CROCODILE SPECIALIST GROUP NEWSLETTER

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IUCN • Species Survival Commission

CROCODILE

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GROUP

NEWSLETTER

VOLUME 37 Number 2
APRIL 2018 - JUNE 2018

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

EDITORIAL AND EXECUTIVE OFFICE:
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COVER PHOTOGRAPH: Mugger (*Crocodylus palustris*) hatchlings basking with Common Flap-shell turtle (*Lissemys punctata*). Photograph: Pranav M. Vaghashiya. See article on pages 16-18.

EDITORIAL POLICY: All news on crocodilian conservation, research, management, captive propagation, trade, laws and regulations is welcome. Photographs and other graphic materials are particularly welcome. Information is usually published, as submitted, over the author's name and mailing address. The editors also extract material from correspondence or other sources and these items are attributed to the source. If inaccuracies do appear, please call them to the attention of the editors so that corrections can be published in later issues. The opinions expressed herein are those of the individuals identified and are not the opinions of CSG, the SSC or the IUCN unless so indicated.

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The CSG Newsletter is produced and distributed by the Crocodile Specialist Group of the Species Survival Commission (SSC) of the IUCN (International Union for Conservation of Nature).

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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CSG Executive Office, P.O. Box 530, Karama, NT 0813, Australia.
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Phoenix Herpetological Society, Arizona, USA.
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Jeff Lang, Minnesota, USA.
Libor Kopecny, Czech Republic
Lou Densmore, Texas, USA.
Matthew Shirley, Florida, USA.

Editorial

The 25th CSG Working Meeting, in Santa Fe Argentina, 7-10 May 2018, was attended by 236 delegates from 30 countries, and was a huge success. The theme, "Thirty Years Later .... a Problem becomes a Livelihood", focused attention on integrating livelihoods into management programs (see pages 13-15), a philosophy which the CSG has embraced for the decades.

We were very fortunate that the Chair of the SSC, Dr. Jon Paul Rodriguez, was able to interrupt his busy schedule to attend, the Working Meeting meet many CSG members, and see for himself the diverse expertise - young and old - that the CSG network brings together. Our ability to solve most problems expediently is a direct consequence of this expertise and experience.

The CSG Steering Committee meeting on 6 May was attended by 38 SC members and more than 60 other CSG members and interested participants. As always, the meeting was open and transparent, with a diverse range of issues (see Minutes on pages 6-13). As usual, detailed notes had been prepared and distributed on each agenda item prior to the meeting.

Two written submissions (India, Morocco) and one verbal submission (Mexico), later confirmed, were received to host the 26th CSG Working Meeting in 2020. The Mexican submission was accepted for a variety of reasons, but particularly because the Mexican focus on crocodilian conservation, research and management has increased exponentially in the last decade.

A tremendously diverse range of papers was presented, covering the full spectrum of current research, from the cellular to the population level. The contribution by Latin American countries was astounding in quality and diversity. A few decades ago there were relatively few Latin researchers reporting at Working Meetings. Now they dominate the agenda. Proyecto Yacare, coordinated under CSG Deputy Chair Alejandro Larriera, in Santa Fe, Argentina, is arguably the biggest single program committed to crocodilians in the world. An outstanding achievement.

Industry issues were discussed at length, because we appear to be in a global but cyclic overproduction phase, as has occurred before. Added to this, some Animal Rights organizations have mounted campaigns against the "iconic brands" for using crocodilians and other animal products, with no reference to the role these "brands" and the industry as a whole, play in driving incentive-driven conservation programs for crocodilians in many countries. Any shift towards purchasing factory-farmed skins over those derived from ranching and wild harvest, within management programs that extend benefits to the livelihoods of people, would be a retrograde step for conservation. Additional information to that provided at the Working Meeting is now being gathered with a view to the CSG better understanding current trends and their ramifications for both conservation and livelihoods.

It was announced that Dr. Marisa Tellez, in collaboration with the Belize Forest Department and CSG members from the Latin American and Caribbean region, has organised a Central America and Caribbean Sub-regional CSG meeting to be held in Belize, on 26-29 June 2019. This is a complex and diverse governmental sub-region, and the 4-day meeting is intended to expand the network of key stakeholders, discuss current conservation and management strengths and weaknesses, and promote opportunities for increased collaboration in both conservation and general research. On 29 June a workshop will be held on conducting crocodilian population surveys for interested students and participants. The meeting website will be available by October 2018.

It was also announced that a 2nd Forum on Crocodiles in the Philippines will be held at the Southeast Asian Regional Centre for Research in Agriculture, University of the Philippines, Los Banas, Laguna, Philippines, on 6-8 March 2019. The meeting website is expected by the end of September 2018. As at the first meeting, Crocodile Porosus Philippines Inc. is the key hosting organisation, and the forum will provide an opportunity to review and update local and regional issues. Long-term crocodile researcher Dr. Angel C. Alcala will attend. He was among 11 Filipino alumni inducted into the Fulbright Philippines Hall of Fame, acknowledging 70 years of the Fulbright program in the Philippines. We extend our congratulations to Dr. Alcala for this award.

A number of recently published books are featured in this newsletter (see pages 4-5): "Gharial is a Fish-eating Crocodile: Its Ecology, Behaviour and Conservation" by Lala Singh; 2nd edition of "Discoveries of a Crocodile Man" by Tony Pooley; "Credit the Crocodile" by Godfrey Harris; "My Husband and Other Animals 2" by Janaki Lenin; and, "Muggers of Vadodara" by Raju Vyas. I also draw your attention to "Go Tell the Crocodiles: Chasing Prosperity in Mozambique" by Rowan Moore Gerety, which among other challenging humanitarian and moral issues discusses life in a riverside community that has lost dozens of people to crocodile attacks (https://thenewpress.com/books/go-tell-crocodiles).

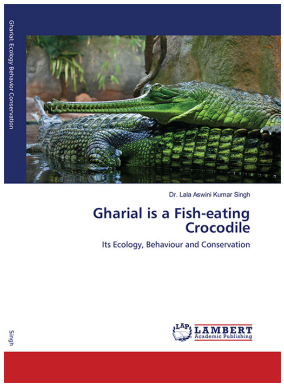
Professor Grahame Webb, *CSG Chair.*

Addendum to CSG Newsletter 37(1) [Jan-Mar 2018]

Page 9: The credit for Figure 3 should have been attributed to Heryanto Sumanbowo (BKSDA, East Kalimantan Province).

Books

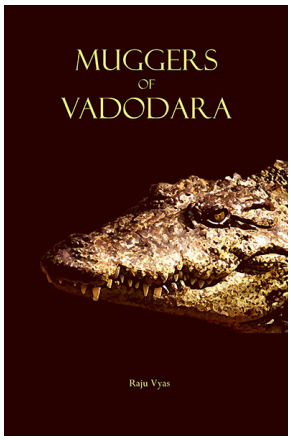
"**Gharial is a Fish-eating Crocodile: Its Ecology, Behaviour and Conservation**" by Dr. Lala Singh, was recently published (Lambert Academic Publishing, Mauritius; 2018). The book is largely based on the author's 1978 PhD [Ecological Studies on the Indian Gharial *Gavialis gangeticus* (Gmelin) (Reptilia, Crocodilia)] and Post-doctoral work in the Mahanadi and Chambal Rivers of India.



The book, published in black and white with a colour cover, comprises 270 pages and numerous photographs and graphics.

"**Muggers of Vadodara**", conceived and compiled by Raju Vyas, and supported by the Voluntary Nature Conservancy, covers the urban Mugger crocodiles (*Crocodylus palustris*) in Vadodara City, Gujarat, India, and makes very interesting reading.

The book is now available for download at: http://bit.ly/MoVRajuV.



"**Discoveries of a Crocodile Man**" by Tony Pooley is an autobiographical account of the development of a childhood passion into an international career in crocodile conservation. Tony succeeded in describing the challenging early days of crocodile conservation in southern Africa with a forthright commitment and dedication to conservation, but also great sensitivity to the natural world, and empathy with the humans affected by the conservation of large predators. It is the story of Tony's struggle to learn more about the maligned and secretive Nile crocodile (*Crocodylus niloticus*), including observing and documenting important aspects of crocodile reproductive behaviour, and to convince the authorities and the public of its right to survive in Africa's protected waterways. Along the way, the reader learns a great deal about crocodile biology and behaviour, the ecological relations of crocodiles with their fellow creatures, and gains insights into the lost world of Zululand in the 1950s-1970s, both ecologically and socially.

This 2nd edition, edited by Tony's son, Simon Pooley, includes: new photographs and illustrations (44 colour photos, 9 black & white photos, 6 maps and drawings) sourced from Tony's personal collection; an introduction by Simon providing further biographical information and historical context; a brief afterword about Tony's career after the 1st edition of the book was published in 1982; appendices on name changes; an update on the status of Nile crocodiles in the region; and, a detailed index. The book is available as a paperback (15 x 23 cm) or ebook, from: www.blurb.co.uk/b/8702472-discoveries-of-a-crocodile-man.

Discoveries of a Crocodile Man

Tony Pooley

"**Credit the Crocodile**" (Consideration Books: Los Angeles; 260 pp.), by Godfrey Harris, is set in South Africa, and tells the story of two idealistic American teenagers who visit the country in hopes of freeing Nile crocodiles from a farm back to the wild. The boys are dismayed to learn that local residents oppose their campaign because the farm provides jobs, and

farming has saved the iconic species from extinction.

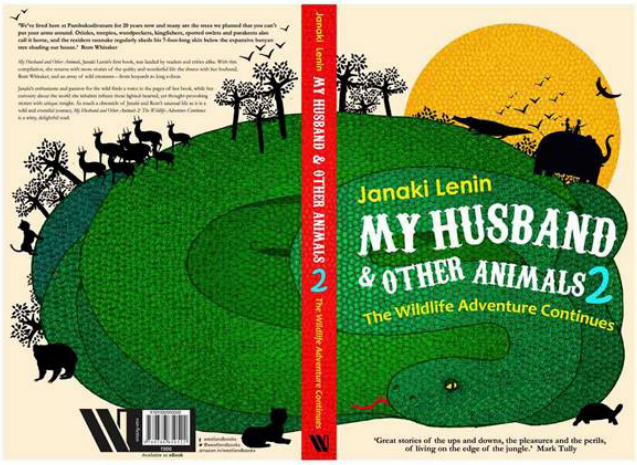
The two are arrested and sentenced to live in the bush for two weeks to experience life among predators and prey just as the "freed" crocodiles would. To their astonishment, they are protected by Credit, the dominant male crocodile at the farm, who finds a way to communicate with them. He wants them to carry a message home that African wildlife is an African responsibility.

The book is designed to open the eyes of adults through the fresh perceptions of their children, particularly to the possibility of saving a species while maintaining a trade in its parts. The book raises a few questions: Does the world appreciate the reality that sustainable use of wildlife products, such as ivory or rhino horns, actually creates an incentive for conserving wildlife? How can we best communicate this message so that people begin to appreciate a different approach to conservation?

The book has a 5-page index with references to true events and factual information described in the story. To research the book, the author visited South Africa twice and toured reptile parks, crocodile farms and wildlife sanctuaries. He interviewed their operators and met with judicial and diplomatic officials to gather additional facts for the story.

Sources: *Emanuel Kor, The Namibian, 10 April 2018 (https://www.namibian.com.na/176270/archive-read/Credit-the-Crocodile); GlobeNewsWire, 1 May 2018 (https://globenewswire.com/news-release/2018/05/01/1494161/0/en/Crocodiles-in-South-Africa-Are-the-Heroes-of-This-Political-Novel-for-Young-Adults.html).*

"My Husband and Other Animals 2", authored by Janaki Lenin, was released at the end of April. It includes stories about herself and Rom Whitaker, such as how they met, Rom's aborted calling as a lyricist for a rock group, and of course his obsession with snakes and crocodilians. But the book also delves into much, much more - with humour, science and story-telling.



CSG Student Research Assistance Scheme

The Student Research Assistance Scheme (SRAS) provided funding to 4 students in the April-June 2018 quarter, and four further applications are currently under review.

1. Diego Pacheco Gordillo (Mexico): Population abundance of *Crocodylus acutus* and zoning of risk areas in Osumacinta, Chiapas, Mexico.

2. Gualberto Pacheco Sierra (Mexico): Population genetic ecology of *Caiman latirostris* and *Caiman yacare*: variation and hybridization.

3. Samuel Hilevski (Venezuela): Use of soy (*Glycine max*) to supplement feeds of *Caiman latirostris* for commercial purposes.

4. Phoebe Griffith (UK): Building an evidence base for Gharial (*Gavialis gangeticus*) conservation in Nepal.

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

Quehacer Científico en Chiapas

Volume 12, issue 2 (July-December 2017) of Quehacer Científico en Chiapas is now available on the CSG website (www.iucncsg.org). It contains 14 papers on crocodilians (see below), devoted to the theme of "Conservación y Manejo de los Crocodylia en América".

1. Quiroz, G.B.: Gustavo Casas Andreu (1943) Síntesis Biográfica.

2. Seijas, A.E.: Growth rates of the American crocodile (*Crocodylus acutus*): an analysis of regional and habitat related differences.

3. Charruau, P., Hernández-Marcial, F. and Méndez de la Cruz, F.R.: Reproductive ecology of the American crocodile in northern Quintana Roo, Mexico.

4. Carbot-Chanona, G.: Restos de cf. *Crocodylus* sp. en el Mioceno tardío de Chiapas, México: importancia paleobiogeográfica y paleoambiental.

5. Rueda Cordero, B.A., López Luna, M.A. and Olivera Gómez, L.D.: Uso de hábitat del cocodrilo de pantano *Crocodylus moreletii* en una laguna urbanizada en México.

6. Rodas-Trejo, J., Ocampo-González, P., Mandujano-Camacho, H., Grajales-Zepeda, R. and Hernández-Nava, J.: Estado poblacional del *Crocodylus moreletii* (Reptilia: Crocodylidae) en el Área Natural Protegida Laguna de Términos, Campeche, México.

7. Serna-Lagunes, R., Espinosa-Blanco, A.S. and Mora-Collado, N.: Distribución potencial de *Caiman crocodilus*

chiapasius en México.

8. Cupul-Magaña, F.G., Escobedo-Galván, A.H., Casas-Andreu, G. and Uriarte-Garzón, P.: Hasta el Río Yaqui y más allá: localidades históricas y actuales de *Crocodylus acutus* (Cuvier, 1807) en la costa noroccidental del Pacífico mexicano.

9. Mandujano-Camacho, H., de la Cruz-López, C., Alfaro-Farrera, A.H., Pérez-Vázquez, L.A. and Hernández-García, P.A.: ¿Cómo reaccionan los cocodrilos en un evento sísmico? Observaciones en *Crocodylus moreletii*.

10. Esquinca-Cano, F., Avendaño-Gil, M.J., Coutiño-José, M.A., Gómez-Pérez, L.E. and Carbot-Chanona, G.: Rescate y conservación del patrimonio paleontológico de Chiapas: impacto en el conocimiento de la historia de los Crocodylia fósiles de Chiapas.

11. Velasco B., A.: La conservación y el uso sustentable de los cocodrilos en Latino América y el Caribe.

12. Aguilar-Miguel, X. and Casas-Andreu, G.: Bases para la incubación de huevos de cocodrilo en prácticas de rancheo.

13. Flores-Urtiaga, L.L.: Revisión bibliográfica de la respuesta inmune en crocodilianos.

14. García-Garduño, M.E., Monroy-Vilchis, O. and González-Desales, G.A: Retos de las comunidades locales en la conservación de los Crocodylia en México.

Minutes of CSG Steering Committee Meeting, Santa Fe, Argentina, 6 May 2018

Meeting opened at 0900 h.

Steering Committee Members present: Grahame Webb, Alejandro Larriera, Tom Dacey, Charlie Manolis, Perran Ross, John Caldwell, Mark Merchant, Simone Comparini, Christine Lippai, Lonnie McCaskill, Paolo Martelli, Alvaro Velasco, Carlos Piña, Marisa Tellez, Luis Bassetti, Allan Woodward, Thomas Rainwater, Kent Vliet, Val Lance, Phil Wilkinson, Matthew Shirley, Enrico Chiesa, Cathy Shilton, Jerome Caraguel, Sally Isberg, Pablo Siroski, Yoichi Takehara, Alfonso Llobet, Hesiquio Benítez Dias, Manuel Tabet, Curt Harbsmeier, Sergio Balaguera-Reina, Rainier Manalo, Laura Porras Murillo, Alfonso Llobet, Oswald Braken Tisen, Steve Platt, Fabian Schmidt

Others present: Sukenao Iida, Mitsuko Takehara, Helen Crowley, Rob Gandola, Alba Imhof, Juan Larriera, Joe Partyka, Lauren Augustine, Miryam Venegas-Anaya, Weber Girardi, Russell Lowers, Ashley Pearcy, Jeff Lang, Shawn Heflick, Miriam Boucher, Robert Godshalk, R.J. Rao, Charles Caraguel, Rambli bin Ahmad, Philip Baltazar, Vic Mercado, Chona Mercado, Leonor M. Alcantara, Luis Sigler, Christie Wilkinson, Gerry Swan, Takayuki Kataoka, Toby Ramos Targarona, Colette Adams, Jon Paul Rodriguez, Zilca Campos, Simon Pooley, Jan Myburgh, Melina Simoncini, Christy Plott, Robinson Arias-Botero, Terry Cullen, Gisela Poletta, Maikel Bitolo, Joey Brown, Samuel Hilevski, Stephany del Rosario, Melciellyne del C. Aguilar M., David Oudjani, Yairen Alonso Jiminez, Tamara Anderson, Paul Reilly, Etiam Perez Fleiten, Betzaida Rivera, Venetia Briggs-Gonzalez, Csaba Geczy, Victor Vest, Brian Sibongga, Robby McLeod, Frank Robb, Lucia Fernandez, Marcos Coutinho, Buddy Baker, Matt Eschenbrenner, Kate Anderson

Apologies
Steering Committee members: Ruth Elsey, Bruce Shwedick, Thomas Ziegler, Asghar Mobaraki, Eric Langelet, Anslem De Silva, C.H. Koh, Hank Jenkins, Yosapong Temsiripong, Sergio Medrano-Bitar, Manuel Muñiz, Matthew Brien, Wu Xiaobing, Thomas Ziegler

CSG members: Samuel Martin, Richard Fergusson, Sam Seashole, Joe Wasilewski, Antoine Cadi, Obdulio Menghi, Agata Staniewicz, Kim Lovich, Pierre Charruau, Godfrid Solmu

1. Executive Reports

1.1. Chair's Report (verbal - Grahame Webb)

The Chair opened the meeting at 0910 h, welcomed participants, and thanked Alejandro Larriera and the Projecto Yacare team, and the various institutions (CICYTTP-CONICET, Ministerio de Medio Ambiente, FHUC-Univerity Nacional del Litoral, BIOS Santa Fe, Gobierno de la Ciudad de Santa Fe) for hosting the working meeting.

One minutes' silence was held for CSG members who have passed since the last Steering Committee meeting (May 2016).

The Chair raised various "Boom/Bust" issues:

a. CITES meeting (CoP17) held in South Africa
   - A number of FLWG members attended.
   - Mexico, Sarawak, Colombia and Madagascar submitted amendment proposals.
   - Colombia (compliance problem, not a conservation problem).
   - Traceability.
   - CoP18 (Colombo, Sri Lanka, May-June 2019): should Madagascar choose to resubmit it should engage with EU from the start; Egypt may submit a proposal to lift the zero quota currently in place.

b. Reviews: Queensland population monitoring and trial wild nest harvesting; and, Nepal's "Gharial Conservation Action Plan for Nepal (2018-2022)".

c. Albuquerque Bio-Park collaboration project for the development of a "CSG Conservation Priorities for World Crocodilians".

d. Best Management Practice Manual (on CSG website).

e. Red List assessments.

f. CSG Action Plans update.

g. CSG website.

h. CSG Newsletter.

i. Apaporiensis caiman project, Colombia.

j. Student Research Assistance Scheme.

k. Wildlife Management International contract.

l. Next Working Meeting bids from India and Morocco.

m. Sustainable Use: SULI - Hunting; and, Born Free Foundation now a member of IUCN.

n. McIlhenny family recognition.

Yoichi Takehara delivered a short address to the Steering Committee, announcing his resignation as a representative of the Japan Leather & Leather Goods Industries Association, CITES Promotion Committee & Japan Reptile Leather Industries Association. As a long-serving member of the CSG and SC, Takehara-san has contributed significantly to the group over many years, and will continue to do so as a CSG member in a private capacity. He also provided a history of Japan's involvement with CITES, and specifically with crocodilian trade.

1.2. Minutes from SC meeting, Skukuza

The minutes of the previous SC meeting were noted, with the opportunity for participants to comment on any issues.

1.3. Actions from SC meeting, Skukuza

The actions from the previous SC meeting were noted.

Discussion was held on the African Survey Database, which had been established by WCMC, but had not been updated for some time. Christine Lippai subsequently advised that she had followed this matter up with Jon Hutton and WCMC. Preliminary indications are that a revision and update would cost around $US14,000.

Action 1: A working group, led by Matthew Shirley, Christine Lippai and Sergio Balaguera-Reina, was established to review the issue and come back with recommendations on a way forward during the course of the working meeting.

1.4. Executive Officer's Report

The Executive Officer presented his report, highlighting:

- Current SC membership of 76 people;
- CSG membership of 612 people from 64 countries;
- Regional Offices are currently maintained in Latin America & Caribbean (Argentina), Central America & Caribbean (Belize), South Asia & Iran (Sri Lanka), East & Southern Africa (South Africa); and,
- The CSG Student Research Assistance Scheme (including the FHVS-SRAS) has approved 142 applications since its inception in 2009 (see SC.5.1).

Currently, CSG members are listed on the website without contact details (eg e-mail address). When the website was established, contact details were not included, as some members cited privacy issues. Perran Ross indicated that contact details of most members could be found within minutes on the web, and so privacy may not be such an issue now. Suggestions on ways in which members could be reached through the CSG website without showing e-mail addresses were discussed.

Action 2: Charlie Manolis to review this matter and come back with recommendations.

1.5. CSG/IACS Financial Reports

The Executive Officer reported that:

- The IACS bank balance at 31 March 2018, was $AUD844,952 (approximately $US650,613).
- The IACS bank balance at 30 April 2018, was $AUD836,567 (approximately $US644,157).
- The IACS Annual General Meeting was held on 24 October 2017, noting the Audit Report and approving the re-election of office bearers.

Matt Shirley enquired whether there was any proposal for greater income earning capacity. The Chair advised that he was currently considering the publication of a crocodilian source book or magazine, in which all members within and outside industry who pursue professional activities linked to crocodilians, including competitive grants and consulting, could advertise. There is a danger in CSG competing with its members if it starts expanding into "projects"; CSG is a network of members.

The report was noted.

2. Regional Reports

2.1. East & Southern Africa

Christine Lippai, Regional Chair for East & Southern Africa, presented the report, advising that the region is very large and she was developing a networking strategy, including identification of focal points. Matt Shirley advised that Egypt is planning to go back to the next CITES meeting, seeking to lift the current zero export quota on wild *C. niloticus* specimens.

The report was noted.

2.2. West & Central Africa

A late report was received and posted on the website the day before the SC meeting. Matt Shirley addressed the meeting, advising:

a. They will be building up their networking and membership over the next couple of years;

b. There are ongoing projects in 9 countries;

c. There is a massive bushmeat trade in Dwarf crocodiles, as there appears to be no control in the exporting countries; and,

d. The Proceedings from the 3rd regional meeting, held in Abidjan, Côte d'Ivoire, 8-10 December 2015, are in preparation.

The report was noted.

2.3. East & Southeast Asia

Lonnie McCaskill, Regional Chair for East & Southeast Asia, presented the report, highlighting:

a. Cambodia: conservation programs currently being undertaken by FFI and WCS.

b. Indonesia: Lake Mesangat project (Siamese crocodile) being undertaken by WCS and the recent survey by Steve Platt [reported in CSG Newsletter 37(1)].

c. Laos: reintroduction of Siamese crocodiles in Xe Champone Ramsar site.

d. Philippines:
   i. Finalisation of "Conservation and Management Plan for Crocodiles in the Philippines" by DENR.
   ii. Protocol for "Managing Human-Crocodile Conflict in the Philippines".
   iii. Release of 29 captive-bred Philippine crocodiles in Paghungawan Marsh, Siargao Island, on 17 June 2017.
   iv. Proposed "2nd Philippine Crocodile Forum" to be held in Laguna, Philippines, in March 2019.

e. Thailand:
   i. Siamese Crocodile Task Force meeting held 1-2 June 2017.
   ii. Pilot release of three *C. siamensis* into Pang Sida National Park on 23 April 2018 (one of them equipped with a radio-transmitter) (see SC.4.3).

Steve Platt provided a verbal update on reintroduction efforts for the Chinese alligator.

The report was noted

2.4. Australia & Oceania

Charlie Manolis, Regional Chair for Australia & Oceania, reported:

a. Papua New Guinea:
   i. The annual nest monitoring survey is continuing but lack of government funding means industry will again need to assist.
   ii. Degradation of habitat by introduced fish species and burning during dry years continues to affect nesting habitats, although nest monitoring indicates positive trends for both *C. porosus* and *C. novaeguineae*.
   iii. The ever-stricter grading standards for skins, resulting in lower prices, will most likely discourage rural communities from continuing to support the crocodile conservation programs.

b. Solomon Islands: HCC continues to be a major issue. Some recent funding will allow some population surveys to be carried out.

c. Timor-Leste: about 70+ fatalities over the past 7 years. Crocodiles are possibly coming from the Northern Territory of Australia.

The report was noted.

2.5. South Asia & Iran

Anslem de Silva, Regional Chair for South Asia & Iran, was unable to attend the meeting. The report was noted.

2.6. Latin America & the Caribbean

The Joint Regional Chairs, Pablo Siroski, Alvaro Velasco and Alfonso Llobet, highlighted the following:

a. Cuba held an international Crocodile Workshop

in June 2017, attended by 76 participants, including a number of CSG members.

b. A "Tri-Country Review Meeting of *C. moreletii*" among Belize, Guatemala and Mexico, is proposed by the end of 2018.

c. A Central America & Caribbean sub-regional office has been established in Belize, and Regional Vice Chair Marisa Tellez is proposing to hold a CSG regional meeting in Belize. Tentative dates (25-28 June 2019) may clash with CITES meeting in Sri Lanka (May-June 2019).

d. Mexico: Hesiquio Benitez reported:
   i. The first ranching facility for *C. moreletii* has been established.
   ii. A Ranching Protocol has been developed.
   iii. A number of publications have been produced.
   iv. Human-Crocodile Conflict is an issue.

e. Venezuela: Alvaro Velasco highlighted:
   i. National survey of *C. intermedius* commenced in October 2016.
   ii. The "Second Venezuelan Symposium on Ecology and Conservation of Crocodylia" was held in Caracas on 29 November 2017.

The report was noted

2.7. Europe

Regional Vice Chair Fabian Schmidt addressed the report, highlighting the following:

a. There are now 8 programs in EAZA, one EEP (European Endangered Species Program) and 7 ESB (European Stud Book).

b. Zigler, Rauhaus and Schmidt published an important article on the "Review of Crocodiles in Zoological Gardens with a focus on Europe".

c. Ashley Pearcy and Agata Staniewicz organised the first European Croc Networking Meeting (ECNM) held at "Crocodiles of the World" in Brize Norton, UK, October 2016. A second ECN meeting was held at the Krokodile Zoo, Denmark in October 2017 and a third meeting is planned for 2018 at Planete des Crocodiles, Civaux, France.

The report was noted.

2.8. North America

Joint Regional Chair Allan Woodward raised the following issues:

a. The impact of skin grading standards resulting in lower prices for wild alligator skins.

b. The increasing population of American crocodiles in South Florida is causing concern.

c. Limited wild harvest proposed in North Carolina.

The report was noted.

3. Thematic Group Reports

3.1. CITES

Vice Chair Hank Jenkins, had tendered his resignation from the position, and the report was prepared by the Executive Officer, Tom Dacey. Issues raised included:

a. Matthew Shirley is IUCN Focal Point for the intersessional CITES Animals Committee Working Group on Captive-bred and Ranched Specimens.

b. Daniel Natusch is on the CITES Animals Committee Traceability Working Group.

Considerable discussion was held on both these working groups, and the Chair indicated that the CSG will need to be careful and maintain a watching brief on both these important issues.

The report was noted.

3.2. Industry

A partial report was received from Mexico. Issues discussed by SC included:

a. With the loss of Don Ashley, Vice Chair of the Industry group, there is now a need for it to be restructured.

b. There is pressure from welfare/animal rights interests, forcing quick industry responses, particularly from the fashion industry. However, responses from industry will not satisfy these critics.

c. Real problems are developing with the demand for high quality skins if the ability for people to make economic benefit from wild harvesting is reduced.

d. Corporate Social Responsibility, as interpreted by the fashion houses, needs to be examined to ensure conservation benefits remain high in the social effects of decisions made to combat Animal Rights campaigns against them.

e. The CSG Chair will prepare a statement/ document regarding the industry-conservation link, after discussion with all interested CSG members, within and outside industry. It was agreed to discuss this matter with industry representatives at the CSG meeting, as some may not stay for the full duration.

The report was noted.

3.3. Trade Monitoring

John Caldwell, Vice Chair for Trade Monitoring, addressed his report, highlighting: that he will continue producing the IACTS reports, under contract with WCMC; and, the 2017 IACTS report is due for completion in July 2018.

The report was noted.

3.4. Veterinary Science

Vice Chairs Paolo Martelli and Cathy Shilton raised the following issues:

a. Six FHVS-SRAS applications have been approved for funding.

b. Gowri Mallapur has been appointed Secretary for the group, which has resulted in better organisation and response times.

c. The Veterinary Science section on the CSG website has been updated.

d. The group mailing list has been expanded.

e. Group members have contributed to the document on the humane killing of reptiles.

f. Veterinary workshops at CSG meetings continue to be popular.

The report was noted.

3.5. Zoos

Kent Vliet, Vice Chair for Zoos, raised the following issues:

a. The report does not include advice from the Latin America & Caribbean or East & Southeast Asia regions.

b. World Tomistoma Day was held on 5 August 2017.

c. Alberquerque Bio-Park activities.

d. North American Zoos had contributed approximately $US125,000 for various crocodilian conservation projects, with a similar amount from other zoos, which goes straight to projects where numerous CSG members benefit.

e. Since 2010, CrocFest has raised $US315,000 for a dozen projects. Last year $US81,000 was raised for a Cuban Workshop.

f. Romulus Whitaker was conferred the prestigious and highly deserved Padma Shiri for his work in wildlife conservation (one of India's highest civilian honours) over decades.

The report was noted

3.6. Public Education & Community Participation

Myrna Cauilan-Cureg, Vice Chair for PECP, was not present at the meeting and no report was received. It was noted that the PECP had not really been successful, as it was a tall ask to contribute globally to public education issues when people are fully engaged in education at the national level. The Chair indicated that the Executive would review what can be achieved with this group, and indicated that any ideas from CSG members would be welcomed.

3.7. General Research

Joint Vice Chairs, Val Lance, Mark Merchant and Carlos Piña, raised the following points:

a. A Crocodile Symposium, organised by Mark Merchant and Wu Xiao Bing, was held at the 8th World Congress of Herpetology in Hangzhou, China, in August 2016. Report is on the CSG website. This has led to fostering of collaboration with some Chinese students in parasitology.

b. A proposed Crocodile Genetics and Molecular Science meeting was cancelled due to a lack of interest.

c. A Crocodilian Symposium organised by Pablo Siroski, Alvaro Velasco and Sergio Balaguera-Reina was held within the Xl Latin American Herpetology Congress in Quito, Ecuador, on 24-28 August 2017.

d. A Congress of Zoology is proposed for Bogota, Colombia, in December 2018.

e. Carlos Piña called for nomination of articles from the 25th CSG Working Meeting for inclusion in a special issue of the South American Journal of Herpetology.

The report was noted.

3.8. Legal Affairs

Vice Chair for Legal Affairs Curt Harbsmeier highlighted the following:

a. Global transition in alligator farming in Florida.

b. Science-based humane guidelines for crocodilians. Suggested that perhaps the CSG should expand animal welfare guidelines for crocodilians outside of the farming industry.

c. Role of external fundraising for in-situ crocodilian conservation and research. Fundraisers such as CrocFest and Octoberfest have provided a new model for independent fundraising which contributes significantly to global research efforts with crocodilians, involving CSG members in their private capacities.

The report was noted.

3.9. IUCN Red List Authority

The augmented Red List Authority team of Perran Ross, Sally Isberg and Sergio Balaguera-Reina, highlighted the following:

a. They have been able to fast track the Red List Assessments.

b. Information being provided in the CSG Action Plans provides valuable information to assist the Red List assessments.

c. Since the last Working Meeting, assessments have been accepted for 5 species, a further 2 species have been submitted. It is hoped to complete a further 4 at the Santa Fe meeting, leaving only 5 to be undertaken in the last half of 2018.

The report was noted.

3.10. Taxonomy

Vice Chair Kent Vliet pointed out the following:

a. Currently 17 members of the group.

b. Terms of Reference have been finalised.

c. Survey of members undertaken to determine current positions on current crocodilian taxonomy and to identify any areas of disagreement or uncertainty.

d. The group have been in contact with Dr. Peter Paul Van Dijk, new Chair of the CITES Nomenclature Committee.

e. Have not had the opportunity yet to discuss the development of identification tools for crocodilian taxa.

The report was noted.

4. Task Force/Working Group Reports

4.1. Tomistoma Task Force

Bruce Shwedick, Chair of the Tomistoma Task Force, was unable to attend the meeting, and SC members were requested to read the report. The report was noted.

4.2. Future Leaders Working Group

The report was received just before the meeting. FLWG Chair Matt Shirley addressed the meeting, highlighting:

a. The working group was established in 2016 to develop protocols for ensuring intergenerational transfer of knowledge and experience from CSG veterans to younger CSG members, so that they could play a more active leadership role within the CSG.

b. Some 10 FLWG members are now on the Steering Committee, in leadership roles.

c. FLWG members have participated in: the mission to China; and CITES events (CoP17, Steering Committee, Animals Committee).

d. Assisted in the evaluation of the SRAS review.

e. Several members have been actively facilitating updated Red List assessments.

f. Marisa Tellez is organising a Central American & Caribbean regional meeting.

g. On-going and future work of the FLWG could include:
- Becoming more present in social media;
- Developing and FLWG page on the CSG website; and,
- Brainstorming CSG's bigger commitment as a group to the non-commercially exploited species and how we can play a bigger role in assuring sustainability of initiatives, interest and funding.

The group would hold a side meeting during the Working Meeting and report back.

The report was noted.

5. General Business

5.1. SRAS and FHVS-SRAS Review

Charlie Manolis highlighted the following:

a. SRAS started in 2009 and FHVS-SRAS commenced in 2013.

b. To date 142 applications have been approved and funded.

c. In August 2016 a questionnaire was sent out to all SRAS and FHVS-SRAS students and responses were forwarded to FLWG for review and comments.

d. FLWG Chair Matt Shirley provided a summary of recommendations from the group, which are summarised as:

i. Make minor revisions to the SRAS application form. Revised forms provided.
ii. More explicit instructions for final reporting requirements are provided. These should be provided to awardees at the time they are informed of their successful award and at the time that their report is due (if possible).
iii. Grant amount be increased to $US1100 or $US1250 to account for inflation and the rising costs of field materials and fieldwork globally. The Executive Committee indicated that a small increase in the award would not forcibly change the way the grant program is currently implemented (eg rolling open requests, "unlimited" potential awards). Should this change, the FLWG is willing to provide recommendations on how best to modify the grant to fit a fixed/limited budget.
iv. The CSG should highly recommend to future working meeting organizers that any funding raised for participation of students in the working meeting should prioritize participation by SRAS awardees before considering other students who've had no previous relationship with the CSG.
v. The current policy of one award per degree should be maintained.
vi. Availability of the SRAS and FHVS-SRAS should be more widely advertised across online platforms and databases.
vii. As one of the objectives of the SRAS award is to serve as seed funding for students to leverage more grant awards, we recommend that the CSG include links to significant online grant databases on the SRAS and FHVS-SRAS webpages (eg http://terravivagrants.org/ and https://www.aza.org/conservation-funding). It is also recommended that CSG communicate to awardees that it is willing, when and where appropriate, to write letters of endorsement for SRAS and FHVS-SRAS funded projects that can be used with other funders.
viii. Recommend that the CSG facilitate better access to its members who can serve as mentors to SRAS and FHVS-SRAS applicants and awardees. This is partially fulfilled via changes to the application template.

The report was noted.

5.2. Junior CSG Program

No further action to be taken on this issue.

5.3. Alberquerque Bio-Park Collaboration

Tom Dacey provided a background to this issue, welcoming Alberquerque Bio-Park officers, Matt Eschenbrenner and Kate Anderson, to the meeting. Matt Eschenbrenner addressed the members advising that Alberquerque Bio-Park had entered into a formal agreement with the CSG to help develop a "CSG Conservation Priorities for World Crocodilians", based largely on the completed CSG Species Action Plans.

The report was noted.

5.4. WMI Contract

The Chair outlinedthe history of WMI involvement in supporting the operations of the CSG over the past 14 years, estimated to be in the order of $1,000,000, enabling the CSG to accumulate substantial funds to ensure its sustainability. In the current economic climate WMI can no longer afford to underwrite CSG activities to this this extent.

Perran Ross provided a comparison between 1990-2004 and 2005-2017, and how the CSG operated under the leadership of Harry Messel, with Perran as the Executive Officer based at the University of Florida. He provided a detailed statement of all CSG activities then, what it was costing the CSG, and the services now being provided by WMI.

The SC reaffirmed its previous decision that the CSG enter into a contract with WMI for the payment of $US68,000 p.a. for 2017-2018. This contract to be reviewed each year and WMI to provide an annual statement of the services provided to the CSG.

6. 26th CSG Working Meeting

Tom Dacey reported that two formal applications had been received and considered by the Executive Committee, and a third application was tabled at the SC meeting.

1. Agadir, Morocco - submitted by Luc Fougeirol, Crocparc.
2. Gwalior, Madhya Pradesh State, India (May 2020) - submitted by Prof. R.J. Rao, Jiwaji University.
3. Mexico - submitted by Hesiquio Benitez.

Although the Executive considered Morocco was better suted to a regional meeting at some time in the future. India as an option raised concerns that other stakeholders were not included in the proposal, and it would be difficult for the increasing Latin members to attend. Mexico, despite being a late bid, was widely considered by CSG members to be ideal for hosting the 26th Working Meeting. Enormous advances have been made in crocodilian conservation and management in Mexico, and much more is following. It is an important time for showcasing what is a rapidly emerging program. .

Meeting closed at 1530 h.

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

25th CSG Working Meeting, Santa Fe, Argentina, 7-10 May 2018

Working Meeting

The 25th CSG Working Meeting was held at the Faculty of Biology Conference Centre at the Universidad Nacional del Litoral Campus, Santa Fe, Argentina, on 7-10 May 2018. The meeting was attended by 236 delegates from 30 countries (Argentina, Australia, Benin, Belize, Bolivia, Brazil, Colombia, Costa Rica, Cuba, Denmark, France, Germany, Hong Kong, India, Ireland, Italy, Japan, Malaysia, Mexico, Norway, Panama, Philippines, Slovakia, South Africa, Spain, United Arab Emirates, United Kingdom, United States of America, Venezuela, Zambia).

The meeting was hosted by the State Government Ministry of Environment (represented by Jacinto Speranza) and Local Government (represented by Pablo Tabares as Director of the Agency for International Cooperation, Investments and Foreign Trade of the Government of the City of Santa Fe), and many additional sponsors provided financial support. The principal non-government sponsors were: Mutual de la Unión Personal Civil de la Nación (MUPCN); Yacaré Porá (farm from Corrientes Province); Trachter Genuine Reptile Skins; and, Asociación Biológica Santa Fe (BIOS).

The theme for the meeting was "Thirty years later … a problem becomes a livelihood", and included a strong emphasis on programs looking at strategies to generate incentives for conservation and livelihoods. Presentations covered: biology and general research; conservation and sustainable use; zoos and education; and, human-crocodilian conflict.

The Organising Committee (Alejandro Larriera, Alba Imhof, Lucía Fernandez, Carlos Piña, Guillermo Príncipe, Melina Simoncini, María Virginia Parachú Marcó, Gisela Poletta, Pablo Siroski and the whole Proyecto Yacaré team) ensured that the venue, program, sponsors, entertainment, etc., were in place. The Organizing Committee also assisted with the complex logistic arrangements required by delegates from around the world.

A Veterinary Workshop preceded the working meeting on 5 May 2018 at the Proyecto Yacaré facilities (Santa Fe). Unfortunately, participation had to be capped at 38 participants. Enormous thanks to the local team (María Virginia Parachú Marcó, Gisela Poletta, Patricia Amavet, Pablo Siroski and volunteers) for coordinating the event, and to Paolo Martelli, Cathy Shilton and Marisa Tellez who presented the various veterinary activities.

Figure 1. Veterinary Workshop participants.

Following the Steering Committee meeting on 6 May (see above), a cocktail reception was organized on a boat that made its way along the river surrounding Santa Fe City and natural environment characteristic of the Parana River Islands.

The official opening of the working meeting on 7 May 2018 included addresses by CSG Deputy Chair Alejandro Larriera, CSG Chair Grahame Webb, Jacinto Speranza (Minister of Environment of Santa Fe Province), Jon Paul Rodriguez, (Chair of the IUCN Species Survival Commission), Laura Tarabella (Head, Faculty of Humanities and Sciences, UNL) and Pablo Tabares (Government of the City of Santa Fe).

Figure 2. Official opening (from left): Alejandro Larriera, Grahame Webb, Laura Tarabella, Jacinto Speranza, Pablo Tabares, Jon Paul Rodriguez. Photograph: Alvaro Velasco.

For some presenters, this was their first time participating in a CSG working meeting, and simultaneous translation for presentations was very helpful to both English- and Spanish-speaking participants. To assist translators, the schedule of presentations was coordinated on the basis of themes and the language of presenters.

At the beginning of each of the four days of the meeting, a plenary lecture was delivered: Alejandro Larriera (Argentine crocodiles conservation programs assessment: Which is the baseline?); Jon Paul Rodriguez (The role of the IUCN Species Survival Commission in saving the world's species); Grahame Webb (Learning as we go); and, Perran Ross (Dynamic change in crocodylian conservation: An historic perspective on CSG's role and work).

The first day of the meeting was dedicated to "Local issues", beginning with presentations on research and history of Proyecto Yacaré, followed presentations on conservation and sustainable use within management programs in Bolivia (*Ca. yacare*), Colombia (*C. intermedius*), Brazil (*Ca. latirostris*) and Mexico (*C. acutus*). Later in the day, presentations covered a range of topics, including body condition score for crocodilians, sexual identification of *Ca. latirostris* hatchlings by cloacal inspection, and microorganisms in oral, blood and cloacal samples from crocodilians, etc. Before dinner, delegates enjoyed a tango music show.

The second day was dedicated to a biology and general research, and covered diverse topics ranging from morphometry, embryology, nesting behavior and predation, influence of climatic variables on different physiological systems, general behavior and the impact of pollution. The poster session followed the afternoon break, where participants enjoyed a beverage and spoke with poster authors (Fig. 3).

Figure 3. Poster session. Photograph: Alvaro Velasco.

On the third day, the session on biology and general research continued, and presentations explored environmental health, chemical pollution and ecotoxicology effects on different species with particular focus on genes expressions and biochemistry. Also, a update on humane slaughter methods for crocodilians was highlighted. The rest of the day included presentations on conservation and sustainable use, with focus on population ecology, status, and novel tools (eg drones, apps.) to improve the work in crocodilian habitats for conservation and management purposes. During the dinner, a local music band presented a dance show with traditional dancers dressed as "gauchos".

The last day covered conservation and sustainable use, as well as HCC, zoos and education themes, and included new ranching programs in Mexico, interesting studies on ecology and education on crocodilian conservation in northeastern Brazil and the Philippines, telemetry studies, and updates on conservation of the Critically Endangered *Mecistops cataphractus* and Gharial, the "European Croc Network" and a current perspective on HCC and some mechanisms to mitigate them, amongst others.

In addition to the oral presentations and the poster session, various thematic and working groups met as side-meetings, including; Veterinary Science (Dr. Paolo Martelli, Dr. Cathy Shilton), IUCN Red List Authority (Dr. Perran Ross, Dr. Sally Isberg, Dr. Sergio Balaguera-Reina), Zoos (Dr. Kent Vliet), Taxonomy (Dr. Kent Vliet), Future Leaders (Dr. Matt Shirley, Dr. Marisa Tellez). Participants interested in human-crocodile conflict (Dr. Simon Pooley) also met, as did Regional Chairs from the Latin America and Caribbean (Alfonso Llobet, Alvaro Velasco, Dr. Pablo Siroski).

The Argentinean Banquet on the final night was a highlight of the social agenda, with a typical music show called "gauchos night". After dinner, CSG Chair Grahame Webb presented various prizes and awards:

- The Castillo Award for Crocodilian Conservation was presented to Alejandro Larriera on behalf of Projecto Yacaré. Although the Castillo Award is typically awarded to an individual, the contribution of Proyecto Yacaré to crocodilian research, management and conservation over a long period of time is considered exemplary (Fig. 4).
- The Chairs Encouragement Award was shared by Pablo Siroski ($US250) and Sergio Balaguera-Reina ($US250).
- Prizes for student oral presentations were awarded to Joseph Brown ($US250), Sergio Balaguera-Reina ($US150) and Rob Gandola ($US50) (Fig. 5).
- Prizes for student posters were awarded to Sierra McLinn ($250), Todd Bell ($150), America Jaimes ($50) and Karin Ebey ($50) (Fig. 5).

We thank the judges who devoted their time and effort to assessing more than 60 student oral presentations and posters.

Figure 4. Projecto Yacaré team. Photograph: Alvaro Velasco.

Figure 5. Student prize winners flanked with CSG Chair Grahame Webb (right) and CSG Deputy Chair Alejandro Larriera (left). Photograph: Alvaro Velasco.

For the first time in CSG history, the meeting website provided an option for participants to donate money for student travel grants through the registration process. This resulted in $US2250 being raised, which allowed financial assistance for 9 students ($US250 each; Sierra McLinn, Etiam Perez Fleitas, Joseph Brown, André Felipe Barreto Lima, Fabiola Mejías Rodriguez, André Costa Pereira, Stephany Michelle Del Rosario Rivera, Grégoire Boussens-Dumon, Felipe Parra).

A donation of $US2000 from the Ebey family was matched by the CSG, thus providing $US4000 to support the attendance of 8 students from Central and South America ($US500 each; Edgar Marina, Juan Carlos Morales Franco, Verónica Arias Perez, Nidia Farfán Ardila, Paulo Braga Mascarenhas Júnior, Yairen Yairen Alonso Jiménez, Gustavo Soza Rodríguez, America María Jaimes Ortiz). We thank the Ebey family, the CSG, and participants who contributed funds that allowed the participation of so many students to the working meeting.

Auction and Raffle

On Tuesday night, the traditional auction took place, and it was once again skillfully choreographed by Carlos Piña and Shawn Heflick (Fig. 6). A variety of items were donated, some of which were offered through a silent auction. The silent and open auctions raised $US9216, and Dr. Rich Fergusson ($US500) and Dr. Jeff Lang ($US300) kindly added to the proceeds, bringing the total to $US10,016. These funds will be used to develop a project to update the status of *Ca. latirostris* populations in Bolivia, Paraguay and Uruguay.

Figure 6. Auctioneers Carlos Piña and Shawn Heflick in action. Photograph: Alvaro Velasco.

A raffle with prizes of *Ca. latirostris* leather products raised $US830, which will be used to evaluate a system of socioeconomic indicators that provide the necessary information for the promotion of socio-environmental policies. These policies must be oriented towards the conservation of resources on the basis of the recognition generated by the integration of livelihoods, an essential asset in the development of the region (Santa Fe and Corrientes Provinces). For the first time in the CSG's history, the group photograph was taken using a drone.

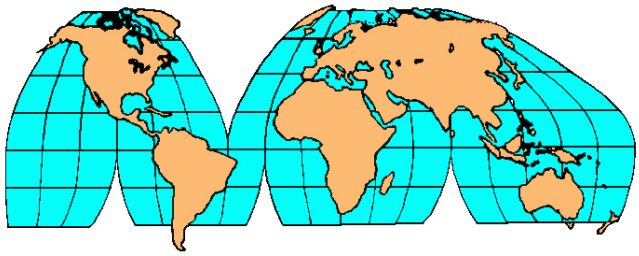
Field Trip

Due to heavy rain, the planned field trips on 11 May had to be cancelled. However, a trip was organised to The Archaeological Park, The Old City of Santa Fe, at Cayasta. We thank Carlos Piña who acted as translator for the tour guide, and who added his unique humorous spin to the translation. Lunch at the Vuelta del Pirata Restaurant allowed participants to sample a variety of the region's fish dishes.

Photographs: Alvaro Velasco.

Pablo Siroski, *member of the 25th Working Meeting Organising Committee (cocokaima@hotmail.com).*

Regional Reports



South Asia and Iran

India

PARENTAL BEHAVIOUR OF MUGGER (*CROCODYLUS PALUSTRIS*) AT LAL DHORI, JUNAGADH, GUJARAT, INDIA. The Mugger crocodile (*Crocodylus palustris*) is one of the most adaptable and widely distributed crocodilian species in South Asia (Da Silva and Lenin 2010). Due to their incredible adaptability, Muggers are found in a variety of natural and artificial waterbodies, including large rivers, village ponds, man-made tanks and even oxbow lakes and puddles.

One small population of Muggers occurs in water bodies around Girnar, Gujarat State, India. Girnar Hill has the highest altitude in Saurashtra Peninsula, and was recently declared a wildlife sanctuary. It is home to diverse wildlife, including a small satellite population of Asiatic Lions (*Panthera leo persica*). A survey by the Forest Department in 2009 recorded 63 Muggers in surrounding waterbodies (Table 1), including Lal Dhori (Fig. 1), located at Bhavanath, Junagadh.

Figure 1. Lal Dhori at the end of summer. Photograph: Pranav M. Vaghashiya.

On the night of 2 June 2017 we observed an adult Mugger (approximately 2.5 m TL) walking away from Lal Dhori wetland. June signifies the end to the hot arid summers, and most average-sized waterbodies were drying or already dried up. Upon seeing this Mugger, we considered that it may have been in the process of migrating to another waterbody.

As we observed the crocodile in the beam of a torch, we noticed that it stopped walking after a few minutes, about 30-40 m from the water, and started digging with its forelimbs (Fig. 2). What we then observed was an interesting parental behavior. After a few minutes of digging the Mugger was seen to hold newly-hatched hatchlings within its jaws. It walked back to the water, and released them into the water. The Mugger repeated this process five times, carrying hatchlings from the nest to the water each time.

Table 1. Results of Forest Department survey of 13 waterbodies surrounding Girnar Hills in 2009. Numbers of Muggers (N) were determined through direct day counts and reports/information from local people. *= breeding populations.

Waterbody	Coordinates	N
Hasnapur Dam*	21°34’13.16”N, 70°31’8.03”E	25
Willmingdon Dam*	21°30’21.93”N, 70°28’53.50”E	15
Khodiyar R. Pool*/Stream	21°25’57.15”N, 70°31’37.06”E	5
Bordivi R. stream	21°28’50.58”N, 70°32’35.75”E	2
Sonarkh R. stream	-	1
Ramnath	21°27’29.20”N, 70°31’51.09”E	2
Sarkhadiya	-	2
Lal Dhori	21°32’17.87”N, 70°30’9.79”E	1
Machhariya	-	2
Sudershan	21°31’37.22”N, 70°30’12.10”E	4
Gopalpura	21°33’31.92”N, 70°36’25.34”E	1
Ravat Sagar Talav	21°28’33.69”N, 70°36’6.88”E	1
Ratpara Dam (sririshnapur)	21°30’4.82”N, 70°37’15.62”E	2
Total	-	63

Figure 2. Adult Mugger digging on banks of Lal Dhori. Photograph: Pranav M. Vaghashiya.

On its 6th (and final) trip to the nest the Mugger was observed to pick up and carry intact eggs in its jaws (Fig. 3) to the water. On entering the water, it swam slowly, maintaining its head partially above the water surface, to a small island in the middle of the waterbody, on which it gently released the eggs (Fig. 4). The entire process, from when we first noticed the Mugger, to carrying eggs to the island, took around 38 minutes. On checking the nest site later we found only eggshells and eggshell membranes, but were unable to ascertain exactly how many eggs had hatched.

We were also unable to determine the exact number of eggs transported to the water, but a week later we sighted seven hatchlings (Fig. 5) with an adult Mugger at the site. We assume that as this was the only adult Mugger present, that it may be a female and that the nest (and hatchlings) were hers.

Figure 3. Mugger carrying egg/s to Lal Dhori. Photograph: Pranav M. Vaghashiya.

Figure 4. Mugger with egg/s going up onto the island in Lal Dhori. Photograph: Pranav M. Vaghashiya.

Figure 5. Seven Mugger hatchlings sighted in Lal Dhori. Photograph: Pranav M. Vaghashiya.

During the first week of August, with the onset of the monsoon, the wetland was filled with fresh rainwater. One of our volunteers was able to document feeding and basking activities of these seven hatchlings, including feeding on a burrowing frog (*Sphaerotheca* sp.; Fig. 6) and basking with Common flap-shell turtle (*Lissemys punctata*) (see front cover of Newsletter).

Figure 6. Hatchling Mugger feeding on a burrowing frog (*Sphaerotheca* sp.) at Lal Dhori. Photograph: Prem Lalchandani.

Parental care has been recorded for crocodilians (Cott 1971; Ferguson 1985) including Muggers (Whitaker and Whitaker 1984; Lang *et al*. 1986; Mobaraki *et al*. 2013). Adult Muggers are capable of locating nests in response to vocalisations from hatchlings within the eggs, assisting hatchlings to emerge from eggs, carrying them to the water, and guarding them. In this case, we observed unhatched eggs also being transported to an island by an adult Mugger along with some hatchlings.

We are unaware of the fate of the egg/s that were deposited on the island, nor are we aware whether they were fertile, infertile or dead. At this stage it is conjectural as to the reasons for the Mugger's behaviour. Perhaps it was moving them so as to avoid predation, as it would be more difficult for predators to reach the small island. In captivity, crocodilians are known to eat unhatched eggs, and some species have been reported to "cache" prey on land (eg Doody 2009) - that the Mugger may have consumed the eggs later cannot be discounted.

Acknowledgements

We are sincerely thankful to Mr. Amit Vaghashiya, Dr. Devendra Chauhan and Mr. Chirag Pathak, Volunteers of Vasundhara Nature Club, Junagadh, for accompanying us in the field and monitoring the adult Mugger and hatchlings. We also thank Mr. Prem Lalchandani for sharing observations and images of a hatchling feeding on a frog. Finally we thank the Forest Department, Junagadh, Gujarat, for support and sharing of past data of Muggers in various waterbodies around Girnar Hills, Junagadh.

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Pranav M. Vaghashiya[1], Bhautik Dudhatra[2] and Raju Vyas[3]; *[1]193, Amrutam, Bapunagar Society, B/H Gaytri School, Joshipura, Junagadh. Gujarat, India (pranav4940@gmail.com), [2] 93, Kohinoor Complex, Kohinoor Society, Mini Bazar, Varacha, Surat-395007, Gujarat, India (bhautikdudhatra24@gmail.com); [3]Krishnadeep Tower, Mission Road, Fatehgunj, Vadodara-Gujarat, India (razoovyas@hotmail.com).*

Latin America and the Caribbean

French Guiana

HABITAT USE AND BEHAVIOUR OF SCHNEIDER'S DWARF CAIMAN (*PALEOSUCHUS TRIGONATUS* SCHNEIDER 1801) IN THE NOURAGUES RESERVE. FRENCH GUIANA. Amongst the 9 genera of existent crocodilians, two are known to display very different ecological habits compared to the others: *Paleosuchus* in South America and *Osteolaemus* in West and Central Africa (Merchant, Shirley *et al*. 2016). Both genera include species inhabiting mainly small streams or forest ponds in closed canopy rainforests (Magnusson and Lima 1991; Eaton 2010; Campos and Magnusson 2013). The ecological particularities of those two convergent genera lead them to display adaptations for habitats unsuitable for other crocodilians, given that they live mainly in forest environments where they have few basking opportunities. For example, Campos and Magnusson (2013) show that *P. palpebrosus* mean body temperature is maintained between 20.1°C and 25.6°C all year around, whereas other species' preferred body temperature (PBT) is above 30°C.

Forest dwelling crocodylians are difficult to study in the field and their biology and ecology remain largely unknown (Magnusson *et al*. 2010). *Paleosuchus trigonatus* is the least studied of the two species of *Paleosuchus*, with few studies conducted in the field, often on small sample sizes, and most of them focusing on the Amazon Basin (Magnusson *et al*. 1985; Magnusson and Lima 1991; Magnusson *et al*. 1997; Morato *et al*. 2011). The present work is a preliminary study aiming to get the first data about habitat use of *P. trigonatus* in this undisturbed region of primary forest in French Guiana. Our goals were: to obtain qualitative and quantitative data about its behavior and habitat use during day and night; and, to record how the species move along the stream during a 10-week period in the rainy season (7 April-15 June 2016).

The study took place in two phases, in the northeast quarter of the Nouragues Natural Reserve in French Guiana (4°05' N, 52°41'W), where a 9500-ha area is dedicated to an international research station managed by the French National Centre for Scientific Research (CNRS). Firstly, caimans were captured, measured and marked with temporary and permanent marks (see below), and released. Secondly, behavior and habitat use observations were was carried out mainly on four individuals which were followed over three weeks. This study focuses on animals living along the mainstream of the "Inselberg Camp", called "Crique Nouragues" (Fig. 1).

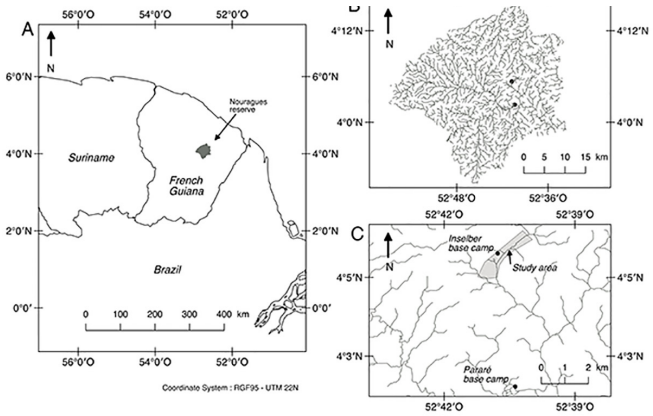

Figure 1. Study area: a) location of Nouragues Reserve in French Guiana; b) location of the two scientific base camps; c) location of study area.

During the period of study, water temperature and water depth were recorded every 10 minutes and once a day, respectively. Air temperature and relative humidity were recorded every 30 minutes.

As foraging activity occurs mostly at night (Grigg and Kirshner 2015), caimans were located by eyeshine using a Scurion® 1500 head lamp. Crique Nouragues was searched by walking a path along a 1200-m section of this forest stream. Searches were carried out between 1945 and 0015 h. When a caiman was detected, it was captured by hand or with a noose on a 2-m pole. We used the dorsal scalation between the posterior limbs as the best criterion to distinguish between the two *Paleosuchus* species - there are 4 rows scales for *P. palpebrosus* and 2 for *P. trigonatus* (Dewynter *et al*. 2016). Only *P. trigonatus* were sighted and/or captured.

For each animal captured, we recorded GPS coordinates of the capture site (Garmin64® GPS, precision <3 m), however, because of the density of the canopy the accuracy of the measurements was closer to 10 m. The date and time of capture, as well as air temperature were recorded. Each animal was brought to basecamp for biometric data collection and then released back at the capture site. Weight was measured using a portable scale up to 40 kg (± 10 g) or a precision scale up to 300 g (± 0.001 g). A measuring tape was used to measure snout-vent length (SVL), from the tip of the muzzle to the middle of the cloaca and total length (TL) to the nearest mm. Sex was assessed by cloacal palpation for sub-adult and adult animals (ie individuals with a minimal TL of 75 cm; Ziegler and Olbort 2007). For smaller animals, a soft pressure exerted by two fingers from either side of the cloaca can sometimes allow the penis to stand out from the cloaca, but this methodology can lead to gender misidentification in young animals (Ziegler and Olbort 2007). In case of doubt, we recorded the gender as "undefined". The approximate age of the animal was estimated based on the theoretical growth curve (Magnusson *et al*. 1997).

Each caiman was marked with a temporary number, written on the cranial platform with a white marker (Posca®) and covered by colourless varnish (Tenue&Strong, Gemey-Maybelline). The aim of this marking was to be able to recognize individuals after their release and collect data on behavior without having to recapture them. In addition, during the capture/release period, this marking makes it possible to avoid recapturing the same individuals twice. Each caiman was also implanted with a microchip (Biomark PIT) inside the muscle on the right side of the tail. This marking is a backup identification in case of disappearance of the temporary marking and will also allows future long-term monitoring of the caimans. To ensure the regular recording of several individuals we equiped 7 of them with radio-transmitters so that they could be found systematically over several weeks. Transmitters weighed 9 g (<1% of weight of caiman) and had 12 months of standard life (Holohill Ltd., SI-2). The transmitter was taped to a nylon tie that was attached around the waist of the animal. For logistical reasons, transmitters had to be removed after 60 days because we were not able to stay longer in the field. The radio-receiver was a Sika with a Yagi flexible antenna (Biotrack Ltd.).

The animals were tracked twice a day: once during the day (0900-1130 h or 1400-1730 h, depending on weather conditions) and once at night (approximately 2000-2330 h). As the animals did not tend to flee but rather to stop moving at the surface or under the water, for most visual contacts we were able to record the number written on the head or the frequency of its transmitter (if one was attached). We also recorded the time, GPS coordinates, rain (yes/no), and water depth for each sighting. The behavioral units of habitat use were recorded as follows: at the surface/under the water/out of the water; in open water/hidden in vegetation/hidden in a burrow or under branches or trunks; moving/motionless; basking (ie exposed to direct sunlight); eating (yes/no); or, alone/in group. The length of stream used by each caiman was estimated with QGIS software.

The frequency of the behavioral units observed and the graphs were done using R software (3.2.4 version, R Core Team (2017)). The mapping and the formatting of spatial data were done with QGIS software (QGIS version 2.18) in order to have maps comparable to Magnusson and Lima (1991). The proportion of overlap of area used between the caimans was defined as the percentage of overlap of linear metre of river occupied between two animals. This proportion was calculated with QGIS software.

Table 1. Size, sex, estimated age (based on Magnusson *et al*. 1997), number of observations and length of stream used for 16 *P. trigonatus*. * total area could not be calculated.

No.	Sex	Est. Age (y)	SVL (cm)	TL (cm)	Weight (g)	Start Date	Finish Date	Day Obs.	Night Obs.	Total Obs.	Stream Used (m)
TRIG01	?	<1	18.5	33.5	130	-	-	0	1	1	-
TRIG02	?	<1	19	34	126.70	-	-	0	2	2	-
TRIG03	?	<1	17	30	95.88	-	-	1	1	2	-
TRIG04	?	<1	17.5	30.7	105.30	-	-	0	1	1	-
TRIG05	F	7	52	91.4	3000	-	-	0	1	1	-
TRIG06	F	4	40	70.6	1250	10 Apr	15 Jun	53	19	72	1788 (± 10)
TRIG07	M	3	28	50.6	500	-	-	0	3	3	-
TRIG08	F	20	66	113.6	4700	16 Apr	15 Jun	49	29	78	522 (± 8) *
TRIG09	F	5	45	79.5	2000	16 Apr	16 Jun	51	29	80	276 (± 7)
TRIG10	F	20	68	120	6750	-	-	5	1	6	-
TRIG11	?	<1	16.5	29	75.68	-	-	0	2	2	-
TRIG12	M	5	42	74	1600	9 May	15 Jun	20	7	27	1725 (± 10)
TRIG13	?	<1	20	36.8	173.64	-	-	0	2	2	-
TRIG14	F	3	33	59.6	840	-	-	0	1	1	-
TRIG15	M	4	31	56.5	660	-	-	0	1	1	-
TRIG16	?	<1	19	35.1	118.26	-	-	0	1	1	-

During the study, 95% of the values of air temperature varied between 22.8°C and 31.2°C and relative humidity between 61.4% and 100%. Water temperature in Crique Nouragues varied between 23.4°C and 25.7°C. The depth along the stream varied between 1 and 90 cm. The maximum amplitude of variation of water depth between two days at the same place was 42 cm.

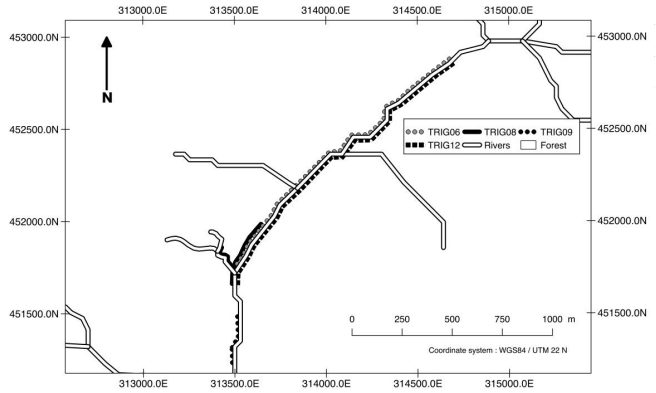

Figure 2. Length of stream used by four radio-tracked *P. trigonatus* during the rainy season between April and June 2016.

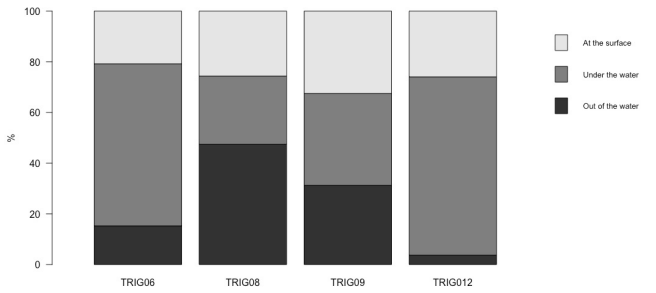

Figure 3. Proportion of observations relative to position in the water for four *P. trigonatus* during the rainy season between April and June 2016.

Observations and radio-tracking lasted for 63 days, during which 290 observations were made. Two of the 7 caimans with transmitters lost them, and one transmitter stopped transmitting after 6 days. As expected, caimans not equipped with radio-transmitters were very difficult to follow, and only 4 radio-tracked animals gave meaningful data (Table 1).

TRIG09 (sub-adult female) stayed in a restricted portion of stream (276 ± 7 m), compared to TRIG06 (sub-adult female; 1788 ± 10 m) and TRIG12 (sub-adult male; 1725 ± 10 m). The area used by TRIG08 was on the periphery of the study area and we could not determine the total area used. The proportion of overlap of area used, was very different between pairs of individuals, ranging from 93% between TRIG06 and TRIG12, to 49% between TRIG06 and TRIG08 and 70% between TRIG08 and TRIG12.

Of the 161 daytime observations: 57.8% were in a burrow or under dead vegetation out of the water; 9.9% were on the bank in open areas; 29.8% were among aquatic vegetation; and, 2.5% were in open water. Of the 84 night-time observations: 9.5% were in a burrow or under decaying vegetation out of the water; 6.0% were on the bank in an open areas; 50.0% were in aquatic vegetation; and, 34.5% were in open water.

Animals were mostly expressing no specific activity (96.9% of observations). Basking was only observed 9 times (3.3% of observations). The four radio-tracked caimans varied with respect to time spent in/out of the water (Fig. 3).

Discussion

According to Magnusson and Lima (1991), adult *P. trigonatus* often use terrestrial retreats sometimes quite far from the stream (eg 5-90 m from the stream). In our case, only one individual was observed using a cave formed by fallen rocks close to the water as a shelter during the day. Studied animals were sub-adults, which spent the majority of their time in the water with a mean temperature of 24.4°C. Typically, they were hidden in aquatic vegetation or under fragments of decaying vegetation or fallen tree trunks.

There are very few basking opportunities in the forest and despite some local sun spots we rarely observed individuals directly exposed to the sun. These observations are in line with observations made on *P. palpebrosus* showing very low temperature requirements compare to other crocodilians species with a body temperature varying between 20.1°C and 25.6°C (Campos and Magnusson 2013).

Tracking data suggest that the caimans do not use the stream in the same way. Upstream movements were observed by Magnusson and Lima (1991) to be the main dispersal direction for hatchling *P. trigonatus*. Our study provides preliminary data, which need to be extended over longer periods and different seasons of the year.

Acknowledgments

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Jérémy Lemaire[1,3], Olivier Marquis[1], David Oudjani[2], and Philippe Gaucher[3]: *[1]Sorbonne Université, Muséum national d'Histoire naturelle, Parc Zoologique de Paris, 53 avenue de Saint Maurice, 75012 Paris, France; [2]M2GBI, Université Paul Sabatier, 118, route de Narbonne, 31062 Toulouse, France; [3]LEEISA, CNRS Guyane, Centre de recherche de Montabo, 275 route de Montabo, Cayenne, French Guiana.*

Venezuela

POSSIBLE FIRST RECORD OF BLACK CAIMAN (*MELANOSUCHUS NIGER*) IN THE IMATACA FOREST RESERVE, BOTANAMO RIVER, BOLIVAR STATE, VENEZUELA. *Caiman crocodilus*, *Paleosuchus palpebrosus* and *P. trigonatus* have been reported by Gorzula (1984) and Gorzula and Paolillo (1986) to be present in Bolivar State, Venezuela. Here, we report on a skull and remains, possibly belonging to Black caiman (*Melanosuchus niger*), discovered through a preliminary study of patterns of wildlife use by the Botanamo Kariña community (Fig. 1) in Imataca Forest Reserve (Block 5 between Tumeremo and Bochinche, Bolívar State; 7° 25' 46.77'' N, 61° 13' 55.41'' W), as part of the Sustainable Forest Management and Forest Conservation Project in the Ecosocial Perspective in this reserve.

Figure 1. Skull of possible *Melanosuchus niger* being handed over by member of the Kariña community.

The color of the upper surface of skull is uniform black, with small yellow transverse bars on both sides of the lower jaw, typical of *M. niger* (Lafleur *et al*. 1995; Fig. 2). That the skull may reflect melanism in *C. crocodilus*, a species with which this specimen could be confused, was discounted, as the snout is relatively longer, with a length-width ratio of 1.5 (ratio for *C. crocodilus* is less than 1.3; Lafleur *et al*. 1995). The head length of 256 mm indicates that the animal would have been around 1800 mm total length (Gorzula 1984; Magnusson 1983). The upper part of the skull has bony ridges between the front corners of the eyes and longitudinal ridges that diverge towards the tip of the skull, with the lower part being yellow-ochre (Fig. 2).

The other remains comprised pieces of tail skin and dorsal osteoderms (Fig. 3), that were found in the houses of the two families of this ethnic group that shared the hunted animal. Based on the nomenclature established by Brazaitis (1989), the remains can be described as "ossified and strongly keeled rectangular scales of the back (D)", black, "scales unkeeled ventral (V)" yellow, parts of the tail with "scales later round, keeled, ossified, rectangular and lateral of the tail (LC)" color black, and "scales unkeeled ventral (SC)", with vestige of a possible "inclusion of scales" which is also used for the identification of *M. niger* (Brazaitis 1989; Lafleur *et al*. 1995; Fig. 4).

Chiviri-Gallegos (1973) reported *M. niger* in Venezuela

Figure 2. Skull of possible *Melanosuchus niger*.

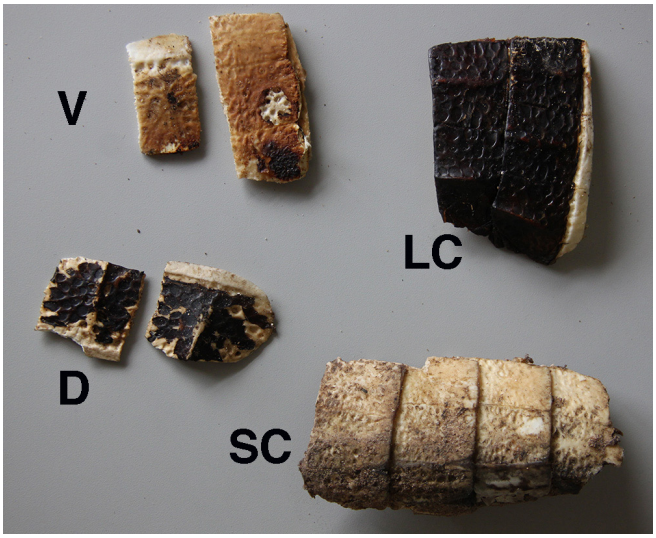

Figure 3. Remains of the possible *Melanosuchus niger*: V= "scales unkeeled ventral"; D= "ossified and strongly keeled rectangular scales of the back"; LC= "scales later round, keeled, ossified, rectangular and lateral of the tail"; SC= "scales unkeeled ventral" (Brazaitis 1989).

Figure 4. Remains of ventral tail area showing traces of inclusion scales characteristic of *Melanosuchus niger*.

in Amazona State, between the limits of Venezuela and Colombia, but the locality was not confirmed, which is why it appears in some distribution studies as unconfirmed.

Thorbjarnarson (1992) reported the species in tributaries of the Essequibo River, in the Reclamation zone between Venezuela and Guyana. The Botanamo River, where this animal was possibly captured, begins in Imataca Forest Reserve and is a tributary of the Cuyuní River, which flows into the Essequibo River. More detailed studies are required to confirm the presence of this species in this region of Venezuela.

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Alfredo Arteaga *(Universidad Bolivariana de Venezuela; arteaga.alfredo@gmail.co)*, Guillermo Barreto *(Universidad Simón Bolívar; guibarre@gmail.com)*, Alexander Cegarra, *(Proyecto de Ordenación Forestal Sustentable y Conservación de Bosques en la Perspectiva Ecosocial de la Reserva Forestal Imataca, Estado Bolivar; alexcegarra21@gmail.com)* and Grabiela Omaña Camacho *(Empresa Nacional Forestal, Venezuela)*.

East and Southern Africa

South Africa

INVESTIGATING LOCAL PEOPLE'S INTERACTIONS WITH NILE CROCODILES AROUND SOUTH AFRICA'S NDUMO GAME RESERVE: PRELIMINARY VISIT AND WORKSHOPS. Today, the remaining viable populations of wild Nile crocodiles (*Crocodylus niloticus*) in South Africa are restricted to five disjunct protected areas, the smallest and most vulnerable of which is Ndumo Game Reserve (NGR; 10,117 ha) in northern KwaZulu-Natal (KZN) Province (Calverley and Downs 2014a). In 1966, Tony (A.C.) Pooley started a crocodile breeding and restocking program in NGR for the Natal Parks Board (now Ezemvelo KZN Wildlife) because populations were severely depleted as a result of two decades of hunting for the skin trade and more recently snaring and illegal killings in KZN, and in neighbouring Mozambique and Swaziland. Crocodiles were also negatively affected by habitat destruction and water shortages in the region due to expanding human populations, agriculture and forestry (Pooley 1982).

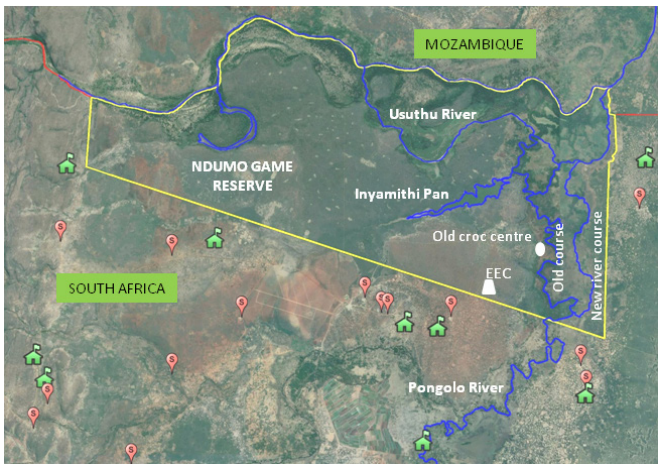

Figure 1. Ndumo Game Reserve, KZN.

The crocodile restocking program, in combination with legal protection in South Africa (effective from 1969), resulted in a dramatic recovery: the observed (counted from helicopter) crocodile population of NGR increased from 273 in 1971 to 833 individuals by 1993 (Calverley and Downs 2014a). Other factors that may have contributed to this population increase included influxes of crocodiles from the Makhathini Flats upstream of Ndumo as a result of agricultural development in the 1980s, and downstream, people returned to their lands following the General Peace Accord in Mozambique of 1992 (Calverley 2010; Calverley and Downs 2014a; Harvey and Marais 2014).

Since the early 1990s the Ndumo population decreased, on average by 2.9% per year, and by 2009, 516 crocodiles were counted. The population has seemingly stabilised and 535 individuals were counted in 2017 (C. Hanekom, pers. comm. 2017). Snaring and illegal killing continue and have escalated since the removal of the eastern boundary fence in May 2008 (Calverley and Downs 2014b). Historically,

most crocodile nesting sites were located along the banks of the Pongola River in the reserve (Pooley 1982b), but the diversion of the main river course eastwards in 2002 has led to the abandonment of these nesting sites. The new course of the river flows very close to the removed boundary fence and no nesting activity has been recorded here, mainly due to anthropogenic disturbance caused by agricultural activities within the reserve (Calverley 2010). With continued illegal killings and almost no recent records of nesting within Ndumo, one of South Africa's historically viable populations of Nile crocodile is now under severe threat.

Field Visit and Workshops

In March 2018 I (SP) travelled to KZN to investigate human-wildlife conflict issues and interview people involved in crocodile attacks across the province. SP linked up with fellow XC and Cheryl Ogilvie (Manager of the Tshwane University of Technology's Ndumo Environmental Education Centre at NGR). It was a pleasure to stay at 'the croc house,' which is Tony Pooley's old office building at the Experimental Crocodile Restocking Centre where SP spent his early years - though little else now remains except a few depressions where the pools were, half obscured by dense subtropical bush.

On Saturday (24 March), we facilitated a workshop on human-crocodile conflict for 20 local teachers from 8 primary schools and 5 secondary schools, for 2 librarians, and six field rangers ('Teachers Workshop' for short), at the TUT's Environmental Education Centre in the reserve (Fig. 2). On the Sunday (25 March), we facilitated a similar workshop for local men living in the communities bordering the reserve. We expected around 15, but 49, mostly young men, arrived (Figs. 3 and 4).

CO has been running environmental outreach activities in the area for 18 years, and is well known to the local communities. She has a team of excellent young African university students who help her run the centre. They facilitated contact with the local community, and handled translations from English to isiZulu and vice versa, so big thanks to Sphiwe Ratshekani, Derrine Moabelo, Brian Kikain and Michael Ndovu.

CO's goal for the workshops was to inform the teachers, rangers and local people about the ecological and conservation importance of Nile crocodiles, as she is very concerned that local people are killing crocodiles, particularly in the eastern part of the game reserve where the boundary fence have been cut and farming is taking place. This is a very problematic and unsatisfactory situation given the historical importance of Ndumo as the springboard of Nile crocodile conservation efforts in KZN. Furthermore the South African Government declared Ndumo a Ramsar Wetland of International Importance in 1997.

SP's main goal was to learn about what the local people know, and believe, about Nile crocodiles. We therefore began both sessions with a one-page questionnaire that SP had devised, refined with the input of CO and her students, which the participants were asked to complete in groups. The feedback sessions after the questionnaires were very animated, and

Figure 2. Simon Pooley (right) in discussion with one of the Teachers' Workshop groups.

Figure 3. Mens' Workshop.

Figure 4. Xander Combrink (standing) in discussion with the Field Rangers.

The questionnaire included questions on perceptions, natural history knowledge, personal experiences, safety, conservation issues, and social norms. The most commonly used words for crocodiles were 'dangerous' (both workshops), 'lives in water' (Teachers Workshop), and 'sharp teeth' (Men's Workshop). The answers we got raise a few concerns over limitations in biological and behavioural knowledge which put people at risk in areas where crocodiles are present. These include: three of the (ten) Teachers Workshop groups thought

crocodiles grow up to a maximum of 1-2 m in length; and, 6 teachers' groups estimated that large adult crocodiles can stay underwater for 45 minutes or less (a teacher asked if crocodiles have gills). The men did better on both size estimates and how long crocodiles can stay underwater. Three Teachers Workshop groups and one Men's Workshop group guessed that crocodiles are most active in the winter months - the rest said correctly that it is the hot summer months (October to March).

While all but two groups (teachers) had seen a crocodile, only one teachers' group (Mzibuli and Zandlazethu High Schools) had seen them outside the game reserve, locally, and all in the Pongolo River. Three teachers' groups (including members from Mzibuli High School, Mandla Mthethwa School, Zandlazethu High, and Bhekabantu Primary School) said their communities used the river, with uses including washing swimming, fishing and fetching water. These communities should be a focus for any local outreach efforts. Six men's groups had seen crocodiles in the Pongolo River, and that their communities used the river, mostly for fetching water and fishing (line and net fishing, and traditional fonya basket fishing), with some swimming and washing.

It was notable that most teachers' and men's groups stated only avoidance of water bodies inhabited by crocodiles as a safety precaution. Only the field rangers mentioned fostering awareness and building enclosures. One men's group commented that their community fetches water and carries it away from the river to wash.

Two teachers' groups, and half of the men's groups, said crocodiles should not be protected, though some said only crocodiles posing a threat should be killed. Seven teachers groups said their communities would be pleased if they killed a crocodile. In verbal discussion on the Sunday, someone said their community would be pleased if a crocodile was killed because of the many uses of crocodile body parts (Table 1). We asked the men about the uses of crocodiles and from whom they learned about this. They answered that they gained the knowledge from their elders, inyangas (practitioners of traditional medicine) and from experience.

Table: Local uses for Nile crocodile body parts.

Category	Uses
Magical	Fat as antidote against bewitchment
	Love potion - and antidote!
Medicinal	Fat to cure ear problems
	Cures constipation
Other	Skin for bangles, shoes, watchstraps, catapults (not clear is actually used for these by locals)
	Stomach skin protects homes from lightning
	Liver used (in food) as a lethal poison
	Fat rubbed on body as protection from crocodiles
	Food (14 men said they ate crocodile)

Following the teachers' workshop questionnaire session, SP gave a slide show on ways to think about human wildlife conflict, and talked them through his crocodile attack booklet and infographics, which hopefully they will use with schools (to be followed up on a subsequent visit). SP concluded with an illustrated history of crocodile conservation at Ndumo, explaining why it is a special place for humans and crocodiles in South Africa. He drew on his father Tony Pooley's slides to show the crocodile restocking centre in its heyday, including photographs of several local Zulu men who had worked with Tony.

XC gave a slide presentation on crocodilians worldwide, and then talked about Nile crocodile biology, ecology and behaviour in detail. There were some interesting questions, for example: can you age a crocodile by counting gastroliths (they believe crocodiles swallow one annually)? The men at the Sunday workshop didn't know there were other species of crocodilians, and when learning that African Dwarf crocodiles are small and don't eat people, they applauded and said: 'we want those kinds of crocodile here!' Both Teachers and Men asked whether crocodile liver is poisonous. Afterwards, we all visited the beautiful Inyamithi Pan to see crocodiles and enjoy the game reserve.

At the Sunday workshop for local men, we followed the same broad outline, with 11 groups filling in questionnaires (results above). In the following discussion, the men expressed their concerns about the risk of crocodile attacks in the Pongola River in particular, which some of their wives and children use to collect water. SP has no records of attacks in the area since 2000, but the teachers and rangers' workshop (Fig. 3) participants said that a boy had been killed in 2015, and two boys caught in 2016 - one killed. The men mentioned an attack in 2015, and another in 2017 (a girl). We were told different stories, and the only evidence was a mobile (cell) phone photograph of a dead crocodile which some of the men said was the one that bit the girl (she was saved). The crocodile was apparently killed and eaten.

XC gave a simpler version of his presentation on crocodilians worldwide at the Men's Workshop. In his slideshow, SP focussed on the history of conservation and crocodile research at Ndumo, showing the local men who had been involved, and used Tony Pooley's slides to talk about his discoveries about courtship, mating, nesting and parental care. Communicating this knowledge in narrative form seems to work well.

Conclusions

Although we have little concrete evidence of Nile crocodile killing or serious predation on humans and livestock by crocodiles, the decline of this important crocodile population and verbal evidence from our workshops suggests that further crocodile conservation work in the area would be beneficial. All participants were both wary of and very interested in crocodiles. It seems that killing crocodiles is fairly widely approved of, and crocodiles are eaten and have a variety of other uses for locals. It is possible that unreported attacks have occurred in the area, and few people think it necessary

to report this to the conservation authorities. It is surprising how strong traditional beliefs about crocodiles are among young men in the community. Thus, further research could investigate cultural and social attitudes to crocodiles in more depth, as well as more practical matters like exposure and vulnerability (risk) to locals and their livestock (and as a result, to crocodiles). Awareness work focused on safety-related information on crocodile biology, ecology and behaviour, as well as promoting a conservation message, could be done through the Environmental Education Centre and in local schools using posters, booklets (Pooley 2015, 2017), and materials developed specifically for this purpose.

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Simon Pooley *(Lambert Lecturer in Environment, Birkbeck University of London, 32 Tavistock Square, London WC1H 9EZ, UK; s.pooley@bbk.ac.uk)* and Xander Combrink *(Tshwane University of Technology, Pretoria Campus, Staatsartillerie Road, Pretoria West, South Africa; CombrinkAS@tut.ac.za)*.

Recent Publications

Sarker, S., Isberg, S.R., Milic, N.L., Lock, P. and Helbig, K.J. (2018). Molecular characterization of the first saltwater crocodilepox virus genome sequences from the world's largest living member of the Crocodylia. Scientific Reports Reports 8(1):5623.

Abstract: Crocodilepox virus is a large dsDNA virus belonging to the genus *Crocodylidpoxvirus*, which infects a wide range of host species in the order Crocodylia worldwide. Here, we present genome sequences for a novel saltwater crocodilepox virus, with two subtypes (SwCRV-1 and -2), isolated from the Australian saltwater crocodile. Affected belly skins of juvenile saltwater crocodiles were used to sequence complete viral genomes, and perform electron microscopic analysis that visualized immature and mature virions. Analysis of the SwCRV genomes showed a high degree of sequence similarity to CRV (84.53% and 83.70%, respectively), with the novel SwCRV-1 and -2 complete genome sequences missing 5 and 6 genes respectively when compared to CRV, but containing 45 and 44 predicted unique genes. Similar to CRV, SwCRV also lacks the genes involved in virulence and host range, however, considering the presence of numerous hypothetical and or unique genes in the SwCRV genomes, it is completely reasonable that the genes encoding these functions are present but not recognized. Phylogenetic analysis suggested a monophyletic relationship between SwCRV and CRV, however, SwCRV is quite distinct from other chordopoxvirus genomes. These are the first SwCRV complete genome sequences isolated from saltwater crocodile skin lesions.

Wang, X., Wang, P., Wang, R., Wang, C., Bai, J., Ke, C., Yu, D., Li, K., Ma, Y., Han, H., Zhao, Y., Zhou, X. and Ren, L. (2018). Analysis of TCRβ and TCRγ genes in Chinese alligator provides insights into the evolution of TCR genes in jawed vertebrates. Developmental and Comparative Immunology (https://doi.org/10.1016/j.dci.2018.01.009).

Abstract: All jawed vertebrates have four T cell receptor (TCR) chains that are expressed by thymus-derived lymphocytes and play a major role in animal immune defence. However, few studies have investigated the TCR chains of crocodilians compared with those of birds and mammals, despite their key evolutionary position linking amphibians, reptiles, birds and mammals. Here, employing an Alligator sinensis genomic bacterial artificial chromosome (BAC) library and available genome data, we characterized the genomic organization, evolution and expression of TRB and TRG loci in *Alligator sinensis*. According to the sequencing data, the *A. sinensis* TRB locus spans approximately 500 Kb of genomic DNA containing two D-J-C clusters and 43 V gene segments and is organized as $V\beta_{(39)}$-pJβ1-pCβ1-pDβ1-Dβ2-$J\beta2_{(12)}$-Cβ2-$V\beta_{(4)}$, whereas the TRG locus spans 115 Kb of DNA genomic sequence consisting of 18 V gene segments, nine J gene segments and one C gene segment and is organized in a classical translocon pattern as $V\gamma_{(18)}$-$J\gamma_{(9)}$-Cγ. Moreover, syntenic analysis of TRB and TRG chain loci suggested a high degree of conserved synteny in the genomic regions across mammals, birds and *A. sinensis*. By analysing the cloned TRB/TRG cDNA, we identified the usage pattern of V families in the expressed TRB and TRG. An analysis of the junctions of the recombined VJ revealed the presence of N and P nucleotides in both expressed TRB and TRG sequences. Phylogenetic analysis revealed that TRB and TRG loci possess distinct evolutionary patterns. Most *A. sinensis* V subgroups have closely related orthologues in chicken and duck, and a small number of *A. sinensis* V subgroups have orthologues in mammals, which supports the hypothesis that crocodiles are the closest relatives of birds and mammals. Collectively, these data provide insights into TCR gene evolution in vertebrates and improve our understanding of the *A. sinensis* immune system.

Bevan, E., Whiting, S., Tucker, T., Guinea, M., Raith, A. and Douglas, R. (2018). Measuring behavioral responses of sea turtles, saltwater crocodiles, and crested terns to drone disturbance to define ethical operating thresholds. PLoS ONE 13(3): e0194460.

Abstract: Drones are being increasingly used in innovative ways to enhance environmental research and conservation. Despite their widespread use for wildlife studies, there are few scientifically justified guidelines that provide minimum distances at which wildlife can be approached to minimize visual and auditory disturbance. These distances are essential to ensure that behavioral and survey data have no observer bias and form the basis of requirements for animal ethics and scientific permit approvals. In the present study, we documented the behaviors of three species of sea turtle (green turtles, *Chelonia mydas*, flatback turtles, *Natator depressus*, hawksbill turtles, *Eretmochelys imbricata*), saltwater crocodiles (*Crocodylus porosus*), and crested terns (*Thalasseus bergii*) in response to a small commercially available (1.4 kg) multirotor drone flown in Northern Territory and Western Australia. Sea turtles in nearshore waters off nesting beaches or in foraging habitats exhibited no evasive behaviors (eg rapid diving) in response to the drone at or above 20-30 m altitude, and at or above 10 m altitude for juvenile green and hawksbill turtles foraging on shallow, algae-covered reefs. Adult female flatback sea turtles were not deterred by drones flying forward or stationary at 10 m altitude when crawling up the beach to nest or digging a body pit or egg chamber. In contrast, flyovers elicited a range of behaviors from crocodiles, including minor, lateral head movements, fleeing, or complete submergence when a drone was present below 50 m altitude. Similarly, a colony of crested terns resting on a sand-bank displayed disturbance behaviors (e.g. flight response) when a drone was flown below 60 m altitude. The current study demonstrates a variety of behavioral disturbance thresholds for diverse species and should be considered when establishing operating conditions for drones in behavioral and conservation studies.

Leardi, J.M., Pol, D. and Gasparini, Z. (2018). New Patagonian baurusuchids (Crocodylomorpha; Notosuchia) from the Bajo de la Carpa Formation (Upper Cretaceous; Neuquén, Argentina): New evidences of the early sebecosuchian diversification in Gondwana. Comptes Rendus Palevol. (https://doi.org/10.1016/j.crpv.2018.02.002).

Abstract: The Bajo de la Carpa Formation (Santonian) of the Neuquén basin (southwestern Argentina) has one of the most complete crocodyliform records of South America, together with the Adamantina and Marília formations of Brazil. In this contribution we report two fragmentary individuals from two different localities of the Bajo de la Carpa Formation: a middle-sized individual (MLP 26-IV-30-2), represented by postcranial remains from the Boca del Sapo locality and a large-bodied individual (MACN Pv-RN 1150), consisting only of snout elements from Paso Córdoba locality. Despite the remains of both specimens are fragmentary, they display anatomical characters of a specialized notosuchian carnivore clade: Baurusuchidae. Our phylogenetic analysis recovers these new individuals as non-baurusuchine baurusuchids, although they take multiple phylogenetic positions on the different most parsimonious trees. These new remains highlight the relevance of the Bajo de la Carpa Formation for understanding the rise of notosuchians during the Late Cretaceous.

Martínez-Juárez, A., López-Luna, M.A., Porras-Gómez, T.J. and Moreno-Mendoza, N. (2018). Expression of the Sox9, Foxl2, Vasa, and TRPV4 genes in the ovaries and testes of the Morelet's crocodile, *Crocodylus moreletii*. J. Exp. Zool. B Mol. Dev. Evol. (doi: 10.1002/jez.b.22799).

Abstract: The Sox9 gene is important for determining sex in vertebrates, as well as for maintaining testis morphology and fertility during adult life. In the same way, Vasa is an important gene for the maintenance of the germinal lineage and has been highly conserved throughout evolution, as it is expressed in germ cells of both vertebrates and invertebrates. In the particular case of crocodiles, the expression of Sox9 during gonadal morphogenesis and in the testes of 3-month-old *Alligator mississippiensis* has been studied. However, it is interesting to carry out studies on other species of crocodiles in relation to their particular mechanism for sex determination influenced by temperature. In this work, we investigated the expression of the Sox9, Vasa, Foxl2, and TRPV4 genes in the ovaries and testes of 5-year-old juvenile *Crocodylus moreletii*. As expected, Sox9 expression was found in males, but surprisingly, it was also found in females. For the first time, the expression of Vasa was reported in spermatogonia, oogonia, and oocytes of 5-year-old crocodiles. Foxl2 is important for the development and maintenance of the ovary during adult life in vertebrates; moreover, Foxl2 protein and transcripts are both highly expressed in the ovaries compared to the testes. A possible upstream regulator of the Sox9 gene in reptiles has not yet been discovered; as such, the expression of the TRPV4 ion channel was evaluated. The TRPV4 ion channel was expressed in the cytoplasm of Sertoli and follicular cells and was therefore proposed as a possible regulator of SOX9.

David Perpiñán (2018). Reptile anaesthesia and analgesia. Companion Animal 23(4): 236-243.

Abstract: Anaesthesia and analgesia in reptiles is not more difficult than in any other veterinary species. However, general practitioners often lose the opportunity to perform different procedures in snakes, lizards, chelonians and crocodilians because they may feel uncomfortable with anaesthesia and analgesia of these patients. It is unfortunately common for veterinary surgeons, even those seeing reptiles on a regular basis, to under-use analgesics in reptile patients (Read, 2004). This article will guide practitioners on performing proper and safe anaesthetic procedures, and will discuss the developing science of reptile analgesia.

Syme, C.E. and Salisbury, S.W. (2018). Taphonomy of *Isisfordia duncani* specimens from the Lower Cretaceous (upper Albian) portion of the Winton Formation, Isisford, central-west Queensland.R. Soc. open sci. 5: 171651.

Taphonomic analysis of fossil material can benefit from including the results of actualistic decay experiments. This is crucial in determining the autochthony or allochthony of fossils of juvenile and adult *Isisfordia duncani*, a basal eusuchian from the Lower Cretaceous (upper Albian) distalfluvial-deltaic lower Winton Formation near Isisford. The taphonomic characteristics of the *I. duncani* fossils were documented using a combination of traditional taphonomic analysis alongside already published actualistic decay data from juvenile *Crocodylus porosus* carcasses. We found that the *I. duncani* holotype, paratypes and referred specimens show little signs of weathering and no signs of abrasion. Disarticulated skeletal elements are often found in close proximity to the rest of the otherwise articulated skeleton. The isolated and disarticulated skeletal elements identified, commonly cranial, maxillary and mandibular elements, are typical of lag deposits. The holotype QM F36211 and paratype QM F34642 were classified as autochthonous, and the remaining *I. duncani* paratypes and referred specimens are parautochthonous. We propose that *I. duncani* inhabited upper and lower delta plains near the Eromanga Sea in life. Their carcasses were buried in sediment-laden floodwaters in delta plain overbank and distributary channel deposits. Future studies should refer to *I. duncani* as a brackish water tolerant species.

Ito, A., Aoki, R., Hirayama, R., Yoshida, M., Kon, H. and Endo, H. (2018). The rediscovery and taxonomical reexamination of the longirostrine crocodylian from the Pleistocene of Taiwan. Paleontological Research 22(2):150-155.

Abstract: A partial crocodylian skull was found among the

paleontological collection at the Archaeological Museum, Waseda University in Honjo-shi, Saitama Prefecture. Following a bibliographical survey, this was verified as a specimen reported by Tokunaga as the first known crocodile from Taiwan but then regarded as lost due to World War II. Molten glass debris is attached to the specimen, suggesting that it had been subject to air raids during World War II in May 1945, most likely at the Waseda University campus. Based on its largest seventh maxillary alveoli and the prominent lateral expansion towards the posterior direction, this specimen was identified as *Toyotamaphimeia* sp.; up to now a single species under this genus has been reported. The discovery demonstrates that this crocodylian genus once had a wide geographical distribution during the Pleistocene.

Mueller, C.A., Eme, J., Tate, K.B. and Crossley II, D.A. (2018). Chronic captopril treatment reveals the role of ANG II in cardiovascular function of embryonic American alligators (*Alligator mississippiensis*). Journal of Comparative Physiology B (https://doi.org/10.1007/s00360-018-1157-2).

Abstract: Angiotensin II (ANG II) is a powerful vasoconstrictor of the renin-angiotensin system (RAS) that plays an important role in cardiovascular regulation in adult and developing vertebrates. Knowledge of ANG II's contribution to developmental cardiovascular function comes from studies in fetal mammals and embryonic chickens. This is the first study to examine the role of ANG II in cardiovascular control in an embryonic reptile, the American alligator (*Alligator mississippiensis*). Using chronic low (~5-mg kg embryo^{-1}), or high doses (~450-mg kg embryo^{-1}) of captopril, an angiotensin-converting enzyme (ACE) inhibitor, we disrupted the RAS and examined the influence of ANG II in cardiovascular function at 90% of embryonic development. Compared to embryos injected with saline, mean arterial pressure (MAP) was significantly reduced by 41 and 72% under low- and high-dose captopril treatments, respectively, a greater decrease in MAP than observed in other developing vertebrates following ACE inhibition. Acute exogenous ANG II injection produced a stronger hypertensive response in low-dose captopril-treated embryos compared to saline injection embryos. However, ACE inhibition with the low dose of captopril did not change adrenergic tone, and the ANG II response did not include an α-adrenergic component. Despite decreased MAP that caused a left shifted baroreflex curve for low-dose captopril embryos, ANG II did not influence baroreflex sensitivity. This study demonstrates that ANG II contributes to cardiovascular function in a developing reptile, and that the RAS contributes to arterial blood pressure maintenance during development across multiple vertebrate groups.

Gifford-Gonzalez, D. (2018). Mammalian and reptilian carnivore effects on bone. Pp. 225-253 *in* An Introduction to Zooarchaeology. Springer: Cham.

Abstract: This chapter provides an overview of the effects of mammalian carnivores on vertebrate bodies, including human gnawing and reduction of skeletal elements, plus research on bone modifications by crocodiles. It offers summaries of systematic patterns of carcass and bone consumption by mammalian carnivores in general and by specific taxa – canids, felids, hyenids, ursids – and how these may be modulated by regional ecology. Building upon actualistic research on regularities in carcass and skeletal element consumption sequences, it details common modifications to bones inflicted by the teeth of gnawing carnivores and typical patterns of destruction of different elements and discusses whether tooth marks can be used to infer the taxon of the gnawing mammal. Modifications are well illustrated to facilitate identification. It reviews bone modifications inflicted by human gnawing and summarizes what is known of bone modification by crocodiles. Succeeding chapters on the effects of various actors and processes follow the same general format.

Vyas, R. (2018). Results of the 2015 Mugger Crocodile (*Crocodylus palustris*) count at Vadodara, Gujarat, India. IRCF Reptiles & Amphibians 25(1): 20-25.

Abstract: This report documents the Mugger Crocodile census conducted on 20-21 January 2015 at Vadodara City, Gujarat. This is a periodic procedure and part of an ongoing study designed to monitor this urban population with the help of public participation. The results show a gradual increase in the Mugger population within the demarcated stretch of the Vishwamitri River. The night-count numbers indicated the presence of 250 individuals of various sizes (<1 to >4 m TL). Mugger Crocodiles are wild, aquatic, carnivorous animals that have been flourishing in close proximity to humans, allowing for a noteworthy case study of the human-Mugger relationship. However, direct and indirect conflict data from the year 2014 are alarming - 24 documented Mugger attacks (12 of which were fatal) within the state, 7 (3 fatal) within the city limits, and 48 Muggers of various sizes rescued from the area. These numbers are indicative of a unique, complicated, and delicate relationship between humans and crocodiles as a balance is sought between Mugger conservation and a steadily rising urban population.

Cescato, M., Dumas, L., Gerlin, L., Grandjean, M., Hebra, T., Poulalier-Delavelle, M., Thibert, A., Vivier, M., Zanoni, P., Bordes, F., Enjalbert, B., Escudie, M.-P., Faure, R., Henras, A., Heux, S., Louis, Y., Millard, P., Montanier, C. and Romeo, Y. (2018). A synthetic microbial consortium to detect and kill *Vibrio cholerae*. bioRxiv (doi: http://dx.doi.org/10.1101/288712).

Abstract: *Vibrio cholerae* is nowadays still problematic in several countries which are exposed to recurrent disease outbreaks. The current disease detection and treatment methods are efficient so this approach focused on the prevention of the disease. Indeed, current solutions are not efficient enough to deal with this situation. As *V. cholerae* which infects more than a million people each year is usually found in water, a synthetic microbial consortium was designed to detect and kill efficiently the bacteria in water. This work shows that *Vibrio harveyi*, a non-pathogenic strain to human, can be an efficient detector of *V. cholerae*. Moreover, it proves that *Pichia pastoris*, a yeast, can efficiently produce a novel antimicrobial peptide coming from the crocodile *Crocodylus siamensis* (ie D-NY15) and that this peptide has a killing action towards *V. cholerae*. This study also shows that a communication between a prokaryote (*Vibrio harveyi*) and an eukaryote (*Pichia pastoris*) may be possible.

Domínguez-Rodrigo, M. and Baquedano, E. (2018). Distinguishing butchery cut marks from crocodile bite marks through machine learning methods. Sci. Rep. 8(1): 5786.

Abstract: All models of evolution of human behaviour depend on the correct identification and interpretation of bone surface modifications (BSM) on archaeofaunal assemblages. Crucial evolutionary features, such as the origin of stone tool use, meat-eating, food-sharing, cooperation and sociality can only be addressed through confident identification and interpretation of BSM, and more specifically, cut marks. Recently, it has been argued that linear marks with the same properties as cut marks can be created by crocodiles, thereby questioning whether secure cut mark identifications can be made in the Early Pleistocene fossil record. Powerful classification methods based on multivariate statistics and machine learning (ML) algorithms have previously successfully discriminated cut marks from most other potentially confounding BSM. However, crocodile-made marks were marginal to or played no role in these comparative analyses. Here, for the first time, we apply state-of-the-art ML methods on crocodile linear BSM and experimental butchery cut marks, showing that the combination of multivariate taphonomy and ML methods provides accurate identification of BSM, including cut and crocodile bite marks. This enables empirically-supported hominin behavioural modelling, provided that these methods are applied to fossil assemblages.

Jensen, B., Boukens, B.J., Crossley, II, D.A., Conner, J., Mohan, R.A., van Duijvenboden, K., Postma, A.V., Gloschat, C.R., Elsey, R.M., Sedmera, D., Efimov, I.R. and Christoffels, V.M. (2018). Specialized impulse conduction pathway in the alligator heart. Elife (doi: 10.7554/eLife.32120).

Abstract: Mammals and birds have a specialized cardiac atrioventricular conduction system enabling rapid activation of both ventricles. This system may have evolved together with high heart rates to support their endothermic state (warm-bloodedness), and is seemingly lacking in ectothermic vertebrates from which first mammals then birds independently evolved. Here, we studied the conduction system in crocodiles (*Alligator mississippiensis*), the only ectothermic vertebrates with a full ventricular septum. We identified homologues of mammalian conduction system markers (Tbx3-Tbx5, Scn5a, Gja5, Nppa-Nppb) and show the presence of a functional atrioventricular bundle. The ventricular Purkinje network, however, was absent and slow ventricular conduction relied on trabecular myocardium, as it does in other ectothermic vertebrates. We propose the evolution of the atrioventricular bundle followed full ventricular septum formation prior to the development of high heart rates and endothermy. In contrast, the evolution of the ventricular Purkinje network is strongly associated with high heart rates and endothermy.

Joyce, W., Elsey, R.M., Wang, T. and Crossley, II, D.A. (2018). Maximum heart rate does not limit cardiac output at rest or during exercise in the American alligator (*Alligator mississippiensis*).

Abstract: In most vertebrates, increases in cardiac output result from increases in heart rate (fH) with little or no change in stroke volume (Vs), and maximum cardiac output ($\dot{Q}$) is typically attained at or close to maximum fH. We therefore tested the hypothesis that increasing maximum fH may increase maximum $\dot{Q}$. To this end, we investigated the effects of elevating fH with right atrial pacing on $\dot{Q}$ in the American alligator (*Alligator mississippiensis*) at rest and whilst swimming. During normal swimming, $\dot{Q}$ increased entirely by virtue of a tachycardia (29 ± 1 to 40 ± 3 beats min^{-1}) whilst Vs remained stable. In both resting and swimming alligators, increasing fH with right atrial pacing resulted in a parallel decline in Vs that resulted in an unchanged cardiac output. In swimming animals, this reciprocal relationship extended to supraphysiological fH (up to ~72 beats min^{-1}), which suggests that maximum fH does not limit maximum cardiac output and that fH changes are secondary to the peripheral factors (for example vascular capacitance) that determine venous return at rest and during exercise.

Joyce, W., Crossley, J., Elsey, R.M., Wang, T. and Crossley, II, D.A. (2018). Contribution of active atrial contraction to cardiac output in anesthetized American alligators (*Alligator mississippiensis*). Journal of Experimental Biology (doi: 10.1242/jeb.178194).

Abstract: Ventricular filling may occur directly from the venous circulation during early diastole or via atrial contraction in late diastole. The contribution of atrial contraction to ventricular filling is typically small in mammals (10-40%), but has been suggested to predominate in reptiles. We investigated the importance of atrial contraction in filling of the ventricle in American alligators (*Alligator mississippiensis*) by bypassing both atria (with the use of ligatures to prevent atrial filling) and measuring the resultant effects on cardiac output in anesthetized animals. Atrial ligation had no significant effects on total systemic blood flow before or after adrenaline injection. Unexpectedly, pulmonary flow was increased following atrial ligation prior to adrenaline, but was unaffected after it. These findings suggest that the atria are non-essential (ie redundant) for ventricular filling in alligators, at least under anesthesia, but may serve as important volume reservoirs.

Briscoe, S.D. and Ragsdale, C.W. (2018). Molecular anatomy of the alligator dorsal telencephalon. Journal of Comparative Neurology (doi: 10.1002/cne.24427).

Abstract: The evolutionary relationships of the mammalian neocortex and avian dorsal telencephalon (DT) nuclei have been debated for more than a century. Despite their central importance to this debate, non-avian reptiles remain underexplored with modern molecular techniques. Reptile studies harbor great potential for understanding the changes in DT organization that occurred in the early evolution of amniotes. They may also help clarify the specializations in the avian DT, which comprises a massive, cell-dense dorsal ventricular ridge (DVR) and a nuclear dorsal-most structure, the Wulst. Crocodilians are phylogenetically and anatomically attractive for DT comparative studies: they are the closest living relatives of birds and have a strikingly bird-like DVR, but they also possess a highly differentiated reptile cerebral cortex. We studied the DT of the American alligator, *Alligator mississippiensis*, at late embryonic stages with a panel of molecular marker genes. Gene expression and cytoarchitectonic analyses identified clear homologs of all major avian DVR subdivisions including a mesopallium, an extensive nidopallium with primary sensory input territories, and an arcopallium. The alligator medial cortex is divided into three components that resemble the mammalian dentate gyrus, CA fields, and subiculum in gene expression and topography. The alligator dorsal cortex contains putative homologs of neocortical input, output, and intratelencephalic projection neurons and, most notably, these are organized into sublayers similar to mammalian neocortical layers. Our findings on the molecular anatomy of the crocodilian DT are summarized in an atlas of the alligator telencephalon.

Merchant, M., Hale, A., Brueggen, J., Harbsmeier, C. and Adams, C. (2018). Crocodiles alter skin color in response to environmental color conditions. Scientific Reports 8: 6174.

Abstract: Many species alter skin color to varying degrees and by different mechanisms. Here, we show that some crocodylians modify skin coloration in response to changing light and environmental conditions. Within the Family, Crocodylidae, all members of the genus *Crocodylus* lightened substantially when transitioned from dark enclosure to white enclosures, whereas *Mecistops* and *Osteolaemus* showed little/no change. The two members of the Family Gavialidae showed an opposite response, lightening under darker conditions, while all member of the Family Alligatoridae showed no changes. Observed color changes were rapid and reversible, occurring within 60-90 minutes. The response is visually-mediated and modulated by serum α-melanocyte-stimulating hormone (α-MSH), resulting in redistribution of melanosomes within melanophores. Injection of crocodiles with α-MSH caused the skin to lighten. These results represent a novel description of color change in crocodylians, and have important phylogenetic implications. The data support the inclusion of the Malayan ghar ial in the Family Gavialidae, and the shift of the African slender-snouted crocodile from the genus *Crocodylus* to the monophyletic genus *Mecistops*.

De Souza, R.G. and Campos, D.A. (2018). New Crocodyliform specimens from Recôncavo-Tucano Basin (Early Cretaceous) of Bahia, Brazil. Anais da Academia Brasileira de Ciências (http://dx.doi.org/10.1590/0001-3765201720170382).

Abstract: In 1940, L.I. Price and A. Oliveira recovered four crocodyliform specimens from the Early Cretaceous Bahia Supergroup (Recôncavo-Tucano Basin). In the present work, we describe four different fossil specimens: an osteoderm, a fibula, a tibia, and some autopodial bones. No further identification besides Mesoeucrocodylia was made due to their fragmentary nature and the reduced number of recognized synapomorphies for more inclusive clades. With exception of the fibula, all other specimens have at least one particular feature, which with new specimens could represent new species. The new specimens described here increase the known diversity of Early Cretaceous crocodyliforms from Brazil. This work highlights the great fossiliferous potential of Recôncavo-Tucano Basin with regard to crocodyliform remains.

Escobedo-Galvan, A.H., Elsey, R.M., McCann, F., Cupul-Magaña, F.G. and Lopez-Luna, M.A. (2018). Putting eggs in one big basket: communal egg-laying between long-lived reptiles. North-western Journal of Zoology 2018: e182501.

Abstract: Understanding communal nesting has provided a deeper insight into reptile social behavior. Conspecific communal nesting has been reported frequently, while interspecific communal nesting has remained somewhat opaque. Here, we report communal egg-laying involving long-lived reptiles (American Crocodile and Ornate Slider Turtle). Our results from both field observations and literature reviewed indicate this is the first known case of communal nesting between these two species, and could suggest that crocodilians provide secondary nest attendance for nesting turtles. In addition, we present a brief review of commensal egg-laying between crocodilians and other reptiles.

Ryberg, W.A and Lawing, A.M. (2018). Genetic consequences and management implications of climate change for the American alligator *Alligator mississippiensis*. Chapter 6 *in* American Alligators: Habitats, Behaviors, and Threats, ed. by S.E. Henke and C.B. Eversole. Nova Science Publishers: New York.

Abstract: The American alligator (*Alligator mississippiensis*) has been found in essentially its present form in the fossil record for 30 million years. This long relatively unchanged evolutionary history gives the impression that alligator habitat has remained so stable over time that there was little evolutionary pressure to change, but evidence from the fossil record, genetics research reviewed here, and models of climate change presented here, suggest otherwise. In particular, the lack of genetic variation range-wide indicated that alligators were forced into a single Pleistocene refugium, which, according to fossil evidence and model projections in this study, was most likely restricted to the paleo coastline of peninsular Florida. The apparent expansion of suitable habitat from the mid-Holocene to modern day resulted in the current distribution of alligator populations, which follow an isolation by distance model of genetic structure. These data support the theory that alligators were fully capable of tracking changes in their distribution in response to past climate change, rather than evolving absolute climate tolerances to persist. Indeed, the amount and location of suitable habitat available to alligators fluctuated greatly during the last 2.5 million years of glacial-interglacial cycles. Under future climate scenarios, models predicted that suitable alligator habitat will expand north, increasing the number and area of habitat patches, but also retract from the southern tips of both Florida and Texas. In the context of the fossil record, these results illustrated that regions without alligators for thousands of years could potentially be recolonized in the near future, and also that regions that contained alligators for millions of years, such as southern Florida, could include populations that may be difficult or potentially impossible to maintain over the next half-century. Furthermore, if the distributional response of alligators to climate change is constrained by natural and human barriers, then the rate of climate change may outpace the alligator's capacity to adjust in those areas, leading to rapid localized changes in the size and distribution of alligator populations. These results warn that the alligator could be highly vulnerable to future changes in climate in specific regions throughout its current distribution. Thus, while alligators have shown a remarkable capacity to adjust to long-term climate changes, the potential for alligators to respond to climate change over much shorter timescales (ie decades vs. millennia), as depicted here, may be dependent on human intervention. Several landscape conservation perspectives and active management strategies are discussed that could help preserve the adaptive potential of populations and maintain species resilience to climate change.

Thongkamkoon, P., Tohmee, N., Morris, E.K., Inamnuay, L. and Lombardini, E.D. (2018). Combined fatal systemic *Chlamydia* sp. and *Aeromonas sobria* infection in juvenile Siamese crocodiles (*Crocodylus siamensis*). Veterinary Pathology (https://doi.org/10.1177/0300985818768382).

Abstract: Chlamydial infections in crocodiles have been described in several countries and in several different species. These are typically associated with severe pharyngitis and conjunctivitis, with death occurring secondary to compromise of the upper respiratory tract due to obstruction of the trachea. A population of ranched Siamese crocodiles in central Thailand experienced an epizootic of sudden death in juvenile animals. The affected animals had fulminant systemic disease primarily involving the liver and spleen but also affecting the kidneys, heart, and the whole of the respiratory tract. *Chlamydia* sp. were noted in liver and spleen during histopathological examination and confirmed with transmission electron microscopy and polymerase chain reaction (PCR). The sequence of the PCR product suggested a novel *Chlamydia* sp. of Siamese crocodiles. Crocodile farming represents an important economy in several parts of the world. Epizootics, such as the one described in this manuscript in association with *Chlamydia* sp., can have devastating impact on the industry and represent a potential zoonosis of significant public health concern. This is the first report of *Chlamydia* sp. and *Aeromonas sobria* causing systemic disease in crocodiles as well as the first histopathological and ultrastructural description of *Chlamydia* infection in Siamese crocodiles.

Gcebe, N., Michel, A.L. and Hlokwe, T.M. (2018). Non-tuberculous *Mycobacterium* species causing mycobacteriosis in farmed aquatic animals of South Africa. BMC Microbiology 18: 32.

Abstract: Mycobacteriosis caused by non-tuberculous mycobacteria (NTM), is among the most chronic diseases of aquatic animals. In addition, fish mycobacteriosis has substantial economic consequences especially in the aquaculture and fisheries industry as infections may significantly decrease production and trade. Some fish NTM pathogens are highly virulent and zoonotic; as such, infection of aquaria with these pathogens is a public health concern.In this study, we report isolation of nine different NTM species from 16 aquatic animals including different fish species, frogs and a crocodile. Given the clinical significance of *Mycobacterium marinum* and its close relation to *M. tuberculosis*, as well as the significance of ESAT 6 and CFP-10 secretion in mycobacterial virulence, we analysed the esxA and esxB nucleotide sequences of *M. marinum* isolates identified in this study as well as other mycobacteria in the public databases. *Mycobacterium shimoidei*, *M. marinum*, *M. chelonae*, *M. septicum*/*M. peregrinum* and *M. porcinum* were isolated from gold fish, Guppy, exotic fish species in South Africa, koi and undefined fish, Knysna seahorse, as well Natal ghost frogs respectively, presenting tuberculosis like granuloma. Other NTM species were isolated from the studied aquatic animals without any visible lesions, and these include *Mycobacterium* sp. N845 T, *M. fortuitum*, a member of the *M. avium* complex, and *M. szulgai*. Phylogenetic analysis of mycobacteria, based on esxA and esxB genes, separated slow growing from rapidly growing mycobacteria as well as pathogenic from non-pathogenic mycobacteria in some cases. Isolation of the different NTM species from samples presenting granuloma suggests the significance of these NTM species in causing mycobacteriosis in these aquatic animals. The study also revealed the potential of esxA and esxB sequences as markers for phylogenetic classification of mycobacteria. Observations regarding use of esxA and esxB sequences for prediction of potential pathogenicity of mycobacteria warrants further investigation of these two genes in a study employing NTM species with well-defined pathogenicity.

Reigh, R.C. and Williams, M.B. (2018). Plant products in compounded diets are effectively utilized by American alligator, *Alligator mississippiensis*. Journal of the World Aquaculture Society (https://doi.org/10.1111/jwas.12520).

Abstract: Growth performance of American alligators fed a plant-based diet was measured in a 10-mo feeding trial. Hatchling alligators (192 in total) received one of three dietary treatments: a 56% crude protein (CP) commercial diet fed for 3 mo followed by

a 50% CP commercial diet fed for 7 mo (56/50); a 56% CP diet fed for 3 mo followed by an experimental 45% digestible-protein (DP), plant-based diet fed for 7 mo (56/45); or a 45% DP diet fed for 10 mo (45/45). Final mean length and weight (L/W) of alligators fed 45/45 were lower ($P<0.05$) than L/W of animals fed 56/50, but L/W of alligators fed 56/45 was not different ($P>0.05$) from L/W of alligators fed 56/50 or 45/45. Also, the range of growth responses among animals in all treatment groups showed that some better-performing individuals fed 45/45 or 56/45 grew as large as animals fed 56/50. Results indicated that the American alligator can effectively utilize plant products in a compounded diet, and additional research on optimizing the use of selected plant products in alligator feeds is warranted.

González Jáuregui, M., Padilla, S.E., Hinojosa-Garro, D., Valdespino, C. and Rendón von Ostend, J. (2018). Evaluation of the use of dermal scutes and blood samples to determine organochlorine pesticides in *Crocodylus moreletii*: A non-destructive method for monitoring crocodiles and environmental health. 88: 161-168.

Abstract: This study determines the suitability of using blood plasma and dermal scute samples as a non-destructive technique for monitoring the health of Morelet's crocodiles and the presence of organochlorine pesticides (OCPs) in the environment. We collected samples (blood plasma and caudal scutes) from 30 Morelet's crocodiles (*C. moreletii*); 16 were wild, and 14 were captive. The 30 samples were analyzed for 24 different OCPs and compared in 10 groups based on chemical affinities (isomers and degradation products). Endrin and Chlordane were the most frequent OCP groups detected, found in 63% and 57% of the samples, respectively. We did not find significant differences in OCP concentrations in tissues (plasma and scutes) between wild and captive crocodiles; there were also no significant correlations among concentrations in tissues. Blood plasma and scutes are good indicators of OCP body burdens in Morelet's crocodiles for monitoring the presence and fluctuation of toxicity in the environment; however, it is not possible to infer the concentrations in one tissue from the concentrations detected in the other tissue. Selecting which tissues to use for OCP analyses depends on the specific objectives of the researcher. For research, on individual health and local exposure to contaminants, plasma is suitable. For evaluating the presence over time of OCPs in the environment, the caudal dermal scutes are the most appropriate tissue. Overall, it is important to take into account the body condition to avoid biases due to bioamplification effects.

Behroozi, M., Billings, B.K., Helluy, X., Manger, P.R., Güntürkün, O. and Ströckens, F. (2018). Functional MRI in the Nile crocodile: a new avenue for evolutionary neurobiology. Proceedings of the Royal Society B 285(1877) (doi: 10.1098/rspb.2018.0178).

Abstract: Crocodilians are important for understanding the evolutionary history of amniote neural systems as they are the nearest extant relatives of modern birds and share a stem amniote ancestor with mammals. Although the crocodilian brain has been investigated anatomically, functional studies are rare. Here, we employed functional magnetic resonance imaging (fMRI), never tested in poikilotherms, to investigate crocodilian telencephalic sensory processing. Juvenile *Crocodylus niloticus* were placed in a 7 T MRI scanner to record blood oxygenation level-dependent (BOLD) signal changes during the presentation of visual and auditory stimuli. Visual stimulation increased BOLD signals in rostral to mid-caudal portions of the dorso-lateral anterior dorsal ventricular ridge (ADVR). Simple auditory stimuli led to signal increase in the rostromedial and caudocentral ADVR. These activation patterns are in line with previously described projection fields of diencephalic sensory fibres. Furthermore, complex auditory stimuli activated additional regions of the caudomedial ADVR. The recruitment of these additional, presumably higher-order, sensory areas reflects observations made in birds and mammals. Our results indicate that structural and functional aspects of sensory processing have been likely conserved during the evolution of sauropsids. In addition, our study shows that fMRI can be used to investigate neural processing in poikilotherms, providing a new avenue for neurobiological research in these critical species.

Lacerda, M.B., de França, M.A.G. and Schultz, C.L. (2018). A new erpetosuchid (Pseudosuchia, Archosauria) from the Middle-Late Triassic of Southern Brazil. Zoological Journal of the Linnean Society (https://doi.org/10.1093/zoolinnean/zly008).

Abstract: The evolution and diversification of Triassic pseudosuchian lineages has been the subject of much interest and revision in the last couple of decades, fuelled by new and important discoveries, which have allowed for better-sampled phylogenetic analysis. In the present contribution, we add to this by describing a new taxon, *Pagosvenator candelariensis* gen. et sp. nov., for the Middle-Late Triassic *Dinodontosaurus* Assemblage Zone of the Santa Maria Supersequence of southernmost Brazil. A comparative osteological analysis combined with a phylogenetic analysis supports its inclusion within the clade Erpetosuchidae and provides an insight into the phylogenetic relationship and evolutionary history of this clade, with two possibilities for the Erpetosuchidae relationship: as an early branch of pseudosuchians, being a sister group of Ornithosuchidae; or a closer relationship with the clade composed by Gracilisuchidae and Paracrodylomorpha with respect to Orntithosuchidae and Aetosauria. Additionally, the results presented and discussed here are of biostratigraphical importance, given that the taxon is from the Ladinian/Carnian age and would fill a temporal gap that exists within Erpetosuchidae between *Parringtonia gracilis* from the Anisian and *Erpetosuchus* from late the Carnian to Norian. Furthermore, it would be the first occurrence of a member of this clade in South America.

Parsons, E.C.M., MacPherson, R. and Villagomez, A. (2018). Marine "Conservation": You keep using that word but I don't think it means what you think it means. Frontiers in Marine Science Volume 14, article 299.

Introduction: What exactly does "doing conservation" or "incorporating conservation" into ocean science mean? Although today it is often coupled with the sustainable use of natural resources, by definition, conservation traditionally involves the preservation, protection, or restoration of the natural environment or natural ecosystems (Soulé and Wilcox, 1980). In other words, if the conservation intervention is successful then the ecosystem should reflect a better (or perhaps, more commonly, a "less worse") state as a result. In this context, is simply conducting science conservation? Are outreach and advocacy conservation - whether through old school print and TV/radio broadcasts or through social media such as blogs or building a Twitter following? The field of modern marine conservation is an interdisciplinary one (eg van Dyke 2008; Parsons and MacPherson 2016) with a landscape that is populated with individuals engaged in science, education, socialmarketing, economics, resource management, and policy. But how are we measuring our impact considering this diverse field? How do we know that the ecosystems toward which we direct our conservation efforts are "better" or at least "less worse" than they would be without them? Conservation needs to be more than just "being busy" or "feeling" that we are having an impact. And shouldn't we strive to ensure that conservation is not just conversation? How do we connect our actions to ecosystem responses in meaningful time frames? This paper summarizes the results of a focus group discussion session on this topic held at the 2016 International Marine Conservation Congress, St John's, Newfoundland. It aims to assess ways to measure positive effects of marine conservation efforts beyond the "feel good" aspect to demonstrable impact.

Lim, H. (2018). Thematic analysis of YouTube comments on disclosure of animal cruelty in a luxury fashion supply chain. Pp. 75-92 *in* Sustainability in Luxury Fashion Business, ed. bu C. Lo and J. Ha-Brookshire. Springer: Singapore

Abstract: While consumers' increasing demands for luxury leather goods drives luxury brands to secure supplies of exotic and high-quality animal skins, animal welfare activists have attempted to raise the public's awareness of cruelty in the luxury fashion supply chains. Adopting the attribution theory, this study aims to uncover the pattern of consumers' responses to the issue of animal cruelty in the luxury fashion industry. Data were collected from consumers' responses to animal cruelty as revealed in PETA (People of Ethical Treatment of Animal)'s video on YouTube. Data analysis revealed distinct blame attributions and coping strategies, which depend heavily on viewers' attitude toward the video content. Findings from this study suggest that consumers' blame attributions are dispersed among different stakeholders, with luxury fashion brands and their customers treated as the causes of animal cruelty, slaughterhouse workers, and humans in general treated as perpetrators, and PETA and commenters that support PETA's message treated as accusers. Implications for the luxury fashion business and animal welfare promotion are discussed.

Cerda, I.A., Desojo, J.B. and Scheyer, T.M. (2018). Novel data on aetosaur (Archosauria, Pseudosuchia) osteoderm microanatomy and histology: palaeobiological implications. Palaeontology (https://doi.org/10.1111/pala.12363).

Abstract: One of the most striking features of aetosaurs is the possession of an extensive bony armour composed of dorsal, ventral and appendicular osteoderms. With the purpose of establishing the main histological changes during ontogeny and the degree of histological variation within the armour, we analysed the bone histology of dorsal (paramedian and lateral), ventral and appendicular osteoderms from different taxa from the Late Triassic of South America, including *Aetosauroides scagliai*, *Aetobarbakinoides brasiliensis* and *Neoaetosauroides engaeus*. Histological data support an intramembranous origin for osteoderms. Nevertheless, evidence for metaplastic ossification (ie structural fibres) at advanced ontogenetic stages, in at least some elements, is also present. A variant type of parallel fibred bone, which we have named 'crossed parallel fibred bone', is characterized for aetosaurs. In this pseudosuchian group, osteoderms exhibit very important microstructural changes during ontogeny, which can be useful for determining ontogenetic stages from isolated elements. Histological data suggest a relatively early onset of sexual maturity among aetosaurs. Microanatomical analysis from different taxa reveal that having high values of compactness is the plesiomorphic condition for Aetosauria. The notably increased compactness of the osteoderms does not appear to be related to size, ontogeny, sex or reproductive status of the individuals. Although a high degree of compactness of osteoderms and other bones has been considered as evidence for an aquatic lifestyle in vertebrates, such an inference contradicts the current concept of a fully terrestrial lifestyle in aetosaurs.

Carrillo-Páez, C.C. (2018). Wildlife trafficking by parcel service: A national problem that threatens biodiversity. Pp. 115-125 *in* Green Crime in Mexico. Palgrave Macmillan: Cham.

Abstract: The dynamics of wildlife trafficking involve operations contravening local, national, and international laws, which are low cost to and of minimal risk to offenders. Offenders exploit the poor monitoring occurring along trafficking routes. In Mexico, in recent years the use of national and international mail for the sending of wildlife has been detected. The law enforcement authority does not yet have the ability to verify all goods shipped as parcels, and detection of illicit goods depends to a large extent on the ability of the courier companies shipping the parcels. Verification of shipments is further complicated because there are no typical and/or repetitive modes of operation on the part of traffickers. Environmental authorities and private and public parcel services should strengthen their actions and technical-operative capacities to detect this type of illegality.

Ezat, M.A., Fritsch, C.J. and Downs, C.T. (2018). Use of an unmanned aerial vehicle (drone) to survey Nile crocodile populations: A case study at Lake Nyamithi, Ndumo Game Reserve, South Africa. Biological Conservation 223: 76-81.

Abstract: Observer bias and inexperience are challenging aspects of crocodile survey methods for determining population numbers and structure. Aerial surveys with either a helicopter or a fixed winged aircraft are generally preferred methods to ground surveys; however, the high cost of the former is a limiting factor. Recently unmanned aerial vehicles (UAVs) or drones have been proposed for surveys because of their potential of improving over traditional techniques of wildlife monitoring and as they have relatively lower costs. We investigated of the suitability of a UAV to determine numbers and structure of the Nile crocodile, *Crocodylus niloticus*, population during winter at Lake Nyamithi, Ndumo Game Reserve in South Africa. We used the UAV for eight flights covering ~132 ha. We also conducted a diurnal ground survey of crocodiles for comparison. Using the UAV, 287 crocodiles were identified and body length measured accurately for size class allocation whereas only 211 crocodiles were counted in the diurnal ground survey. Consequently, the UAV aerial survey recorded 26% more crocodiles. The potential of using UAVs to estimate crocodile population size and measure the total length (TL) of individuals accurately and precisely at a relatively low cost should improve management actions, enable monitoring of the crocodile populations annually and importantly avoid observer bias. Implications of this may facilitate improved crocodilian survey techniques.

Finger, J.W., Hamilton, M.T., Kelley, M.D., Zhang, Y., Kavazis, A.N., Glenn, T.C. and Tuberville, T.D. (2018). Dietary selenomethionine administration and its effects on the American alligator (*Alligator mississippiensis*): Oxidative status and corticosterone levels. Archives of Environmental Contamination and Toxicology (https://doi.org/10.1007/s00244-018-0530-1).

Abstract: Selenium (Se) is an essential nutrient which in excess causes toxicity. The disposal of incompletely combusted coal, which often is rich in Se, into aquatic settling basins is increasing the risk of Se exposure worldwide. However, very few studies have looked at the physiological effects of Se exposure on long-lived, top trophic vertebrates, such as the American alligator (*Alligator mississippiensis*). During a 7-week period, alligators were fed one of three dietary treatments: mice injected with deionized water or mice injected with water containing 1000 or 2000 ppm selenomethionine (SeMet). One week after the last feeding alligators were bled within 3 min of capture for plasma corticosterone (CORT). A few days later, all alligators were euthanized and whole blood and tail tissue were harvested to measure oxidative damage, an antioxidant-associated transcription factor, and antioxidant enzymes [glutathione peroxidase-1 (GPX_1), superoxide dismutase-1 (SOD_1), and SOD_2] by Western blotting. There was a dose-dependent increase in baseline CORT levels in alligators administered SeMet. Except for blood SOD_2 levels, SeMet treatment had no effect ($p > 0.05$ for all) on oxidative status: oxidative damage, GPX_1, SOD_1, and muscle SOD_2 levels were similar among treatments. Our results illustrate that high levels of Se may act as a stressor to crocodilians. Future studies should investigate further the physiological effects of Se accumulation in long-lived, top-trophic vertebrates.

Silliman, B.R., Hughes, B.B., Gaskins, L.C., He, Q., Tinker, M.T., Read, A., Nifong, J. and Stepp, R. (2018). Are the ghosts of nature's past haunting ecology today? Current Biology 28(9): R532-R537.

Summary: Humans have decimated populations of large-bodied consumers and their functions in most of the world's ecosystems. It is less clear how human activities have affected the diversity of habitats these consumers occupy. Rebounding populations of some predators after conservation provides an opportunity to begin to investigate this question. Recent research shows that following

long-term protection, sea otters along the northeast Pacific coast have expanded into estuarine marshes and seagrasses, and alligators on the southeast US coast have expanded into saltwater ecosystems, habitats presently thought beyond their niche space. There is also evidence that seals have expanded into subtropical climates, mountain lions into grasslands, orangutans into disturbed forests and wolves into coastal marine ecosystems. Historical records, surveys of protected areas and patterns of animals moving into habitats that were former hunting hotspots indicate that - rather than occupying them for the first time - many of these animals are in fact recolonizing ecosystems. Recognizing that many large consumers naturally live and thrive across a greater diversity of ecosystems has implications for setting historical baselines for predator diversity within specific habitats, enhancing the resilience of newly colonized ecosystems and for plans to recover endangered species, as a greater range of habitats is available for large consumers as refugia from climate-induced threats.

Huang, X.M., Sun, L. and Wu, X.B. (2018). Molecular cloning, sequence analysis, and expression of Pepsinogens C Gene from adult *Alligator sinensis* stomach. Acta Academiae Medicinae Sinicae 40(2):201-210.

Abstract: Objective - To investigate the molecular clone and structural features of pepsinogen C(PGC) gene in the stomach of *Alligator sinensis*, explore the phylogenetic relationships and tissue distribution, and analyze the variation of PGC expression in the stomachs of adult *A. sinensis* at different life stages. Methods - The full-length cDNA of PGC gene of *Alligator sinensis* was cloned by reverse transcription polymerase chain reaction and rapid amplification of cDNA ends and then sequenced. The physical and chemical parameters and advanced structures of the PGC protein were predicted by bioinformatics methods and tools. The PGC amino acid sequences of *A. sinensis* and other vertebrates were compared by Clustal X software. The neighbor-joining phylogenetic tree was built by MEGA 6 software. Immunohistochemistry was used to locate PGC in the gastric mucosa of *A. sinensis*. The variation of the PGC mRNA levels in the stomach at different life stages was detected by quantitative real-time polymerase chain reaction. Results - Reverse transcription polymerase chain reaction and rapid amplification of cDNA ends revealed a 1568 bp cDNA full-length sequence containing 1167 bp open reading frame, which encoded 388 amino acids. The PGC gene of *A. sinensis* had been deposited in the GenBank Data Libraries under the accession number of KY799383. Bioinformatics analysis predicted that the *A. sinensis* PGC had a theoretical relative molecular mass of 41,998 with a theoretical isoelectric point of 4.16. In addition, the three-dimensional structure of the PGC was constructed by homology modeling to predict its active site with two essential aspartyl residues and six essential cysteine residues involved in forming three disulphide bonds. The neighbor-joining phylogenetic tree of vertebrates from the amino acids sequences of PGC showed all crocodiles were clustered as a group, and the PGC of *A. sinensis* was the closest to *A. mississippiensis*. *Alligator sinensis* PGC was specifically expressed in the gastric mucosa, and its expressions significantly differed during reproduction and hibernation significantly ($P<0.05$). Conclusions - *Alligator sinensis* PGC gene is highly conserved in evolution. Its protein is a gastric specific digestive proteinase that belongs to a aspartic proteinase family.

Fukuda, Y. and Jang, N.C. (2018). Crocodile tears: secretion of orbital fluid in a large saltwater crocodile *Crocodylus porosus* Schneider, 1801. Herpetology Notes 11: 373-374.

Harfoot, M., Glaser, S.A.M., Tittensor, D.P., Britten, G.L., McLardy, C., Malsch, K. and Burgess, N.D. (2018). Unveiling the patterns and trends in 40 years of global trade in CITES-listed wildlife. Biological Conservation 223: 47-57.

Abstract: Wildlife trade can provide commercial incentives to conserve biodiversity but, if unsustainable, can also pose a threat. CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) aims to ensure international trade in CITES-listed species is sustainable, legal and traceable. However, large-scale temporal and spatial patterns in wildlife trade are poorly known. We address this by analysing the CITES Trade Database: >16 million shipment records for 28,282 species, from 1975 and 2014. Over this period, the volume of reported trade in CITES-listed wildlife quadrupled, from 25 million whole-organism equivalents per year to 100 million, and the ratio of wild- to captive-sourced trade in mammals, birds, reptiles, invertebrates and plants declined by an order of magnitude or more. Our findings start to reveal the scale of the legal wildlife trade, shifting trade routes and sources over time and we describe testable hypotheses for the causes of these changes.

Wang, T. (2018). Evolution: The beat goes on. eLife 2018; 7: e36882 (doi: 10.7554/eLife.36882).

Abstract: Why is the alligator heart so similar to the hearts of birds and mammals?

Hallmann, K. and Griebeler, E.M. (2018). An exploration of differences in the scaling of life history traits with body mass within reptiles and between amniotes. Ecology and Evolution 2018: 1-15.

Abstract: Allometric relationships linking species characteristics to body size or mass (scaling) are important in biology. However, studies on the scaling of life history traits in the reptiles (the nonavian Reptilia) are rather scarce, especially for the clades Crocodilia, Testudines, and Rhynchocephalia (single extant species, the tuatara). Previous studies on the scaling of reptilian life history traits indicated that they differ from those seen in the other amniotes (mammals and birds), but so far most comparative studies used small species samples and also not phylogenetically informed analyses. Here, we analyzed the scaling of 9 life history traits with adult body mass for crocodiles (n= 22), squamates (n= 294), turtles (n= 52), and reptiles (n= 369). We used for the first time a phylogenetically informed approach for crocodiles, turtles, and the whole group of reptiles. We explored differences in scaling relationships between the reptilian clades Crocodilia, Squamata, and Testudines as well as differences between reptiles, mammals, and birds. Finally, we applied our scaling relationships, in order to gain new insights into the degree of the exceptionality of the tuatara's life history within reptiles. We observed for none of the life history traits studied any difference in their scaling with body mass between squamates, crocodiles, and turtles, except for clutch size and egg weight showing small differences between these groups. Compared to birds and mammals, scaling relationships of reptiles were similar for time-related traits, but they differed for reproductive traits. The tuatara's life history is more similar to that of a similar-sized turtle or crocodile than to a squamate.

Liu, C., Pookulangara, S. and Shephard, A. (2018). Will young consumers buy fast fashion with the luxury ingredient of American alligator leather: A study of lifestyle characteristics and motivating factors. Institute for Global Business Research Conference Proceedings 2(1): 129-132.

Abstract: Fashion clothing life cycle is associated with major environmental and social issues. (Ozdamar Ertekin and Atik 2015). Over the last 30 years, awareness of the impact of fashion production and consumption on both human being and the environment has grown significantly (Beard 2008). It has been realized that if fashion consumption keeps increasing at the current rate with accelerating product life cycles, the quality of life of current and future generations will be jeopardized (Cataldi, Dickson and Grover 2010; Clark 2008; Fletcher 2007). Consequently, current fashion system has been questioned along with calls to re-design the unsustainability fashion system and practices. Slow

Fashion concept, which is based on sustainability within the fashion industry and design incorporating high quality, small lines, regional productions, and fair labor conditions (Slow Fashion Award 2010) is slowly gaining momentum.

Liu, C. and Zhang, L. (2018). Can American alligator leather be ingredient branded? An exploratory study. Institute for Global Business Research Conference Proceedings 2(1): 133-136.

Abstract: Ingredient branding (InBranding) is a popular co-branding strategy involving host brands and ingredient brands (InBrands) to develop an ingredient branding offering (IBO). However, most of the successful InBranding cases focus on the functional features. This exploratory study intends to explore the role that non-functional features of an InBrand component can play in creating added symbolic value to the final consumer goods. The American produced wild alligator leather and fashion brand J.Crew were selected as InBrand component and host brand for empirical testing. An online 2x2 experiment survey was designed and implemented. Findings provided information to answer research questions. Implications were provided.

Faulkner, P.C., Burleson, M.L., Simonitis, L., Marshall, C., Hala, D. and Petersen, L.H. (2018). Effects of chronic exposure to 12‰ saltwater on the endocrine physiology of juvenile American alligator (*Alligator mississippiensis*). Journal of Experimental Biology (jeb.181172 doi: 10.1242/jeb.181172).

Abstract: American alligator (*Alligator mississippiensis*, Linnaeus) habitats are prone to saltwater intrusion following major storms, hurricanes or droughts. Anthropogenic impacts affecting hydrology of freshwater systems may exacerbate saltwater intrusion into freshwater habitats. The endocrine system of alligators is susceptible to changes in the environment but it is currently not known how the crocodilian physiological system responds to environmental stressors such as salinity. Juvenile alligators were exposed to 12‰ saltwater for 5 weeks to determine effects of chronic exposure to saline environments. Following 5 weeks, plasma levels of hormones (eg progesterone, testosterone, estradiol, corticosterone, aldosterone, angiotensin II) were quantified using LC-MS/MS. Compared to freshwater kept subjects, saltwater exposed alligators had significantly elevated plasma levels of corticosterone, 11-deoxycortisol, 17α-hydroxyprogesterone, testosterone, 17β-estradiol, estrone and estriol while pregnenolone and angiotensin II (ANG II) were significantly depressed and aldosterone (ALDO) levels were unchanged (slightly depressed). However, saltwater exposure did not affect gene expression of renal mineralo- and glucorticoid (MR, GR) and angiotensin type 1 (AT-1) receptors or morphology of lingual glands. On the other hand, saltwater exposure significantly reduced plasma glucose concentrations whereas parameters diagnostic of perturbed liver function (enzymes AST, ALT) and kidney function (creatinine, creatine kinase) were significantly elevated. Except for plasma potassium levels (K^+), plasma ions Na^+ and Cl^- were significantly elevated in saltwater alligators. Overall, this study demonstrated significant endocrine and physiological effects in juvenile alligators chronically exposed to a saline environment. Results provide novel insights into the effects of a natural environmental stressor (salinity) on renin-angiotensin-aldosterone system and steroidogenesis of alligators.

Gross, M. (2018). Reptiles on the EDGE. Current Biology 28(10): R581-R584.

Summary: Conservation science is struggling to keep up with the dramatic loss of species already described as the sixth mass extinction. In a bid to help prioritise conservation efforts and funding, researchers have developed the EDGE metric, which combines evolutionary distinctiveness (ED) and global endangerment (GE). One limitation is that the ED score depends on phylogenetic trees that may not be available, but a new method of predicting ED has enabled researchers to establish EDGE ranks for reptiles in spite of the gaps in phylogenetic data. Michael Gross reports.

Yamaguchi, S. and Iwasa, Y. (2018). Temperature-dependent sex determination, realized by hormonal dynamics with enzymatic reactions sensitive to ambient temperature. Journal of Theoretical Biology (https://doi.org/10.1016/j.jtbi.2018.05.023).

Abstract: Temperature-dependent sex determination (TSD) is adopted by many animal taxa, including reptiles and fishes. In some species, the eggs develop into females under a low hatching temperature, whereas they will develop into males under a high hatching temperature (called the FM-pattern). In other species, the eggs develop into males (or females) under a low (or high) hatching temperature (MF-pattern). Still, in other species, the eggs develop into females, males, or females, respectively, when under a low, intermediate, or high hatching temperature (FMF-pattern). In this paper, we study a mechanism for realizing TSD. Specifically, we explore a hypothesis that the temperature dependence of enzymatic reaction rates causes a clear switching of sex hormone levels with gradual change of temperature. Herein, we analyze a simple hormonal-dynamics with temperature-sensitive rates of enzymatic reactions included in the sex-determining gene-protein regulatory network. We first examined the cases in which the enzymatic reactions followed Arrhenius equation. The MF-pattern appeared when the rates of aromatase production and/or estradiol production depend more strongly on temperature than do the rates of their decay. By contrast, the FM-pattern appeared when the temperature dependence is stronger for the decay rates of aromatase and/or estradiol than their production rates. However, the FMF-pattern appeared only when some enzymatic reactions follow Berthelot-Hood equation, which exhibits a stronger temperature dependence under higher temperatures than Arrhenius equation. We discuss the possible mechanisms for TSD of FMF-pattern, including alternative splicing and post-translational modification.

Leite, K.J. and Fortier, D.C. (2018). The palate and choanae structure of the cf. *Susisuchus* (Crocodyliformes, Eusuchia): phylogenetic implications. PeerJ Preprints (https://doi.org/10.7287/peerj.preprints.26956v1).

Abstract: Crocodyliformes have undergone few modifications in their morphology since they have emerged. The change in the position of the choana was important during the evolutionary history of this group. Such character is relevant in the phylogenetic position of many crocodyliforms. The Susisuchidae clade has been placed in different phylogenetic positions: as a sister group of Eusuchia, advanced Neosuchia and in Eusuchia. In *Isisfordia* there are reports that the choana of this taxon is or not fully enclosed by pterygoid. A new skull of cf. *Susisuchus* from the Crato Formation of the Santana Group (Lower Cretaceous) is described and we recover Susisuchidae in a new phylogenetic position within Eusuchia. The preservation in the ventral view of FPH243-V allows character encoding not yet observed for the species. The new specimen shows a typical eusuchian palate for Susisuchus, in which the choana is fully enclosed by the pterygoid. The encoding of the ventral characters of *Susisuchus* places Susisuchidae in Eusuchia. However, this position must be further studied, since the matrices showed fragility in the reconstitution of the Neosuchia-Eusuchia transition.

Lewis, R. (2017). Romans, Egyptians, and crocodiles. Shakespeare Quarterly 68(4): 320-350.

Abstract: The exchange between Antony, Lepidus, and Octavius on the nature of the Nile crocodile is one of the most striking passages of Antony and Cleopatra: on Antony's account, this curious reptile is like unto itself alone. In this essay, I look afresh at the sources and analogs on which Shakespeare may have drawn in scripting Antony's crocodile, and use them as a tool with which to reconsider

the apparent collision between the Roman and Egyptian worldviews that shapes so much of the play. The crocodile emerges as a representative of Egypt as a whole, and as a token whose currency is determined by the value assigned to it within the moral and cultural economy of Rome - both before and after Octavius subjects Egypt to Roman dominion. Viewed from here, the play's Egyptian culture is not the mighty opposite of Romanitas, but is the transculturated fantasy of Roman civic and rhetorical doctrine; a fantasy, furthermore, that Cleopatra is willing to exploit in her attempt to assert a measure of political sovereignty. Antony's crocodile helps us to see that rather than an existential struggle between East and West, Actium - like Philippi before it - marks the point at which one Rome triumphs over another.

While, G.M., Noble, D.W.A., Uller, T., Warner, D.A., Riley, J.L., Du, W.-G. and Schwanz, L.E. (2018). Patterns of developmental plasticity in response to incubation temperature in reptiles. JEZ-A Ecological and Integrative Physiology (https://doi.org/10.1002/jez.2181).

Abstract: Early life environments shape phenotypic development in important ways that can lead to long-lasting effects on phenotype and fitness. In reptiles, one aspect of the early environment that impacts development is temperature (termed 'thermal developmental plasticity'). Indeed, the thermal environment during incubation is known to influence morphological, physiological, and behavioral traits, some of which have important consequences for many ecological and evolutionary processes. Despite this, few studies have attempted to synthesize and collate data from this expansive and important body of research. Here, we systematically review research into thermal developmental plasticity across reptiles, structured around the key papers and findings that have shaped the field over the past 50 years. From these papers, we introduce a large database (the 'Reptile Development Database') consisting of 9773 trait means across 300 studies examining thermal developmental plasticity. This dataset encompasses data on a range of phenotypes, including morphological, physiological, behavioral, and performance traits along with growth rate, incubation duration, sex ratio, and survival (eg hatching success) across all major reptile clades. Finally, from our literature synthesis and data exploration, we identify key research themes associated with thermal developmental plasticity, important gaps in empirical research, and demonstrate how future progress can be made through targeted empirical, meta-analytic, and comparative work.

Brackhane, S., Webb, G., Xavier, F.M.E., Gusmao, M. and Pechacek, P. (2018). When conservation becomes dangerous: Human-Crocodile Conflict in Timor-Leste. The Journal of Wildlife Management (doi: 10.1002/jwmg.21497).

Abstract: In northern Australia and nearby Timor-Leste, saltwater crocodile (*Crocodylus porosus*) populations were seriously depleted historically but recovered rapidly after protection: 1969-1974 in northern Australia, and 2000-2005 in Timor-Leste. In both places, recovery caused increased rates of human-crocodile conflict (HCC). Within northern Australia, the crocodile recovery and HCC have been documented over time. In contrast, this has not been the situation in Timor-Leste, where we investigated HCC based on 130 attack records (1996-2014; 52% fatal). In 1996-2006, 0.55 attacks/year were reported in Timor-Leste. By 2007-2014, 9 years later, a 23-fold increase had occurred (13 attacks/year). Traditional subsistence fishing (82.5% of all attack records) is the highest risk activity, followed by bathing (7.5%) and water collecting (4.2%). Although the human population was correlated with crocodile attacks in Timor-Leste, it likely does not explain the dramatic increase in crocodile attacks. Alternatively, crocodile numbers may have increased, either in the remnant resident crocodile population, or via migrants from elsewhere. Permanent crocodile habitat is limited, and limited breeding does not explain the high number of large crocodiles, and consequent increase in attacks in such a short time. A plausible explanation, consistent with traditional knowledge in Timor-Leste, is that the influx of large crocodiles attacking people are migrants from Australia. We examined this possibility from available sources. Within Australia crocodiles have recovered since protection and they regularly invade adjacent habitats, such as Darwin harbor, where they are removed to prevent attacks on people. Saltwater crocodiles have been sighted at oil rigs, in the open ocean, moving between northern Australia and the south coast of Timor-Leste. The likelihood of crocodiles migrating from Australia to Timor-Leste raises obvious conservation, moral, and ethical dilemmas when conserving a large dangerous predator in one country to increase abundance results in dispersal to another country, where the predator attacks and kills people.

Wich, S.A. and Koh, L.P. (2018). Conservation Drones: Mapping and Monitoring Biodiversity. Oxford University Press: Oxford, UK.

Rudolf, C.A., Jaimes, A., Espinosa-Blanco, A.S., Contreras, M. and García-Amado, M.A. (2018). Oral and cloacal *Helicobacter* detection in wild and captive Orinoco crocodiles (*Crocodylus intermedius*) in Venezuela. Vector-Borne and Zoonotic Diseases (http://doi.org/10.1089/vbz.2017.2210).

Abstract: *Helicobacter* species can colonize digestive tract of animals and humans and have been associated with gastrointestinal diseases; however, this genus has not been studied in crocodiles. Our objective was to detect by PCR *Helicobacter* genus and *Helicobacter pylori* in oral and cloacal swabs from Orinoco crocodiles of two wild (Cojedes River System and Capanaparo River) and two captive breeding centers (CBCs; Masaguaral Ranch and UNELLEZ) populations. Bacterial DNA was found in 100% of oral samples (10 wild and 10 captives), and in the 95% of cloacal samples (10 wild and 9 captives). In wild populations, *Helicobacter* spp. was not detected, whereas in CBCs, *Helicobacter* was detected in 10% of the oral samples, and 66.7% of cloacal samples. *H. pylori* was detected in two Orinoco crocodiles. Two cloacal non-pylori *Helicobacter* amplicons were sequenced, showing low similarity (≤97%) to *Helicobacter* sequences reported. This is the first report of *Helicobacter* species, including *H. pylori* in *Crocodylus intermedius* from CBCs.

Zhang, R., Zhang, Y., Wu, M., Yan, P., Izaz, A., Wang, R., Zhu, H., Zhou, Y. and Wu, X. (2018). Molecular cloning of androgen receptor and gene expression of sex steroid hormone receptors in the brain of newborn Chinese alligator (*Alligator sinensis*). Gene 674: 178-187.

Abstract: Sex steroid hormones play an important role in mediating physiological responses and developmental processes through their receptors across all vertebrates. Chinese alligator (*Alligator sinensis*) is a critically endangered reptile species unique to China. In this study, we have cloned one of the sex steroid hormone receptor genes, androgen receptor (AR) from the brain of *A. sinensis* for the first time. The full-length AR cDNA is 2717 bp in length with an open reading frame (ORF) encoding 722 amino acids. Amino acid alignment analyses indicated that the ARs exhibit highly conserved functional domains. Especially, the P-box and D-box, which are essential to ensure that receptor binding to the androgen response elements, are completely conserved in selected species. Using the quantitative real-time PCR (qPCR), the spatial expression of four receptor mRNAs in all newborn brain tissues and temporal expression of them in the cerebrum during the embryonic development in *A. sinensis* were investigated. The results of qPCR showed ubiquitous expression of the four receptor mRNAs in all newborn brain tissues examined and significant changes in the expression levels of these receptor mRNAs in the embryonic development. These results suggest that sex steroid hormones might play an important role in the regulation of complex neuroendocrine activities in newborn Chinese alligator. Furthermore, these data provide an important foundation for further studies on endocrinology and molecular biology of non-mammalian sex steroid hormone receptors.

Steering Committee of the Crocodile Specialist Group

Chair: Professor Grahame Webb, P.O. Box 530, Karama, NT 0813, Australia
For further information on the CSG and its programs on crocodile conservation, biology, management, farming, ranching, or trade, contact the Executive Office (csg@wmi.com.au) or Regional Chairs

Deputy Chairs: Alejandro Larriera (alelarriera@hotmail.com); Dr. Perran Ross (pross@ufl.edu); Charlie Manolis (cmanolis@wmi.com.au); Christine Lippai (lippainomad@gmail.com).

Executive Officer: Tom Dacey, P.O. Box 530, Karama, NT 0813, Australia (Tel.: +63.9393356750; csg@wmi.com.au).

Regional Chair, East and Southern Africa: Christine Lippai (lippainomad@gmail.com). **Regional Vice Chairs**: Dr. Alison Leslie (aleslie@sun.ac.za); Howard Kelly (crocfarm@venturenet.co.za); Dr. Xander Combrink (CombrinkAS@tut.ac.za).

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Regional Chair, East and Southeast Asia: Lonnie McCaskill (lonnie.mccaskillcroc@gmail.com). **Regional Vice Chairs**: Prof. Wu Xiaobing (wuxb@ahnu.edu.cn); Dr. Choo Hoo Giam (giamc@singnet.com.sg); Dr. Nao Thuok (naothuok.fia@maff.gov.kh); Kornvika Youngprapakorn (panyafarm@gmail.com); Yosapong Temsiripong (yosapong@srirachamoda.com); Ranier Manalo (rimanaloecology@yahoo.com); Dr. Luke Evans (lukeevans603@yahoo.co.uk); Oswald Braken Tisen (oswaldtisen@sarawakforestry.com); Adrian Sugiarto (suryaraycroc@gmail.com); Dr. Steve Platt (sgplatt@gmail.com).

Regional Chair, Australia and Oceania: Charlie Manolis (cmanolis@wmi.com.au). **Regional Vice Chairs**: Eric Langelet (elangelet@mainland.com.pg); Dr. Matthew Brien (crocmatt@hotmail.com).

Regional Chair, South Asia and Iran: Anslem de Silva (kalds@sltnet.lk). **Regional Vice Chairs**: Madhava Botejue (madhavabotejue@gmail.com); Maheshwar Dhakal (maheshwar.dhakal@gmail.com); Raju Vyas (razoovyas@gmail.com); Abdul Aleem Choudhury (aleemc1@gmail.com); Asghar Mobaraki (amobaraki@yahoo.com); Dr. S.M.A. Rashid (carinam.bangladesh@gmail.com).

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Regional Chair, Europe: Thomas Ziegler (ziegler@koelnerzoo.de); **Regional Vice Chair**: Fabian Schmidt (fschmidt@zoo-leipzig.de).

Regional Chairs, North America: Dr. Ruth Elsey (relsey@wlf.la.gov); Allan Woodward (allan.woodward@myfwc.com). **Regional Vice Chairs**: Noel Kinler (noelkinler@gmail.com); Dr. Frank Mazzotti (fjma@ufl.edu); Dr. Thomas Rainwater (trrainwater@gmail.com).

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Vice Chair, Trade Monitoring: John Caldwell (john.caldwellxx@mail.com).

Vice Chairs, Veterinary Science: Dr. Paolo Martelli (paolo.martelli@oceanpark.com.hk); Dr. Cathy Shilton (Cathy.Shilton@nt.gov.au).

Vice Chair, Zoos: Dr. Kent Vliet (kvliet@ufl.edu).

Vice Chair, Taxonomy: Dr. Kent Vliet (kvliet@ufl.edu). **Deputy Vice Chair**: Dr. Chris Brochu.

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Vice Chairs, General Research: Dr. Valentine Lance (valcrocdoc@gmail.com); Dr. Mark Merchant (mmerchant@mcneese.edu); Dr. Carlos Piña (cidcarlos@infoaire.com.ar).

Vice Chair, Legal Affairs: Curt Harbsmeier (charbsmeier@hdalaw.com).

CSG IUCN Red List Authority: Dr. Perran Ross (pross@ufl.edu); Dr. Sally Isberg (sally@crocresearch.com.au).

Honorary Steering Committee Members: Ted Joanen (USA), Romulus Whitaker (India), Phil Wilkinson (USA), Prof. F. Wayne King (USA), Dietrich Jelden (Germany).

Task Force/Working Group Chairs: Future Leaders Program Dr. Sergio Balaguera-Reina (sergio.balaguera-reina@ttu.edu); Tomistoma Task Force, Bruce Shwedick (Bshwedick@aol.com).