CROCODILE SPECIALIST GROUP NEWSLETTER

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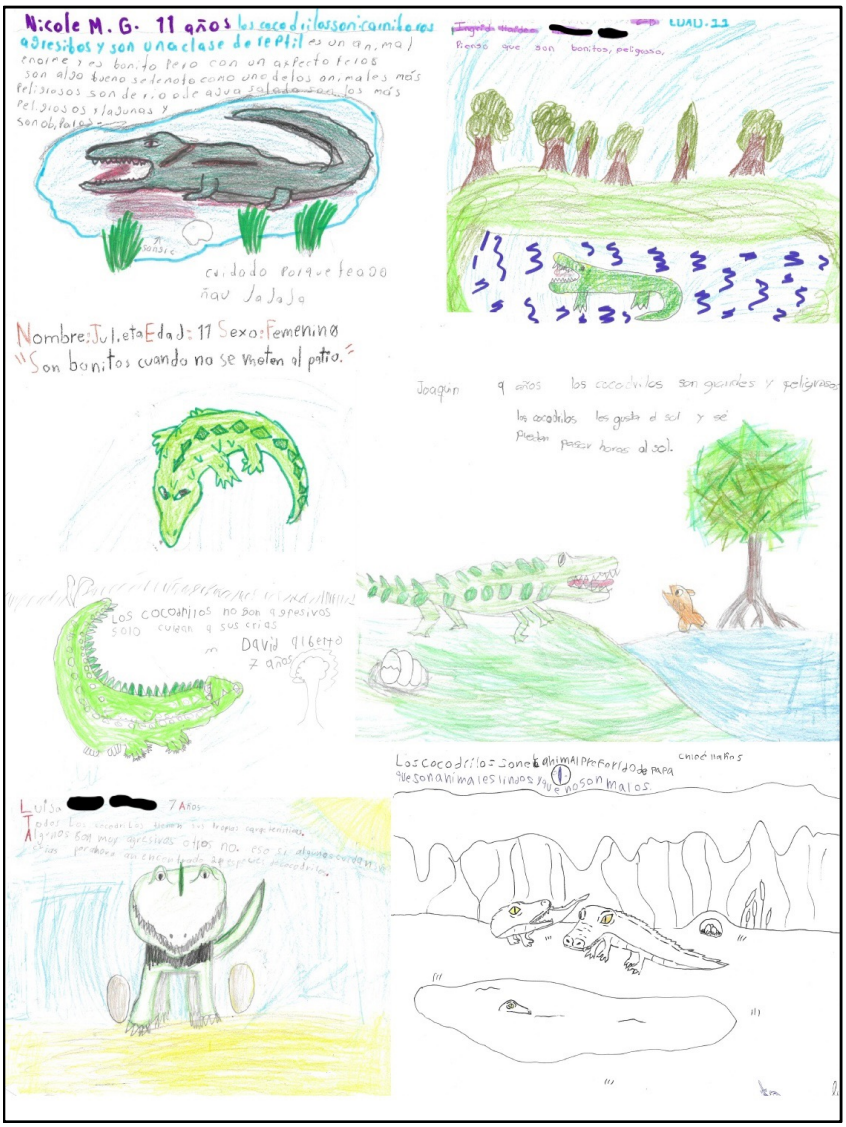

IUCN • Species Survival Commission

CROCODILE

SPECIALIST

GROUP

NEWSLETTER

VOLUME 43 Number 1
JANUARY 2024 - MARCH 2024

IUCN Species Survival Commission

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Cover: Selection of drawings obtained during different crocodile outreach events with children in the state of Tabasco, Mexico, in 2023 (see pages 13-15). The drawings are accompanied by phrases/words from the children about what crocodiles represent to them.

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.

CSG Newsletter

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. It is available as a free electronic, downloadable copy from http://www.iucncsg.org/pages/Publications.html

All CSG communications should be addressed to:
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We thank all patrons who have donated to the CSG and its conservation program over many years, and especially to donors in 2023-2024.

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Cathy Shilton, Darwin, Australia.

Editorial

All members of the IUCN SSC, and thus CSG members, are bound by the "SSC Code of Conduct of the Members of IUCN Commissions". Although the CSG drafted a Code of Conduct that pre-empted the SSC Code, the former was considered redundant once the SSC Code had been finalised. Regardless, since the inception of the CSG in 1971, the underlying premise upon which CSG members are expected to operate is, and always has been, "respect, understanding and tolerance", regardless of an individual's characteristics.

Although the CSG operates under the SSC Code of Conduct, it also adheres to the IUCN's "Policy on the Protection from Sexual Exploitation, Sexual Abuse, and Sexual Harassment" and related "Anti-harassment Policy, including bullying and sexual harassment, for IUCN Events". A claim of harassment at a CSG Working Meeting (in 2018) stimulated the IUCN to formulate guidelines for handling claims of harassment, should they arise, and also resulted in a "closed" investigation on the case by the IUCN in 2022-2023. Prior to the completion of this investigation, concerns were raised by two members of the CSG Steering Committee that additional measures may be required to deal with allegations of bullying, harassment or discrimination at CSG-endorsed events, and ensure that events continue to provide a professional, respectful and harassment-free environment.

Accordingly, the CSG Executive Committee developed its own Policy and Procedures (see below) to address incidents of harassment, bullying or discrimination, should they occur, at CSG-endorsed events (eg working meetings, regional meetings, species meetings, virtual meetings) and other forms of communication. Draft versions of the Policy and Procedures were circulated to CSG Steering Committee members in February 2024, seeking their review and comments, and the documents were finalised by late March 2024. The "Bullying, Harassment, and Discrimination Prevention Policy for CSG-Endorsed Events" and "Bullying, Harassment, and Discrimination Resolution Procedures for CSG-Endorsed Events" are now available on the CSG website. Both are considered to be "living" documents, and comments from CSG members are welcome.

At CoP14 of the Convention on Migratory Species (Bonn Convention) on 12-17 February 2024, the Parties adopted the "Action Plan to Address Aquatic Wild Meat Harvests in West Africa" *with the goal of making tangible progress towards the sustainable management of aquatic wild meat harvesting across West Africa and securing the conservation status of all impacted CMS-listed species* (UNEP/CMS/COP14/Doc.30.1.2/Rev.3). The Parties also directed the CMS's Scientific Council, through its Aquatic Wild Meat Working Group, to collaborate with the relevant IUCN Specialist Groups to present a case to the Scientific Council for the assessment of the migratory nature of crocodylians (*Gavialis*, *Crocodylus*, *Mecistops*, *Caiman*, *Melanosuchus*) and freshwater chelonians, and the relevance of CMS to their conservation and management, including whether or not they may fit the criteria for inclusion in the CMS Appendices. For the purpose of this Convention, "Migratory species" means *the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries*. Two crocodilian species are currently listed on CMS - *Crocodylus porosus* (CMS App. II) and *Gavialis gangeticus* (CMS App. I). We await communication with CMS on this issue before advancing it.

The CITES Workshop on Non-Detriment Findings (NDFs) took place in Nairobi, Kenya, on 4-8 December 2023. A number of CSG members had participated in various working groups leading up to the workshop, at which draft guidances on NDF were finalised (see https://cites.org/eng/news/calendar.php). Under Articles III and IV of the CITES Convention, export permits for Appendix-I and Appendix-II specimens should be granted only when a Scientific Authority of the State of export has advised that such export will not be detrimental to the survival of the species (a determination known as a "non-detriment finding"). Of particular relevance to crocodilians were the following modules resulting from the workshop:

- Module 1: Principles and Concepts of Non-Detriment Findings. Provides an understanding of the principles of making NDFs. Looks specifically at what NDF is, and how the issue of assessing a species' role in its ecosystem can be understood and addressed. It examines risk, uncertainty, and the use of conditions or precautionary measures on which a positive NDF might be dependent. Also considers the making of NDFs in circumstances of low risk, low data, or low capacity, and considers how all these issues might be addressed through adaptive management.
- Module 9: NDFs for Reptiles. Provides additional guidance to Parties on some of the key considerations when undertaking NDFs for reptiles. Where possible, the preparation of NDFs should be relatively simple, not onerous. Offers guidance for simple NDFs and includes a template-based framework for simple NDFs.
- Module 2: Practical Considerations for Making NDFs. Offers information on the "How to" of NDF making.
- Module 3: Incorporation of Local and Traditional Knowledge. Provides information on role and utility of local and traditional knowledge in the making of NDFs.

The 17 Sustainable Development Goals (SDGs) were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity. The CSG and its members play a significant role in contributing to the achievement of the SDGs. A summary document outlining the relationship between the SDGs and crocodilian conservation is now available on the CSG website (http://www.iucncsg.org/content_images/attachments/UN%20SDGs.pdf). We are very

27th CSG Working Meeting

Theme: Crocodile Conservation: What Works!

The Centre for Crocodile Research (www.crocresearch.com.au) is proud to host the 27th CSG Working Meeting in Darwin, Northern Territory, Australia, in April 2024.
Registrations are still open and we cordially invite all people interested in crocodilians to attend this biennial event. The full program is now available on the website (www.csg2024.com):

Day/Date	Program	Social Event
Sun, 14 April	Drone workshop, Veterinary workshop	
Mon, 15 April	Steering Committee meeting (and/or Morning Field Trip)	Welcome drinks
Tue, 16 April	Official welcome/working meeting	
Wed, 17 April	Working meeting (and/or Morning Field Trip)	Gala dinner and auction
Thu, 18 April	Working meeting (and/or Morning Field Trip)	Cocktail poster session
Fri, 19 April	Working meeting	Banquet night
Sat, 20 April	Post-meeting Field Trip (Adelaide and Mary Rivers)	

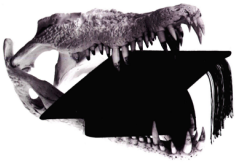
Workshops: There are a few places left for the Drone and Veterinary Workshops on 14 April at Crocodylus Park.
- Drone Workshop will include demonstrations and discussion of current uses and advancements in drone technology and its application to crocodilian management and conservation. Lead co-ordinator: Dr. Matt Brien.
- Veterinary Workshop will include presentations on topics such as surgical procedures, skin histology/quality, as well as a practical session on necropsy. Lead co-ordinator: Dr. Cathy Shilton.

Abstracts: Call for Abstracts for oral presentations is now closed, as we have a full program. Abstracts for poster presentations are still being accepted. See www.csg2024.com for author instructions and online portal for abstract submission.

Morning Field Trips: Come along on this rare opportunity to accompany the Northern Territory Crocodile Management Team as they conduct their routine patrols of Darwin Harbour as part of the program to keep the public safe. Spaces are still available for Wednesday or Thursday mornings. You will be back at the conference venue by midday to participate in the working meeting schedule.

Field Trip: The post-meeting field trip on 20 April promises to be awesome, but is limited to 98 participants - be quick to register your spot! Participants will partake in cruises on two of the most densely Saltwater crocodile populated rivers in the Top End of Australia - the Adelaide River (Jumping Crocodile Cruise) and Corroboree Billabong (Mary River).

Meeting Website: Details on accommodation, venue, registration, etc., are available at: www.csg2024.com or follow us on Facebook (Crocodile Specialist Group Working Meeting 2024)!



See you in Darwin in April 2024!

Dr. Sally Isberg, Chair of Organising Committee
(sally@crocresearch.com.au)

grateful to Christine Lippai who drafted the summary report.

The 3rd Forum on Crocodiles in the Philippines was held in Manila, on 8-10 November 2023, with the theme "Engaging Communities and Partners Participation Towards Sustainable Conservation". The organisers paid special tribute to the late Dr. Angel C. Alcala, National Scientist and ASEAN Biodiversity Hero, who pioneered the conservation of crocodiles in the Philippines. Details on the Forum are on page 13.

The 10th World Congress on Herpetology (WCH10) will take place on 5-9 August 2024, in Kuching, Sarawak, Malaysia (https://www.worldcongressofherpetology.org). The mission of the WCH is "to promote herpetological research, education and conservation, by facilitating communication between individuals, societies and other organisations engaged in the study of amphibians and reptiles".

The 27th CSG Working Meeting will take place in two weeks (15-20 April 2024), and we again urge people considering attendance at this important event to register as soon as possible. Working Meetings are an opportunity to showcase the diversity of work being undertaken around the world on crocodilians. See page 4 for more details on the Working Meeting and associated events (drone and veterinary workshops, Steering Committee meeting, field trip, etc.).

Alejandro Larriera and Charlie Manolis, *CSG Co-Chairs*.

CSG Student Research Assistance Scheme

The Student Research Assistance Scheme (SRAS) and Fritz Huchzermeyer Veterinary Science Student Research Assistance Scheme (FHVS-SRAS) provided funding to five students in the January-March 2024 quarter (see below), and one application is under review.

1. Diana Caro Martinez (Mexico): Characterization of microplastics in the American crocodile *Crocodylus acutus* as an indicator of pollution in the Mexican Caribbean.

2. Gerardo Gabriel Vega (Argentina): Effect of fire on *Caiman yacare* populations in Ibera National Park.

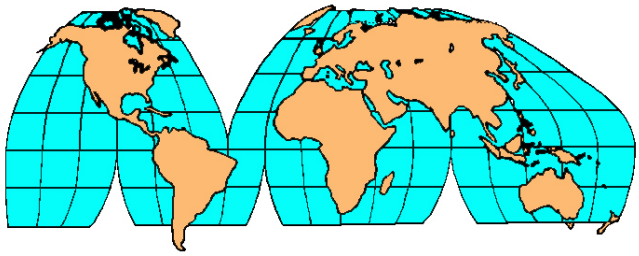
3. Marie Luiza da Silva (Brazil): Distribution of the Broad-snouted caiman (*Caiman latirostris*) within an urban Atlantic Forest habitat in northeastern Brazil.

4. Yairen Alonso (Cuba): Reproductive success of *Crocodylus acutus* in Monte Cabaniguan Fauna Refuge, Cuba.

5. Tathagata Bhowmik (India): Developing photogrammetry model as a tool to monitor body conditions in freshwater Mugger crocodiles.

Dr. Sally Isberg, *CSG Executive Officer (csg@wmi.com.au)*.

Regional Reports



North America

USA

SAFE: A NEW DIRECTION FOR SUPPORTING CUBAN CROCODILE CONSERVATION. The Association of Zoos and Aquariums (AZA) has long promoted conservation through cooperative breeding and the sustainability of populations through its membership. In recent years, the AZA introduced a new initiative, "Saving Animals From Extinction" (SAFE; https://www.aza.org/aza-safe), aimed at utilizing the expertise of AZA-accredited zoos and aquariums in leveraging their massive potential for outreach to save species where it matters most, in the wild. The Cuban crocodile (*Crocodylus rhombifer*) is now an AZA SAFE Program, in order to strengthen *in-situ* and *ex-situ* efforts for conserving this species. The plan involves multiple partners from AZA institutions and Zapata Crocodile Farm. Several CSG members serve in their private capacities on the programs steering committee or as advisors.

AZA has been managing Cuban crocodile populations in North America since 1993 through a Studbook and a Species Survival Plan (SSP). The first recorded Cuban crocodiles appeared in North American zoos in 1900 and breeding began in the mid-1970s. Cuban crocodiles were exported to the USA prior to the widespread hybridization of the species with American crocodiles (*Crocodylus acutus*). Recently, the Conservation Genomics Laboratory at the American Museum of Natural History, which has amassed the world's most comprehensive DNA database on both American and Cuban crocodiles, evaluated 45 individuals from the AZA North American population. This genetic analysis revealed that not only were all 45 samples genetically identified as Cuban crocodiles, but six of these samples possessed alleles previously unknown to the Cuban crocodile genome. These results indicate that the AZA SSP population has preserved original genetic variation that was once found in wild Cuban crocodile populations but has since been extirpated. The AZA program is now focusing efforts on propagating these rare alleles to ensure the highest genetic diversity is represented in the AZA population (McMahan *et al*. 2022a).

Conservation-breeding has been identified a priority action for the conservation of this species (McMahan *et al*. 2022b). In addition to preserving the genetic integrity of potentially extirpated populations of Cuban crocodiles, the AZA population has also served as a mechanism to increase our knowledge about this unique crocodilian. Publications on

behaviour (Augustine and Watkins 2015; Murphy *et al*. 2016; Augustine *et al*. 2015a, 2015b, 2017, 2020), reproduction (Augustine and Watkins 2015; Augustine 2016, 2017a, 2017b; Augustine *et al*. 2018a) and other aspects of biology (Augustine *et al*. 2018a, 2021), have contributed to how we manage and conserve this critically endangered species.

Lastly, AZA institutions have a long history of supporting Cuban biologists in their efforts to preserve this unique species in Cuba. Between 2017 and 2021, AZA institutions contributed an estimated $116,000 towards Cuban crocodile conservation and research. Most notably, the Wildlife Conservation Society and the Saint Louis Zoo WildCare Institute and Institute for Conservation Medicine have been providing dedicated resources to these efforts. Recent collaborations have focused on supporting the operations at the Zapata Crocodile Farm and studying the health of the conservation breeding population (Alvarez *et al*. 2021; Palmer *et al*. 2023).

The mission of an AZA SAFE Species program is to bring member institutions together with field-based partners to enhance the probability of conservation success for threatened species or a group of related taxa in the wild (AZA 2019). The goal of the Cuban crocodile SAFE program is to support *in-situ* and *ex-situ* efforts to preserve this species, both in the wild and in AZA facilities, through supporting conservation-breeding, research, fieldwork, and education outreach initiatives in Cuba and abroad. The Steering committee of this Program includes staff from the following AZA institutions; Cameron Park Zoo, Louisville Zoo, Philadelphia Zoo, St. Augustine Alligator Farm and Zoological Park, Saint Louis Zoo, Smithsonian National Zoological Park, Wildlife Conservation Society Bronx Zoo and Zoo Knoxville. Together, these institutions developed a 3-year plan that aligns with the goals and objectives of the primary *in-situ* partner, Zapata Crocodile Farm and the recommendations from the IUCN (McMahan *et al*. 2022b).

While many challenges still exist, the members of this plan are committed to supporting this plan. With a rich history, devoted Cuban conservationists, and AZA support, the future of Cuban crocodile conservation is optimistic.

1. Conservation Objectives (Recovery Actions 1 and 3)

    1.1. To support the operational needs of the Zapata Crocodile Farm that serves as the in-country base for conservation breeding and reintroduction:
        1. a conservation breeding facility for the species;
        2. a facility for research on the species biology, behavior, and health;
        3. a platform for community outreach programming that aims to create local stewards of natural and re-established crocodile populations;
        4. an opportunity to establish eco-tourism in the region that garners support for local communities and wildlife; and,
        5. a base for Cuban biologists studying the Cuban crocodile both in the field and in human care.

    1.2 To support research and management of wild Cuban crocodile populations through the current reintroduction strategy that aims to repatriate farm-bred crocodiles into locations where populations:
        1. no longer exist, or require supplementation for continued existence; and,
        2. will not be in high threat of hybridization with *C. acutus*.

    Furthermore, identifying additional ideal locations for reintroduction given the high rates of hybridization and climate change impacting the swamps, is a priority.

2. Stakeholder Engagement Objectives (Recovery Actions 2)

    2.1. Increase the number of Cuban stakeholders by two, for a total of four by 2025 in order to increase resources and expertise in:
        1. research;
        2. community involvement; and,
        3. protection.

    2.2. Develop community educational platforms for engaging people in crocodile conservation by providing:
        1. community programs that empower local people to respect and protect crocodiles from poachers, conserve habitat, and reduce human-wildlife conflict;
        2. explore alternate livelihood programs to reduce the demand on wild crocodiles; and,
        3. engage local communities in crocodile conservation efforts to garner further support.

3. Communication/Public Awareness Objective (Recovery Action 2)

    3.1. Increase the number of AZA member institutions participating in the Cuban Crocodile SAFE Program by four to a total of 15 by January 2026.

    3.2. Double the number of AZA member institutions that incorporate Cuban crocodile conservation messaging on social media, websites and on-grounds by 2026. Currently 5 out of 10 institutions have this species represented on their websites.

4. Funding Objective (Recovery Actions 1, 2 and 3)

    4.1. Increase AZA institution and donor funding of Cuban crocodile conservation through a comprehensive fundraising strategy.

    4.2. Seek support and collaboration from EAZA as a potential future partner.

5. Population Management Objectives (Recovery Action 3)

5.1. Continue managing the AZA's North American population of *C. rhombifer* with the goals of maintaining a genetically diverse and sustainable population.

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Lauren Augustine, *AZA SAFE Program Leader: Cuban Crocodile, Philadelphia Zoo, USA*.

South Asia and Iran

India

ANNUAL CENSUS OF ESTUARINE CROCODILES (*CROCODYLUS POROSUS*) IN THE RIVER SYSTEMS IN AND OUTSIDE BHITARKANIKA NATIONAL PARK OF ODISHA, INDIA (2024). On 10-14 January 2024, the annual census of Estuarine crocodiles (*Crocodylus porosus*) was conducted in the river systems of Bhitarkanika National Park/ Sanctuary and associated rivers and creeks of Gahirmatha Wildlife Sanctuary and Mahanadi delta region (Fig. 1). A total of 23 teams in 56 segments were engaged to carry out the count in the identified rivers and creeks.

The census was conducted during the day and night. Adult and sub-adult crocodiles (>1.8 m) were counted during the day, and hatchlings (<0.6 m), yearlings (0.6-0.9 m) and juveniles (0.9<1.8 m) were mainly counted at night, using spotlights (Kar 2022, 2023a; Singh and Kar 2021). There were favourable climatic conditions such as severe cold and sunny weather, low day and night air/water temperatures and low tide conditions, during the surveys.

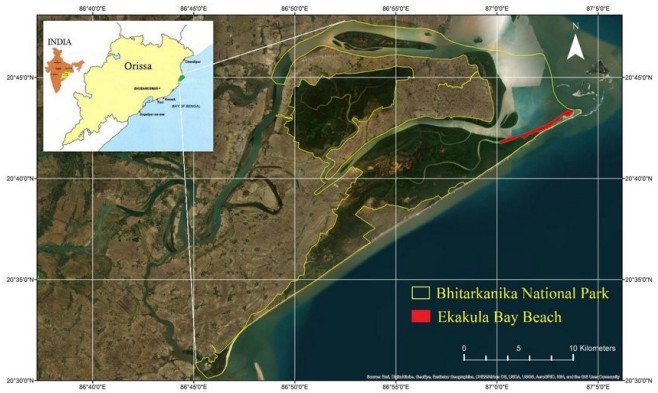

Figure 1. Location of Bhitarkanika National Park/Sanctuary.

A total of 1811 crocodiles were counted: hatchlings 582 (32.1%); yearlings 387 (21.4%); juveniles 327 (18.0%); sub-adults 167 (9.2%); and, adults 348 (19.2%). Most (1422; 78.5%) crocodiles were spotted in Kanika Wildlife Range which included forest blocks and rivers starting from Khola to Bhitarkanika-Pathasala confluence and beyond in Brahmani-Baitarani River systems, followed by Rajnagar Wildlife Range (272; 15.0%). Within Mahanadi delta, 83 crocodiles (4.6%) were counted in Mahakalapada Wildlife Range and 34 (1.9%) in Gahirmatha Wildlife Range (Figs. 2-5).


Figure 2. Adult female (3.0 m TL) and juvenile (1.2 m TL) Estuarine crocodiles. Photograph: Sudhakar Kar


Figure 3. Adult male Estuarine crocodile (4.9 m TL) on increasing tide. Photograph: Sudhakar Kar.


Figure 4. Adult partially-white female Estuarine crocodile (3.3 m TL). Photograph: Nimai-Bhakta.


Figure 5. Adult partially-white male Estuarine crocodile (4.4 m TL) basking on Bhitarkanika River bank. Photograph: Nimai-Bhakta.

The survey count in 2024 (1811 crocodiles) was slightly higher (18; 1%) than that in January 2023 (1793 crocodiles; Kar 2023a). Seventeen partially white crocodiles (locally known as 'Sankhua'; Kar 2023b) were sighted, compared to 16 in 2023 (Fig. 5).

The Estuarine Crocodile Conservation and Research Programme was implemented by the Odisha Forest Department in Bhitarkanika Wildlife Sanctuary/National Park in mid-1975. During 1976, for the first time, winter census was conducted in the Bhitarkanika river systems. The total count was 96 crocodiles, comprising 29 adults (17 males, 12 females), 6 sub-adults and 61 juveniles (Kar 1980; Kar 1981; Kar and Bustard 1989).

Acknowledgements

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CHRONICLES OF MUGGER TRANSLOCATION AT 'STATUE OF UNITY' TOURIST COMPLEX: THE BLUNDER FROM A WONDERLAND. The Narmada Dam has long been in the national news, but recent attention has been on a different issue. The Narmada Dam project (at Kevadia, Narmada, Gujarat) has been intensely debated due to its massive manmade water bodies. As a result of dam construction, large areas of agricultural, scrub and forest lands have been submerged, uprooting thousands of families from their traditional lands and depriving them of their livelihoods, as well as having a negative impact on wildlife (Kaur 2018). The final status of the environment after the completion of this mega-project is unknown, but clues are emerging to enable us to make predictions about human-crocodile conflict (HCC). Muggers (*Crocodylus palustris*) occur naturally in many parts of the Narmada River, and they have naturally settled in the manmade system of dykes and lakes for over a decade.

There have been local newspaper and media broadcast reports about poor tribal people losing their lives to 'man-eating' Muggers in the Narmada Reservoir, especially in the vicinity of Dyke 3 (Fig. 1). The Mugger translocation issue initially started after two fatal crocodile attacks on a mother and her son were recorded in Dyke 3 on 7 and 15 November 2004, respectively. Later, two more attacks were recorded in the Narmada River, and it is estimated that over a dozen other attacks may have gone unreported - local people killed some of the crocodiles involved in the attacks. However, such incidents are restricted to very remote areas inhabited by tribal communities on the borders of Gujarat State and its neighbours. Narmada Dam has created a platform for various media, tribal welfare groups, activists and politicians to pressure authorities such as the State Forest Department (SFD) to eliminate all Muggers from the water body and rehabilitate them away from the human settlements (Basu 2006).

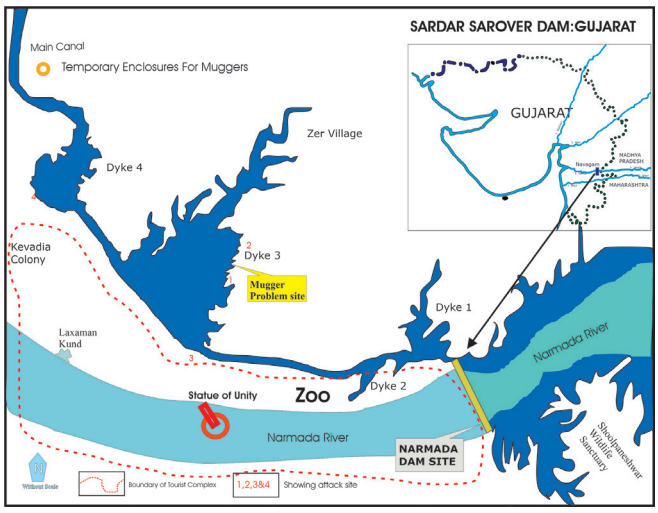

Figure 1. Narmada Dam area showing location of Mugger capture sites and Statue of Unity (SoU) Tourist Complex.

On 6 November 2006, we had visited Laxman Kund, a backwater pool of the river, considered good habitat for over a dozen Muggers. Local people believed that Muggers were holy animals that never attacked devotees, because they were the vehicle of 'Maa Namamidevi Narmada'. This natural population of Muggers is hardly a few kilometres from the dyke lakes (Basu 2006). We were also aware that SFD had sporadically rehabilitated Muggers rescued from urban areas into the lake system (Vyas 1994). We estimate that some two dozen Muggers may have been rehabilitated into the dyke lakes over a few years (Vyas and Basu 2008).

Local forest officers estimated over 200 Muggers in Dyke 3, with some 3-4 m long, without any scientific study. The SFD 2006 survey estimated over four dozen individuals inhabiting the dyke systems, and there could be no more than 75 individual animals (Vyas and Basu 2008). In December 2018, the dam authority, Sardar Sarovar Narmada Nigam Ltd and SFD speculated that there were 500 Muggers in the area, but without any surveys being undertaken. However, the issue of removing Muggers from the water body was diluted after SFD's rapid survey and systematic re-assessment of the Mugger population, and the water body being proposed for wildlife tourism in the report of Basu (2006).

Proposed development at the dam site and surrounding area included the world's tallest statue, known as Statue of Unity (SoU) in memory of Sardar Vallabhai Patel ("Ironman of India"), and other tourism facilities (eg floating hotel, seaplane). The dam authority took advantage of this ambitious mega-tourist project and declared that Muggers should be eliminated from the area in the interest of safety for tourists.

On 5 July 2021, it was reported that 194 Muggers had been translocated from SoU, Panchmuli Lake (Dyke 3), Sardar Sarovar Dam (Narmada Dam) area (Figs. 1 and 2). The news was released by the range officer of the forest, Kevadia, Vadodara Wildlife Division, Gujarat SFD. Specifically, in October-March 2019-20, 143 Muggers were reported to be relocated, of which 73 were released in the backwaters of

‘Safety of tourists’: 194 crocodiles relocated from lake near SoU

PRESS TRUST OF INDIA
AHMEDABAD, JULY 4

AS MANY as 194 crocodiles have been relocated from a lake near the Statue of Unity in Narmada district in the past two years for the safety of tourists who come to enjoy boat rides there, officials said on Sunday.

The Panchmuli lake, situated near the 182-metre tall statue of Sardar Vallabhbhai Patel in Kevadia, a major tourist attraction, had a large number of crocodiles that posed a threat to visitors, they said. “In 2019-20 (October-March), we relocated 143 crocodiles. In 2020-21, another 51 crocodiles were shifted to two rescue centres in Gandhinagar and Godhra,” Kevadia Range Forest Officer Vikramsinh Gabhania, told PTI.

The authorities decided to relocate crocodiles from Panchmuli lake to prevent any harm to tourists. *File*

There are still many crocodiles in the lake, he said. The Panchmuli lake, also known as ‘Dyke-3’ of the Sardar Sarovar Dam, was developed for tourists visiting the Statue of Unity. Hence, the authorities decided to relocate crocodiles from the water body to prevent any harm to tourists, the official said.

In 2019-20, 73 rescued crocodiles were released in the the Sardar Sarovar reservoir. The animals rescued later from the lake were shifted to the rescue centres at Godhra in Panchmahal district, and Gandhinagar, he said.

“Some 60 cages are placed around the lake to trap the crocodiles. The part of the lake where sea planes (flying between Ahmedabad and Kevadia) land is completely safe,” he said.

Spokesperson of the Statue of Unity authority said the boat ride is a major tourist attraction in the area and witnesses a heavy rush of visitors, especially on weekends.

Figure 2. Newspaper report of press release by Forest Department, Gujarat. Source: Press Trust of India, 4 July 2021.

the dam side and upper Narmada River. In April 2020-March 2021, 51 crocodiles were reportedly moved to facilities at: Indroda Nature Park, Gandhinagar (GEER Foundation); and, Pavagadh Rescue Center, Panchmahal (Sharma 2021) (Table 1; Figs. 3 and 4).

The practice of translocation is notable in India for a few reptilian species, especially crocodilians. The present flourishing populations of Gharials (*Gavialis gangeticus*), Saltwater crocodiles (*C. porosus*) and Mugger crocodiles are thanks to translocation programs based on collection of wild eggs, incubation and subsequent rearing in captivity and head-starting of juveniles/sub-adults released back into the wild as part of formal reintroduction programs (Choudhury 1999; Jacobson 1999). These are scientific translocation programs with the pure motivation of restocking all three species of crocodilians (Singh 1999).

IUCN-SSC guidelines define “translocation” as the human-mediated movement of organisms from one area to release into another area (IUCN 2013). Translocations are often undertaken with captive-bred stocks being released into natural habitats as part of reintroduction programs, or animals taken away from human-dominated landscapes to new natural habitats away from human settlement areas or confined habitat. They are playing an increasingly important role in the conservation of reptiles, including crocodilians (Germano and Bishop 2008; Ewen *et al*. 2014; Burke 2015). In many cases, translocation may be the only remaining option for re-establishing depleted or extirpated populations (Stofer 1999).

Crocodiles are often rescued from areas of human settlement and translocated away from human habitats, to mitigate human-crocodile conflict (HCC). In such cases, translocation usually involves individual animals or a small batch of animals. However, this case at SoU involves a large number of animals, and if the press release is accurate, it represents the most significant translocation operation in Gujarat state. Indeed, it would probably be the largest translocation operation in Indian history.

I have addressed this case of translocation, specifically the

Figure 3. Transport of large Mugger captured at Narmada Dam.

Figure 4, Capture of large Mugger at Pavagadh Rescue Center.

Table 1. Information relating to on Mugger translocation from SoU. *CZA Inventory of Animals in Indian Zoos; 2020-21 and 2021-22; CZA = Central Zoo Authority, Delhi, India.

Year	No. of Animal Rescues	No. of Translocated Muggers	CZA Inventory	Physical Stocks (2022)	Remarks
2019-20	143	73 - released in Narmada R.			Released upper dam site
2020-21	51	25 - Gandhinagar	19	18 + a few hatchlings	Indroda Nature Park
2020-21	-	26 - Panchmahal	-	42 + a few hatchlings	Rescue center was de-notified by CZA
Totals	**194**	**124**			Records of 70 animals untraceable

removal of Muggers from their prime habitat to confined areas, and consider it to be biased, unethical, not meeting any scientific criteria, and raising many questions (Sinha 2019).

During visits to both rescue facilities in 2022, I noted that the numbers of rescued Muggers and livestock registered data (Central Zoo Authority Inventory of Animals in Indian Zoos) did not match the numbers mentioned in the press release (Table 1). We were unable to obtain detailed information on morphometrics, gender and capture techniques for Muggers from forest officials and Sardar Sarovar Dam authorities. However, we gathered some information from print and electronic media, local NGOs, and some extracts from legal matters of environmental activists and from forest staff about the operation. This included:

1. Capture activities were initiated on 1 January 2019 with the help of local trappers and NGO volunteers.

2. Muggers of various sizes were captured over a 2-year period (eg Figs. 3 and 4).

3. From 1 February 2019, some 60 baited cage traps were deployed for capture of Muggers.

4. Some Muggers were held in temporary enclosures at Bhumaliya-Gadkoi village (Fig. 5).

5. On 22-26 January 2019, a "blast" in Dyke 3 killed fish and Muggers. No action was taken by authorities.

6. In November 2021, reports that large number of Muggers had died during capture activities and in temporary enclosures (see 4. above), were obtained.

Finally, we concluded that the Mugger translocations were not well planned, and raised a big question (see Ghai 2019) - why did authorities not divulge facts on the translocations and their intention? The removal operation also raised many issues regarding faith in the process, legality of the India Wildlife Protection Act 1972 and assurances of wildlife conservation policy, especially the authority which is involved in the operation and the function of forest officials and finally state wildlife policy.

The guidelines for reintroductions and other conservation translocations state that translocations should be fully

Figure 5. Mugger capture in temporary enclosure at Bhumaliya-Gadkoi village.

documented and their outcomes made publicly and suitably available to inform future conservation planning (IUCN 2013). However, the present case indicates that the authorities failed to share the details of the translocation information, and they also did not adhere to the IUCN translocation guidelines, which are widely internationally accepted. In addition, there appeared to be little acknowledgement of what has been learned from past translocation successes and failures, which may be a vital step, particularly at the planning stages of a translocation project (Berger-Tal *et al*. 2020).

The translocation of Muggers, under the pretext of 'Tourist Safety', is neither an apt reason nor a good solution because such translocation essentially shifts the problem from one place to another. It may necessitate many more translocations in the near future, or the species might migrate back to these impoundments. Hence, the problem would persist. The following aspects also need to be considered and/or heeded:

1. In the absence of data on the number of crocodiles in Dykes 3 and 4 (Fig. 1), it is not possible to claim a crocodile-free environment. Moreover, there is also the possibility of crocodiles entering the dykes from adjoining water bodies some 18-20 km from Narmada Dam and the Narmada River.

2. Relocated Muggers may exhibit homing instincts and return to their original capture site (eg see Read *et al*. 2007; Vyas and Bhatt 2004).

3. In 2006, the Gujarat Forest Department appointed

a crocodilian expert, whose opinion was that "zero Muggers" is not possible for the water body; it is the best site for wildlife tourism, and better to develop for that purpose only (see Basu 2006).

4. The decision to capture and relocate Muggers from their natural habitat is against the principles of The Wildlife (Protection) Act 1972.

5. The importance of Muggers is illustrated by the multiple legal and policy efforts that the Government of India has developed to protect the crocodile population.

6. Any activity that is against the survival of a legally protected species, without having been approved by the State Wildlife Board and National Wildlife Board and the Government of India, is patently illegal. There are established rules, regulations and policies to be followed before attempting to relocate 'Schedule 1' species.

7. Some translocated Muggers were kept at Pavagadh Rescue Centre, but this center was not eligible as per CZA guidelines.

8. The forest authority did not tag (microchip) Muggers as per CZA guidelines.

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East & Southeast Asia

Philippines

3RD FORUM ON CROCODILES IN THE PHILIPPINES. The Department of Environment and Natural Resources, ASEAN Centre for Biodiversity, University of Santo Tomas and Crocodylus Porosus Philippines, Inc. organized the "3rd Forum on Crocodiles in the Philippines", with the theme "Engaging Communities and Partners Participation Towards Sustainable Conservation". The event took place on 8-10 November 2023 at the Buenaventura Garcia Paredes, O.P. Building (Thomasian Alumni Center), University of Santo Tomas, Manila.

The Forum aimed to encourage more involvement from communities and stakeholders nationwide in the management and conservation strategies for crocodiles in the country. Eighty (80) participants from six countries attended the Forum, with affiliations with government agencies, non-government organizations, local government units, academia, museums, and zoos.

On the first day, the four host agencies delivered welcome messages and a group photograph was taken (Fig. 1). Later, a technical session took place where keynote speakers discussed various topics related to international agreements affecting crocodile conservation and industry, government conservation activities in Palawan, and past and present conservation champions in the Philippines. In the afternoon, DENR-Biodiversity Management Bureau facilitated a national consultation for the "Crocodile Conservation Action Plan of the Philippines 2020-2028". The day concluded with a welcome dinner hosted by the University of Santo Tomas.

Scientific sessions were held during the second day and morning of the third day, with 13 studies on crocodilian natural history and ecology, breeding and husbandry management, conservation research, population management, and human-crocodile coexistence being presented. After each scientific session, open forums were conducted to allow participants to engage in discussions with presenters. The second day ended with a banquet and cocktail party hosted by Crocodylus Porosus Philippines, Inc. and the Foundation for the Philippine Environment.

During the third day, three workshops were held simultaneously on the topics of: crocodile breeding and husbandry management; conservation research and population management; and, the national review of the "Protocol for Managing Human-Crocodile Conflicts in the Philippines". The workshop sessions resulted in crafting of resolutions, which were later presented to the plenary.

Four resolutions were passed to address various issues related to crocodile conservation in the Philippines.

- First resolution aimed to establish guidelines for the welfare of crocodiles in the country.
- Second resolution was a reminder to the National Crocodile Conservation Committee (NCCC) of the Crocodile Forum Resolution No. 2.3, series of 2019, which seeks to prevent hybridization between *Crocodylus mindorensis* and other crocodilian species.
- Third resolution aimed to update Crocodile Forum Resolution No. 2.5, series of 2019, which ensures the sustainability of funds for crocodile research in the Philippines.
- Fourth resolution updated Crocodile Forum Resolution No. 2.6, series of 2019, which aims to address research gaps in crocodilian research in the Philippines and recognize the contributions of various sectors to crocodile conservation.

Finally, the Forum Chair provided closing remarks to officially close the event, followed by a farewell dinner hosted by the ASEAN Centre for Biodiversity.

Figure 1. Participants at 3rd Forum on Crocodiles in the Philippines.

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Latin America & the Caribbean

Mexico

DRAW YOUR CROCODILE: STUDYING CHILDREN'S PERSPECTIVES ON CROCODILES. Children's drawings are often used to study children´s conceptions and representations (Ehrlén 2009). Here, we present three drawing activities carried out with children from the state of Tabasco, Mexico, which arose from the interest in knowing what crocodiles represent to them.

1. The first activity took place on 20 May 2023, and was part of "Celebrating Biodiversity". The event was organized by El Colegio de la Frontera Sur (ECOSUR) and the Municipal Government of Centro, Tabasco, to celebrate the International Day of Biological Diversity (22 May).

   The event was set at Laguna de las Ilusiones, an urban

lagoon located in the centre of the city of Villahermosa, where we can find an important and well-studied population of Morelet's crocodile (*Crocodylus moreletii*) (López-Luna *et al*. 2011, 2015, 2019; Rueda-Cordero *et al*. 2017). It made it possible for some ECOSUR researchers to disseminate research on the organisms we study.

2. The second activity took place on 20 August 2023, during the 2nd edition of the "Lagarto Fest" ("lagarto" is local name for "crocodile"), which was organized by the Herpetario Cultura Reptil and Yumká Park, to celebrate National Crocodile Day (23 August). The event took place at the Centro de Interpretación y Convivencia con la Naturaleza (CICN) Yumká on the shore of El Vigía Lagoon (6 km east of Villahermosa), where Morelet's crocodile is also present. This event consists of giving talks about crocodiles to the public and setting up stands with recreational activities, sales, or information about crocodiles. Talks presented were:

    - Dr. Marco A. López Luna (Universidad Juárez Autónoma de Tabasco): Crocodiles in the city.
    - Dr. Pierre Charruau (ECOSUR): What, how and for what purpose data and samples are collected on crocodiles?
    - Lic. Manuel Kim (Herpetario Cultura Reptil): The history of Papillon.

3. The third activity took place on 19 October 2023, during "ECOSUR open doors in the Villahermosa Unit", an annual event of the public research center ECOSUR (https://www.ecosur.mx/). This event consists of receiving children from schools in the state of Tabasco so that they can discover the research carried out at this centre through presentations or activities. This year, 242 children (of which 74 participated in the activity on crocodiles), as well as 18 teachers and parents from 4 elementary schools, participated in activities facilitated by 45 people from ECOSUR. The event took place at the ECOSUR Villahermosa facilities located 15.5 km southwest of the city of Villahermosa.

In the first two events, the activity consisted of a drawing contest for boys and girls, who were separated into two categories: 6-8 years old and 9-11 years old. They had to draw a crocodile using pencils and crayons, and write a sentence or a few words about what crocodiles represent to them, or what they think about these reptiles (Fig. 1). Prizes were awarded to the first three first places in each age category.

In the third event, four primary school groups participated. The same procedure was followed as in the previous activities, except that the activity had a defined time (15-20 minutes) to do the drawings (Fig. 2), followed by 15-20 minutes for an exchange of questions where the children asked the researcher questions and the researcher asked the children questions, about aspects of the life and biology of crocodiles.

There were 108 children in the three activities: 6 in the first, 28 in the second, and 74 in the third. There were more girls

Figure 1. Drawing contest activity during the event "Celebrating Biodiversity".

Figure 2. Drawing activity during the ECOSUR open doors event.

(n= 65) than boys (n= 43), and ages ranged from 5 to 12 years. In addition to having shared and exchanged information about crocodiles with the children, these activities allowed us to obtain more than 100 drawings accompanied by phrases about what these reptiles represent to the children of the region (see Cover).

During 2024, we will analyze all this information. The methodology is not yet well established, but the drawings will be analyzed by reviewing the level of detail of the crocodile's anatomy as well as whether additional elements about its environment (eg vegetation, water body) or biology (eg nests) were included. The sentences will also be analyzed by checking mainly if the terms used are positive (eg beautiful, amazing) or negative (eg aggressive, ugly).

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MAIN PROBLEMS AND FINDINGS OBSERVED DURING MORELET'S CROCODILE BREEDING SEASON (2022) AT LA ESCONDIDA CROCODILE FARM, CHIAPAS, MEXICO. Crocodilian reproduction is similar between species, being a mixture of complex sounds, visual signals and behaviours (Stevenson 2019). Booth (1991) mentions that different anatomical, physiological, meteorological and even historical variables in the reproduction of the female will directly affect the characteristics of the egg and therefore the product.

In Morelet's crocodile (*Crocodylus moreletii*), mating can occur from late-February to mid-June (Casas 2011; Kuchel and Franklin 2000). Incubation takes place in May-August, varying from 65 to 98 days (Casas 2013), although in some cases up to 115 days, being shorter at higher temperatures (Stevenson 2019) due to acceleration of embryonic metabolism (Deeming 1994). Under professional care, the management of reproduction in this species requires attention and care to space and environmental parameters, as well as human procedures. Inadequate or careless management may negatively affect reproductive potential of this species and the production of skins and meat on farms.

This research was carried out in conjunction with the Environmental Management Consultancy "Yaax Pixam", at La Escondida Crocodile Farm (registration code SEMARNAT-UMA-IN-0533-CHIS/13), in the municipality of Acalá, Chiapas, Mexico. The farm has three artificial breeding lagoons (El Lagartero, Corralito and Jícara), and incubation, nursery and rearing areas (Fig. 1).

Figure 1. Distribution of lagoons and buildings at La Escondida Crocodile Farm. Source: Google Earth 2022.

The predominant climate is sub-humid, the average annual temperature is 26.2°C, and average annual rainfall recorded in May-October is 1000 mm (INEGI 2023).

Activities were carried out in the breeding season in March-September 2022, from the courtship stage to the maintenance of hatchlings. Records of infertile eggs, embryonic deaths, abnormalities and hatching were maintained.

Eggs were collected as soon as possible after nests were located (through traces left by the females), typically within 1-2 days of laying. Eggs were processed (length, width, weight) before being placed in an incubator with temperature of 32°C ± 0.5°C, 92% relative humidity, and vermiculite as the incubation media (Fig. 2).

Figure 2. Trays of eggs in incubator.

Results

During this breeding season, 31 nests and 825 eggs were collected, with 807 eggs from the breeding lagoons (El Lagartero 428 eggs, Corralito 311 eggs, Jícara 68 eggs) and 18 eggs laid by an injured female that had been moved out of a breeding lagoon into the nursery area.

The main problems and observations made are listed below.

1. Stock inventories

   One of the primary challenges faced by the farm was the lack of updated inventories of breeding stock (eg numbers, sex ratio, maturity status). We recommended monitoring during the non-breeding season months to update stock inventories (eg through capture), and track the overall health status of the breeding population in the lagoons, and where possible for individuals (eg body condition, sex, biometric measurements). In the absence of data, it is difficult to ascertain whether the high rate of egg infertility is due to the lack of males, high density relative to size of lagoons, etc. In the wild, the average adult sex ratio is reported as 1.6:1 - that is, 1.6 males for every female (Domínguez-Laso *et al*. 2005).

   It was currently difficult to assess nesting and breeding success with respect to numbers of adult breeding females. With such data, breeding success in lagoons can be monitored over time through indices such as: nests/female, viable eggs/female, hatchlings/female (Sánchez *et al*. 2011).

2. Incubation period

   Generally, nests/eggs were collected within 1-2 days of laying. For the purposes of this study, incubation period for a nest was categorised as the period between egg collection and when the last hatchling had hatched, under conditions of artificial incubation. We recognise that this does not reflect the real incubation period (ie including incubation that occurred between egg laying and egg collection).

   Artificial incubation period for clutches that were considered to have hatched "normally" was 71 days. It is recommended that eggs are collected as soon as possible after laying, and that "aged" on the basis of opaque band development in order to better estimate real incubation period. Assuming that other conditions of incubation are optimal (eg humidity, oxygen), incubation period is a good indicator of average incubation temperature.

3. Premature hatching

   In mid-June, 68 eggs (8.2%) from four "late" nests were collected, and they had a much shorter artificial incubation period - averaging 54 days. Hatchlings were considered to have hatched prematurely due to stimulation from hatchling calls from neighboring clutches in the incubator. These hatchlings were small, and the yolk sac was large and still external.

4. Egg infertility

   Eggs that did not show any opaque band development during incubation were considered to be infertile. In all, 156 infertile eggs were identified, representing 18.9% of the total egg production for the season.

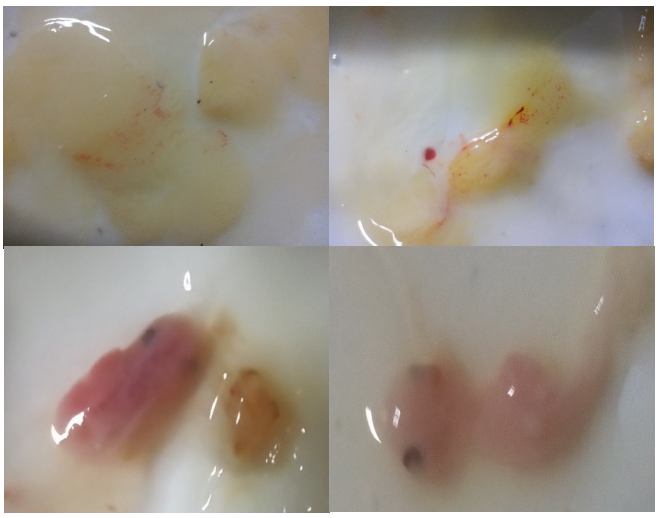

Figure 3. Dead embryos.

   Infertility varied between lagoons, with the highest in Jícara, with 76.5% of eggs produced there being infertile. Corralito had 17.4% infertility, and El Lagartero just 7.5%. The 18 eggs laid by the isolated female in the nursery area were all infertile (100%).

   There are various factors that could be implicated in the relatively high rate of infertility, including age/size of females, extent of social interactions between breeders, sex ratio of breeders, etc.

4. Embryo mortality

   Eggs that were considered to have died during incubation, or which failed to hatch 7 days after hatching had begun for a particular clutch, were opened and examined. Embryonic mortality was 91 eggs, representing 13.6% of fertile eggs incubated (Fig. 3).

   Although crocodile eggs may be collected and transported at any age, particular care should be taken to avoid mechanical stimulation when eggs are near hatching (it may stimulate premature hatching) or 8-16 days of age (when embryos are delicately attached to the eggshell and can be dislodged and die).

   During the collection process, the uppermost surface of the egg should be marked (eg using soft pencil), and care taken to ensure that eggs are not rolled/rotated, but kept horizontal in the collection crate/box with the marked surface uppermost. Staff should be provided with appropriate training for all aspects of egg collection.

   During ovoscopy, the egg should be handled carefully. This procedure can assist to detect eggs that have died, for example through development of the opaque band and the associated vascularization of the chorioallantois.

5. Agonistic behaviour in breeding lagoons

   During monitoring in the lagoons to detect nests, some adult females were noted to have injuries, considered to

be the result of fighting with conspecifics (eg for territory, nest theft or nest protection) (Fig. 4). Depending on the severity of the injuries and the time elapsed, there may be complications such as infection, myiasis (Fig. 5) or death of the animal.

Figure 4. Injury resulting in exposure of dorsal osteoderms in an adult female *C. moreletii*.

It is important to conduct daily monitoring of the lagoons as wounds can quickly become infected and/or become contaminated by flies (Fig. 5). Breeding females with serious wounds may be placed in separate areas, away from the other crocodiles, where wet and dry areas are provided. It may be necessary to remove individuals identified as being particularly aggressive.

Figure 5. Wound showing myiasis (infection with fly larvae) in an adult female *C. moreletii*.

Nest theft among females can occur due to a lack of nesting areas and/or materials for nest construction, so it is important to ensure that there are shaded areas with abundant vegetation close to the water, but easily accessible to farm staff.

6. Egg dehydration

Environmental parameters (temperature, humidity, gas exchange) are of utmost importance for successful incubation (Manolis and Webb 1987). A dry incubation environment (low humidity) can result in air spaces in the egg, which typically occur between the eggshell membrane and the eggshell (Manolis *et al*. 1987), are visible to the naked eye, and can occur at any stage of development (Fig. 6).

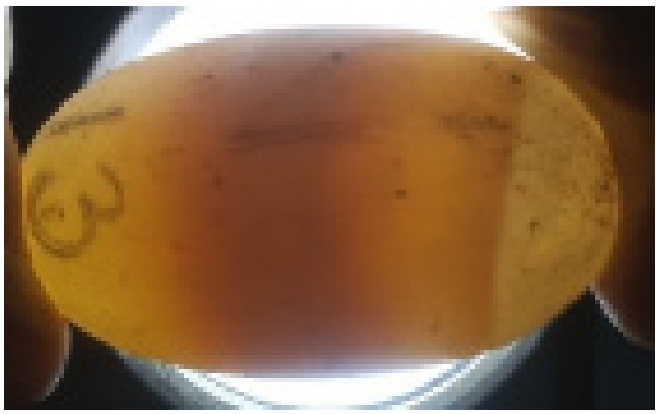

Figure 6. Air space (right-hand end) resulting from dehydration.

Ovoscopy is recommended once 20 days have passed since a clutch is placed in the incubator. Temperature and humidity and temperature should be recorded at least once per day. Systems for monitoring incubation conditions constantly may considered.

Other observations from the 2022 breeding season, that are not considered significant, are listed below:

a. Myiasis: Cracks in the eggshell were observed to provide access to flies, resulting in their larvae entering through the eggshell membrane and into the egg itself, including in/on the embryo (Fig. 7).

Figure 7. Detection of myiasis on embryo at necropsy.

b. Crushing of hatchlings: At hatching, hatchlings are gregarious, and stay as close together as possible. During the hatching of one clutch, a premature hatchling was crushed under the weight of its conspecifics, resulting in its death (Fig. 8).

Figure 8. Death of a premature hatchling due to crushing.

c. Abnormalities: In three specimens minor malformations were detected in the tip of the tail ("curled tail"), which may be of congenital origin (Fig. 9). One other hatchling was missing its right forelimb, which is also possibly congenital in nature (Fig. 10).

Figure 9. "Curled tail" observed in three hatchlings.

Figure 10. Hatchling hatched with missing a limb.

Discussion

Aggression in the breeding lagoons could have been due to a lack of available nesting areas, resulting in nest robbery (Casas 2003), or size disparity between individuals (Hunt 1977), especially with larger individuals attacking smaller, younger ones, when they are close to their nests.

The most sensitive period for embryonic detachment due to movement is between 7 and 10 days after egg laying, as embryos are attached through a very limited area of allantois to the eggshell membrane (Ferguson 1987). Aging eggs at time of collection would help to determine if embryos died at the time of collection or due to other factors.

The incubation conditions are considered to be sub-optimal with regard to humity, which is considered too low, as evidenced by dehydration and formation of air spaces. Hetchenleitner (2023) concluded that the pores of the eggshell are indicators of water balance between the embryo and its external environment. If incubation parameters are properly managed (Lutz *et al*. 1980; Manolis and Webb 1991), problems such as egg swelling and dehydration can be easily avoided.

The premature hatching of the last nests collected, possibly due to calls of hatchlings emerging from older nests being incubated nearby, is of concern. According to Barrios (2018), between days 84 and 92, the embryo will be ready for hatching with complete organogenesis and the process of absorption of the yolk sac beginning. However, as the time spent incubating in the nest was not included in the calculation of incubation temperatures at La Escondida Crocodile Farm makes comparisons difficult. Likewise, it is difficult to assess the effect of temperature on incubation period.

There were few hatchlings with physical abnormalities, with missing limbs and "curled tail" representing 0.7% of hatchlings produced. Bonilla (2002) reports that in his study populations, 1.2% were present in the first season and 0.5% in the second season, which is considered an acceptable percentage due to the large volumes of eggs handled. Exposure to high temperatures (>34ºC) can lead to physical abnormalities (Manolis and Webb 1991), which can be fatal (Huchzermeyer 2003). It is assumed that incubation temperatures at the farm are within acceptable limits.

Addressing the issues that presented during the breeding season will require a comprehensive approach encompassing monitoring, environmental management and husbandry practices. By implementing recommended solutions, the farm can improve breeding success, minimize health issues, and enhance the welfare of hatchlings and breeding adults. Additionally, ongoing research and collaboration within the field are crucial for advancing our understanding of crocodile biology and improving farming practices. Although not all problems can be solved immediately, they can be solved in the short- and medium-terms.

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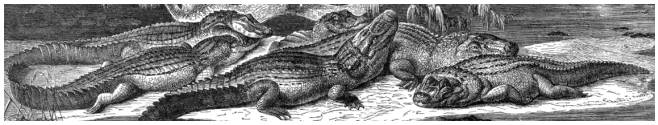


Recent Publications

Hesari, R., Chuchla, T., Carnemolla, A.R., Tyndall, N. and Scott, R. (2024). Delayed medical care following an alligator bite: A case report and literature review. Cureus 16(1): e53005.

Abstract: Alligator bites in humans present a significant concern for

public safety in the southern United States, especially in states like Florida with substantial alligator populations. Although these reptiles play a vital role in the local ecology, encounters with humans can lead to severe injuries and even fatalities. A case report is presented of a 58-year-old male who suffered an alligator bite while attempting to take a selfie with the reptile during a hunting trip in rural Florida. The patient's injuries included multiple lacerations on the dorsum of his right hand. Despite the incident, the patient hesitated in seeking medical attention due to a lack of insurance, emphasizing the need for public awareness of alligator bite management. The discussion highlights the potential complications of alligator bites, including hemorrhage and infection, as well as the importance of appropriate medical treatment, including wound irrigation, debridement, and antibiotic therapy. Moreover, preventive strategies are discussed, such as maintaining a safe distance from alligators and refraining from feeding them, to ensure coexistence between humans and these reptiles in their natural habitats. As knowledge of alligator bites remains limited, this case report contributes valuable information to promote public safety and guide future research in this area.

Briggs-Gonzalez, V., Godahewa, A., Balaguera-Reina, S., Dixon, J. and Mazzotti, F. (2024). American crocodile nesting in sediment-nourished habitats on Crocodile Lake National Wildlife Refuge, Florida, USA. Amphibia-Reptilia (https://doi.org/10.1163/15685381-bja10167).

Abstract: The American crocodile (*Crocodylus acutus*) is the most widely distributed New World crocodile. However, the species has experienced severe declines due to overexploitation. In South Florida, loss of nesting habitat, with coastal degradation from sea level rise and urban development has prompted American crocodiles to nest in novel habitats. Crocodile Lake National Wildlife Refuge (CLNWR) serves as an important nesting site for the South Florida population of American crocodiles and more recently nesting habitat has been supplemented to manage coastal erosion. The goal of this study was to investigate the internal nest biology of American crocodile nests laid in sediment nourished sand mounds on CLNWR. We monitored internal nest temperature and volumetric water content of five live and two control sand nests in 2021 (N= 73 eggs) and 2022 (N= 84 eggs). The metabolic heat generated by incubating eggs in internal nest temperatures ranged from 0.8°C to 2.0°C warmer and more stable than ambient temperatures and reflecting a seasonal pattern. Average clutch size was 31.4 ± 7.09 eggs and incubation period ranged from 78 to 114 days until hatching. These data provide the first insight into thermal regimes of nests laid in novel/supplemented nesting habitat as is the case for a significant proportion of nests in the South Florida population of American crocodiles. Here we provide an opportunity to evaluate the importance of creating artificial nesting habitat for American crocodiles where habitat degradation from climate change threatens species survival.

Delbosc, N.C., Thévenet, J., Boyer, N., Grimault, N. and Mathevon, N. (2023). Multimodal perception of aquatic vibrations and airborne sound in crocodiles. Pp. 3963-3964 *in* Proceedings of the 10th Convention of the European Acoustics Association (doi: 10.61782/fa.2023.0351).

Abstract: In order to locate their prey precisely, crocodiles have to use all available sensory modalities, in particular the numerous mechano-sensory receptors on their skin. Although crocodiles are known to communicate acoustically, we do not yet know to what extent they are able to integrate the two communicative channels. The aim of the study was to reproduce and play back to a crocodile the presence of a younger conspecific by using speakers and vibratory devices, and to observe the behavioral responses. All these responses were captured by video analysis that allowed to compute some parameters to assess crocodiles' interest for the stimuli (like the minimum distance to stimulation reach by the crocodile during the observation period). This experiment was aimed: first, at determining to what extent crocodiles are able to use auditory and vibratory stimuli simultaneously in different spatial and temporal patterns; second, at studying the possible dominance of one perceptual modality over the other. Lastly, at determining if these stimuli can be perceptually related to each other.

Ogorode, I.O. and Vincent-Akpu, I.F. (2024). Sacred lakes as conservation sites for crocodiles. Case study of Esiribi Sacred Lake in Niger Delta, Nigeria. Thalassia Salentina 45(2023): 27-40

Abstract: The Biseni Clan is located in Central Bayelsa State, Nigeria. It is a small tribe represented by Southeast Ijaw speaking people. The Biseni people occupy the upper regions of the Niger Delta River. They perceive their lands and particularly their lakes as sacred and are home to the crocodiles. This study examined the perception of residents around Esiribi Sacred Lake to investigate the effectiveness of sacred lake in biodiversity conservation with respect to crocodiles. A structured questionnaire was used to obtain information from the people of Biseni on the presence and type of crocodile found in Esiribi Lake. Focus group discussions were carried out with the community members while Key Informant Interviews (KII) were conducted with the Lake Priest and some of the elders conversant with history of the lake. A total of 175 adults residents, comprising of 96 males and 74 females having formal education were interviewed. The people of Biseni regard the crocodiles in Esiribi Lake as sacred animals and live in harmony with them. The number of crocodiles in the lake seems to have increased over the years as a result of the sacredness the people accord to the species. The two most common species are the West African dwarf crocodile (*Osteolaemus tetraspis*) and Nile crocodile (*Crocodylus niloticus*). Fishing is only allowed in the lake biennially. We conclude that communal governance should be strengthened for the continued protection of crocodiles and other species in and around the lake as well as a reduction in human activities that could threaten the species conservation.

Meneses, C.G., Pitogo, K.M.E., Supsup, C.E. and Brown, R.M. (2024). Philippine herpetology (Amphibia, Reptilia), 20 years on: two decades of progress towards an increasingly collaborative, equitable, and inclusive approach to the study of the archipelago's amphibians and reptiles. ZooKeys 1190: 213-257.

Abstract: A first review of the history, status, and prospects for Philippine herpetology conducted more than two decades ago (2002) summarized the diverse topics studied and highlighted the development and achievements in research up to the year 2000. This study revisits and re-assesses what Philippine herpetology has accomplished, both as a discipline and a community, during the last two decades (2002-2022). A total of 423 herpetological publications was collated, revealing a substantial increase in annual publications, rising from approximately four per year during 2002-2008 to around 28 per year in 2009-2022. Half of the published studies focused on squamate reptiles (lizards 30.5%, snakes 21%) and 28.4% on amphibians, 5.9% on turtles, and 2.6% on crocodiles. The remaining 11.6% of studies focused simultaneously on multiple taxa (ie faunal inventories). Diversity and distribution (35.2%) and ecological (26.5%) studies remained popular, while studies on taxonomy (14.9%), phylogenetics and biogeography (11.8%), and conservation (11.6%) all increased. However, geographical gaps persist urging immediate surveys in many understudied regions of the country. Finally, we found a balanced representation between Filipino and foreign first authors (1.0:1.1), yet a substantial gender gap exists between male and female first authors (7.1:1.0). Nonetheless, the steep increase in publications and the diversity of people engaged in Philippine herpetology is a remarkable positive finding compared to the 20 years preceding the last review (1980-2000). Our hope is that the next decades will bring increasingly equitable, internationally collaborative, and broadly inclusive engagement in the study of amphibians and reptiles in the Philippines.

Bhagarathi, L.K., Da Silva, P.N.B., Pestano, F. and Cossiah, C. (2024). Impact of climate change on the reproduction, distribution and abundance of herpetofauna: A review of literature. GSC Advanced Research and Reviews (doi: https://doi.org/10.30574/gscarr.2024.18.1.0027).

Abstract: The purpose of this paper is to review and assess published literature on the impact of climate change on herpetofauna. A systematic approach was used to accumulate research works of literature on "Impact of climate change on herpetofauna." A total of forty (40) research papers published between the years 1930 to 2023 were accessed and used for this review. Tables were used to present all results. A subjective approach was used to select the topics: impact of climate change and herpetofauna. In this paper, nine (9) detrimental impacts of climate change were assessed and presented; four (4) which are specific to reptiles and five (5) which are specific to amphibians. The published papers established that extreme weather conditions, such as high temperature, heavy precipitation, synergistic vulnerabilities, ultraviolet radiation and repercussions of ectotherm metabolic rate all contribute to the global climate change that are affecting the reproduction, distribution and abundance of herpetofauna. This review highlights the fact that more extensive studies on the impact of climate change on herpetofauna should be done in neotropical countries since there is a paucity of such information on research and published data in these biodiversity rich regions.

Ciocan, H. (2023). Ecología Poblacional de *Caiman latirostris* Reintroducidos y silvestres, y Evaluación de sus Métodos de Monitoreo. PhD thesis, Universidad Nacional de Cordoba, Cordoba, Argentina.

Abstract: Crocodilia order includes three extant families, Crocodylidae (crocodiles), Gavialidae (gavials), and Alligatoridae (caimans and alligators). This order represents large predators associated with aquatic environments in tropical and subtropical zones throughout the world. In our country, the black caiman (*Caiman yacare*) and the broad-snouted caiman (*Caiman latirostris*) are the species present. These species are in constant danger mainly due to the pressure exerted by the anthropization of the environments in which they inhabit, although their populations have historically been threatened by indiscriminate hunting due to the value of their skin. That is why several projects based on sustainable management through the ranching technique were developed in Argentina. One of them is "Proyecto Yacaré", which began in 1990, with the species *C. latirostris* in Santa Fe Province. Although the presence of sustainable use programs presupposes an improvement in the crocodilian populations on which they are applied, there is bit information on the effect of released animals on natural populations and their readaptation potential in nature. In fact, some authors claimed that releasing hatchlings into the wild was a useless procedure, due to the very low or non-existent recapture rate of reintegrated and marked individuals in the workplace. In the Santa Fe Province, where the "Proyecto Yacaré" operates, the existence in nature of reintroduced individuals of *C. latirostris* that have reached adult size and are reproducing has been verified, although it is not yet known if there is any influence from confinement period in farms, since released animals variables in pre-adult sizes (Class II) such growth rate, sex ratio are unknown. Therefore, it was proposed whether populations made up of specimens of *C. latirostris* collected in nature through ranching, incubated and raised under controlled conditions and subsequently reintroduced to their place of origin; present similar population attributes as wild ones. For this, it's necessary to use different sampling methods (direct or indirect) and population control combined; since those normally used don't answer several questions arised, because the most common methods are used as prescriptions, using either, without determining if they are the most suitable for the species under study and the morphology place. That's why it was raised whether the methods usually used to survey *C. latirostris* populations, such as night counts, nest count and capture-mark-recapture, present differences in the precision to estimate the population size, It may be a less robust sampling methodology to detect changes in population abundance generated by programmed releases. We consider that the known methods will be more efficient one than the other according to the moment, the circumstance in which they're used and the objective to answer, since each one has its advantages and disadvantages. Therefore, the objective of this work was to determine the effect of the sustainable use program "Proyecto Yacaré" on population and individual parameters of reintroduced *C. latirostris* against to wild ones, and contribute to the improvement of surveys and control methods of their populations. In chapter 1 of the thesis, a general introduction of the topics covered and the Hypotheses and Objectives are presented. Chapter 2 develops the analysis of the monitoring methods used to assess *C. latirostris* population in "El Fisco" reserve. In this section, 3 methods were compared: Night Count, Capture-Mark-Recapture and Nest Count, observing among these the sensitivity of detection to programmed releases in the place, in order to determine which of them is more accurate. Subsequently, it was proposed to implement a comparative methods table to be used, which determines which of them was the most appropiate according to the research objetives that method is most effective according to different conditions, wherein was concluded that the best method was night counts. In chapter 3, wild and reinserted animals were compared in different parameters such as population structure, growth rate, sexual ratio, maximum movement distance. After analysis, it was concluded that confinement period of "Proyecto Yacaré" use program on the animals, does not affect their ability to reintegrate into nature. In addition, evidence was found that the sustainable use program was successful, showing a recovery of the *C. latirostris* population over the years in which it has been operating. Finally, in chapter 4, a general discussion was held and the hypotheses and objectives were re-evaluated, to return to the problem posed and the final conclusions of the thesis.

Polanco Rodríguez, M.C. (2023). Caracterización del microbioma bacteriano intestinal del críticamente amenazado Cocodrilo del Orinoco (*Crocodylus intermedius*) presente en la mayor población *ex situ* en la Estación de Biología Tropical Roberto Franco (EBTRF) en Villavicencio, Colombia. MSc thesis, Universidad Nacional de Colombia, Colombia.

Abstract: The Orinoco crocodile (*Crocodylus intermedius*) is an endemic reptile found in lowland areas of the Orinoco River basin. Currently, the species faces serious threats to its survival, demanding an all-encompassing conservation program that includes modern programs such as maintaining a healthy microbiome, which can improve its maintenance, reproduction, and release. This study aimed to characterize the bacterial microbiota of feces from *C. intermedius* kept in the largest *ex-situ* Colombian population (EBTRF, Villavicencio, Meta) and compare the bacterial populations between juvenile and adult crocodiles. The 16S rRNA gene sequencing was performed on 24 fecal samples (Juveniles n= 15; Adults n= 9), using the Illumina MiSeq platform (2×250 bp). The results indicate that the fecal microbiota is predominantly composed of Firmicutes, followed by Bacteroidetes and Proteobacteria in both groups. Alpha diversity and bacterial structure measurements did not show significant differences between juveniles and adults; however, the membership of bacterial populations differed significantly between the groups. The majority presence of Firmicutes and Bacteroidetes have been associated with diseases such as obesity and endocrine disorders in reptiles. Despite previous reports of pathogenic bacteria in the fecal microbiota, reptiles possess a robust immune system that may confer greater resistance to infections, cancer, and senescence. This research provides a tool for the conservation of the Orinoco crocodile and expands our understanding of reptilian fecal microbiota.

Resumen: El Cocodrilo del Orinoco (*Crocodylus intermedius*) es un reptil endémico de zonas bajas de la cuenca del río Orinoco. Actualmente la especie enfrenta serias amenazas para su supervivencia, por lo cual es necesario un plan de conservación integral que incluya programas modernos como el mantenimiento de

un microbioma saludable, lo cual puede mejorar su mantenimiento, reproducción y liberación. Este estudio tuvo como objetivo caracterizar la microbiota bacteriana de las heces de *C. intermedius*, mantenidos en la mayor población *ex-situ* colombiana (EBTRF, Villavicencio, Meta) y comparar las poblaciones bacterianas entre cocodrilos juveniles y adultos. Se realizó la secuenciación del gen rRNA 16S de 24 muestras de materia fecal (Juveniles n= 15; Adultos n= 9), utilizando el equipo Illumina MiSeq (2×250 bp). Los resultados indican que la microbiota fecal de está predominada por Firmicutes, seguido por Bacteroidetes y Proteobacterias. Los índices de medición de Alfa diversidad y la estructura bacteriana no tuvieron una diferencia significativa entre los Juveniles y Adultos, sin embargo, el membership de las poblaciones bacterianas difirió significativamente entre los grupos. La composición de la microbiota fecal de ambos estuvo fuertemente predominada por Firmicutes y Bacteroidetes, distribución que se ha relacionado con enfermedades como la obesidad y desórdenes endocrinos. A pesar de que investigaciones previas han reportado bacterias patógenas en la microbiota fecal, los reptiles poseen un fuerte sistema inmunológico que podría conferir una mayor resistencia a infecciones, cáncer y senescencia. Esta investigación presenta una herramienta para la conservación del Cocodrilo del Orinoco y amplía el conocimiento de la microbiota en reptiles.

Bhattarai, D., Lamichhane, S., Pandeya, P., Gautam, J., Bhattarai, S., Kandel, R., Pokheral, C. and Gautam, B. (2024). Status, distribution and habitat preference of Mugger crocodile (*Crocodylus palustris*) in and around Koshi Tappu Wildlife Reserve. Authorea (doi: 10.22541/au.170670865.52132397/v1).

Abstract: Mugger crocodile is the only resident crocodilian of the Koshi Tappu Wildlife Reserve (KTWR), Nepal. Fewer studies have been carried out on the status and distribution of this crocodilian with limited information on its habitat characteristics. This study sets forth to highlight the population status, distribution and habitat preference of Mugger crocodile in and around KTWR. A detailed survey was conducted in the rivers, natural pond and private ponds of the reserve on December 2020. For habitat survey, all transects were divided into 500 m intervals. Generalized Linear Model under binary logistic regression was used to test variables associated with presence and absence of Muggers for statistical significance. The population status of the Mugger was surveyed in the study area boating and walking along several transects. During the research period, 35 Muggers were recorded in the study area. Out of the seven habitat variables examined, the probability of sighting Mugger differed significantly with respect to two variables; slope and water depth. In the near future, the prevailing fishing pressure in the reserve and shifting of the Muggers from core area to the private ponds is bound to raise human Mugger conflict. In order to subdue the muggers inside the reserve, the reserve authority has a vital role for proper habitat management and control of fishing activities inside the reserve.

Wang, Y., Liu, R., Hu, R., Chen, H., Li, Z., Yin, X. and Liu, Z. (2024). 5-HT neurons in the brain of newborn Chinese alligator (*Alligator sinensis*). Available at SSRN: https://ssrn.com/abstract=4706078 or http://dx.doi.org/10.2139/ssrn.4706078.

Abstract: In current study, we used Nissl staining to examine the histological structure of the Chinese alligator brain, and 5-HT immunohistochemistry (IHC) staining to detail the localization and morphology of neurons belonging to the serotonergic system. Nissl staining revealed that the Chinese alligator brain was divided into four regions (telencephalon, diencephalon, brainstem, and cerebellum) and a connected ventricular system (containing the pair of lateral ventricles, third ventricle, and fourth ventricle). According to the IHC results, 5-HT immunoreactive (5-HT-IR) neurons were primarily observed in the cerebral cortex, the hypothalamic paraventricular nucleus (PH), tectum and tegmentum of the optic lobes, the medial longitudinal fasciculus (Flm) of medulla oblongata and the cerebellar cortex. 5-HT-IR fibers were mostly located lateral to the hypothalamic paraventricular nucleus (PH), in the medial vestibular nucleus (MVe) of the medulla oblongata, and in the choroid plexus (CP) of the lateral ventricles. Additionally, our findings paralleled those of other reptiles; nevertheless, some distinctions in terms of both histological architecture and function were identified. The layering of the cerebral cortex and tectum, as well as the arrangement of Purkinje cells, differed between reptile brains. The distribution of 5-HT-IR neurons varied in the layer of cerebral and cerebellar cortex when compared to other reptiles. Within the diencephalon, 5-HT-IR neurons formed distinct nuclei in the hypothalamic paraventricular nucleus (PH), but few in the infundibular recess.

O'Malley, A., Ruethers, T., Lopata, A., Ray, J., Cierpicki, T., Kowal, K. and Chruszcz, M. (2024). Characterization of fish and reptilian parvalbumins as relevant food allergens. Journal of Allergy and Clinical Immunology (doi: https://doi.org/10.1016/j.jaci.2023.11.846).

Abstract: Fish allergy affects up to 3% of the population, with the majority of fish-allergic individuals having IgE recognizing β-parvalbumins. It was shown that fish allergic individuals are at risk of allergic reaction when consuming meat from crocodiles. Therefore, comparative studies of fish and reptilian parvalbumins will help to understand the molecular basis of the cross-reactivity and can improve generation of avoidance guidelines for parvalbumin-allergic patients. Gad m 1.0201 (Atlantic cod), Cro p 1.0101 and Cro p 2.0101 (saltwater crocodile), human α-parvalbumin, and α-parvalbumins from *Raja clavata* and *Callorhinchus millii* were recombinantly produced in *E. coli*. The produced proteins were used for structural, stability and antibody binding studies. Differential scanning fluorimetry was used for assessment of thermal stability, X-ray crystallography and NMR were used for structural characterization, and ELISA and immunoblotting were used for antibody binding. The studied parvalbumins displayed remarkable thermal stability, which is important from the perspective of food processing, and it was shown that calcium cations are necessary for protein stability. Five novel structures were determined via x-ray crystallography. They not only provided a detailed picture of the parvalbumins' structures, but they also revealed the existence of a domain-swapped Gad m 1 dimer. Cross-reactivity between fish and reptilian parvalbumins was demonstrated. Further analysis of the structural and biochemical properties of α- and β-parvalbumin will allow for better understanding of the allergic response to seafood parvalbumin as well as the protein's capacity for oligomerization.

Parker, S., Cramberg, M., Scott, A., Sopko, S., Swords, A., Taylor, E. and Young, B.A. (2024). On the spinal venous sinus of *Alligator mississippiensis*. Anatomical Record (Hoboken) (doi: 10.1002/ar.25403).

Abstract: The epidural space of the American alligator (*Alligator mississippiensis*) is largely filled by a continuous venous sinus. This venous sinus extends throughout the trunk and tail of the alligator, and is continuous with the dural sinuses surrounding the brain. Segmental spinal veins (sl) link the spinal venous sinus (vs) to the somatic and visceral venous drainage. Some of these sl, like the caudal head vein along the occipital plate of the skull, are enlarged, suggesting more functional linkage. No evidence of venous valves or external venous sphincters was found associated with the vs; the relative scarcity of smooth muscle in the venous wall of the sinus suggests limited physiological regulation. The proatlas (pr), which develops between the occipital plate and C1 in crocodylians, is shaped like a neural arch and is fused to the dorsal surface of the vs. The present study suggests that the pr may function to propel venous blood around the brain and spinal cord. The vs effectively encloses the spinal dura, creating a tube-within-a-tube system with the (smaller volume) spinal cerebrospinal fluid (CSF). Changes in venous blood pressure, as are likely during locomotion, would

impact dural compliance and CSF pressure waves propagating along the spinal cord.

Rahman, Lokollo, F.F., Manuputty, G.D., Hukubun, R.D., Krisye, Maryono, Wawo, M. and Wardiatno, Y. (2024). A review on the biodiversity and conservation of mangrove ecosystems in Indonesia. Biodiversity and Conservation (https://doi.org/10.1007/s10531-023-02767-9).

Abstract: This study was conducted to analyze the biodiversity of mangrove species and fauna in Indonesia as well as the management strategies for its preservation. The results showed that the total number of mangrove species was 240, consisting of 48 true and 192 associated mangrove. This number also comprised 74 trees, 36 shrubs, 52 herbs, six palms, 43 epiphytes, 23 lianas, three ferns, and three parasite species. *Aglaia mackiana* was identified as a new record in the Papua region attributed to the New Guinea Coastal Current (NGCC), while *Ceriops australis* was newly found in regions of Papua, Bali-Nusa Tenggara (Timor, Flores, Sumbawa), Java, and Sumatra (Pulau Bilinton). The diversity of marine fauna in the mangrove area consisted of 125 fish species from 47 families and 169 macrozoobenthos from 52 families. In addition, there were 161 terrestrial faunas, consisting of 80 birds, 38 squamata, four crocodiles, six amphibians, 11 testudinate, and 21 mammal species. This high level of biodiversity was influenced by the commitment of the Indonesian government to managing mangrove ecosystems through conservation. These efforts were carried out to preserve and improve ecosystem services such as mangrove biodiversity, carbon stock potential, coastal protection, and the unique biodiversity of marine and terrestrial fauna. Based on the results, incredibly unique fauna included Crocodilus found in Papua, Kalimantan, Java, and Sumatra region, *Halcyon* sp. in Papua and Java region, *Anhinga* sp. in Kalimantan and Java region, as well as *Nasalis larvatus* in Kalimantan.

Shipley, A.E., Elsler, A., Singh, S.A., Stubbs, T.L. and Benton, M.J. (2024). Locomotion and the early Mesozoic success of Archosauromorpha. Royal Society Open Science 11: 231495.

Abstract: The Triassic was a time of ecological upheaval as life recovered from the Permian-Triassic mass extinction. Archosauromorphs were a key component of the recovery, diversifying substantially during the Triassic and encompassing the origins of dinosaurs, pterosaurs and crocodylomorphs. Here, we explore the evolution of locomotion in Archosauromorpha to test whether dinosaurs show any distinctive locomotory features that might explain their success. We implement geometric morphometrics on limb bone shapes and use limb ratios to calculate bipedality and cursoriality metrics. We find that the Avemetatarsalia (dinosaurs, pterosaurs and relatives) exhibit more variable limb form and limb ratios than any other group, indicating a wider range of locomotory modes. The earliest avemetatarsalians were bipedal and cursorial, and their range of form increased through the Triassic with notable diversification shifts following extinction events. This is especially true of dinosaurs, even though these changes cannot be discriminated from a stochastic process. By contrast, the Pseudosuchia (crocodilians and relatives) were more restricted in limb form and locomotor mode with disparity decreasing through time, suggesting more limited locomotor adaptation and vulnerability to extinction. Perhaps the greater locomotor plasticity of dinosaurs gave them a competitive advantage in the changing climates of the Late Triassic.

McAllister, C.T., Hnida, J.A., Boylan, S.M. and Siesto, M. (2024). Two new Eimerians from American alligator, *Alligator mississippiensis* (Crocodilia: Alligatoridae), from Georgia, USA. Acta Parasitologica (doi: 10.1007/s11686-023-00788-6).

Abstract: Little is known about the coccidian parasites of the American alligator, *Alligator mississippiensis* (Daudin). To date, only two species of *Eimeria* Schneider, 1875 have been previously reported from *A. mississippiensis*. Here, we report from mensural and morphometric data on two new species of *Eimeria* from *A. mississippiensis* from Georgia, USA. Fresh feces were collected in June 2023 from a single captive juvenile male *A. mississippiensis*. Multiple samples were placed in individual zip-lock bags and aqueous potassium dichromate was added. They were examined for sporulated oocysts after flotation in Sheather's sugar solution, measured, and photographed. Samples contained oocysts representing two new species of *Eimeria*. Oocysts of *Eimeria tellezae* n. sp. are subspheroidal to ellipsoidal with a pitted bi-layered wall, measure (L × W) 34.5 × 31.5 μm, and have a length/width (L/W) ratio of 1.1; a micropyle and polar granule were absent but an oöcyst residuum was present. Sporocysts are ellipsoidal and measure 17.2 × 7.7 μm, L/W 2.2; a nipple-like Stieda body bearing one to several filaments was present but sub-Stieda and para-Stieda bodies were absent. The sporocyst residuum is composed of various-sized granules in a compact rounded or irregular mass, sometimes dispersed between the sporozoites. Oocysts of *Eimeria daudini* n. sp. are ellipsoidal with a pitted bi-layered wall, measure (L × W) 32.5 × 20.2 μm, and have a length/width (L/W) ratio of 1.6; a micropyle and polar granule were absent but an oöcyst residuum was present. Sporocysts are ellipsoidal and measure 15.4 × 7.4 μm, L/W 2.1; a nipple-like Stieda body bearing one to several filaments was present but sub-Stieda and para-Stieda bodies were absent. The sporocyst residuum is composed of various-sized granules in a compact rounded or irregular mass, sometimes dispersed between the sporozoites. Both new species can readily be distinguished from previously described eimerians from crocodilians, including those from *A. mississippiensis*. We document two new species of *Eimeria* from the American alligator. Currently, four species of *Eimeria* are known from *A. mississippiensis* examined from both east and west of the Mississippi River, USA.

Stocking, G. and Everham III, E.M. (2024). American alligator (*Alligator mississippiensis*) behavioral ecology on the FGCU Campus. Aquila - The FGCU Student Research Journal (doi: 10.24049/aq.9.1.1).

Abstract: Wild animals often travel deeper into urban areas than they realize and find themselves confronted with an environment they do not understand. They may wander into heavily trafficked areas, get hit by cars, get frightened by people, or, if it happens to be a bird, fly into glass (Threats to wildlife 2018). The top predator, the American alligator (*Alligator mississippiensis*) is one of the native animals that still call Florida Gulf Coast University its home. The purpose of this research is to better understand how human activity and development affect the behaviors of the American alligators at Florida Gulf Coast University. Interactions between humans and alligators have become more frequent, so understanding how human presence and activity changes the detectability of these alligators is important to their long-term management on a human dominated landscape (Kidd-Weaver *et al*. 2022). This study focused on the ability to track radio-tagged alligators toward a visual sighting and whether this changes with time of day or location on campus. This project built on a previous study where alligators on the FGCU campus were captured, measured, gender-identified, radio-tagged, and released. This part of the study focused on the spatial ecology of movements of the American alligators based on gender. This phase of the study focused on the time of day they can be found and how this varies between more, to less-developed parts of the campus. Counts of visual locations versus non-visual locations were compared by time of day, campus location, and gender and tested for significant differences using Fisher's Exact Test. Alligators were visible 53% of the time when tracked. This did not vary significantly by gender or area of campus, though males showed some tendency to be more visible where there were less people (p= 0.173). Understanding the behavior of American alligators in a developing landscape is critical to the sustainable management of this species.

Rodrigues De Souza Neto, C.F., Sá Leitão Barboza, R., Maranhão Dos Santos, E. and De Sousa Correia , J.M. (2024). Predation of a neonate caiman, *Caiman latirostris* (Daudin, 1802) by red fire ants *Solenopsis* sp. in Atlantic Forest, North-eastern Brazil. Tropical Ecology (https://doi.org/10.1007/s42965-024-00337-w).

Abstract: Ants of the genus *Solenopsis* are highlighted as the potential nest predators of many crocodilian species. During a study on the aspects of the natural history of the broad-snouted caiman in a protected area of Atlantic Rainforest in Pernambuco, north-eastern Brazil, a predation event was documented during nest visiting activities related to reproduction monitoring. The predation of a *Caiman latirostris* neonate by red fire ants *Solenopsis* sp. was observed, a dead neonate *C. latirostris* hatchling was found partially out of its shell, soon after hatching, still in the nest and covered in red fire ants.

Morton, O., Nijman, V. and Edwards, D.P. (2024). Assessing and improving the veracity of international trade in captive-bred animals. Journal of Environmental Management 354 (https://doi.org/10.1016/j.jenvman.2024.120240).

Abstract: Captive breeding is often seen as a solution to sustainably increasing the supply of individuals in the wildlife trade. To be an effective conservation measure this requires robust systems to verify the authenticity of captive-bred species. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) monitors the international trade in Listed species - which for many taxa is dominated by captive-bred individuals - using the Review of Captive Trade (RCT) process. A key question is how best to identify laundered or inauthentic captive-bred trade and how has this changed over time and space. We develop targeted assessments based on multiple RCT criteria to identify probable instances of laundering and misuse of source and purpose codes in international trade records, and apply this to 39,167 records of captive trade from 2000 to 2020 spanning 53,674,762 individuals. We find a very low proportion of trade volume (1.8%, 37,835 individuals) misreported as originating from non-existent, registered Appendix I-breeding facilities, and low instances of exporter-reported captive trade being recorded by importers as wild-sourced (<4%) or ranched (1%). We also find that <2% of species-year-exporter records have abrupt shifts from wild to captive sources, potentially indicating laundering. Conversely, we find high incidences of exporter- and importer-reported trade differing in whether the trade was commercial or not - a phenomenon we attribute to differing definitions, not illegal activity. Our results indicate a low incidence of concerning international trade being reported, but we suggest this likely stems from reporting requirements that limit our assessments. We highlight additional trade data that, if embedded into Party's annual reports, would vastly improve inferential potential, greatly increasing the number of records (Appendix II and III species) that could be verified with minimal effort for management authorities.

Mateus Vargas, R.H., Arias-Pérez, V., Sandoval-Hernández, I., Hammerl, J.A. and Barquero-Calvo, E. (2024). American crocodiles (*Crocodylus acutus*: Reptilia: Crocodilidae) visiting the facilities of a freshwater aquaculture of the Northern Pacific region, Costa Rica, carry tetracycline-resistant *Escherichia coli*. Frontiers in Veterinary Science 11 (doi: 10.3389/fvets.2024.1374677).

Abstract: Apex predators are exposed to antimicrobial compounds and resistant microbes, which accumulate at different trophic levels of the related ecosystems. The study aimed to characterize the presence and the antimicrobial resistance patterns of fecal *Escherichia coli* isolated from cloacal swab samples obtained from wild-living American crocodiles (*Crocodylus acutus*) (n= 53). Sampling was conducted within the distinctive context of a freshwater-intensive aquaculture farm in Costa Rica, where incoming crocodiles are temporarily held in captivity before release. Phenotypic antimicrobial susceptibility profiles were determined in all isolates, while resistant isolates were subjected to whole-genome sequencing and bioinformatics analyses.The study aimed to characterize tetracyclineresistant *Escherichia coli* (*E. coli*) obtained from cloacal swab samples of 53 wild-living American crocodiles (*Crocodylus acutus*) captured in an aquaculture farm in Costa Rica for release purposes. Characterization was performed by antimicrobial susceptibility testing, whole-genome sequencing, and bioinformatics. In total, 24 samples contained tetracycline-resistant *E. coli* (45.3 %). Isolates carried either tet(A), tet(B), or tet(C) genes. Furthermore, genes conferring resistance to ß-lactams, aminoglycosides, fosfomycin, sulfonamides, phenicol, quinolones, trimethoprim, and colistin were detected in single isolates, with seven of them carrying these genes on plasmids. Genome sequencing further revealed that sequence types, prevalence of antibiotic resistance carriage, and antibiotic resistance profiles differed between the individuals liberated within the next 24 hours after their capture in the ponds and those liberated from enclosures after longer abodes. Due to their natural history, crocodiles may The overall presence of tetracycline-resistant *E. coli*, coupled with potential interactions with various anthropogenic factors before arriving at the facilities, hinders clear conclusions on the sources of antimicrobial resistance for the studied individuals. These aspects hold significant implications for both the aquaculture farm's biosecurity and the planning of environmental monitoring programs using such specimens. provide a vague picture about the regional epidemiology of antimicrobial resistance within the human-wildlife interface. Considering human-crocodile conflicts from the One Health perspective, the occurrence of antimicrobial resistance underscores the importance of systematical surveillance of antibiotic resistance development in American crocodiles.

Ayamba, A.J., Ajemalebu, T.K.T., Ajemalebu, H.N.A., Ajemalebu, N.J. and Ajemalebu, P.M.V. (2024). Distribution of Dwarf crocodile (*Osteolaemus tetraspis* Cope, 1861) populations on the outskirts of the Ebo Forest: Implications for conservation. American Journal of Environment Studies 7(1) (https://doi.org/10.47672/ajes.1768).

Abstract: The study was carried out in three riparian areas of the Ebo forest (Iboti, Lognanga and Ndokmem-North zones) to determine the distribution and status of dwarf crocodiles, and environmental factors influencing their distributions. Survey on the various listed sites were carried out during the months of April, May and June 2023. The Qgis software was used to produce the distribution map of dwarf crocodiles in the periphery of the Ebo forest from the coordinates recorded at 11 water points using a GPS and 37 fishermen/ hunters were interview. The species were classified according to their status defined according to the IUCN red list protocol. The study showed that of the 11 water points studied, 6 were home to dwarf crocodiles, representing a proportion of 54.54%. Although we did not observed dwarf crocodiles in the watercourses in the Iboti zone, their presence is more established in the Lognanga zone (60%) than in the Ndokmem-north zone (40%). The average density of dwarf crocodiles in the periphery of the Ebo forest is around 0.50 crocodiles/km of riverbank covered. This implies that the population of dwarf crocodiles is decreasing and there is high need to increase conservation efforts to protect it from disappearing within the Ebo forest area. To guarantee the survival and viability of crocodiles in the periphery of the Ebo forest, it is necessary to opt for organic agriculture, monitoring the quality of rivers and water bodies and regular ecological monitoring of crocodiles.

Quiling Jnr., T.R. (2024). Distress in the Agusan Marshlands: Mapping landscapes of fear in Francis Xavier Pasion's Bwaya (2014). Pp. 41-59 *in* Indigenous Media and Popular Culture in the Philippines. Palgrave Macmillan: Singapore.

Abstract: In March 2009, 12-year-old Rowena Romano, an Agusanon Manobo, was aboard one of two boats with a guardian, her classmate Jennifer Rodrigo, and a Save Mindanao Volunteers member, heading to a floating school on Lake Mihaba near the

town of Loreto in the province of Agusan when a 30-foot-long crocodile knocked over their boat and took Rowena. The incident occurred in the fourth largest province in the Philippines in terms of land area. Primarily occupying the province's vast marshlands, the Agusanon Manobo is one of Mindanao's eight Indigenous cultural communities. This chapter explores the illustrations of fear conveyed by the rural landscape in the film Bwaya ["Crocodile"] (dir. Francis Xavier Pasion, 2014) and the Indigenous characters' responses to the emotive qualities towards the rural landscape, which underlines fear as the primary sentiment for the Agusanon Manobos, given the crocodile attack. I inquire how the rural landscape portrayed in the film illustrates fear as experienced by the characters. Finally, I draw attention to the conceptions and the manifestations of fear outlined by Yi-Fu Tuan in Landscapes of Fear (1979), where the potential roots of human society's "Fear of Nature" correlate with Filipino conventions and Indigenous beliefs of the Agusanon Manobos that are represented in the selected film.

Rainwater, T.R., Singh, R., Tuten, C.A., Given, A.M., Gibbons, P.W., Song, B., Platt, S.G., Wilkinson, P.W. and Bodinof Jachowski, C.M. (2024). Fauna associated with American alligator (*Alligator mississippiensis*) nests in coastal South Carolina, USA. Animals 14: 620.

Abstract: Crocodilians are considered to be "ecosystem engineers" because their modification of habitats provides opportunities for feeding, drinking, breeding, and other vital life activities to a wide variety of other animals. One such habitat modification is the construction of nest mounds during the breeding season by most crocodilian species, including American alligators (*Alligator mississippiensis*). While many reports exist describing wildlife associated with alligator nests, no studies have quantified faunal associates and their corresponding behaviors while visiting nests. To address this data gap, we used automated game cameras to monitor wildlife and their behaviors at alligator nests during the egg incubation period (June-September) in coastal South Carolina, USA (2016-2021). We documented a total of 81 species (79 vertebrates and 2 invertebrates) at 78 alligator nests representing six taxonomic groups, including 48 birds (59.2%), 9 mammals (11.1%), 19 reptiles (23.4%), 3 amphibians (3.7%), 1 malacostracan (1.2%), and 1 insect (1.2%). Collectively, faunal associates primarily used alligator nests for feeding/foraging (51.8%), traveling (29.3%), and loafing (19.9%) and to a much lesser extent basking, burrowing/shelter, breeding, and nesting. However, trends in alligator nest use varied among faunal associate groups (birds, mammals, reptiles, amphibians, etc.), subgroups (eg passerines, raptors, wading birds, and waterfowl), and species. Several novel behaviors by some nest associates were also noted during the study, including the first observations of Virginia oppossum (*Didelphis virginiana*) opening and predating nests, bobcat (*Lynx rufus*) consuming alligator hatchlings, and Carolina wren (*Thryothorus ludovicianus*) feeding on the contents of a recently predated alligator egg. The results of this study indicate that a diverse assemblage of vertebrates (and some invertebrates) use alligator nest sites in coastal South Carolina for a variety of life activities during the egg incubation period, and the proportion of the behaviors exhibited varies among animal groups and species. This study provides a first step for investigations regarding the net impacts of alligator nest-faunal associate interactions and ultimately the greater ecological role of alligators and other crocodilians.

Luo, J., Zhang, M., Zeng, Y., Guo, H., Wu, X., Meng, Z. and Yin, R. (2024). Structural and functional properties of protein hydrolysates from myofibrillar protein of crocodile (*Crocodylus siamensis*) meat. LWT - Food Science and Technology 196: 115862.

Abstract: In this study, three proteases (papain, neutral protease, bromelain) were employed to hydrolyze crocodile (*Crocodylus siamensis*) myofibrillar protein (MP), effects of hydrolysis duration on functional and structural properties of MP hydrolysates was investigated. The findings revealed that solubility of all hydrolysates exceeded 60%, with the highest reaching 96.7%. The emulsifying activity of neutral protease hydrolysates exhibited a significant superiority over the other two hydrolysates ($P<0.05$). The Fe^{2+} chelating and DPPH radical scavenging activity of hydrolysates ranged from 20% to 60%, and 60%-90%, respectively. Based on the experiment results, the hydrolysates of papain at 1h, neutral protease at 1h, and bromelain at 2h were used for structural analysis. Compared to MP, the secondary structure of hydrolysates showed a reduction of 9.6%, 15.2%, and 4.7% in α-helix and the increase of 42.4%, 29.6%, and 44.2% in β-fold content of papain, neutral protease and bromelain hydrolysates respectively, suggesting the transition from spiral to folding structure and the exposure of hydrophobic group, which was proved by free amino acid analysis. SEM results confirmed the alterations in MP structure. The molecular weight distributions of three hydrolysates were predominantly below 1000 Da, demonstrating that crocodile MP was effectively hydrolyzed into bioactive peptides.

Ulfa, M., Mulyadi, M., Pujiono, M. and Nasution, K. (2024). A natural semantic metalanguage approach on the meaning of animal taboo names in the Acehnese culture. Studies in English Language 11(1): 491-509.

Abstract: This paper utilizes the Natural Semantic Metalanguage Approach (NSM) to explore the meanings of animal-related taboo names among the Acehnese in Indonesia. Through qualitative interviews with 12 respondents from Langsa City and Peureulak District in East Aceh, the NSM approach reveals two categories of animal taboos. The first, the taboo of swearing, involves offensive language equating individuals with animals like 'bui' (pig), 'asèe' (dog), 'pa'ee' (gecko), 'muruwa' (monitor lizard), and 'lemo' (cow). The second, the taboo of fear, rooted in cultural beliefs, deems certain animals sacred and prohibits mentioning their names in natural settings, including 'rimueng' (tiger), 'gajah' (elephant), 'buya' (crocodile), 'badeuk' (rhinoceros), 'uleue' (snake), and 'tikôh' (rat). Acehnese use alternative names to show respect, reflecting a belief that respecting nature facilitates harmonious living. The semantic primitive meaning of animals' taboo for swearing involves a substantive component, a substantive relational of a kind, and bad as an evaluator. Equating humans with these animals is prohibited when their names are used in the context of insulting others. The taboo of fear is attributed to the animals' perceived holiness and sacredness, with the semantic primitive involving something kind and bad. Acehnese believe these animals possess mystical powers and can hear their names when being called, hence suggesting the use of alternative names for these animals is preferable.

Williams, S. (2023). Evolutionary Analysis of Crocodilian β-Defensins: Structure and Function of *Crocodylus porosus* β-Defensin 13. PhD thesis, La Trobe University, Victoria, Australia.

Kojima, L.V., Kohl, M.T., Rainwater, T.R., Parrott, B.B. and Tuberville, T.D. (2024). Association of size, climatic factors, and mercury body burdens with movement behavior in American alligators. Science of the Total Environment (doi: 10.1016/j.scitotenv.2024.170859).

Abstract: Animal movement behavior provides insight into organismal and ecological function. These functions are often disturbed by anthropogenic influences, such as urbanization and habitat fragmentation, yet the effects of long-term exposures to environmental contaminants on movement have yet to be examined. The long lifespans and broad diets of crocodilians often lead to bioaccumulation of persistent contaminants and confer a marked vulnerability to consequent physiological effects. In this study, we investigate the relationships between blood concentrations of mercury (Hg), a widespread contaminant with well characterized neurotoxicity, and movement patterns in free living, naturally exposed American alligators (*Alligator mississippiensis*). We

sampled adult male alligators from two former nuclear cooling reservoirs with different Hg contamination histories and placed GPS transmitters on a subset of individuals from each reservoir (13 total). Data collected over the ensuing two years were analyzed using a linear mixed effects framework combined with AICc model selection to resolve the relationships linking seasonal alligator movement (daily activity (s) and daily distance (m)) and home range to climate conditions, individual traits, and blood Hg concentrations (mg/kg; wet weight). We found that climate conditions, alligator size (snout-vent length), and blood Hg concentrations all influence alligator daily activity but do not contribute to alligator daily movement (distance). Furthermore, we found that blood Hg concentrations were strongly correlated with seasonal home range size where individuals with elevated Hg had larger home ranges in spring, fall, and winter. These findings provide insight into how climate, anthropogenic contaminants, and individual traits relate to alligator movement patterns across seasons.

Castillo-Rodríguez, N., Saldarriaga-Gómez, A.M., Antelo, R. and Vargas-Ramírez, M. (2024). Population genetic structure in the critically endangered *Crocodylus intermedius* (Crocodilia: Crocodylidae): A shift in perspective for conservation actions in Colombia. Biological Journal of the Linnean Society XX (https://doi.org/10.1093/biolinnean/blad174).

Abstract: Conservation actions for threatened species and populations aim to preserve their genetic diversity and prevent issues such as inbreeding or outbreeding depressions. This perspective has been incorporated into the management plans proposed for the critically endangered Orinoco crocodile (*Crocodylus intermedius*) in Colombia. A previous study, which used mitochondrial cytochrome b and cytochrome c oxidase subunit I, suggested that the *in situ* population management of the Orinoco crocodile in Colombia does not face genetic restrictions. In this research, we re-evaluated this proposal by using an expanded sampling and additional molecular markers (microsatellite nuclear DNA and the mitochondrial D-loop) that have successfully identified crucial information at the population level in other crocodilians. Our findings reveal, for the first time, a pattern of population structure consisting of three genetic clusters with geographical correspondence, matching three ecoregions in the Colombian Orinoco basin. This pattern might be a historical and current consequence of the ecological, bioclimatic, and/or geographical features of the ecoregion. Additionally, we examined the correspondence with the genetic clusters of the confiscated individuals that formed part of the initial population (F0) of the Colombian *ex situ* species population and successfully assigned most of them to one of these clusters. The genetically distinct clusters should be regarded as independent management units for conserving and managing the species in Colombia.

Zhang, Q.Q., Tang, J., Wu, Y.F., Qian, C.Y., Qin, S., Cai, Z.H., Wang, H. and Xiao, H.M. (2024). Gelation of crocodile myofibrillar protein - κ-carrageenan mixtures in two low-NaCl solution. Food Chemistry (https://doi.org/10.1016/j.foodchem.2024.138753).

Abstract: Crocodile meat is a novel reptile meat source, but its processing method is rare. This study investigated the effect of κ-carrageenan addition and partial substitution of NaCl on the gel properties of crocodile myofibrillar protein (CMP). Result showed that CMP formed gel when temperature above 60°C. The water-holding capacity, gel strength, denaturation degree, sulfhydryl content covalent bond and hydrophobic bond of gel in KCl solution were significantly higher than those in CaCl2 solution ($P<0.05$). K^+ induced CMP to form a tight network structure with uniform small pores though covalent and hydrophobic bonds, but the gel properties were reduced by κ-carrageenan. In $CaCl_2$ solution, κ-carrageenan improved the gel structure by filling the protein network through hydrogen bonding. Therefore, it can be concluded that KCl is better than $CaCl_2$ in the manufacturing of low-sodium crocodile foods. Moreover, κ-carrageenan was only beneficial to gel quality in $CaCl_2$ solution.

Singh, R.K., AjjiM, J., Lang, J.W., Segu, H., Ramesh, H. and Vasudevan, K. (2024). Population genetics of gharial *Gavialis gangeticus* in the Chambal River, India, using novel polymorphic microsatellite markers. Endangered Species Research 53:127-138.

Abstract: The gharial *Gavialis gangeticus* is a Critically Endangered crocodylian endemic to the Indian subcontinent. The species has experienced a 95% population decline over the past 2 centuries. The largest self-sustaining population inhabits the protected National Chambal Sanctuary (NCS) in north India and represents >80% of extant gharials globally. We developed de novo a panel of polymorphic gharial-specific microsatellites, using whole genome information and microsatellite search tools. These 15 new markers have multiple numbers of polymorphic alleles that are more informative than those obtained from previous studies. Analyses of 93 scute samples collected across age classes from wild gharials residing in the NCS facilitated accurate assessments of genetic diversity and inbreeding coefficient and identified a historical bottleneck event. Estimates of the observed and expected heterozygosities were lower than those reported earlier. The inbreeding coefficient was low, and the population did not deviate significantly from Hardy-Weinberg equilibrium. The calculated M ratio and 2 heterozygosity tests detected a genetic bottleneck, which is consistent with historic sharp declines in population size, followed by recent recovery. These new gharial microsatellite markers are statistically robust and provide an improved means to assess the population genetics of the largest self-sustaining wild gharial population. This study will facilitate additional investigations on the genetic diversity of other extant gharial populations not only the few remaining wild populations but - also those in zoos and rearing facilities. Additional genetic studies of gharial in the NCS are warranted to inform management strategies.

Ayala, J.D., Schroeter, E.R. and Schweitzer, M.H. (2024). Porphyrin-based molecules in the fossil record shed light on the evolution of life. Minerals 14: 201.

Abstract: The fossil record demonstrates the preservation of porphyrins (eg heme) in organic sediments and the fossilized remains of animals. These molecules are essential components in modern metabolic processes, such as electron transport (cytochromes) and oxygen transport (hemoglobin), and likely originated before the emergence of life. The integration and adaptation of porphyrins and structurally similar molecules (eg chlorophylls) are key aspects in the evolution of energy production (ie aerobic respiration and photosynthesis) and complex life (ie eukaryotes and multicellularity). Here, we discuss the evolution and functional diversity of heme-bound hemoglobin proteins in vertebrates, along with the preservation of these molecules in the fossil record. By elucidating the pivotal role of these molecules in the evolution of life, this review lays the groundwork necessary to explore hemoglobin as a means to investigate the paleobiology of extinct taxa, including non-avian dinosaurs.

Pérez-González, E., Quintero-Borquez, I.P., Herrera-Moreno, M.N., Ley-Quiñónez, C.P., Polanco-Torres, A., González-Ocampo, H.A., Llanes-Cárdenas, O. and Salomón-Soto, V.M. (2024). Detection of organochlorine pesticides in infertile eggs of *Crocodylus acutus* from Sinaloa. Environ Sci Pollut Res Int (doi: 10.1007/s11356-024-32147-x).

Abstract: Environmental contaminants endanger human health and non-target organisms such as crocodiles (*Crocodylus acutus*) that live in aquatic bodies surrounding agricultural areas. Due to their intrinsic characteristics, these organisms could be bioaccumulating and transmitting organochlorine pesticides (OCs) to their eggs. The objectives of this study were to determine the OCs in infertile

eggs of *C. acutus* from Sinaloa and their correlation with the morphometric characteristics (MC), and to perform a preliminary estimate of the ecological risk due to the presence of pesticides using the PERPEST model. In June 2022, 76 infertile eggs (Ie) were collected: 57 from wild areas (Wa) and 19 from a crocodile farm (CSMf). Determination of OC in Ie was performed according to the USEPA method 8081b, modified. The observed percentages of Ie in Wa were 31.48% and 21.33% in CSMf. Twenty OCs were detected in the Ie, where dieldrin recorded the highest average concentration in Wa (6542.6 ng/g), and endosulfan-II in the CSMf (2172.8 ng/g). Bad negative and positive correlations were observed between OCs and MC, standing out the correlations between endosulfan-II and %Ie (-0.688) in the Wa, Cedritos drain, and between endrin and the weight of Ie (0.786) of the CSMf. The evaluation of the ecological risks of the aquatic environment due to the presence of OCs follow the sequence cyclodienes > aromatic > alicyclic hydrocarbons. A potential risk to the endocrine health of the species *C. acutus* was observed. Crocodiles are excellent biological models for monitoring the effects of OCs.

López-Pérez, J.E., Goessling, J.M. and Murray, C.M. (2024). Testing androgen-induced immunosuppression: Environmental androgens as a model system for steroid-immune interaction. Journal of Experimental Zoology A Ecology and Integrative Physiology (doi: 10.1002/jez.2795).

Abstract: It is well known that hormones influence and direct most facets of physiology; however, there is still contention regarding the directions of certain relationships, for example, between gonadal hormones and immunity. Among the many proposed relationships relating to gonadal-immune interactions, support for immunosuppressive effects of androgens remains prominent within physiological literature. Although ample study has been directed toward the immunosuppressive effects of androgens, considerable disagreement remains regarding their influence on immune function. In this study, we test the hypothesis that androgens inhibit immunocompetence in the American alligator (*Alligator mississippiensis*). Developing alligators were incubated at female-producing temperatures with a subset of individuals being exposed to 17-α-methyltestosterone (MT) before sexual determination. 17-α-methyltestosterone is a potent androgen, not aromatizable by crocodilians, that has been found to exert masculinizing effects in exposed crocodilian populations *in vivo* and *in vitro*. Additionally, a subset of animals was exposed to a novel antigen to quantify innate and acquired immune function. We recovered no significant differences in leukocyte ratios or proportions between groups and found no significant differences in innate immune function as measured by hemolysis-hemagglutination. However, we did find significant differences in acquired immune function, where masculinized individuals expressed greater antibody titers. Our findings reject the hypothesis that androgens suppress immune function; rather, androgens may be immunoenhancing to acquired humoral responses and neutral to innate humoral immunity in crocodilians.

Smaga, C.R., Bock, S.L., Johnson, J.M., Rainwater, T., Singh, R., Deem, V., Letter, A., Brunell, A. and Parrott, B.B. (2024). The influence of incubation temperature on offspring traits varies across northern and southern populations of the American alligator (*Alligator mississippiensis*). Ecology and Evolution 14(2): e10915.

Abstract: Maternal provisioning and the developmental environment are fundamental determinants of offspring traits, particularly in oviparous species. However, the extent to which embryonic responses to these factors differ across populations to drive phenotypic variation is not well understood. Here, we examine the contributions of maternal provisioning and incubation temperature to hatchling morphological and metabolic traits across four populations of the American alligator (*Alligator mississippiensis*), encompassing a large portion of the species' latitudinal range. Our results show that whereas the influence of egg mass is generally consistent across populations, responses to incubation temperature show population-level variation in several traits, including mass, head length, head width, and residual yolk mass. Additionally, the influence of incubation temperature on developmental rate is greater at northern populations, while the allocation of maternal resources toward fat body mass is greater at southern populations. Overall, our results suggest that responses to incubation temperature, relative to maternal provisioning, are a larger source of interpopulation phenotypic variation and may contribute to the local adaptation of populations.

Harrer, S., Ginal, P., Tan, W.C., Binaday, J.W., Diesmos, A.C., Manalo, R., Ziegler, T. and Rödder, D. (2024). Disappearing archosaurs - an assessment of established protected areas in the Philippines to save the critically endangered, endemic Philippine crocodile (*Crocodylus mindorensis*). Salamandra 60(1): 29-41.

Abstract: Once distributed all over the Philippines, the endemic Philippine crocodile (*Crocodylus mindorensis*) is nowadays threatened with extinction. It is estimated that less than 140 mature individuals live in the wild. Human activities like fishing and poaching, as well as land-use change and habitat conversion cause a continuing threat to the remaining populations. Therefore, designated protected areas (PAs) were evaluated with species distribution models (SDMs) and also to see if most suitable areas are covered by PAs in order to improve future conservation efforts. For this purpose, the existing IUCN-reserves were analysed for potential habitat suitability (combining bioclimatic and remote sensing variables), wetland occurrences and the human footprint index by using MaxEnt and QGIS. Based on species records, our final SDM showed high performance and revealed the climatically most suitable areas for the species, which were mostly on Luzon and Mindanao. However, only small parts of the climatically suitable wetlands are currently covered by reserves (0.3-46.3%). In addition, none of the species' records was located within a PA. The anthropogenic pressures in the reserves measured by human footprint index (considering eight variables ie 'population density', 'navigable waterways', 'crop lands' and 'roads') were diverse and varied between a low and moderate level. Most of the records were found in areas with a moderate human footprint. Considering the three criteria, 'Lake Lanao Watershed Reservation', 'Angat Watershed Forest Reserve District (Metro Water District)', 'Northern Sierra Madre Natural Park', 'Talaytay Protected Landscape' and 'Agusan Marsh Wildlife Sanctuary' revealed to be the most suitable conservation areas for *C. mindorensis*, whereas suitable areas outside PAs are highly recommended for further surveys. We recommend to declare Ligawasan Marsh, Mindanao as a PA as this area harbours a large population of *C. mindorensis*. The declaration of more climatically suitable areas with low level of human footprint to PAs is a necessary step for the long-term conservation of this endemic crocodile species. The current network of existing PAs needs improvement in order to provide well-suited and long-term protection for *C. mindorensis*. More surveys are also necessary to find hidden, so far overlooked populations and to assess *C. mindorensis* tolerance level for human impacts.

Bors, M.S., Gowri Shankar, P. and Gruszczynska, J. (2024). Current state of Mugger populations. Animals 14: 691.

Abstract: The mugger (*Crocodylus palustris*) is a medium-sized crocodilian inhabiting South Asia. As a result of intensive hunting, its range declined drastically up till the 1970s. Currently, the world mugger population is fragmented and threatened mainly by habitat loss and the consequences of human-crocodile conflict, being classified as Vulnerable by the IUCN. The goal of this paper is to comprehensively determine the mugger's current range, and assess risks in notable habitats of the species across its range. To determine the range and notable habitats, extensive literature covering surveys, monitoring, population studies and reports of human-crocodile

conflict was examined. Habitat suitability and risk assessment were performed by evaluating selected habitats using eight factors: the legal status of the area, elevation, surface water availability, water quality, salinity, availability of nesting and basking sites, interaction with humans and interspecific competition. Based on our findings, the chances of the mugger's survival varies greatly across its range and the threats they face are complex and often site-specific. Defining these threats is the first step for determining suitable risk mitigation efforts, some of which are explored in this review.

Teixeira Oliveira, A., Carvalho Santos, M.Q., Gonzaga Lemos, J.R., Almeida Santos, A.N., Cunha Guimarães, C., Soares Ribeiro, M.W., Faggio, C. and Rocha Aride, P.H. (2024). Hematological values of two species of Amazonian caimans, *Caiman crocodilus* and *Melanosuchus niger*. Research Square (doi: https://doi.org/10.21203/rs.3.rs-3962563/v1).

Abstract: The Amazon is one of the most biodiverse regions for crocodilians globally. Four of the five Amazonian caiman species exist in the Brazilian Amazon region. Determining hematological values is essential to provide baseline health and condition data. We evaluated the hematological parameters of free-living specimens of *Caiman crocodilus* and *Melanosuchus niger* from the middle Negro River region of Brazil. We captured 18 *C. crocodilus* and 16 *M. niger*, which averaged 60.5 ± 13.0 cm and 46.1 ± 18.5 cm in total length, respectively. Blood was drawn using syringes containing 10% EDTA, and blood parameters were determined according to the previously described methodology. The analyzed erythrocyte parameters were similar between the species, demonstrating that, despite presenting different sizes, they have similar strategies for absorption and transport of oxygen in the blood. In the morphological analysis of blood cells, erythrocytes, erythroblasts, thrombocytes, lymphocytes, neutrophils, azurophils, heterophils, and basophils were found and, in the quantification of leukocytes and thrombocytes, it was noted that lymphocytes are the central cells in the blood of *Caiman* of Amazonian. In the results found for plasma metabolites, no significant differences were observed between glucose and total protein levels. The information generated herein is intended to aid in establishing management plans, conservation, and farming of these species of Amazonian *Caiman*.

Rath, L.P., Dash, S.K., Khan, A., Mohapatra, R.K., Kumar, S., Nair, M.V., Paul, S. and Maharana, S. (2024). Monitoring the movement, habitat use and mortality of captive-bred reintroduced gharials in the Mahanadi River, India. Aquatic Conservation: Marine and Freshwater Ecosystems (https://doi.org/10.1002/aqc.4097).

Abstract: Gharials (*Gavialis gangeticus*) are endemic to the Indian subcontinent and meet IUCN Red List criteria for critically endangered. The Mahanadi River, located in the southernmost part of the Gharial range, currently has a few individuals survived although historically had many more. Between 2019 and 2021, the movement, habitat use and survival rate of 13 captive-bred (juvenile= 6, subadult= 5, adult= 2) reintroduced Gharials were monitored using very high frequency (VHF) radio transmitters tracked manually from the river banks. Kernel density estimates and generalized linear model (GLM) were used to investigate the home range and habitat use of individuals. Tagged gharials travelled throughout the river system, with the highest movement during summer and the least in winter. Females moved further and established larger linear home ranges than males. Kernel home ranges were established in and around the Satkosia Gorge wildlife sanctuary, which has favourable ecological conditions for gharials, namely, deep water, sandbars, abundant fish and low human disturbance. Gharial mortality was detected during the study, and post-mortem examination indicated anthropogenic causes. The use of explosives for fishing, entanglement in fishing nets and a lack of ecological awareness within local communities were identified as key factors that need to be addressed if Gharials are to survive the Mahanadi River.

Platt, S.G., Boutxakittilath, S., Thongsavath, O., Leslie, S.C., McCaskill, L.D., Singh, R. and Rainwater, T.R. (2024). First confirmed reproduction by a translocated female Siamese Crocodile *Crocodylus siamensis* (Crocodylidae: Crocodilia) with observations of nest attendance and nest-associated fauna. Journal of Threatened Taxa 16(2): 24760-24768.

Abstract: The Siamese Crocodile *Crocodylus siamensis* is considered one of the most imperiled and poorly-studied crocodilians in the world. Translocations (reintroductions) - often in conjunction with head-starting of juveniles - are a critical component of efforts to restore viable wild populations of *C. siamensis*. We here report the first confirmed nesting by a known-age, head-started, and translocated female *C. siamensis* together with observations of nest attendance and nest-associated fauna based on camera trap imagery. Our observations occurred in the Greater Xe Champhone Wetland Complex (GXCWC) in Savannakhet Province, Lao PDR. GXCWC encompasses 45,000 ha of seasonally inundated natural and anthropogenic wetlands, agricultural ecosystems, scrubland, and forest. While collecting eggs for incubation in May 2022, we were able to identify a unique series of notched tail scutes on a female *C. siamensis* as she aggressively defended a nest. From these markings we determined the female was hatched on 11 August 2012 (age= 9.75 years) and released in March 2014, approximately 3.5 km from the nest site. A game camera placed at the nest on 11 May 2022 and recovered on 5 July 2022 (34 trap nights) recorded 1724 images. These images indicated the female remained in attendance at the nest throughout the monitoring period. Camera trap imagery captured eight nest repair events and two nest defense events; during the latter the female defended the nest from village dogs. Eleven species of nest-associated fauna were recorded by the game camera, including eight and three species of birds and mammals, respectively. Our observations are the first confirmed nesting by a head-started, translocated female *C. siamensis* indicating these are effective conservation strategies for restoring wild populations. We also unequivocally established that head-started female *C. siamensis* are capable of reproducing when nine-years-old.

Carbajal, A., Serres-Corral, P., Olvera-Maneu, S. and Lopez-Bejar, M. (2024). Non-invasive measurement of glucocorticoids: The reptile perspective. Journal of Zoology (doi:10.1111/jzo.13157).

Abstract: Recent advancements in stress physiology, driven by the relevance of the stress response in animal welfare and conservation, have focused on alternative techniques beyond blood sampling for measuring glucocorticoids (GC). While blood samples have been traditionally used, practical and ethical concerns have spurred exploration into minimally invasive media like saliva, feces, milk, hair, and feathers. This review addresses the dearth of research on reptile endocrinology, offering insights into measuring GC or their metabolites in reptiles through various biological tissues. It underscores the importance of considering temporal dynamics in stress response evaluation and advocates for further exploration of alternative tools to enhance our understanding of reptilian stress responses.

Roth II, T.C. and Krochmal, A.R. (2024). Reptilian cognition. Current Biology Magazine 34: R117-R134.

Benítez-Moreno, J.A., Cedeño-Vázquez, J.R. and Castelblanco-Martínez, D.N. (2024). Community engagement and human perception in crocodile conservation: Preliminary steps in Sian Ka'an Biosphere Reserve. Frontiers in Conservation Science 5 (doi: 10.3389/fcosc.2024.1297960).

Abstract: Wildlife tourism is important for the conservation of protected areas, endangered species, and to empower of local communities. Nevertheless, when guidelines and practices are not clear and correctly executed, tourism has a negative impact. We

carried out semi-open interviews (n= 34) and several workshops (n= 50) with locals and tour guides in the village of Punta Allen in Sian Ka'an Biosphere Reserve, Mexico. Most respondents (69%) dedicated 2-10 min to crocodile observation, one quarter (25%) spent 11-20 min, and the remaining (6%) 21-30 min. The majority (97%) of respondents mentioned that when they see a crocodile, they approach at a 5-10 m distance and wait for the occupants of the boat to take pictures, and then leave; only one respondent (3%) said that they feed crocodiles to attract them to the boat. Most respondents (89%) said that crocodile observation does not need be improved, and it is fine the way it is currently carried out; the remaining 11% said that it could be improved. Workshops were received positively and allowed us to share information on crocodile species, their conservation and good tourism practices. It is necessary to enlighten tourism service providers about the biology and importance of crocodilian species, to promote conservation and provide services with an educational impact/focus for visitors to the reserve. There is a need to develop a communication program that provides accurate information for new service providers and renews and reinforces concepts for established providers. Additionally, we need to continuously monitor and evaluate wildlife observation activities to enhance current practices, and to determine if they are having a negative impact on crocodile behavior and biology.

Dos Santos, R.L., Freire Mariz Jr, C., Braga Mascarenhas-Júnior, P., Leitão Barboza, R.S., Maranhão Dos Santos, E., de Sousa Correia, J.M. and Martins de Carvalho, P.S. (2024). Nondestructive evaluation of metal bioaccumulation and biochemical biomarkers in blood of Broad-snouted caiman (*Caiman latirostris*) from northeastern Brasil. Environmental Toxicology and Chemistry (doi: 10.1002/etc.5823).

Abstract: Studies on the bioaccumulation and toxicity of contaminants in crocodylians are scarce. We evaluated alterations in concentrations of the nondestructive biomarkers butyrylcholinesterase (BChE), glutathione-S-transferase (GST), superoxide dismutase (SOD), and reduced glutathione (GSH), together with bioaccumulation of the metals iron (Fe), copper (Cu), zinc (Zn), manganese (Mn), chronium (Cr), aluminium (Al), and lead (Pb) in *Caiman latirostris* captured in Tapacurá Reservoir (TR; São Lourenço da Mata, Pernambuco, Brasil), in urbanized areas of Pernambuco State (UA; Brasil) and from the AME Brasil caiman farm (AF; Marechal Deodoro, Alagoas, Brasil); the latter was used as a potential reference with low levels of contamination. For metal analysis, 500 μL of blood was digested in 65% HNO_3 and 30% H_2O_2. The samples were analyzed by inductively coupled plasma-optical emission spectrometry. For analysis of biomarkers, an aliquot of blood was centrifuged to obtain plasma in which biochemical assays were performed. Blood concentrations of metals analyzed in animals from AF were lower compared with TR and UA, confirming that animals from the caiman farm could be used as references with low levels of contamination. Iron, Cu, Mn, Al, and Pb exceeded toxic levels for other vertebrates in animals from TR and UA. Butyrylcholinesterase activity showed significant reduction in adults from UA and TR compared with AF. An increase in the activity of GST and GSH, in adults of TR and UA in relation to AF, was verified. Superoxide dismutase activity showed a significant reduction in adults of TR in relation to AF, and the concentrations of Cu and Mn were negatively correlated with SOD activity. Animals from UA and TR showed greater concentrations of the analyzed metals compared with reference animals, and changes in biomarkers were seen, confirming the potential of these nondestructive chemical and biological parameters in blood of *C. latirostris* for biomonitoring of pollution.

Sales-Oliveira, V.C., Dos Santos, R.Z., Gomes Goes, C.A., Milan Calegari, R., Garrido-Ramos, M.A., Altmanová, M., Ezaz, T., Liehr, T., Porto-Foresti, F., Utsunomia, R. and Cioffi, M.B. (2024). Evolution of ancient satellite DNAs in extant alligators and caimans (Crocodylia, Reptilia). BMC Biology 22(1) (doi: 10.1186/s12915-024-01847-8).

Abstract: Crocodilians are one of the oldest extant vertebrate lineages, exhibiting a combination of evolutionary success and morphological resilience that has persisted throughout the history of life on Earth. This ability to endure over such a long geological time span is of great evolutionary importance. Here, we have utilized the combination of genomic and chromosomal data to identify and compare the full catalogs of satellite DNA families (satDNAs, ie the satellitomes) of 5 out of the 8 extant Alligatoridae species. As crocodilian genomes reveal ancestral patterns of evolution, by employing this multispecies data collection, we can investigate and assess how satDNA families evolve over time. Alligators and caimans displayed a small number of satDNA families, ranging from 3 to 13 satDNAs in *A. sinensis* and *C. latirostris*, respectively. Together with little variation both within and between species it highlighted long-term conservation of satDNA elements throughout evolution. Furthermore, we traced the origin of the ancestral forms of all satDNAs belonging to the common ancestor of Caimaninae and Alligatorinae. Fluorescence *in situ* experiments showed distinct hybridization patterns for identical orthologous satDNAs, indicating their dynamic genomic placement. Alligators and caimans possess one of the smallest satDNA libraries ever reported, comprising only four sets of satDNAs that are shared by all species. Besides, our findings indicated limited intraspecific variation in satellite DNA, suggesting that the majority of new satellite sequences likely evolved from pre-existing ones.

He, F., Svenning, J-C., Chen, X., Tockner, K., Kuemmerle, T., le Roux, E., Moleón, M., Gessner, J. and Jähnig, S.C. (2024). Freshwater megafauna shape ecosystems and facilitate restoration. Biological Reviews of the Cambridge Philosophical Society (doi: 10.1111/brv.13062).

Abstract: Freshwater megafauna, such as sturgeons, giant catfishes, river dolphins, hippopotami, crocodylians, large turtles, and giant salamanders, have experienced severe population declines and range contractions worldwide. Although there is an increasing number of studies investigating the causes of megafauna losses in fresh waters, little attention has been paid to synthesising the impacts of megafauna on the abiotic environment and other organisms in freshwater ecosystems, and hence the consequences of losing these species. This limited understanding may impede the development of policies and actions for their conservation and restoration. In this review, we synthesise how megafauna shape ecological processes in freshwater ecosystems and discuss their potential for enhancing ecosystem restoration. Through activities such as movement, burrowing, and dam and nest building, megafauna have a profound influence on the extent of water bodies, flow dynamics, and the physical structure of shorelines and substrata, increasing habitat heterogeneity. They enhance nutrient cycling within fresh waters, and cross-ecosystem flows of material, through foraging and reproduction activities. Freshwater megafauna are highly connected to other freshwater organisms via direct consumption of species at different trophic levels, indirect trophic cascades, and through their influence on habitat structure. The literature documenting the ecological impacts of freshwater megafauna is not evenly distributed among species, regions, and types of ecological impacts, with a lack of quantitative evidence for large fish, crocodylians, and turtles in the Global South and their impacts on nutrient flows and food-web structure. In addition, population decline, range contraction, and the loss of large individuals have reduced the extent and magnitude of megafaunal impacts in freshwater ecosystems, rendering a posteriori evaluation more difficult. We propose that reinstating freshwater megafauna populations holds the potential for restoring key ecological processes such as disturbances, trophic cascades, and species dispersal, which will, in turn, promote overall biodiversity and enhance nature's contributions to people. Challenges for restoration actions include the shifting baseline syndrome, potential human-megafauna competition for habitats and resources, damage to property, and risk to human life. The current lack of historical baselines for natural

distributions and population sizes of freshwater megafauna, their life history, trophic interactions with other freshwater species, and interactions with humans necessitates further investigation. Addressing these knowledge gaps will improve our understanding of the ecological roles of freshwater megafauna and support their full potential for facilitating the development of effective conservation and restoration strategies to achieve the coexistence of humans and megafauna.

Oskyrko, O., Mi, C., Meiri, S. and Du, W. (2024). ReptTraits: a comprehensive dataset of ecological traits in reptiles. Scientific Data 11, Article: 243.

Abstract: Trait datasets are increasingly being used in studies investigating eco-evolutionary theory and global conservation initiatives. Reptiles are emerging as a key group for studying these questions because their traits are crucial for understanding the ability of animals to cope with environmental changes and their contributions to ecosystem processes. We collected data from earlier databases, and the primary literature to create an up-to-date dataset of reptilian traits, encompassing 40 traits from 12,060 species of reptiles (Archelosauria: Crocodylia and Testudines, Rhynchocephalia, and Squamata: Amphisbaenia, Sauria, and Serpentes). The data were gathered from 1288 sources published between 1820 and 2023. The dataset includes morphological, physiological, behavioral, and life history traits, as well as information on the availability of genetic data, IUCN Red List assessments, and population trends.

Obuse, S. and Shibata, M. (2024). New goniopholidid specimens from the Lower Cretaceous Kitadani Formation, Tetori Group, Japan. Annales de Paléontologie 110(1) (https://doi.org/10.1016/j.annpal.2023.102661).

Abstract: New crocodyliform fossils have been discovered from the Lower Cretaceous Kitadani Formation of the Tetori Group, Fukui, Japan. They include skull elements (premaxilla, maxilla, parietal, quadrate and dentary), postcranium elements (dorsal vertebra, caudal vertebra, femur and osteoderm) and isolated teeth, and are described as goniopholidid crocodyliforms. Phylogenetic analysis resulted in nesting the Kitadani goniopholidid at the basal position of Goniopholididae and one autapomorphy is recognized: presence of the parietal sagittal crest. In addition, the narrow snout and a heterodont dentition in jaws of this goniopholidid is a unique combination of rostral morphology among Goniopholididae. Generally, the basal taxa bear a narrow snout with homodont dentition, and the heterodont dentition is seen in derived broad-snouted taxa. Judging from those rostral shape and dentitions, the Kitadani form possessing acute caniniform and blunt teeth tends to be more opportunistic as foraging strategy than other basal narrow-snouted goniopholidids with only acute caniniforms throughout. Our new discovery is the first osteological report of Japanese Cretaceous crocodyliform. *Siamosuchus phuphokensis* from the Early Cretaceous Sao Khua Formation, Khorat Group also shows combination of basal and derived cranial characters. Transitional species from Asia suggest allopatric speciation of goniopholidid in geographically intermediate Asian area.

Thuwakum, W., Manimmanakorn, A., Chaeychomsri, W., Siruntawineti, J. and Sukjit, S. (2024). The effect of hypoxic exercise combined with crocodile blood supplementation on aerobic capacity and hematological variables in athletes. Physical Education Theory and Methodology 24(1): 95-101.

Abstract: This study aimed to compare the effects of hypoxic exercise combined with crocodile blood supplementation on hematological and maximum oxygen consumption parameters in soccer players. This study included 39 male soccer players aged 21.69 ± 1.98 years who were randomized to three groups. All groups performed the same training program, which comprised treadmill exercise at 70-75% of maximum heart rate for 7 weeks with sessions of 30 min/day and 3 days per week. The first group was the control placebo group (CG, n= 13), the second group received one capsule per day (60 mg) of a freeze-dried crocodile blood supplement (SUP, n= 13), and the third group received the freeze-dried crocodile blood supplement and performed the training program under hypoxic conditions (H-SUP, n= 13, FiO_2= 16.3%). A hematological evaluation was conducted and maximal oxygen uptake (VO_2max) was measured using the Bruce protocol treadmill test. The H-SUP group demonstrated significantly higher erythropoietin (EPO) levels (14.40 ± 2.41 mIU/mL) compared to the SUP group (11.50 ± 2.08 mIU/mL) and CG (12.01 mIU/mL) after the intervention. From pre- to post-intervention, VO_2max significantly increased in the H-SUP (Pre: 45.63 ± 4.75, Post: 49.33 ± 5.81) and SUP groups (Pre: 44.59 ± 4.75, Post: 47.30 ± 5.68) but not in the CG. This study reveals that a combination of freeze-dried crocodile blood supplementation and hypoxic exercise causes hematological alterations, particularly the activation of EPO secretion, and increases VO_2max in soccer players.

Pritz, M.B. (2024). Nuclei and tracts in the thalamus of crocodiles. Journal of Comparative Neurology (https://doi.org/10.1002/cne.25595).

Abstract: The thalamus is one of the most important divisions of the forebrain because it serves as the major hub for transmission of information between the brainstem and telencephalon. While many studies have investigated the thalamus in mammals, comparable analyses in reptiles are incomplete. To fill this gap in knowledge, the thalamus was investigated in crocodiles using a variety of morphological techniques. The thalamus consists of two parts: a dorsal and a ventral division. The dorsal thalamus was defined by its projections to the telencephalon, whereas the ventral thalamus lacked this circuit. The complement of nuclei in each part of the thalamus was identified and characterized. Alar and basal components of both the dorsal and ventral thalamus were distinguished. Although some alar-derived nuclei in the dorsal thalamus shared certain features, no grouping could account for all of the known nuclei. However, immunohistochemical observations suggested a subdivision of alar-derived ventral thalamic nuclei. In view of this, a different approach to the organization of the dorsal thalamus should be considered. Development of the dorsal thalamus is suggested to be one way to provide a fresh perspective on its organization.

Swords, A., Cramberg, M., Parker, S., Scott, A., Sopko, S., Taylor, E. and Young, B.A. (2024). The Crocodylian proatlas functions to redistribute venous blood and cerebrospinal fluid. Journal of Morphology 285(3) :e21683.

Abstract: The proatlas, a bone located between the skull and the neural spines of the cervical vertebrae, is best known from reptiles. Most previous studies of the proatlas have centered on its developmental, debating the relationship between the proatlas and the cervical neural arches. The present study was intended as a description of the proatlas in the American alligator (*Alligator mississippiensis*) and an experimental test of its hypothesized role in venous blood and cerebrospinal fluid (CSF) distribution. In *Alligator*, the proatlas is chevron-shaped; ventrally it has a loose connection to the dorsal surface of the first cervical vertebrae, dorsally it has a robust elastic tissue tether on the otoccipital and supraoccipital bones. The ventral surface of the proatlas parallels the dorsal margin of the foramen magnum and rests on the dorsal surface of the spinal venous sinus. Experimental manipulation of the proatlas demonstrated that displacement of the proatlas causes pressure changes in both the spinal venous sinus and the enclosed spinal CSF. The results of this study represent the first demonstration of an explicit functional role for the proatlas, the circulation of fluids between the cranial and spinal compartments of the central nervous system.

Arguedas, R. and Troiano, J.C. (2024). Disease ecology in terrestrial reptiles from Latin America: A call for research. *In* Ecology of Wildlife Diseases in the Neotropics, ed. by G. Acosta-Jamett and A. Chaves. Springer: Cham.

Abstract: Latin America comprises continental and insular lands from Mexico to Argentina, including Caribbean islands and the Galapagos archipelago. Population declines due to anthropogenic causes such as habitat fragmentation, pollution, invasive species, and global climate change are affecting reptile populations, but there is almost no information about how diseases may affect wild reptiles, and there are few reports on this topic. Most of the studies regarding infectious diseases have been performed in captive animals with mainly known diseases. These studies are important since the legal and illegal trade of reptiles is a constant threat and a massive problem in the region, and potential transmission to wild animals is always a concern. Despite these approaches, studies involving disease ecology are scarce, and most of the research done in reptile health focuses mostly on parasite identification and clinical pathology. This chapter explores the research done on captive animals as a preliminary and important source of information that can be extrapolated to wildlife studies as well as the threat that the reptile trade imposes on wild animals. Finally, the authors propose some urgent studies that have to be done in terms of disease ecology considering the evaluated aspects before.

Narvaez, I., de Celis, A., Escaso, F., de Jesús, S.M., Pérez-García, A. and Ortega, F. (2024). A new Crocodyloidea from the middle Eocene of Zamora (Duero Basin, Spain). The Anatomical Record (doi: 10.1002/ar.25422).

Abstract: The eusuchian crocodyliforms recorded in the Eocene levels of the Spanish Duero Basin belong to three lineages: Planocraniidae, with the species *Duerosuchus piscator*; Alligatoroidea, represented by several specimens of the genus *Diplocynodon*; and Crocodyloidea, which includes several specimens traditionally attributed to *Asiatosuchus*. The genus *Asiatosuchus*, established in 1940 based on a middle Eocene species from Mongolia, has subsequently served as a wastebasket taxon for Paleogene remains belonging to several species, not only from Asia but also belonging to the European and North American records. Many of these species are known by highly fragmentary remains, sharing the presence of characters such as a flat and triangular skull, and long symphyses in the lower jaw, recognized as characteristic for the crocodyloids. In addition to isolated cranial remains, among the material traditionally attributed to Asiatosuchus at the Duero Basin stands out a nearly complete skull and a left mandible, from the middle Eocene area of Casaseca de Campe an (Zamora Province). The present study analyses in detail these specimens, previously reported during the 1980s, but analyzed in a very preliminary way. They are included for the first time in a phylogenetic analysis to establish the systematic position of this Spanish form. The results confirm that it corresponds to a new species of basal crocodyloid, defined here as *Asiatosuchus oenotriensis* sp. nov.

Piombino-Mascali, D., Jankauskas, R., Piličiauskienė, G., Girčius, R., Ikram, S., Caliò, L.M. and Messina, A. (2023). Crocodile rock! A bioarchaeological study of ancient Egyptian reptile remains from the National Museum of Lithuania. Archaeologia Lituana 24: 115-123.

Abstract: Remnants of what was believed to be a single baby crocodile, originating from ancient Egypt and curated in the National Museum of Lithuania, have been recently assessed using noninvasive and nondestructive techniques. These had been donated in 1862 to the then Museum of Antiquities by the prominent Polish-Lithuanian collector Count Michał Tyszkiewicz. After careful investigation of the three mummified reptile fragments available, the authors were able to identify at least two individuals based on morpho-anatomical characteristics. This indicates that the two small crocodiles originally described in historic records are still present within the collection and that none of these items was lost during the different lootings perpetrated throughout the museum's history. Information regarding the post-mortem treatment of these animals was also obtained. This is the first scientific study of animal mummies in the Baltic States, and it should be followed by proper conservation and display of these findings.

Balaguera-Reina, S.A., Mason, B.M., Brandt, L.A., Hernandez, N.D., Daykin, B.L., McCaffrey, K.R., Godfrey, S.T. and Mazzotti, F.J. (2024). Ecological implications of allometric relationships in American alligators (*Alligator mississippiensis*). Scientific Reports 14: Article number 6140.

Abstract: Morphometric allometry, the effect of size on morphological variation, has been of great interest for evolutionary biologist and is currently used in fields such as wildlife ecology to inform management and conservation. We assessed American alligator (*Alligator mississippiensis*) morphological static allometry across the Greater Everglades ecosystem in South Florida, United States using a robust dataset (~22 years) and investigated effects of sex, habitat, and sampling area on morphological relationships. Regression models showed very strong evidence of a linear relationship between variables explaining equal to or above 92% of the variation in the data. Most trait-size relationships (8 out of 11 assessed) showed hyperallometry (positive allometry) with slope deviations from isometry between 0.1 and 0.2 units while the other three relationships were isometric. Sampling area, type of habitat, and in a lesser extent sex influenced allometric coefficients (slope and intercept) across several relationships, likely as result of differing landscapes and ecosystem dynamic alterations and sexual dimorphism. We discuss our findings in terms of the biology of the species as well as the usefulness of our results in the context of ecosystem restoration and conservation of the species. Finally, we provide recommendations when using trait-length relationships to infer population nutritional - health condition and demographics.

Kidd-Weaver, A.D., Rainwater, T.R., Hoog, M.E. and Bodinof Jachowski, C.M. (2024). Investigating the impact of human disturbance on predator behaviour in human-dominated landscapes. Animal Behaviour 211: 13-24.

Abstract: Human-wildlife interactions are increasing globally due to human population growth and development. Wildlife often develop an increased tolerance of humans through the learning processes of habituation, but habituation of large predators can increase risks to humans. Aversive conditioning is a management strategy that operationalizes learning to reduce wildlife tolerance of humans and thereby improve human safety. However, developed landscapes may select for wildlife phenotypes that are resistant to learning via aversive conditioning. We investigated American alligators', *Alligator mississippiensis*, response to capture and release (an assumed aversive experience) in coastal resort communities as a model system for understanding wildlife learning in human-dominated landscapes. Our objectives were to investigate whether the degree of human disturbance in the landscape was associated with baseline alligator tolerance of humans or mediated alligators' learning ability. We quantified tolerance using flight initiation trials and estimated learning ability as the response to capture and release using a 'before-after control impact' experimental design. Baseline alligator tolerance did not vary with disturbance, nor did the degree of disturbance impact alligator learning. However, alligators in areas where capture and release occurred were 1.5 times more likely to flee from an approaching human after treatment relative to before. Alligators in control units exhibited similar tolerance to humans over time. Alligator tolerance was also influenced by ambient weather, with alligators least tolerant of humans in cool and cloudy conditions and most tolerant in warm conditions, likely reflecting physiological constraints of ectothermy. While human-dominated landscapes may promote high tolerance of humans through habituation, our findings

indicate that high tolerance does not preclude future learning by crocodilians and collectively lend credibility to the use of repeated capture and release as a potential form of aversive conditioning for crocodilians.

Alibardi, L. (2024). Speculations on the loss of regeneration derived from developmental modifications during land adaptation in some evolutionary lineages of animals. Acta Zoologica (https://doi.org/10.1111/azo.12498).

Abstract: Regeneration varies largely among metazoans. Aside molecular processes, this epiphenomenon depends on the biological complexity and evolutive history of each species during the adaptation to their specific environment. While most species adapted to marine or freshwater conditions can extensively regenerate, those adapted to terrestrial conditions and parasitism lost the ability to regenerate. They are mainly represented from ascelmintes evolving eutely and numerous arthropods and amniotes. High regeneration can only occur in water-adapted species and requires high tissue hydration, indirect development through metamorphosis and often also presence of asexual propagation. Metamorphosis allows the anatomical-physiological transformation of a larva in an adult through an initial destructive phase followed by a constructive (regenerative) phase. Invertebrates and vertebrates that possess genomes including metamorphic genes can re-utilize in part or largely similar genes for the regeneration of lost organs. I submit that during land adaptation in both invertebrates and vertebrates the initial larval stages and metamorphosis were lost or altered as some key genes, including those for telomerases, could no longer be expressed in the dry environment. Consequently, also the initial regenerative ability was lost while other epiphenomena were gained, including complex immunity and behaviour but also an evident process of ageing.

Honegger, R.E. (2024). Vom Drachen zum Krokodil - Ein illustriertes Feuilleton - Anmerkungen zu frühen Krokodilen in einigen nicht englischsprachigen Teilen Europas (Teil II). Sekretär 24(1): 21-70.

[From dragon to crocodile - an illustrated feature article - Notes on early crocodiles in some non-English languages Sharing Europe – (Part II)]

Jewitt, D., Van Der Westhuisen, R. and Armstrong, A. (2024). An assessment of survey techniques using Unmanned Aerial Vehicles to monitor Nile crocodiles (*Crocodylus niloticus*). Drone Systems and Applications (https://doi.org/10.1139/dsa-2023-0124).

Abstract: Monitored populations of the Nile crocodile *Crocodylus niloticus* at the southern end of its distribution, in the KwaZulu-Natal province of South Africa, are largely in decline. Trophy hunting of wild Nile crocodiles is only permitted at Pongolapoort Dam in the province, and monitoring of this population is required to enable the setting of annual hunting quotas. The aims of this study were to determine the feasibility of using drones to count and measure Nile crocodiles in the inlet to the dam and evaluate the utility of photo mosaics, individual photographs and videos for this purpose. A total of 16.5 km of shoreline was surveyed and 183 sub-adult and adult crocodiles observed, averaging 10.74 crocodiles per kilometer. The use of drones was cost-effective compared to traditional survey methods even though a higher number of person hours were required for data collection and processing. We recommend that drones be used to acquire video footage, supplemented by photo mosaics in areas where large aggregations of crocodiles occur, to regularly monitor this crocodile population.

Chaiwattanarungruengpaisan, S., Thongdee, M., Arya, N., Paungpin, W., Sirimanapong, W. and Sariya, L. (2024). Diversity and genetic characterization of *Chlamydia* isolated from Siamese crocodiles (*Crocodylus siamensis*). Acta Tropica 253 (https://doi.org/10.1016/j.actatropica.2024.107183).

Abstract: Chlamydiosis, an infection caused by several *Chlamydia* species, has been reported in Nile, saltwater, and Siamese crocodiles. Despite its widespread reports in various countries, including Thailand, genetic information on *Chlamydia* species remains limited. This study presents a whole-genome-based characterization of Siamese crocodile-isolated *Chlamydia*. The results showed that Siamese crocodile *Chlamydia* contained a single circular chromosome with a size of 1.22-1.23 Mbp and a plasmid with a size of 7.7-8.0 kbp. A plasmid containing eight coding sequences (CDSs) was grouped in a β lineage. A chromosome sequence had approximately 1018-1031 CDSs. Chlamydial factors involving virulence were documented in terms of the presence of cytotoxins and several virulence factors in the chromosomes of Siamese crocodile *Chlamydia*. The analysis of antimicrobial resistance genes in the *Chlamydia* genome revealed that the most common resistance genes were associated with aminoglycosides, fluoroquinolones, macrolides, tetracyclines, and cephalosporins, with loose matching (identities between 21.12% and 74.65%). Phylogenetic analyses, encompassing the assessments of both whole proteome and nine taxonomic markers, revealed that Siamese crocodile *Chlamydia* was separated into three lineages (lineages I-III) with high bootstrapping statistic support. Interestingly, isolate 12-01 differed genetically from the others, suggesting that it is a new member of *Chlamydia*. The study findings indicate that Siamese crocodiles are susceptible hosts to *Chlamydia*, involving more than one species. This study is the first employing the highest number of whole-genome data on Siamese crocodile *Chlamydia* and provides better insights into pathogen genetics.

Baez, J.C. (2024). Editorial: Biology and ecology of marine air-breathing animals: challenges for their conservation. Frontiers in Marine Science 11 (https://doi.org/10.3389/fmars.2024.1388682).

Littig, B.F., Beloto, L.M., Lara, N.R.F., Bassetti, L.A.B., Ferreira, R.V.M., Verdade, L.M., Camargo, P. and Marques, T.S. (2024). Effects of anticoagulants time storage on stable isotope values of crocodilians' blood tissues. Preprint from Authorea Preprints (https://doi.org/10.22541/au.171044223.34864676/v1).

Abstract: Rapid coagulation of reptile blood often hinders its use in studies in remote and difficult-to-access areas, necessitating chemical preservation. Therefore, understanding the potential effects of anticoagulants on the isotopic compositions of blood is essential to avoid issues in interpreting the results of ecological studies. In this study we aimed to verify whether the storage time of the blood tissue in anticoagulants can influence its isotopic compositions of the broad-snouted caiman (*Caiman latirostris*), an ectothermic top predator from eastern South America. Blood samples were obtained from ten adult females of *C. latirostris* from a commercial breeding facility in 2015. Samples were stored in vials containing EDTA and SH and centrifuged after 2 and 8 hours to separate red blood cells and plasma. No effect of time was found on the δ C and δ N of whole blood, plasma, and red cells in contact with the two types of anticoagulants, EDTA and SH. The findings have practical implications for researchers in this field, as they suggest that anticoagulants can be used effectively for at least 8 hours under refrigeration.

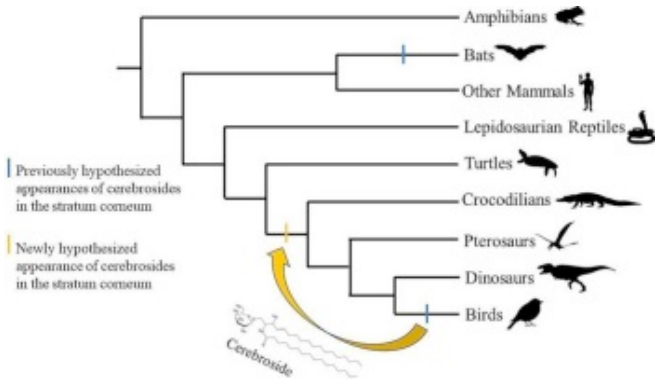
Small, A., Niemeyer, D. and Hewitt, L. (2023). Evaluation of a commercial electrical stunning method for farmed grower saltwater crocodiles (*Crocodylus porosus*) using non-invasive EEG measurements. Animal Welfare 32 (doi: 10.1017/awf.2023.45).

Abstract: The aim of this study was to assess welfare outcomes of electrical stunning as a means of restraint in farmed grower saltwater crocodiles (*Crocodylus porosus*). Physical handling of a stunned,

unconscious crocodile is far safer for the operator than handling a fully conscious animal. Electroencephalogram (EEG) was recorded before and after the application of electrical stunning at 50 Hz or 400 Hz using an electrical stunner applied to the cranial plate (Position 1: P1-50 Hz; n= 31, P1-400 Hz; n= 29) or immediately behind the skull (Position 2: P2-50 Hz; n= 29; P2-400 Hz; n= 30). For all electrical stuns, percentage total EEG power in a 10-s epoch decreased in the alpha and beta frequency bands; and increased in the delta and lower frequencies bands. All electrical stuns resulted in increased strength of signal, based on the quadratic mean EEG power in all frequency bands of the EEG. Greatest change in power occurred in the delta frequency band, with P1-50 Hz. This was greater than with P2-50 Hz; while decibel change using 400 Hz at either position was intermediate and not significantly different from either. Application of either electrical stunner at position 1 resulted in seizure-like activity and activation in low frequencies, but at position 2 this was not consistent across all animals. The ability of the electrical stunning equipment to consistently induce recoverable unconsciousness could be ranked in decreasing order as: P1-50 Hz>P1-400 Hz= P2-50 Hz>P2-400 Hz. Based on behavioural observations, all animals in the study appeared to stunned however evaluation of duration of EEG changes indicates that use of the electrical stunning equipment at 50 Hz would allow some margin for inaccuracies in tong placement, while achieving a consistently reliable stun.

Tam, E.A., Robb, F.E. and Champagne, A.M. (2024). Lipids in the American alligator stratum corneum provide insights into the evolution of vertebrate skin. Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology 292 (https://doi.org/10.1016/j.cbpa.2024.111620).

Abstract: In terrestrial vertebrates, the outermost layer of the skin, the stratum corneum (SC), provides a durable and flexible interface with the environment and is comprised of corneocytes embedded in lipids. However, the morphology and lipid composition of the SC varies throughout evolutionary history. Because crocodilians and birds phylogenetically bracket the Archosaurian clade, lipid composition in crocodilian SC may be compared with that of birds and other vertebrates to make inferences about broader phylogenetic patterns within Archosaurs while highlighting adaptations in vertebrate skin. We identified and quantified lipid classes in the SC of the American alligator (*Alligator mississippiensis*) from three skin regions varying in mobility. Our results find similarities in lipid composition between alligator and avian SC, including a high percentage of cerebrosides, a polar lipid previously found only in the SC of birds and bats. Furthermore, polar lipids were more abundant in the most mobile region of the SC. Because polar lipids bind with water to increase skin hydration and therefore its pliability under physical stress, we hypothesize that selection for lipids in Archosaurian SC was driven by the unique distribution of proteins in the SC of this clade, and cerebrosides may have served as pre-adaptations for flight.



He, J., Feng, C., Kuang, L., Han, L., Jia, W., Bai, H. and Jiang, J. (2024). A numerical study on the hydrodynamics of a swimming crocodile model. Physics of Fluids 36 (doi: 10.1063/5.0191371).

Abstract: Aiming to uncover the propulsion mechanisms underlying a cruising crocodile, we conduct computational fluid dynamics (CFD) simulations on the flow around a simplified three-dimensional model of *Crocodylus siamensis*. The locomotion of the crocodile model is realized through undulating its body and tail, mimicking a crocodile-like swimming pattern. At a cruising speed of $U_\infty = 0.5$ m/s (corresponding to a Reynolds number $Re = 9.95 \times 10^5$ based on U_∞ and the body length L), the hydrodynamics of the crocodile model are investigated, taking into account effects of the undulation parameters (ie amplitude A and frequency f). The normalized undulation parameters cover broad ranges of $0.6 \le A^* = A/W \le 1.0$ and $0.25 \le f^* = fW/U_\infty \le 0.625$, where W is the body width. The CFD simulations are conducted in ANSYS Fluent, with the SST k-ω turbulence model and user-defined functions for dynamic mesh being used. Numerical results reveal that A^* and f^* render profound effects on the hydrodynamic performance of the crocodile model. The time-mean axial force coefficient (C_A) and power coefficient (C_{POWER}) exhibit rapid growth with increasing A^* and/or f^*, while the root mean square lateral force coefficient ($C_{y,rms}$) is more dependent on f^* than on A^*. It is further found that, irrespective of A^*, C_A and C_{POWER} can be well scaled with Strouhal number St ($= 2fA/U_\infty$) or $St^2(1 - U_\infty/c)$. Furthermore, distinct flow patterns are observed in the wake of the crocodile model undulating at different St, corresponding to the drag, transition (or cruising), and thrust type swimming, respectively. Discussion is made on the wake flow structures and their connections to the generation of the hydrodynamic forces. The findings from this work contribute to the understanding of the propulsion mechanisms of the swimming crocodile, meaningful for the design of efficient biomimetic amphibious robots.

Zeng, C. and Li, D. (Eds.) (2024). Integrating Science into Aquatic Conservation. MDPI: Basel.

Abstract: As a key support for human survival and development, how to protect aquatic ecosystems is a hotspot of global concern. This Special Issue was built with the hope of providing scientific references for the conservation of aquatic organisms and ecosystems. Papers cover both freshwater and marine ecosystems, focusing on a single species and multiple species or specific ecosystems. For single-species studies mainly used molecular tools and statistic models to focus on the evolutionary relationships among species, the differentiations among populations within species, and the responses of species to the environment changes. The results of these studies shed light on the evolution, spatial dispersal, and future changes of these species and provided recommendations for the management of population dynamics in these study populations. In multi-species research, biophysical modeling, acoustic technology, and ground surveys were mainly used to predict biodiversity in ecosystems, spatial distribution of different species, and population connectivity among communities. The results of these multi-species studies revealed the spatial patterns of biodiversity, community composition, and ecological corridors from different perspectives, which offer a direct reference for the selection and delineation of marine protected areas. In summary, these papers utilized different tools to reveal the changes or threads faced by important components of water ecosystems from the micro to macro level and provide scientific advice for the conservation and management of protected animals and ecosystems on different spatial scales from local to global.

Ambario-Chávez, E.G., Maldonado-Gasca, A., Andrade-Esquivel, A. and Loc-Barragán, J.A. (2024). Eating habits of *Crocodylus acutus* in estuaries of western México, with comments on dietary diversity and anthropogenic impact. Sonoran Herpetologist 37(1): 31-39.

Resumen: Se caracterizo los hábitos alimenticios del cocodrilo de

río y evaluamos el impacto antropogénico sobre estos, en esteros del sur de Nayarit (Esteros: el Becerro, Los Coamiles y Laguna el Quelele) y el norte de Jalisco (Estero Boca Negra, Laguna de San Juan, Majahuas y canales de La Pintada); entre agosto del 2010 y junio del 2011, se realizaron lavados gástricos a 25 cocodrilos vivos y se obtuvieron muestras del contenido estomacal por disección de 4 ejemplares muertos. Los cocodrilos se alimentan de insectos, arácnidos, escorpiones, crustáceos, peces, reptiles y aves, siendo los crustáceos e insectos las presas de mayor importancia. La variación de la diversidad dietaria no presentó variación significativa entre juveniles (0.19 nits/ind), subadultos (0.34 nits/ind) y adultos (0.13 nits/ind). El mayor solapamiento dietario fue entre las clases adyacentes subadultos y adultos (18.7%); mientras que entre crías y adultos y entre juveniles y adultos, el traslape fue menor (12.5%).

Scheelings, T.F., Koehler, A.V. and Gasser, R.B. (2024). New records of *Hepatozoon* and *Oswaldofilaria* from saltwater crocodiles (*Crocodylus porosus*) in Australia. International Journal for Parasitology: Parasites and Wildlife (https://doi.org/10.1016/j.ijppaw.2024.100926).

Abstract: Diseases affecting wild Australian saltwater crocodiles (*Crocodylus porosus*) are rarely reported due to the difficulty in capturing animals and obtaining samples. In this investigation, we identified two haemoparasites (*Hepatozoon* and a filarial nematode) in saltwater crocodiles in Darwin, Australia. Light microscopic examination identified *Hepatozoon* in 7/7 (100%) wild crocodiles and in 2/20 (10%) of captive ones. When genomic DNAs from these same samples were further investigated using polymerase chain reaction (PCR)-based sequencing, we detected *Hepatozoon* in all 27 blood samples. Using both microscopy and PCR-based sequencing, we detected a filarial worm (proposed to be *Oswaldofilaria*) in one of 20 captive crocodiles. The sequence data were compared with sequence data available in public databases, and phylogenetic analyses indicated that the operational taxonomic units of *Hepatozoon* and *Oswaldofilaria* discovered here in these crocodiles are likely new species. This study is the first to use molecular tools to explore haemoparasites in Australian saltwater crocodiles and highlights the importance of health investigations in poorly studied vertebrate hosts.

Darlim de Oliveira, G. (2023). Phylogeny and Divergence Ages in Crocodylia: Implications for Crown-clades and Paleobiogeography. PhD thesis, Eberhard Karl University of Tübingen, Tübingen, Germany.

Abstract: Crocodylia is represented by semi-aquatic ambush predators that inhabit freshwater and estuarine environments in the tropical and subtropical regions of the globe. Composed by 25 extant recognized species in three main lineages (Crocodyloidea, Gavialoidea and Alligatoroidea), mitogenomic studies recognizes a higher diversity of crocodylians within cryptic species complexes that are otherwise unrecognizable based on morphological analyses. Extinct crocodylian species furthermore outnumber the living diversity as evidenced by a considerable fossil record extending to late Stages of the Cretaceous Period. The combination of well sampled fossil record and low extant diversity that allows comprehensive sampling for molecular data makes Crocodylia a good model clade for macroevolutionary studies. In spite of phylogenetic analysis using molecular data consistently recover a common topology, paleontological studies in Crocodylia often continue to use morphology-only datasets, which in turn impacts on on the inferred phylogenetic position of many fossil taxa. Examples of topological discrepancies in Crocodylia are represented by: (i) the phylogenetic position of the Indian gharial *Gavialis gangeticus* represents one of the long-standing conflicts in crocodylian systematics, as phylogenetic inferences based on morphology alone places *Gavialis* sister to all other living crocodilians (ie alligators and crocodiles), whereas molecular data unite *Gavialis* with the false gharial *Tomistoma schlegelii* as a sister clade to Crocodylidae alone. These topological discrepancies in turn affects particularly taxa close to the root of Crocodylia and/or with a *Gavialis*-like morphology. Hence, the ambiguous phylogenetic position of basal fossil taxa may eventually lead to unreasonable selection of fossil calibrations for divergence age estimates in molecular studies, which in turn majorly affects macroevolutionary inferences in Crocodylia; (ii) Similarly, topological conflicts are furthermore observed in the crown clades of Alligatoridae (Caimaninae, Alligatorinae), as incomplete fossil and unstable phylogenies of extinct caimanines hamper a reconstruction of early evolution in the clade, in addition to poorly justified selection of fossil as calibration in molecular studies overestimate the origin of total and crown-Caimaninae; and finally (iii) the origin of the Chinese alligator (*A. sinensis*) is considered a biogeographical puzzle, as the timing and climatic context of *Alligator* dispersal from North America to Asia is poorly constrained: paleontological evidence and molecular estimates for the split between *A. sinensis* and its only closest living relative *A. mississippiensis* (American alligator) are in conflict; *Alligator* fossils have never been recovered in the stem-lineage of *A. sinensis*; and *Alligator* fossil species from Asia have never been included into a phylogenetic framework. In the present thesis, in order to investigate the three abovementioned conflicts in crocodylian systematics, I explore (I) the effects of the use of molecular data on the position of fossil taxa close to the root of Crocodylia; (II) the phylogeny of Caimaninae as an extensive reappraisal of the position of fossil taxa in addition to provide well-justified fossil calibrations for the total and crown-groups; (III) the evolution of *Alligator* focusing on expanding the dataset by describing a new *Alligator* species, *Alligator munensis*, and by including fossil species from Asia into a phylogenetic context, contributing to the understanding of *Alligator* intercontinental dispersal. A series of methodologies were explored in order to meet the objectives, including traditional alpha-taxonomy descriptions, use of computed tomography, extensive literature review, phylogenetic analysis under Maximum Parsimony, undated Bayesian inference and total evidence tip dating. The studies composing this thesis contribute significantly for the comprehension crocodylian systematics by providing time-scaled phylogenies, highlighting the importance of DNA-informed phylogenetic inference for basal crocodylian relationships and divergence age estimates together with the use of well-justified fossil calibrations, and contributes to the understanding of *Alligator* evolution and biogeography.

Receveur, A., Bonfanti, J., Agata, S.D., Helmstetter, A., Moore, N.A., Oliveira, B.F., Petit- Cailleux, C., Rievrs Borges, E., Schultz, M., Sexton, A.N. and Veytia, D. (2024). David versus Goliath: Early career researchers in an unethical publishing system. Ecology Letters 27(3) (doi:10.1111/ele.14395).

Abstract: The publish-or-perish culture in academia has catalysed the development of an unethical publishing system. This system is characterised by the proliferation of journals and publishers - unaffiliated with learned societies or universities - that maintain extremely large revenues and profit margins diverting funds away from the academic community. Early career researchers (ECRs) are particularly vulnerable to the consequences of this publishing system because of intersecting factors, including pressure to pursue high impact publications, rising publication costs and job insecurity. Moving towards a more ethical system requires that scientists advocate for structural change by making career choices that come with risks, many of which disproportionately impact ECRs. We illuminate major issues facing ECRs in Ecology and Evolution under the current publishing system, and propose a portfolio of actions to promote systemic change that can be implemented by ECRs and established researchers.

Aubert, C., Le Moguédec, G., Velasco, A., Combrink, X., Lang, J.W., Griffith, P., Pacheco-Sierra, G., Pérez, E., Charruau, P., Villamarín, F., Roberto, I.J., Marioni, B., Colbert, J.E., Mobaraki, A., Woodward, A.R., Somaweera, R., Tellez, M., Brien, M. and

Shirley, M.H. (2024). Estimating total length of partially submerged crocodylians from drone imagery. Drones 8: 115.

Abstract: Understanding the demographic structure is vital for wildlife research and conservation. For crocodylians, accurately estimating total length and demographic class usually necessitates close observation or capture, often of partially immersed individuals, leading to potential imprecision and risk. Drone technology offers a bias-free, safer alternative for classification. We evaluated the effectiveness of drone photos combined with head length allometric relationships to estimate total length, and propose a standardized method for drone-based crocodylian demographic classification. We evaluated error sources related to drone flight parameters using standardized targets. An allometric framework correlating head to total length for 17 crocodylian species was developed, incorporating confidence intervals to account for imprecision sources (eg allometric accuracy, head inclination, observer bias, terrain variability). This method was applied to wild crocodylians through drone photography. Target measurements from drone imagery, across various resolutions and sizes, were consistent with their actual dimensions. Terrain effects were less impactful than Ground-Sample Distance (GSD) errors from photogrammetric software. The allometric framework predicted lengths within ~11-18% accuracy across species, with natural allometric variation among individuals explaining much of this range. Compared to traditional methods that can be subjective and risky, our drone-based approach is objective, efficient, fast, cheap, non-invasive, and safe. Nonetheless, further refinements are needed to extend survey times and better include smaller size classes.

Shilovsky, G.A., Putyatina, T.S. and Markov, A.V. (2024). Evolution of longevity in tetrapods: Safety is more important than metabolism level. Biochemistry Moscow 89: 322-340.

Abstract: Various environmental morphological and behavioral factors can determine the longevity of representatives of various taxa. Long-lived species develop systems aimed at increasing organism stability, defense, and, ultimately, lifespan. Long-lived species to a different extent manifest the factors favoring longevity (gerontological success), such as body size, slow metabolism, activity of body's repair and antioxidant defense systems, resistance to toxic substances and tumorigenesis, and presence of neotenic features. In continuation of our studies of mammals, we investigated the characteristics that distinguish long-lived ectotherms (crocodiles and turtles) and compared them with those of other ectotherms (squamates and amphibians) and endotherms (birds and mammals). We also discussed mathematical indicators used to assess the predisposition to longevity in different species, including standard indicators (mortality rate, maximum lifespan, coefficient of variation of lifespan) and their derivatives. Evolutionary patterns of aging are further explained by the protective phenotypes and life history strategies. We assessed the relationship between the lifespan and various studied factors, such as body size and temperature, encephalization, protection of occupied ecological niches, presence of protective structures (for example, shells and osteoderms), and environmental temperature, and the influence of these factors on the variation of the lifespan as a statistical parameter. Our studies did not confirm the hypothesis on the metabolism level and temperature as the most decisive factors of longevity. It was found that animals protected by shells (eg turtles with their exceptional longevity) live longer than species that have poison or lack such protective adaptations. The improvement of defense against external threats in long-lived ectotherms is consistent with the characteristics of long-lived endotherms (for example, naked mole-rats that live in underground tunnels, or bats and birds, whose ability to fly is one of the best defense mechanisms).

Hilevski, S., Cordero, T., Moleon, M.S., Cabañas, E., Belotti, M. and Siroski, P.A. (2024). Serum biochemical profile, intestinal and liver histomorphometry of captive Broad-snouted caiman (*Caiman latirostris*) fed with a diet enriched with soybean (*Glycine max*). Available at SSRN: *https://ssrn.com/abstract=4754227* or *http://dx.doi.org/10.2139/ssrn.4754227*.

Abstract: Plasma biochemistry values serve as a crucial and minimally invasive tool for assessing the nutritional and physiological condition of animals. Biochemical data offer valuable insights, particularly in species fed with plant-supplemented diets. This study aims to elucidate the impact of three levels of soybean meal (SM) substitution combined chicken head minced on the growth and health of broad-snouted caiman (*Caiman latirostris*). The research assesses the effects of diets supplemented with soybean meal on the blood biochemical profile, intestinal histomorphometry, and hepatic parameters of *C. latirostris*, providing essential information for understanding on the implications of dietary changes in this species. Forty-six juvenile broad-snouted caimans were assigned to three dietary groups (0%, 25%, 40% soybean meal). Over a period of 90 days, data on growth, serum biochemical analysis, intestinal and hepatic morphometry were recorded. Results indicated that diets with higher soybean meal content did not significantly affect growth or serum protein profiles. However, changes in intestinal morphology were observed, with longer and wider villi in the animals feed with diets with soybean meal, indicating a gradual adaptation to new feeding diets. The presence of soybean meal reduced hepatic lipid accumulation without affecting macronutrient digestion and absorption, considered beneficial for the caiman's health. This study provides valuable insights into the effects of soybean meal on the physiology and dietary adaptation of *C. latirostris*.

Alexis, B.B., Sande, E. and Ntakimazi, G. (2024). Crocodile ecology, conservation and management in the Ruzizi Delta, northern end of Lake Tanganyika, in Burundi and the Democratic Republic of Congo. Biolife 11(2): 93-114.

Abstract: Crocodile's ecology, conservation and management in the Ruzizi Delta were investigated during the period from April 2019 to April 2021 by interviews using a survey questionnaire, and by direct observation using binoculars during the day, and at night on the secure coastline of Lake Tanganyika between the mouth of the Small Ruzizi River and the mouth of the Kalimabenge River. The investigations were part of a doctoral research aimed at the creation of a Community Reserve in the Ruzizi Congolese Delta and at the conditions improvement for birds, crocodiles and lasting biodiversity conservation in the Rusizi Burundian Delta. The average density of the Nile crocodile, *Crocodylus niloticus* (Laurenti, 1768) was higher in the protected Rusizi Burundian Delta (19 crocodiles/km^2) and lower in the unprotected Ruzizi Congolese Delta (6 crocodiles/km^2). Similarly, the density of the Slender-snouted Crocodile (*Mecistops leptorhynchus*) was higher in the protected Rusizi Burundian Delta (40 crocodiles/km^2) and lower in the unprotected Ruzizi Congolese Delta (11 crocodiles/km^2). The Ruzizi Congolese wetland stakeholders accepted (90%) the protection of the Ruzizi Congolese wetlands as a Ruzizi Congolese Community Reserve to be submitted later to the Ramsar Secretariat for designation as a Ruzizi Congolese Ramsar Site. The sustainable management of crocodiles and biodiversity will require the formulation of joint conservation projects by the Authorities of the Ruzizi Congolese Delta and the Rusizi Burundian Delta.

Benitez-Moreno, J.A., Cedeño-Vazquez, J.R. and Castelblanco-Martınez, D.N. (2024) Community engagement and human perception in crocodile conservation: preliminary steps in Sian Ka'an Biosphere Reserve. Frontiers in Conservation Science 5 (doi: 10.3389/fcosc.2024.1297960).

Abstract: Wildlife tourism is important for the conservation of protected areas, endangered species, and to empower local communities. Nevertheless, when guidelines and practices are not clear and correctly executed, tourism may have a negative impact. We carried out semi-open interviews (n= 34) and several workshops

(n= 50) with locals and tour guides in the village of Punta Allen in Sian Ka'an Biosphere Reserve, Mexico. Data were organized in tables in Excel®, and statistical analysis was conducted with IBM® SPSS® Statistics software. A priori, exploratory data analysis was carried out to identify the general pattern of the data, and a priori data normality test (Shapiro-Wilks) and c2 test were carried out to find out if there were differences in the frequency of a response depending on socioeconomic variables. Most respondents (69%) dedicated 2-10 min to crocodile observation, one quarter (25%) spent 11-20 min, and the remainder (6%) 21-30 min. The majority (97%) of respondents mentioned that when they see a crocodile, they approach at a 5-10 m distance and wait for the occupants of the boat to take pictures, and then leave; only one respondent (3%) said that they feed crocodiles to attract them to the boat. Most respondents (89%) said that crocodile observation does not need to be improved, and it is fine the way it is currently carried out; the remaining 11% said that it could be improved. Workshops were received positively and allowed us to share information on crocodile species, their conservation, and good tourism practices. It is necessary to enlighten tourism service providers about the biology and importance of crocodilian species, to promote conservation and provide services with an educational impact/focus for visitors to the reserve. There is a need to develop a communication program that provides accurate information for new service providers and renews and reinforces concepts for established providers. Additionally, we need to continuously monitor and evaluate wildlife observation activities to enhance current practices in our study area, and to determine if they are having a negative impact on crocodile behavior and biology.

Burne, A.M., Richey, L.J., Schoeb, T.R. and Brown, M.B. (2024). *Galleria mellonella* invertebrate model mirrors the pathogenic potential of *Mycoplasma alligatoris* within the natural host. Transboundary and Emerging Diseases 2024: Article ID 3009838.

Abstract: Most mycoplasmal infections result in chronic, clinically silent disease. In direct contrast, *Mycoplasma alligatoris* elicits a fulminant, multisystem disease in the natural host, *Alligator mississippiensis* (American alligator). The goals of the study were to better understand the disease in the natural host and to determine if the invertebrate model *G. mellonella* could serve as a surrogate alternate host. The survival of alligators infected intratracheally was dose dependent (p= 0.0003), ranging from no mortality (102 CFU) to 100% mortality (108 CFU), with 60% mortality at the 104 and 105 CFU infectious dose. Microbial load in blood, joints, and brain was dose dependent, regardless of whether alligators were infected intratracheally or intravenously ($p<0.002$). Weight loss was similarly impacted (p= 0.001). Experimental infection of the invertebrate *Galleria mellonella* mirrored the result in the natural host. In a dose response infection study, both larval survival curves and successful pupation curves were significantly different ($p\leq0.0001$) and dose dependent. Infected insects did not emerge as moths ($p<0.0001$). Here, we describe the first study investigating *G. mellonella* as a surrogate model to assess the pathogenic potential of *M. alligatoris*. *G. mellonella* survival was dose dependent and impacted life stage outcome.

Carey, M.E. (2024). Forever chemicals in modern dinosaurs: Using CERCLA to force polluters to pay for PFAs contamination of Florida alligators. UCLA Journal of Environmental Law and Policy 42(1) (http://dx.doi.org/10.5070/L542163339).

Abstract: First, this paper will describe what forever chemicals are and the damage these compounds inflict. This paper will then explore what a CERCLA NRD assessment is: a tool to protect the public from chemicals like PFAS. The goals of NRD assessments can be tied back to the Public Trust: a sovereign holding natural resources in public trust for the citizenry. After briefly discussing pending federal regulatory action, which would list PFOA and PFOS as hazardous and thus pull them under CERCLA's jurisdiction, this paper will propose two potential solutions to the problems trustees face when asserting NRD claims. To illustrate these problems and their proposed solutions, this paper uses the Florida marine environment and one of the oldest and most treasured natural resources in the animal kingdom, the alligator, as a muse. The first solution the paper proses is that Congress amend CERCLA to exempt public or municipal wastewater treatment facilities and waste management facilities from litigation related to NRD assessments. Additionally, this paper proposes that Congress amend CERCLA to broaden the potentially responsible parties to include manufacturers of PFAS chemicals, as they so often fall outside CERCLA's four statutorily responsible parties. Finally, this paper will show the NRD process will bolster the science around PFAS, proving causation and not just correlation, so that all potentially responsible parties can be held responsible.

Chabrol, N., Jukar, A.M., Patnaik, R. and Mannion, P.D. (2024). Osteology of *Crocodylus palaeindicus* from the late Miocene-Pleistocene of South Asia and the phylogenetic relationships of crocodyloids. Journal of Systematic Palaeobiology 22(1) (https://doi.org/10.1080/14772019.2024.2313133).

Abstract: Fossil crocodylian remains have been documented from India and other parts of South Asia since the mid-nineteenth century, but specimens attributed to several extinct and extant species of *Crocodylus* have largely been neglected in modern taxonomic treatments. Here, we present a detailed anatomical description of the extinct species *Crocodylus palaeindicus*, which we restrict to the late Miocene to early middle Pleistocene of India. Using an autapomorphy-based approach to species-level identification, we regard *Crocodylus sivalensis* as a junior synonym of *C. palaeindicus* and provide taxonomic re-identifications of all specimens previously referred to these two species. We present a new diagnosis for *C. palaeindicus* that facilitates its distinction from the extant mugger crocodile, *C. palustris*, which does not unequivocally appear in the fossil record prior to the Pleistocene. The lack of clear spatiotemporal overlap, coupled with the otherwise lengthy ghost lineage implied by their sister-taxon relationship in our phylogenetic analyses, provides tentative support that the extant species either is the descendant of *C. palaeindicus* or originated via budding cladogenesis. An expanded phylogenetic analysis recovers the late Miocene African *C. checchiai* and Pliocene South American *C. falconensis* as species within the Neotropical *Crocodylus* clade, supporting an African origin for this radiation. We also recover Kinyang, from the early-middle Miocene of Kenya, as a crocodyline, rather than an osteolaemine as originally described, and it is potentially the stratigraphically earliest known member of the *Crocodylus* lineage. Other notable results from our phylogenetic analyses suggest that crocodyloids might not have been present in North America prior to the late Neogene arrival of *Crocodylus*, with *Albertosuchus knudsenii*, *Prodiplocynodon langi* and '*Crocodylus*' affinis all recovered outside of Crocodyloidea. Furthermore, we demonstrate that an alligatoroid placement for the recently erected latest Cretaceous-Palaeogene East Asian clade Orientalosuchina is highly labile, with relationships at the 'base' of Crocodylia unstable.

Warwick, C., Steedman, C., Jessop, M. and Grant, R. (2024). Reptile expos: An analysis and recommendations for control. Frontiers in Animal Science 5 (doi: 10.3389/fanim.2024.1335982).

Abstract: Reptile expos are typically itinerant events at which live wild-caught and/or captive-bred turtles, tortoises, crocodiles, lizards, and snakes are displayed, sold, or exchanged for pet keeping purposes. We conducted a literature review and analysis of reports regarding animal welfare and public health issues of concern associated with the display and sale of reptiles at expos in Europe and North America. We also conducted a limited survey of several relevant government authorities to briefly appraise existing situations regarding governance and law internationally, and performed a

further limited examination of online advertisements in order to estimate the number of events. In addition, we conducted an analysis comparing husbandry standards for reptile expos versus other animal display or sale situations using UK formal legal guidance, which adopts the Five Welfare Needs as a basis. Finally, we also conducted a SWOT (strengths, weaknesses, opportunities, and threats) analysis of key features associated with reptile expos. We identified at least 10 animal welfare and 5 public health and safety problems as occurring and endemic to the typical operation of reptile expos. Comparisons between the ways in which animal welfare and public health issues are regarded or managed for reptile expos in relation to, for example, traditional zoos, mobile zoos, and pet sales are stark and concerning, with expos constituting the least protective and potentially most harmful situations out of all captive reptile-keeping scenarios. The lack of monitoring and control of reptile expos, combined with their frequent occurrence, strongly indicates the requirement to urgently control and prohibit these events. We recommend that where reptile expos are already essentially prohibited such bans should be immutable and not subject to any weakening provisions. Where reptile expos are permitted and/or subject to limiting conditions, or where reptile expos are not subject to limiting conditions, then our recommended 40 stipulations and overarching control principles should be applied as interim mitigating measures pending the introduction of prohibitions or 'bans'. Governments should aim to ensure that enforcement of such measures is robust.

Mosse, M.N., Odadi, W.O. and Kibue, G.W. (2024). Anthropogenic threats to crocodiles, and the level and sociodemographic determinants of their utilization in Lower River Tana Basin, Kenya. Tropical Conservation Science 17 (https://doi.org/10.1177/19400829241241457).

Abstract: Globally, crocodile ranching programs are intended to generate livelihood benefits for local communities and incentives for crocodile conservation. However, there is need for their contextual scientific evaluation in many human-dominated tropical landscapes. We investigated the anthropogenic threats to crocodiles, and examined the level and sociodemographic determinants of their utilization in lower River Tana basin, Kenya. We conducted seven key informant interviews, four focus group discussions and a quantitative household survey involving 365 respondents randomly selected from local villages. We analyzed anthropogenic threats to crocodiles and other qualitative data thematically. We summarized quantitative data using descriptive statistics and used multinomial logistic regression to analyze the association between selected sociodemographic variables and crocodile utilization. The main anthropogenic threats to crocodiles were agricultural expansion into their habitat, their retaliatory killing, and consumption of their meat and eggs. Only 5% of the respondents utilized crocodiles legally, whereas 32% utilized them illegally. Increasing age, increasing income, being male and being Christian all increased the likelihood of illegal crocodile utilization. Being male increased the likelihood of legal crocodile utilization, whereas increasing age decreased this likelihood. Our study demonstrates multiple anthropogenic threats to crocodiles in lower River Tana despite a long-term ranching program. Furthermore, local community participation in this program is marginal and markedly varies among sociodemographic groups. Taken together, our findings suggest that crocodile ranching, as practiced in this landscape, is largely ineffective in achieving its intended socioeconomic and conservation goals. To enhance their effectiveness, crocodile ranching programs in such landscapes should be tailored for local socio-cultural contexts. We recommend capacity building and awareness raising initiatives tailored for specific groups to increase local community participation in sustainable crocodile utilization and minimize their engagement in practices that are detrimental to crocodiles.

Merchant, M., Hebert, M., Salvador, A.C., Berken, J., Boverie, T. and White, M.E. (2024). Constitutive innate immunity and systemic responses to infection of the American alligator (*Alligator mississippiensis*). Animals 14(6): 965.

Abstract: Uninfected alligators (*Alligator mississippiensis*) exhibited high constitutive levels of hepatic gene expression related to immune function, whereas the highest-expressed hepatic genes of uninfected mice were related to metabolism. Intraperitoneal challenge of mice with bacterial lipopolysaccharide results in dramatic inflammatory effects including peritoneal ascites, febrile response, dramatic alterations in electrophoretic serum profile, and mortality. In contrast, coelomic injection of alligators with 200× the murine LD50 of intraperitoneal bacterial lipopolysaccharide resulted in no changes in serum protein profiles, behavioral effects, mortality, and no coelomic ascites. However, injection of juvenile alligators with live bacteria resulted in a titer-dependent decrease in metabolic rate, as measured by oxygen consumption. These results are the opposite of those observed for mammalian and avian species. The decreased oxygen consumption was not accompanied by changes in heart or respiration rate, indicating that this phenomenon was not due to bradycardia or bradypnea. Interestingly, challenge of alligators with bacteria resulted in the complete expulsion of digestive tract contents within four hours. We interpret these activities as temporary minimization of other biological systemic activities to redirect and devote energy to immune function. The reallocation of resources within an organism to fight infection without increases in metabolic rate has not been described in other animals.

Pierini, S.E., Simoncini, M.S., Larriera, A., Guarascio, V.F.V., Scarpa, L.J. and Pina, C.I. (2024). Camera-traps detect the maned wolf preying on broad-snouted caiman eggs. Global Ecology and Conservation 51 (https://doi.org/10.1016/j.gecco.2024.e02916).

Abstract: The maned wolf (*Chrysocyon brachyurus*) is a South-American canid of which conservation guidelines have been implemented due to its population vulnerability. Its trophic ecology demonstrates an omnivorous and opportunistic diet, and even flexibility in response to anthropogenic disturbances. Among the food items identified, the consumption of reptiles is scarce, and includes snakes and lizards. We monitored broad-snouted caiman (*Caiman latirostris*) nests during four nesting seasons through camera trapping, in savannas and grasslands areas, and recorded maned wolves feeding on caiman eggs during periods of drought. The consumption of an uncommon item, even at low frequency, suggests that camera trapping could become a complementary tool for studying the dietary habits of the maned wolf. Caimans have been a priority for conservation, while maned wolves are currently being released and reintroduced in order to reverse their vulnerable population status. This trophic interaction must be monitored in the long term, to project integral conservation strategies that include both emblematic species.

Piras, I.M., Bezuidenhout, A., Díaz-Delgado, J., Slawski, D. and Kelly, P.A. (2024). Pathology of "double scale" skin defect in farmed American alligators (*Alligator mississippiensis*) and the possible association with hepatic fibrosis. Veterinary Pathology (doi: 10.1177/03009858241238685).

Abstract: "Double scale" is a poorly characterized skin defect of crocodilians that drastically reduces the economic value of crocodilian skin. This study investigated the morphology and pathogenesis of double scale in a ranching farm of American alligators (*Alligator mississippiensis*). We compared the histopathology of skin and selected organs (liver, lung, kidney, heart, spleen, intestine, and brain) of alligators with double scale against healthy control animals, together with serum and liver vitamin and mineral levels. Skin affected with double scale had statistically significant hyperkeratosis, epidermal atrophy, and increased basal cell degeneration compared with control alligators ($P<0.0001$). Interestingly, all alligators with double scale had varying degrees of

hepatic fibrosis. Feed analysis showed that alligators that had double scale and hepatic fibrosis had prolonged dietary exposure to high levels of vitamin A, iron, and copper. Serum analysis indicated that levels of zinc ($p<0.0001$), copper ($P<0.05$), and vitamin E ($P<0.002$) were significantly lower in alligators with hepatic fibrosis and double scale compared with controls. Finally, immunohistochemical analysis of skin with double scale showed a marked reduction in immunolabeling with the zinc-binding protein metallothionein. These results suggest that zinc deficiency, in combination with other micronutrient anomalies, may play a role in the pathogenesis of double scale in alligators with liver fibrosis.

Salmun, R.R., Pello, J. and Wilhelmus, B.V. (2024). Perlindungan hukum terhadap masyarakat yang diserang buaya pada habitat buaya di Nusa Tenggara Timur. Jurnal Hukum Dan Sosial Politik 2(2): 381-393.

Abstract: Conflicts between humans and wild crocodiles still occur frequently in East Nusa Tenggara. Conflicts often occur with residents who live on coastlines and river estuaries, where most of the population earn their living as fishermen and farmers. The objectives of this research are: (1) Want to know the form of legal protection for people who are attacked by crocodiles in crocodile habitats. (2) Want to know the pattern of conflict management between humans and crocodiles in their habitat. This research is a type of empirical juridical research, or what is called field research, namely examining applicable legal provisions and what happens in reality in society. Empirical juridical research is legal research regarding the application or implementation of normative legal provisions in action in every legal event that occurs in society. The results of this research show: (1) Legal protection that protects every human right that is attacked by a crocodile has been clearly regulated in law number 5 of 1990, government regulation number 7 of 199 9, government regulation number 13 of 1994, and ministerial regulations forestry number P.08 of 2008. (2) Efforts to overcome conflict between crocodiles and humans have been carried out by establishing a SATGAS or task force for dealing with conflict between humans and wild animals and consists of two units, where one unit is tasked with dealing with the community and the other unit tasked with dealing with wild animals. There are also several government agencies in it to respond to reports quickly and handle them according to SOPs or standard operational procedures for handling conflicts between humans and wild crocodiles which serve as standard guidelines for handling conflicts reported by the public. As well as efforts from the government, there have also been short-term efforts such as outreach and long-term efforts such as conducting more in-depth research on crocodiles. Based on the results of this research, it is hoped that there will be awareness from all components, both society and government, so as not to excessively convert land so that it destroys the natural habitat of crocodiles and causes crocodiles to escape into public areas.

Sharma, S.P., Ghazi , M.G., Katdare, S., Badola, R. and Hussain, S.A. (2024). Population status and genetic assessment of mugger (*Crocodylus palustris*) in a tropical regulated river system in North India. Scientific Reports 14(1) (doi: 10.1038/s41598-024-57983-2).

Abstract: For rewilding the depleted crocodylian populations in India, a targeted 'one-species one area' based conservation approach was adopted in the early-1970s. Suitable habitats were identified and designated as protected areas, specifically targeted to recover a particular crocodylian species. A ~610 km stretch of Chambal River in the Ganga River Basin was declared as National Chambal Sanctuary to restore the 'Critically Endangered' Gharial (*Gavialis gangeticus*), where active management of Mugger (*Crocodylus palustris*) was discouraged. In the present study, we examined the population trends, occupancy, and genetic status of Mugger by conducting population monitoring and genetic assessment to understand the status of potentially competitive Mugger in the Sanctuary. Our finding suggests that the Mugger population has notably increased and colonised the Sanctuary. We observed a moderate level of genetic diversity in the Mugger, which was relatively higher compared to the Gharial in the Sanctuary. The rapid colonization of ecological generalist Mugger raises concerns about potential competition with ecological specialist Gharial threatening its long-term sustainability. Considering the coexistence dynamics between the species, it is essential to extend adaptive management strategies for mugger to ensure successful recovery of Gharial population in the Sanctuary.

Johnston, R.A., Habarugira, G., Harrison, J.J., Isberg, S.R., Moran, J., Morgan, M., Davis, S.S., Melville, L., Howard, C.B., Henry, C.S., Macdonald, J., Bielefeldt-Ohmann, H., Hall, R.A. and Hobson-Peters, J. (2024). Application of chimeric antigens to paper-based diagnostics for detection of West Nile virus infections of *Crocodylus porosus* - a novel animal test case. bioRxiv (https://doi.org/10.1101/2024.03.24.586480).

Abstract: Laboratory-based diagnostics like plaque reduction neutralization tests (PRNT) and ELISA are commonly used to detect seroconversion to flavivirus infections. However, faster, qualitative screening methods are needed for quicker diagnosis and better patient outcomes. Lateral flow assays (LFAs) can provide rapid results (5-15 mins) at the point-of-care, yet few commercial flavivirus antibody detection LFAs are available. We developed an LFA using novel chimeric viral antigens produced by genetically modifying the mosquito restricted Binjari virus (BinJV) to display the outer virion proteins of pathogenic viruses such as West Nile virus (WNV). The BinJV chimeric platform offers various advantages for diagnostic assay development, including rapid construction of new chimeras in response to emerging viral variants, safe, scalable antigen manufacturing, and structural indistinguishability to the wild-type pathogenic virion. As a demonstration of feasibility, we applied chimeric WNV (BinJV/WNV) antigen to LFA as the capture/test line reagent for detection of seroconversion of crocodilians to WNV - a virus affecting crocodilians on multiple continents. We verified the antigenic conservation of the chimera when applied to the LFA detection surface using monoclonal antibodies. Using well-characterised sera (n= 60) from WNV seropositive or flavivirus naive Australian saltwater crocodiles (*Crocodylus porosus*), we illustrated 100% sensitivity and specificity, with results achieved in less than 15 minutes. The LFA further accurately detected seroconversion in animals experimentally infected with WNV. This qualitative screening method can be performed both inside and outside of a laboratory, and the assay design will guide the optimization of similar tests for vector borne virus infection detection in both humans and other animals.

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