. (2014). A new bernissartiid crocodyliform from the Lower Cretaceous Wessex Formation (Wealden Group, Barremian) of the Isle of Wight, southern England. Acta Palaeontologica Polonica (doi: http://dx.doi.org/10.4202/app.00038.2013).

Abstract: A substantially complete skull of a small crocodyliform recently found on the foreshore near Yaverland on the southeast coast of the Isle of Wight, southern England is described. The locality, mode of preservation and associated matrix indicate that it is derived from one of the plant debris beds of the Lower Cretaceous Wessex Formation (Barremian, Wealden Group). The dentition, unique among crocodyliforms, serves to confirm that the specimen is referable to the, until now, monotypic family Bernissartiidae Dollo, 1883. Apomorphies, including placement of the choana and disposition of cranial sutures demonstrate that the Isle of Wight skull cannot be referred to *Bernissartia fagesii* Dollo, 1883, known from contemporaneous strata. Furthermore, these characters indicate that the specimen should not be referred to a new species of *Bernissartia*. Uniquely among non-eusuchian neosuchian crocodyliforms, the choana appears to be bounded entirely by the pterygoids, although occupying an extreme anterior position within them. The specimen is therefore placed in a new genus and species, *Koumpiodontosuchus aprosdokiti*. The systematic position of Bernissartiidae, and characters used to diagnose Eusuchia are discussed.

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Drumheller, S.K. and Brochu, C.A. (2014). A diagnosis of *Alligator mississippiensis* bite marks with comparisons to existing crocodylian datasets. Ichnos: An International Journal for Plant and Animal Traces 21(2): 131-146.

Abstract: Crocodylians are known to consume and modify bones, but actualistic observations of their bite marks have been limited to forensic case studies and surveys of two taxa: *Crocodylus niloticus* and *Crocodylus porosus*. To further explore patterns of crocodylian bite mark expression, we conducted a survey of traces left by *Alligator mississippiensis*. We compared the results to pre-existing crocodylian datasets regarding the potentially diagnostic traits of bisected marks, hook scores, and a lack of furrows. Mark type did not correlate with vital statistics of the sampled animals or collections protocol. Bisected marks were found in rates similar to those seen in one previous survey of *C. niloticus*, and rates of hook scoring and bone breakage were higher. These traces were all present in higher rates than those reported in *C. porosus*. Unlike results seen in *Crocodylus*, furrows were identified in the *A. mississippiensis* samples. Hook scores were also identified, but recent surveys of non-crocodylian taxa have shown that these features are not unique to crocodylians and instead are related to inertial feeding strategies. The presence and rate of bisected marks found in this study bolster the interpretation that these traces are a clade-wide phenomenon and a useful diagnostic indicator for Crocodylia.

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Elsey, R.M. and Lang, J.W. (2014). Sex ratios of wild American alligator hatchlings in southwest Louisiana. Southeastern Naturalist 13(2): 191-199.

Abstract: The sex of American alligator (*Alligator mississippiensis*) hatchlings is determined by the egg temperature during the middle third of the 9-12 week incubation period. As a consequence, predictable sex ratios are possible for clutches incubated in constant temperatures in the laboratory, but naturally occurring sex ratios of American alligator hatchlings from wild nests exposed to fluctuating temperatures are not well documented. Over a 5-year period (1995-1999), we determined the sex of American alligator hatchlings from wild nests left in the field until after sex was irreversibly determined. A total of 6226 hatchlings from 232 naturally incubated wild nests showed a strong female bias (71.9% females, yearly range= 62.3-89.4% females). Most nests (64.2%) produced hatchlings of both sexes. Of the remaining clutches that produced exclusively one sex (83 nests), 78 nests produced all females, and 5 nests produced only male hatchlings. For the 2 years in which nest-cavity temperatures were known, higher temperatures led to production of significantly more male hatchlings ($P<0.001$ for both 1997 and 1999). Knowledge of natural sex ratios of hatchlings can aid in the management and harvest of this commercially valuable species, and in understanding sex-ratio bias in American alligator populations.

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Kpéra, G.N., Aarts, N., Tossou, R.C., Mensah, G.A., Saïdou, A., Kossou, D.K., Sinsin, A.B. and Van der Zijpp, A.J. (2014). 'A pond with crocodiles never dries up': a frame analysis of human-crocodile relationships in agro-pastoral dams in Northern Benin. International Journal of Agricultural Sustainability (dx.doi.org/10.1080/14735903.2014.909637).

Abstract: Crocodiles, a protected species, share ecosystem services with local communities in agro-pastoral dams in Northern Benin. Using a comparative case study conducted in three villages and a framing perspective, this study aims to elucidate how stakeholders frame the presence of crocodiles, and how they use formal and informal institutions to deal with them. Respondents framed the presence of the crocodiles as problematic because of their negative effects on local livelihoods and people's tranquillity. Both causes and solutions are, however, framed differently in the three communities. Whereas in Nikki and Sakabansi, respondents seek solutions in changing the ecological environment, requiring others (the council, fishermen, and crocodiles) to change their behaviour, Fombawi respondents seek to adapt their own behaviour by respecting and applying traditional and practical rules for sharing their dam. Damage per crocodile is the highest in Nikki and the lowest in Fombawi, suggesting that the crocodiles in Nikki behave more aggressively than those in Fombawi. Further investigation is merited to determine whether or not crocodiles behave less aggressively when dealt with according to specific institutions. Intensive communication among stakeholders in the three villages is recommended to exchange experiences and ideas that may support a peaceful human-crocodile relationship inspired by existing institutional solutions.

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Sertich, J.J.W. and O'Connor, P.M. (2014). A new crocodyliform from the middle Cretaceous Galula Formation, southwestern Tanzania. Journal of Vertebrate Paleontology 34(3): 576-596.

Abstract: A new taxon of peirosaurid crocodyliform, *Rukwasuchus yajabalijekundu*, gen. *et* sp. nov., is described on the basis of a well-preserved partial skull from the middle Cretaceous Galula Formation exposed in southwestern Tanzania. The skull is distinguished from those of other crocodyliforms by the presence of a mediolaterally narrow, elongate, and septate internal narial fenestra (choana) located anteriorly on the pterygoid; a markedly depressed posterior border of the parietal, excluding the supraoccipital from the dorsal cranial table; and a ventrally directed descending process of the postorbital with a well-developed posteroventral process. The lateral surface of the braincase is exquisitely preserved and includes a well-developed laterosphenoid bridge dividing the foramina for the three primary branches of the trigeminal nerve. In overall morphology, the holotype skull and isolated teeth compare closely with *Hamadasuchus rebouli* from the middle Cretaceous Kem Kem Beds of Morocco. Reevaluation of the problematic putative African peirosaurid taxa *Stolokrosuchus lapparenti* and *Trematochampsa taqueti* reveal a number of derived cranial characters shared with Peirosauridae and *Araripesuchus*. A close relationship between *Rukwasuchus* and other African members of Peirosauridae is supported by a parsimony analysis of Crocodyliformes. As the only known sub-Saharan peirosaurid from Africa, *Rukwasuchus* represents the only link between middle Cretaceous southern vertebrate faunas and much more abundant, taxonomically diverse, and potentially penecontemporaneous faunas from northern Africa.

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Myburgh, J.G., Kirberger, R.M., Steyl, J.C.A., Soley, J.T., Booyse, D.G., Huchzermeyer, F.W., Lowers, R.H. and Guillette, Jr., L.J. (2014). The post-occipital spinal venous sinus of the Nile crocodile (*Crocodylus niloticus*): Its anatomy and use for blood sample collection and intravenous infusions. Journal of the South African Veterinary Association 85(1): 2014 (http://www.jsava.co.za/index.php/jsava/article/view/965/1378).

Abstract: The post-occipital sinus of the spinal vein is often used for the collection of blood samples from crocodilians. Although this sampling method has been reported for several crocodilian species, the technique and associated anatomy has not been described in detail in any crocodilian, including the Nile crocodile (*Crocodylus niloticus*). The anatomy of the cranial neck region was investigated macroscopically, microscopically, radiographically and by means of computed tomography. Latex was injected into the spinal vein and spinal venous sinus of crocodiles to visualise the regional vasculature. The spinal vein ran within the vertebral canal, dorsal to and closely associated with the spinal cord and changed into a venous sinus cranially in the post-occipital region. For blood collection, the spinal venous sinus was accessed through the interarcuate space between the atlas and axis (C1 and C2) by inserting a needle angled just off the perpendicular in the midline through the craniodorsal cervical skin, just cranial to the cranial borders of the first cervical osteoderms. The most convenient method of blood collection was with a syringe and hypodermic needle. In addition, the suitability of the spinal venous sinus for intravenous injections and infusions in live crocodiles was evaluated. The internal diameter of the commercial human epidural catheters used during these investigations was relatively small, resulting in very slow infusion rates. Care should be taken not to puncture the spinal cord or to lacerate the blood vessel wall using this route for blood collection or intravenous infusions.

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Moreno-Bernal, J.W. (2014). Fossil crocodilians from the High Guajira Peninsula of Colombia, and the history of Neogene crocodilian diversity in tropical South America. Dissertations and Theses in Earth and Atmospheric Sciences Paper 49, University of Nebraska, USA. (http://digital commons.unl.edu/geoscidiss/49).

Abstract: The greatest diversity of Cenozoic crocodilians occurred during the Miocene in equatorial South America. However, the origin of this high diversity and its relationship to environmental factors are poorly understood. Most described species come from localities assigned to Laventan (13.8-11.8 Ma) and Huayquerian (9.0-6.8 Ma) South American land mammal ages (SALMAS), whereas the record is sparse in the early to middle Miocene and after the latest Miocene and Pliocene. Field research in the Castilletes (early Miocene-Pliocene) Formationin the High Guajira Peninsula of Colombia provides new fossil data on the origin of Neotropical crocodylian diversity. The Castilletes Formation crops out most extensively in the Cocinetas Basin, and represent depositional environments consisting of deltaic and shallow marine systems in the lower Castilletes and predominately fluvial environments in the upper Castilletes. Crocodilian fossils from the Castilletes Formation include gavialoids, alligatoroids and crocodyloids. Gavialoid remains have been recovered from both terrestrial and shallow marine deposits in the lower Castilletes. Remains of the specialized caimanines *Purussaurus* and *Mourasuchus* extend the temporal range of both lineages into the early middle Miocene (15-16 Ma). These records suggest that high diversity crocodilian assemblages were already established by the early Miocene or late Oligocene. Fossils from the upper Castilletes Formation include cranial elements identified as a non-tomistomine crocodyloid, some of them assigned to cf. *Crocodylus*. These records indicate that by the Pliocene, endemic assemblages were extinct, at least in the northern parts of the continent, allowing the establishment of *Crocodylus*. The pattern of crocodilian diversity in the Neogene of equatorial South America suggests that diversity was highly linked to hydrographic conditions. The development of high diversity assemblages developed in a time of greater connections among river drainages and mega-wetland systems. The isolation of river drainages and disappearance of mega-wetlands are correlated with the extinction of most crocodilian lineages. Aridity in peripheral drainages may have caused local extinctions outside Amazonia. The change from wetland to riverine conditions has been proposed as the cause of crocodilian extinctions in the western Amazon, but this remains to be tested.

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Bonke, R., Ihlow, F., Bohme, W. and Rodder, D. (2014).

Movement patterns of *Tomistoma schlegelii* in the Sekonyer Kanan River (Tanjung Puting National Park, Central Kalimantan, Indonesia): preliminary range size estimates. Salamandra 50(1): 40-52.

Abstract: Studies on home ranges and movement patterns have scarcely been conducted for crocodilians so far. Herein we present observations on movement patterns as preliminary home range size estimates for the endangered *Tomistoma schlegelii* (Crocodylia). Fieldwork was conducted at the Sekonyer Kanan River (Tanjung Puting National Park, Central Kalimantan, Indonesia). Three specimens were caught using a snare-pole, fitted with VHF radio tracking transmitters, and studied for a duration of two months between 31 August 2009 and 28 October 2009. Within this period, the individuals were relocated between 23 and 42 times, respectively. We analysed movement patterns by determining the animals' lin-ear range sizes (LR), minimum convex polygon ranges (MCP), kernel density estimators (50% and 90% KDEs), and local a-convex hulls (50% and 90% LoCoH). Linear range sizes (LR) were 0.104, 0.276 and 0.739 km while minimum convex polygon sizes (100% MCP) were 0.1, 0.577 and 1.758 ha. The study animals' kernel range sizes (90% KDE) were 0.094, 0.663 and 2.08 ha. Core areas (50% KDE) were 0.02, 0.211 and 0.639 ha in size. Local a-convex hull range sizes (90% Lo-CoH) were 0.025, 0.323 and 0.821 ha whereby core areas (50% LoCoH) for two study animals measured 0.103 and 0.34 ha. Although, our study was limited to a single dry season and therefore likely underestimates full range sizes for the species - our results provide important baseline data for urgently required follow-up studies on movement patterns of this endan-gered crocodile species.

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## Submitted Publications

ALLIGATOR BUBBLE TRAILS: OBSERVATION AND HYPOTHESIS. Researchers, hunters and others working in the field with American alligators (*Alligator mississippiensis*) often see trails of uniform small bubbles which mark the underwater movements of recently submerged alligators. In observing alligators in the wild at close range in clear water, I have observed that these fine bubble trails originate from the margin of the eye socket nearest the midline of the skull.

An hypothesis which seems to explain the phenomenon follows. The respiratory system of an alligator can be voluntarily sealed and separated from other organs due to the palatal and oesophageal structures. However as the alligator submerges, the sinus cavities in the skull would be subject to an external pressure differential. I propose that the alligator could relieve this pressure differential by forcing air from the lungs into the cranial sinus cavities. A small overcorrection of this pressure differential could be vented from the nasolacrimal duct at the inside margin of the eye. The nature of the bubble trails is consistent with the discharge of a slightly pressurized air stream from a small orifice. The bubble trails being produced shortly after submergence are due to the slightly excessive pressure equalization after the relatively rapid descent of the alligator. As an anology, a SCUBA diver may experience a pressure differential on a face mask which can be relieved by exhaling slightly into the mask until the pressure is equalized. Often a small overcorrection takes place causing a small leakage of air from the margin of the mask.

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MAGDALENA CROCODILE WITH SUPRA-SCAPULAR SUPERSCALES. In a 1926 article by economic botanist Wilson Popenoe is a black and white photograph of a Magdalena River crocodile that is surely an adult American crocodile. It is shown stretched out and fresh dead on the bow of a boat, with its mouth propped open with a stick. The mandibular symphysis of the lower jaws can be seen to extend to approximately the level of the 4th dentary tooth (Fig. 1).

Figure 1. "A trophy from the Magdalena. Alligators are numerous in the waters of the Magdalena River, Colombia's great highway, which flows for 1,000 miles through the heart of the country" (Popenoe 1926).

The Popenoe (1926) animal appears to have been in good health until it was killed, and thus the two separate and strongly keeled superscutes located in the supra-scapular region above the shoulder blades were not a problem for this presumably river dwelling crocodile. One of these scale-covered and isolated pieces of dermal bone is above the left forelimb, and bilaterally symmetrically the other is above the insertion of the right arm (Fig. 1). Both of these special scutes are significantly separated from each other by a broad expanse of granular and undefended skin. They stick outward and away from the body like the dive planes near the bow of a submarine, and I presume that they function to stabilize the crocodile when swimming under water, by lessening the roll of the forward half of the body when and while the tail is working. Additionally they obviously provide protection, each being composed of a substantial amount of solid bone and shaped as a defensive protruding spike.

At and near the base of the neck, and also in the adjacent starting region of the body armor, there is no midline series of dorsal osteoderm armor protecting the underlying vertebrae and muscles of this individual *C. acutus* from attack by jaguars and similar predators. Its cervico-thoracic juncture's midline is notably devoid of bony dermal plates in the region between (but not including) the two superscales. In the American crocodile, this expanse of undefended granular skin gets protected in a compensatory way by an increased range of cervico-thoracic region flexibility. The unarmored part of the vertebral column can now, as a derived innovation, bend both side-to-side and also vertically to a greater degree and with increased freedom of motion compared to the various more primitively and heavily armored living crocodilian taxa. Thus, as a general rule and principle, the more naked-necked an individual *Crocodylus* is, then the more effectively it can defend its flanks and whole body (and the dorsal surface of its neck) with its teeth.

The two most flexibly armored *Crocodylus* species, *C. acutus* and *C. porosus*, both have relatively naked necks, and each has also (in its own distinctive way) reduced the amount of bone in the body carapace. They are adapted for life in salt water, where bone is especially buoyant. If *C. acutus* and *C. porosus* had too much dermal bone embedded in their backs (and necks), they would be forced to stay in fresh water. The lost old bony body and neck protection is functionally replaced (and compensated for) by the newly gained protection provided to hatchlings and young by the red mangrove roots in which these particular juvenile crocodiles can hunt and hide in brackish water environments. The tricky and interesting thing is that for a crocodile to move optimally around among mangrove roots, it probably should not have remarkably protruding supra-scapular superscutes, because its locomotion among the rigid roots would have to be snakelike. In theory, the smoother the serpentine locomotion animal is, then the less it gets snagged.

The Popenoe (1926) crocodile has the generally reduced dorsal armor of *C. acutus*, but this special pair of supra-scapular lengthwise superscutes is a condition that I would expect to happen most frequently in a flowing fresh water river like the Magdalena. It is theoretically possible that estuarine American crocodiles on the Colombian coast near Barranquilla all lack supra-scapular superscales, and that some of them reduce the size or number of their post-occipital scales, and further that they can have their nuchal shield reduced to a single transverse row of four (or rarely fewer) scales. The hypothesis that freshwater riverine *C. acutus* have less bone defending the forward end of the body (the thoracic and cervical regions), in comparison with populations in the ecological zone dominated by mangroves, deserves testing in the Barranquilla region, because *C. acutus* lacking supra-scapular superscutes, and with just one row of nuchals are known from the "Magdalena" or Barranquilla region (the type-description of *Crocodilus lewyanus*), but without any details about the salinity of the water.

Russell Hastings Millward, the photographer credited by Popenoe (1926) for this photograph is someone other than Popenoe himself. This could possibly be because Wilson Popenoe is one of the men in the picture, or alternatively it could be because this photograph was taken in his total absence. He left the Caribbean coast by steam-powered riverboat from Barranquilla to La Dorada, and then took the train around the rapids of Honda, and then continued upriver by boat from Beltrán, and disembarked at Girardot (Popenoe 1926). Thus, because I do not really know if the photograph was taken on a boat bow in brackish water with mangroves along the edges, or alternatively on a boat bow in flowing pure fresh water in an ecology including jaguars, my interpretation about it being the latter is merely a hypothesis based on circumstantial evidence (but it makes sense). The 1926 article was not about the saline coastal city of Baranquilla, but rather about the freshwater and interior region around Bogota.

The bow appears to be that of a barge that is roped to the side of a large river steamboat, and Figure 1 is the first case I have seen of such obviously functional supra-scapular superscutes on any healthy and mature crocodilian. The Popenoe (1926) animal is not deformed. Rather, it had evolved a special tool to handle the special problem of being a relatively naked (reduced dorsal armor) mangrove crocodile species that has colonized a river that flows through jaguar country. The obvious question is whether similar *C. acutus* exhibiting these extraordinary lateral shoulder scutes (undocumented before in the living or fossil Crocodylia) can still be found in the Magdalena today.

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Popenoe, W. (1926). Round about Bogotá: a hunt for new fruits and plants among the mountain forests of Colombia's unique capital. The National Geographic Magazine 49(2): 127-160. (It is the first item in the February issue of volume XLIX, published in Washington.)

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DE BOER'S (2011) EVEN MORE UNIQUE *OSTEOLAEMUS* NUCHALS. While examining African Dwarf crocodiles during the winter of 2006 and 2007 in Yaoundé, Cameroon, an expedition led by Roland Zoer photographed a local animal that exhibited a special kind of nuchal scale on its neck that had never before been reported in the Crocodylia, either living or fossil. This individual *Osteolaemus t. tetraspis* had its cervical shield modified into two lengthwise superscales, one of them located to the left of the midline, and the other located to the right of the midline. Neither of these two parallel and adjacent superscales to any degree physically crosses the midline, and thus they are both technically and fundamentally different from the *Osteolaemus t. osborni* transverse superscales illustrated in De Boer (2011; p. 39, figs. 3.2a and 3.2b) and discussed in Ross (2014).

Of the three possible modern (normal and common) transverse rows of *Osteolaemus* nuchal scales, these unprecedented new lengthwise (long-axis of the animal) superscutes are the result

of recent fusions between modern scales (each of which is the product of a prior longitudinal fusion) in the anterior two (the largest and most conspicuous) expected modern transverse rows. Separately, the often vestigial third and most posterior possible modern nuchal row in *Osteolaemus* (PC 19 in the terminology of Ross and Mayer 1983) is completely absent on this young animal, as shown in De Boer (2011; p. 40, fig. 3.3). Each of the two new super-long scutes is composed of elements contributed from the modern rows that Ross and Mayer (1983) called PC 20+21 compound, and PC 22+23 compound. These two modern rows have evolved to now become secondarily and additionally compounded into what I today characterize as a single PC 20+21+22+23 quadruple compound transverse row.

Each of these quadruple compound scales corresponds with (gets its blood and nerves from) the four cervical vertebrae that Ross and Mayer (1983) called PC 20, PC 21, PC 22 and PC 23. It was formerly thought that two cervical vertebrae was the largest number that could correlate with a single transverse osteodermal row on the crocodilian neck (Ross and Mayer 1983), but De Boer's (2011) figure 3.3 is one extra-long but not extra-wide transverse row consisting of a pair of remarkably elongate (and in this case quadruply compounded) scales, and this discovery of an extraordinary *Osteolaemus* with PC 23 to PC 20 combined into a single transverse row disposed as a pair of lengthwise superscales that is bilaterally symmetrical, although a rare (n= 1) occurrence, definitely and directly supports the Ross and Mayer (1983) assertion and model that longitudinal compounding can and often does occur in various ways in the neck scales of the living and recent Crocodylia.

In addition to the (n= 2) transverse super-sized nuchal scales noted in Ross (2014), and separately in addition to the longitudinal super-sized nuchal scutes (n= 1, above), De Boer (2011) also detailed some asymmetrical and irregular cervical shields in *Osteolaemus* (drawings of two of them are on page 41, as figs. 3.4a and 3.4b). I believe that they are the first published pictures of *O. tetraspis* nuchals that are not bilaterally symmetrical in the anterior two (of three) transverse rows of the cervical shield.

In De Boer's (2011) sample of 64 African Dwarf crocodiles, a substantial number of cervical shields were of unexpected kinds, and he observed that these various oddities seem to occur (individually and collectively) rarely in both *O. t. tetraspis* and *O. t. osborni*. Until very recently, the literature about the external appearance of this genus (and of its alleged two species-group taxa) was based on a remarkably few individual specimens and photographs. There was a consensus that the two big transverse rows of nuchals were each a bilaterally symmetrical pair of rectangular scutes. The more anterior of these two transverse rows was thought to be the larger. However, De Boer (2011) reported some examples in which both of the conspicuous and large pairs of nuchal scutes (ordinarily obligatory modern transverse rows) were the same size (length) as each other, and a few in which the posterior obligatory (almost always present) nuchal row has scales that are longer than in the row anteriorly adjacent to it. The relative proportions between these big transverse rows (of two scales each, except rarely when transverse superscutes are present) is more variable than believed before, and the details of the variation do not support the subspecies hypothesis tested in De Boer (2011). Having unexpected cervical shields is not correlated with geography within the Zoer expedition's sample reported in De Boer (2011).

Roland Zoer's field team examined a random but purposefully widespread *Osteolaemus* sample, seeking to compare *O. t. tetraspis* with *O. t. osborni* in the equatorial region where there is commonly and currently believed to be a taxonomic divide between these two subspecies. They did not discriminate against any individuals as being too normal (Zoer and Pearcy 2010). A few other nuchals that do not exactly fit the traditional *Osteolaemus* stereotype are also illustrated in De Boer (2011). The frequency of *Osteolaemus* exhibiting peculiar cervical shields is, as predicted as theoretically probable by Ross (2006), large enough and of such a nature that the nuchal scales are not a useful tool for species-group level taxonomic identification. Further, the hypothesis in Ross (2006) that the postoccipital scales are essentially useless for separating *O. t. tetraspis* from *O. t. osborni* was supported by De Boer (2011).

The neck (and adjacent thoracic) armor of *Osteolaemus* separates it from *Crocodylus niloticus*, and also from *Mecistops cataphractus*, but when Karl Patterson Schmidt asserted that his own *Osteoblepharon osborni* can be distinguished from Edward Drinker Cope's *Osteolaemus tetraspis* by the neck scales, it was apparently not exactly true.

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