

CROCODILE SPECIALIST GROUP NEWSLETTER

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CROCODILE

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IUCN Species Survival Commission

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Cover: George Craig feeding his "mate" Cassius (see pages 4-5). Photograph: Sudama Scott.

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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.iucnscg.org/pages/Publications.html>

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Editorial

It is with deep regret and sorrow that we announce the sudden passing of Hellen Kurniati (62 y) on 27 October 2024, in Jakarta, Indonesia. Hellen was a senior researcher at the National Research and Innovation Agency (BRIN; formerly Indonesian Institute of Science). I (CM) first met Hellen in 1993, when she participated in a training course on “Crocodile Conservation, Management and Farming”, in Darwin, Australia. From that time, she became involved with monitoring of Saltwater (*Crocodylus porosus*) and New Guinea Freshwater (*C. novaeguineae*) crocodile populations in Papua Province (previously Irian Jaya), and more recently in Kalimantan for *C. porosus*. I worked closely with Hellen since our first meeting, as she worked to ensure that Indonesia met its obligations to CITES, of which population monitoring was an integral part. In the late 1990s, together with Andy Ross, Jack Cox and Scott Frazier, she searched for evidence of *Crocodylus raninus* in Kalimantan, and in the mid-2000s she undertook surveys for the remnant Siamese crocodile (*C. siamensis*) population in the Mahakam River, East Kalimantan. Much of Hellen’s later work was with amphibians and lizards, and she contributed significantly to the advancement of herpetology in Indonesia. In the 1990s and early 2000s, when few women were involved with the study of crocodiles in the field, and particularly so in the Southeast Asian region, Hellen set an example to inspire others. She will be sorely missed.

November also started on a sad note. “Cassius”, considered to be the largest crocodile in captivity, died on 1 November. Grahame Webb, myself (CM) and our staff coordinated his capture in October 1984. In 1987, he was moved to Melanesia Marineland Crocodile Habitat, Green Island, Queensland, where he became a significant attraction for visitors. But more sad news followed on 17 November, when our friend and owner of Melanesia Marineland Crocodile Habitat, George Craig, passed away (see pages 4-5 for details).

In late-October, Alejandro and I participated in the 5th IUCN Species Survival Commission Leaders’ meeting, hosted by Environment Agency-Abu Dhabi (EAD) in Abu Dhabi, United Arab Emirates. The meeting brought together more than 300 participants, most of whom were Chairs/Co-Chairs of many of specialist groups under the SSC umbrella. A declaration affirming that “Saving Species Sustains Life” resulted from the meeting, “created to inspire urgent and widespread action on behalf of all species”. With many new specialist groups now being established, there was much interest in how the CSG has structured itself to deal with one of the oldest and largest of the specialist groups. There is interest in forming an Amphibian-Reptile Conservation Committee, comprising the Amphibian Specialist Group and existing reptile specialist

groups (eg snake, sea snake, crocodylian, chameleon, iguana, marine turtle, tortoise and freshwater turtle).

The IUCN World Conservation Congress (WCC) will be held on 9-15 October 2025, in Abu Dhabi, UAE. Membership of all specialist groups will be terminated at the end of the quadrennium, coinciding with the WCC. Following SSC procedures, after the WCC the CSG Executive Officer will invite members to re-join the group.

Alvaro Velasco (Venezuelan Crocodile Specialist Group) is one of 44 nominees for the [2025 Indianapolis Prize](#), which focuses attention on the inspiring work of distinguished animal conservationists with authentic success preserving animal species around the world. Sergio Balaguera-Reina (University of Florida, USA, and ProCAT, Colombia) is one of 10 finalists for the Indianapolis Prize’s “2025 Emerging Conservationist Award”, given to a conservationist under 40 years of age who is making a clear impact saving a species or group of species. Winners of the Indianapolis Prize and Emerging Conservationist Award will be announced in September 2025. We wish both Alvaro and Sergio the best of luck.

The 20th meeting of the Conference of the Parties to CITES (CoP20) will be held in Samarkand, Uzbekistan, from 24 November to 5 December 2025. The 78th meeting of the CITES Standing Committee will be held in Geneva, Switzerland, on 3-8 February 2025. At this stage, the CSG is not aware of any amendment proposals involving crocodylians that may be submitted to CoP20.

On 18-21 November, a Dwarf Crocodile Red Listing and Conservation Planning Workshop was held in Abidjan, Cote d’Ivoire, to develop Red List assessments and Action Plans for the three *Osteolaemus* species (*O. afzelii*, *O. osborni*, *O. tetraspis*). The workshop was expertly coordinated and facilitated by Matt Shirley (CSG Regional Chair for West and Central Africa), and co-funded by an SSC Edge grant, JRS Biodiversity Foundation and the CSG. There were 21 participants, including 16 from *Osteolaemus* range states, as well as CSG members Jen and John Brueggen (St. Augustine Alligator Farm), Kent Vliet (CSG Chair of Taxonomy group), and Sally Isberg (CSG Red List Authority). By the end of the workshop, Red List assessments were advanced for all three species, and Action Plans are progressing for *O. tetraspis* and *O. afzelii*. A roadmap and timeline for the completion of the outstanding tasks was agreed to ensure delivery of these documents. The workshop also fostered dialogue amongst Dwarf crocodile conservation stakeholders in the region. The West-Central Africa region is both diverse and complex, and the workshop represents a significant step towards improving conservation efforts for these species.

Winter CrocFest, held at Wild Florida, Kenansville, Florida on 14 December 2024, raised more \$US40,000 towards research/conservation efforts with Siamese crocodiles (*Crocodylus siamensis*) in Laos and Black caiman (*Melanosuchus niger*) in French Guiana. We once again congratulate the organisers and participants on this marvellous result.

The US Fish and Wildlife Service has featured the American alligator (*Alligator mississippiensis*) as a conservation success story within CITES. This recognises the vital role that sustainable use programs play in wildlife conservation and community benefits. [Loyack, O. (2024). Gator Gold: How American alligator permits benefit the U.S. economy.]

We remind readers that the next CSG Working Meeting will be held in Morocco, in May 2026. Details will be posted as they become available.

Finally, we wish all CSG members, colleagues and families a happy and prosperous new year for 2025.

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 one student in the October-December 2024 quarter (see below), and 4 applications are currently under review. This brings the total number of successful applications for 2024 to 16.

1. Alberto Castillo Contreras (Mexico): Detection and evaluation of infection by hemoparasites in the genus *Crocodylus* with natural distribution in Mexico.

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

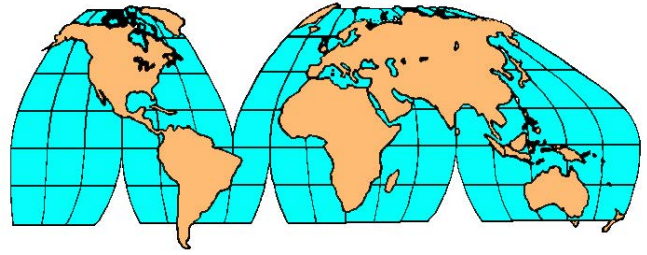
European Croc Network Meeting (Berlin, 1-2 August 2025)

The 7th European Croc Network meeting will be held on 1-2 August 2025, in Berlin, Germany. The theme is ‘Human Dimensions of Crocodylian Conservation’, and the meeting will be hosted at the historic Berlin Zoo and Aquarium and the Leibniz Institute of Freshwater Ecology and Inland Fisheries. The aim of the meeting is to facilitate collaboration and opportunities for people based in Europe who work with, or aspire to work with, crocodylians. This includes academia, zoos and aquaria, industry and media.

This the first European Croc Network meeting to be hosted in Germany, and they look forward to welcoming those from the crocodylian community in Europe and further afield. The team will be opening registration on 1 February on their website (eurocrocnetwork.com), which will contain more information on the event as well as links to social media where updates are shared.

Submission of abstracts for oral and poster sessions and workshops is currently open - please submit a request to “eurocrocnetwork@gmail.com”.

Regional Reports



Australia & Oceania

Australia

LOSS OF AN ICONIC CROCODILE. It is with sadness that we share the passing of “Cassius”, a Saltwater crocodile (*Crocodylus porosus*) considered by Guinness World Records since 2013 to be the largest crocodile in captivity, on 1 November. Cassius’ story began in October 1984, when he was captured by Grahame Webb, Charlie Manolis and their team, from the Finnis River, Northern Territory. As Cassius was considered a problem crocodile on the cattle station, a decision was made to capture and relocate him. After spending three years at Letaba Crocodile Farm, in 1987 Cassius was moved to Marineland Melanesia Crocodile Habitat, on Green Island, Queensland.

For the next 37 years, Cassius was considered more than just a crocodile, and became a cherished member of owner George Craig’s family (see Front Cover). For George, now 94 years old, Cassius was his “best mate”, and he always said that if he had two lives he would give one to find out if Cassius would enjoy a big hug. After 52 years living on Green Island, on 5 October George relocated to Cairns into an assisted care residence. Interestingly, Cassius started refusing food soon after, on 15 October. A necropsy carried out by Dr. Sally Isberg soon after Cassius’ death suggested that the cause of death was related to old age. Sadly, George passed away on 17 November 2024, a little over two weeks after Cassius had died.



Figure 1. Grahame Webb reacquaints himself with Cassius in November 2023. Photograph: Grahame Webb.

Cassius was considered by Grahame Webb and Charlie Manolis to be an “old” crocodile in 1984, and had clearly seen a fair share of social interactions with other crocodiles, as evidenced by various old injuries; missing left front leg, damaged left front foot, missing end of tail, damaged tip of snout, scars over body. He was possibly over 100 years of

age, and it is hoped that skeletochronology may help estimate his age more precisely.



Figure 2. Sally Isberg getting close up and personal with Cassius. Photograph: Sally Isberg.

Cassius measured 5.48 m TL at time of death, but after taking into account the missing part of the tip of his snout and part of his tail, he is estimated to have been 5.80 m TL (19' 4"). Over the 40 years since his capture, he had grown around 0.3 m.



Figure 3. Cassius in late-2023. Photograph: Grahame Webb.

I take this opportunity to thank the thousands of friends and visitors who stood in awe in front of this iconic crocodile during his life at [Marineland Melanesia Crocodile Habitat](#). We are also thankful for the many tributes and condolences that poured in after George passed. He was truly considered the last “crocodile hunter”, amassing a wealth of knowledge on crocodiles over decades hunting them in the Northern Territory and Papua New Guinea.

George and Cassius will be deeply missed, and will continue to remain in our hearts and memories. We will now focus of preserving their legends.

Sudama (“Toody”) Scott, *Marineland Melanesia Crocodile Habitat, Green Island, Queensland 4871, Australia*.

Latin America & the Caribbean

Colombia

SURVEYING *CROCODYLUS ACUTUS* BASED ON TRACKS, NESTS AND CAMERA TRAPS IN CIÉNAGA GRANDE DE SANTA MARTA, MAGDALENA, COLOMBIA. Few studies have focused on the American crocodile (*Crocodylus acutus*) population in the Ciénaga Grande de Santa Marta. The first record for the species goes back to 1920 for Río Aracataca (Ruthven 1922). Later, Medem (1981) made observations and collected some individuals in the water channels such as Caño Palenque, Señora, Cataca and Río Frio, that drain to the estuary. This author commented that during his visits in the 1950s and 1960s there was no evidence of nesting due to the overexploitation of adult *C. acutus* for the skin trade and provided information on a single reproductive event in June 1977 for the protected area of Isla de Salamanca. Later, the species was recorded once again in the same localities (Moreno and Álvarez 2003), but Balaguera and Gonzales (2008) reported a change in population structure due to directed hunting of large-sized adults.

Crocodylians use terrestrial habitats mainly for nesting and basking, activities that are part of their natural behaviour and which allow for camera trapping to be a viable method to study them (Somaweera *et al.* 2011; Charruau and Henaut 2012; Welbourne *et al.* 2017). The identification of individual crocodiles in a population using photo ID based on natural markings (Bouwman and Cronje 2016; Coetzee *et al.* 2018), and/or sexually dimorphic characters such as the presence of preorbital ridge, differences in total length, head shape and size (Rainwater *et al.* 2019), add utility to the use of camera trap images. Estimations of relative abundance of crocodylians using tracks have been employed in two key scenarios; to establish nesting densities and nesting habitat extension (Hernández *et al.* 2017), to study crocodylians in localities where researchers face security threats while working at night (Anzola 2017).

During September and October 2021, we surveyed a section of the Ciénaga Grande inner channels located at the

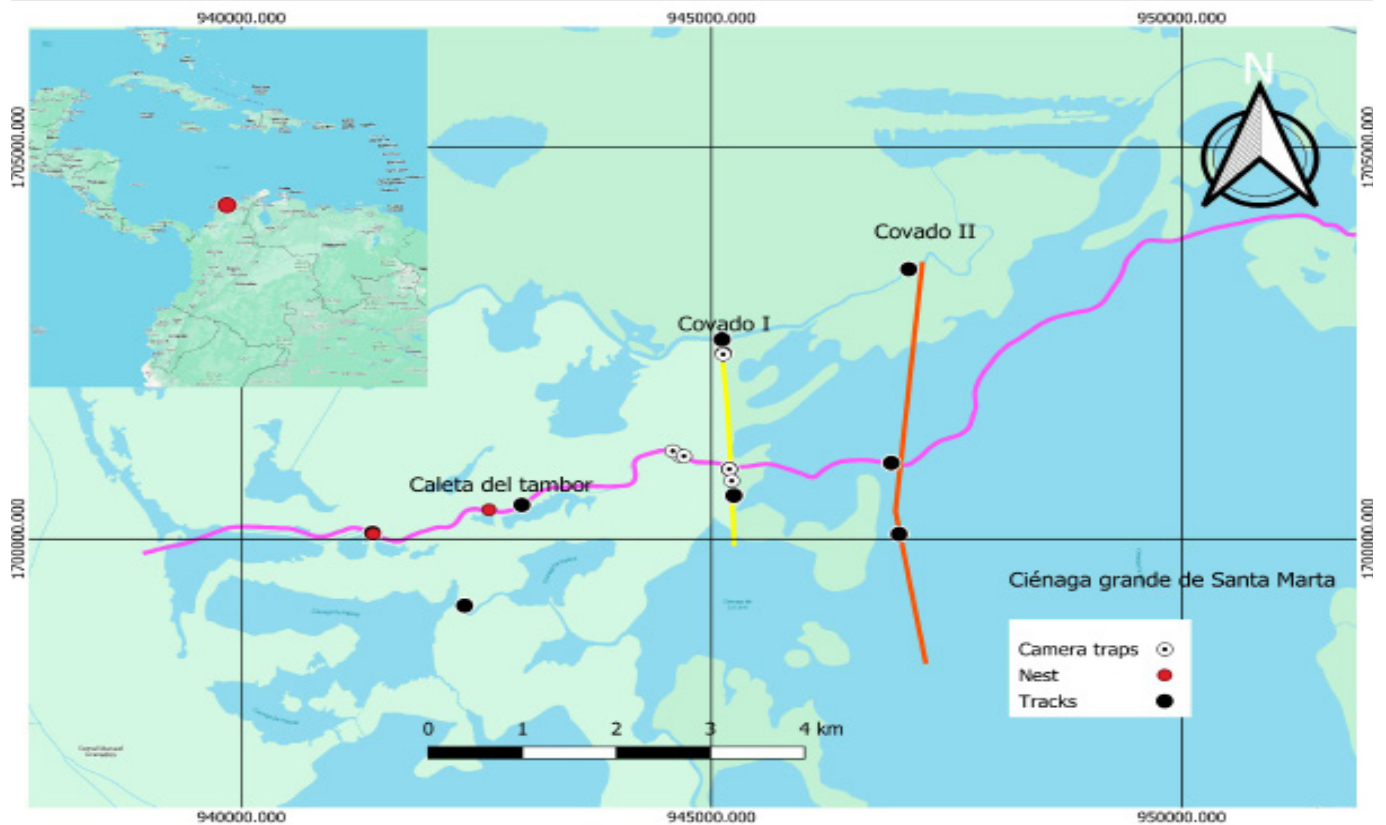


Figure 1. Nests, tracks and camera traps located in water channels (Caleta del tambor, Covado I, Covado II) within the study area.

northwestern portion of this water body. We planned search activities along the channels by subdividing the search area into three sections. Caleta del tambor (8 km) is the main water course, and there are two artificial channels named

Covado I (2.5 km) and Covado II (5 km), respectively (Fig. 1). Because of security issues, surveys had to be restricted to diurnal hours (0800-1500 h).

Table 1. Indirect evidence for presence of *C. acutus*, locations of camera traps, numbers of observations (individuals filmed) per camera trap, and sex and size class of detected individuals.

ID	Evidence	Location of Camera Traps	Watercourse	----- Camera Trap -----			Sex and/or Size Class
				Installed	Removed	No. Obs.	
1	Nest site	10.928483°N, -74.602294°W	Caleta del tambor	-	-	-	-
2	Nest site	10.925647°N, -74.613550°W	Caleta del tambor	-	-	-	-
3	Carcass	10.928936°N, -74.602803°W	Caleta del tambor	-	-	-	IV
4	Tracks	10.925786°N, -74.613619°W	Caleta del tambor	-	-	-	V
5	Tracks	10.929056°N, -74.599097°W	Caleta del tambor	-	-	-	V
6	Tracks	10.935300°N, -74.584419°W	Caleta del tambor	27 Sep	29 Oct	0	V
7	Tracks	10.934722°N, -74.583328°W	Caleta del tambor	4 Oct	13 Oct	2	F (IV)
8	Tracks	10.934758°N, -74.583744°W	Caleta del tambor	19 Oct	12 Nov	22	M (V); F (V)
9	Tracks	10.933217°N, -74.578915°W	Covado I	3 Sep	30 Sep	1	M (V)
10	Tracks	10.931867°N, -74.578689°W	Covado I	14 Sep	4 Oct	28	M (V)
11	Tracks	10.930167°N, -74.578468°W	Covado I	-	-	-	-
12	Tracks	10.946461°N, -74.579542°W	Covado I	19 Oct	29 Oct	1	IV
13	Tracks	10.946569°N, -74.579531°W	Covado I	-	-	-	-
14	Tracks	10.948189°N, -74.579653°W	Covado I	-	-	-	-
15	Tracks	10.933956°N, -74.563164°W	Covado II	-	-	-	-
16	Tracks	10.956336°N, -74.561497°W	Covado II	-	-	-	-
17	Tracks	10.925747°N, -74.562386°W	Covado II	-	-	-	-



Figure 2. Basking site at Covado I showing position of the camera trap. (ID 10 in Table 1).



Figure 3. Basking site at Caleta del tambor (ID 8 in Table 1).



Figure 4. Diurnal activity of *C. acutus* (ID 10 in Table 1).

During September, we covered the sections by means of a motorboat and on foot, looking for indirect evidence such as tracks and abandoned nests. Seventeen sites were detected, two with abandoned nests (Fig. 8), one with the carcass of a hunted individual (Fig. 9), and 14 with tracks (Table 1). The positions of these sites were recorded with a GPS, and where possible, foot tracks were measured using calipers.

Six camera traps were installed - three at Caleta del tambor



Figure 5. Diurnal activity of *C. acutus* (ID 8 in Table 1).



Figure 6. Nocturnal activity of *C. acutus* (ID 10 in Table 1).



Figure 7. Nocturnal activity of *C. acutus* (ID 8 in Table 1).



Figure 8. Nest site (ID 2 in Table 1).

and three at Covado I (Fig. 2). Within the sites, cameras were placed such that they covered recent activity of *C. acutus* (eg active basking sites with fresh tracks) (Fig. 3). They were programmed to be triggered by motion, capturing 15-second videos when activated by a passing animal. Batteries and memory cards were changed every two weeks.



Figure 9. Carcass of dead *C. acutus* due to hunting (ID 3 in Table 1).

Images of *C. acutus* were captured by five of the six cameras (3 at Covado I, 2 at Caleta del tambor). All *C. acutus* filmed were adults, reflecting two size classes (De La Ossa-Velásquez 2002; Hilevski and Velasco 2020); small-sized adults (Class IV; 180-240 cm) and more frequently observed large-sized adults (Class V; >240 cm). The individuals were mainly observed basking on land during the day (Figs. 4 and 5), and less frequently they were observed reaching land during the night and in the early morning hours before sunrise (Figs. 6 and 7).

At Covado I, a large male showed preference for one of the basking spots visited during the day and night, where it was filmed 28 times (ID 10). This same individual was also filmed on a single occasion while using a second basking area (ID 9). For Covado I, a smaller adult was filmed while basking at a different basking spot (ID 12).

Observations for Caleta del tambor indicated frequent activity for one of the basking sites (ID 8), specifically located between the channel and a flood plain, with an underwater entrance to a cave (Figs. 3 and 5). Two large individuals (male and female) were filmed on separate occasions using this area during day and night hours, for a total of 22 filming events (19 events for the male; three events for the female). Other observations for Caleta del tambor include a small-sized female filmed on two occasions using a different spot during night hours (ID 7).

For the study area as a whole, we estimate a relative density of 1.1 adult *C. acutus* per kilometre based on all indirect forms of evidence. For Caleta del tambor, relative abundance was 1.0 adults/km (5 tracks, 1 carcass, 2 abandoned nests). For Covado I, it was higher at 2.4 adults/km (6 tracks), and for Covado II it was lower at 0.6 adults/km (3 tracks).

Adults showed preference for certain basking spots, that they use more frequently (Table 1). We consider that this makes it more favourable for the use of camera trapping as an alternative survey method, making photo ID of basking/ nesting individuals at such sites possible. For future studies, we suggest the use of a capture/recapture image-based method

to estimate abundance. This could generate information, especially on the adult fraction of the population, at sites where surveying at night is not possible, or in the context of intense hunting where adults become more wary and go undetected during spotlight surveys.

More information that contributes to the use of a standardized methodology could allow for a broader application of passive monitoring technologies for the study of crocodylians in Colombia.

Acknowledgements

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Dominican Republic

UPDATES FROM DOMINICAN REPUBLIC: ILLEGALLY COLLECTED CROCODILES SEIZED AND A POSITIVE OUTLOOK FROM A CROCODILE SURVEY AT LAGO ENRIQUILLO. On 13 August 2024, Judá Isaf Martínez participated in the seizure of two American crocodiles (*Crocodylus acutus*) in Espaillat Province, Dominican Republic, by the Espaillat Regional Intelligence Sub-directorate of the National Police and J-2 (responsible for operational planning, management, and monitoring of military operations). This location is approximately 278 km from Lake Enriquillo, the only remaining natural habitat of the American crocodile in the country. Both individuals, a juvenile and a sub-adult (70.6 and 94.0 cm TL, respectively), were weighed, measured and sexed (Table 1; Fig. 1).

The smaller of the seized crocodiles had been scute-clipped (#361) in 2021 by Bobby Greco (Fig. 2), indicating that this individual was most likely taken from its natural habitat, and

Table 1. Measurements of seized crocodiles.

Measurement	Juvenile	Sub-adult
Head Length (HL; cm)	11.4	14.7
Snout Length (SL; cm)	6.6	9.1
Snout-vent length (SVL; cm)	38.2	50.5
Total Length (TL; cm)	70.6	94.0
Head Width (HW; cm)	5.4	7.0
Tail Girth (TG; cm)	15.6	24.2
Left Hind Foot LHF; (cm)	6.3	7.5
Bodyweight (BWt; kg)	1.3	3.3

it is inferred that the untagged specimen was likely removed in the same manner.



Figure 1. A) Collection of morphometric data. B) Transfer of specimens to the National Zoo.



Figure 2. Bobby Greco marking and measuring *C. acutus* hatchlings at Lago Enriquillo in 2021.

Following seizure, the crocodiles were taken to the National Zoo in Santo Domingo (Fig. 1), where they were kept until 27 August. They were then moved to an enclosure at Lago Enriquillo National Park, feeding on live fish, until they were released back into natural habitat in the El Arenazo area of Lago Enriquillo on 25 September by the Lago Enriquillo crocodile monitoring team. This location is free from the influence of fishermen and features a freshwater pool with an abundant food supply for the two crocodiles. The monitoring team continues to oversee the area, tracking the adaptation process of the released specimens.

Crocodile Survey at Lago Enriquillo

On 25 September 2024, the Lago Enriquillo crocodile monitoring team, led by Judá Isaf Martínez, Andrys Gómez and Ramón Joel Espinal, conducted a survey to count and capture crocodiles at Lago Enriquillo. The survey covered 1.21 km over 6 hours, starting at 1800 h at Los Borbollones

and concluding at 0015 h at Kilometre 5. Fifty (50) crocodiles were sighted during the survey, of which 17 juveniles were captured (on 25-26 September).

Of the captured animals, 11 were new captures and 6 were recaptures of previously tagged hatchlings. Morphometric measurements were taken for each specimen, and untagged crocodiles were marked to facilitate monitoring of future growth or sightings in the coming years (Fig. 3). The average size of new captures was 51 cm TL, 27.7 cm SVL and 517 g BWt. These recaptures are particularly promising, as many of these juveniles had not been captured or observed in many years. All individuals captured in the wild displayed high growth and were in excellent health.

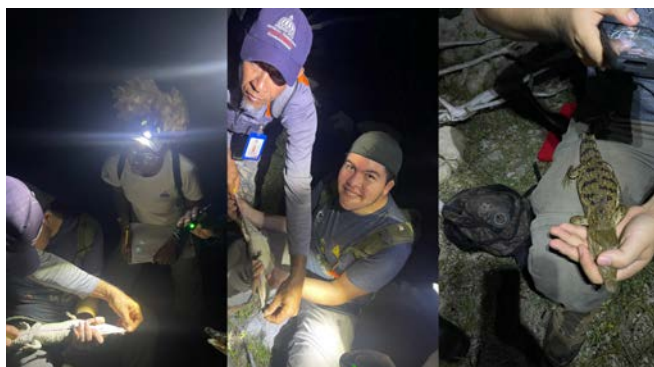


Figure 3. Juvenile American crocodiles captured for marking and measuring during the September survey.

The healthy development of these juvenile crocodiles is a positive sign, as it suggests that current environmental conditions in Lake Enriquillo are favourable for growth and survival of the species. This could be linked to various factors, such as food availability, habitat quality, and a reduction in threats. The absence of similar numbers of juveniles in previous years might indicate that environmental conditions or population dynamics have recently improved, or that monitoring methodologies have been refined, yielding better results.

That six of the captured individuals were recaptures demonstrates the effectiveness of prior tagging and monitoring strategies, allowing for the tracking of their development and health over time. Over the 4-month period since their initial capture (May), the recaptured individuals had doubled their tail girth (from 4.89 to 11.69 cm) and total length (from 25.45 to 51.74 cm) while increasing their bodyweight 9-fold (from 55.4 to 525.0 g).

Acknowledgements

Thanks to the Dominican Ministry of the Environment and Natural Resources and to all of the collaborating organizations, including SOH Conservación, Group Jaragua, ZOODOM and Ecotopia, for their continued assistance and support for this project. Our deepest gratitude to the crocodile monitoring team at Lago Enriquillo for their invaluable monitoring of the crocodiles year-round and assistance with this project.

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Belize

CRC CELEBRATES CROCTOBER. Although science and research play an important role in conserving species, community support and interest have been fundamental principles for the Crocodile Research Coalition (CRC), helping us move closer to our overall conservation goal of creating a “CrocWise” country. For us at CRC, this is the time of the year when we put down our headlamps and prioritize educational outreach throughout our community, as well as countrywide, squashing misguided beliefs and false facts about the two species of crocodile in Belize - Morelet’s crocodile (*Crocodylus moreletii*) and American crocodile (*C. acutus*). Through in-person and virtual presentations, as well as participating on national news media shows, CRC reached over 2000 Belizeans in one month.

CRC also held three fundraisers throughout the month of CROctober, that helped raise ~\$BZ14,000 (\$US7000). These fundraisers included: a 50/50 raffle promoted for the month of CROctober at a local bar (The Flying Pig) during its Trivia Night; a kids Halloween party at The Flying Pig entrance fees donated to CRC’s wildlife youth program “Next Gen Croc”; and, a Croc Run half marathon (Fig. 1). Overall, these outreach events provided a way to interact with communities near and far, allowing us to provide facts about the wonderful world of crocodiles, while also educating about the laws that protect them, in addition to tips on how to co-exist with crocodiles to further pride and stewardship. CRC is grateful for the local and international support during the month of CROctober!



Figure 1. Youth runners from the Seine Bight Running Club who participated in the 2024 Croc Run.

Finally, every year CRC has a theme during CROctober, and this year we highlighted the next generation of crocodilian

scientists. Young students from the USA, Brazil and Zambia (to name a few) all shared their current research on various crocodilian species on our social media outlets. Head to CRC's Facebook, Instagram, X, and YouTube page to see what these amazing young scientists are currently researching around the world!

Now that CROctober is over, CRC is gearing up for World Croc Day on 17 June 2025. Together with the original founders of World Croc Day, we are aiming to organize large international celebrations every year. Check out the CRC social media outlets periodically, as we provide information of a weekend-long World Croc Day celebration in the Dominican Republic!

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Anguilla

A STORY ON HISTORICAL RECORDS OF CROCODILES IN THE CARIBBEAN. Exhausted, starved, thirsty, and with some of his men suffering from scurvy, Captain Thomas Bilton and his nine crewmembers drifted up onto a beach on Anguilla, a tiny, low island in the eastern Caribbean. It was 1707. They had sailed across the Atlantic from Portugal, and nearing the coast of Virginia (USA) a gale blew their ship back to the open sea, almost to Bermuda. Their ship began to take on water and sank, leaving the crew with just the ship's tender to serve as a lifeboat. When they stumbled onto the sand in Anguilla 31 days after abandoning their ship, the sailors were surely uncertain of what sharp-toothed dangers might lurk in the shallows. And they definitely could not have guessed that their story would lead to a minor mystery more than three centuries later.



Figure 1. Arrival in Anguilla. Credit: Richard J. King, *Sea History*.

The meta-story here, before we get back to Captain Bilton and his shipwrecked crew, is that I teach for the Sea Education Association, a study away program for undergraduates out of Woods Hole, Massachusetts. We take students out to sea on one of our tall ships of oceanography or, as with this past fall, after six weeks of research and preparation in Woods

Hole the students travel by plane to study coral reef ecology and conservation at four locations in the eastern Caribbean. Meanwhile, for nearly 20 years I have written and illustrated a quarterly column in *Sea History* magazine that examines historical human relationships to an ocean animal. For this upcoming issue I wanted to research a species relevant to where the students were visiting, especially since I wasn't with them in the field this semester.

To this end, thanks to the Anguilla Archaeological and Historical Society [website](#), I found *Captain Bilton's Journal of His Unfortunate Voyage* (Bilton 1715), which he published after his eventual return to England. At the end is a section titled "Prospect of the Isle of Anguilla," with accounts of several "strange Four-footed Beasts". Of all of the animals, the crocodile is declared the most remarkable. Crocodiles, "hideous to look on," could grow to be eighteen feet long. Their teeth could cut a person in two and the scales on their back and head were so hard that a musket ball barely made "an impression." The author learned to recognize their smell when out of the water and observed how the crocs hunted by floating as still as a log. The book concluded with: "There are abundance of these monstrous Crocodiles in these Islands that come in great Numbers in the Night to the Places where the Tortoises are killed, to feed on the Entrails left by Fishermen, who carry great wooden Leavers to keep them off, and oft kill them by breaking their Back therewith."

By the published description and their range and ecology, these would most likely have been American crocodiles (*Crocodylus acutus*). But today, there are no crocodilians of any species in Anguilla (Fig. 2). In fact, there are now no resident crocodiles anywhere in the eastern Caribbean north of Trinidad-Tobago (aside from an occasional pet introduced into the wild). Did Captain Bilton fabricate seeing these on Anguilla, or were they in fact resident in the numbers he described? If the latter, what happened to them?

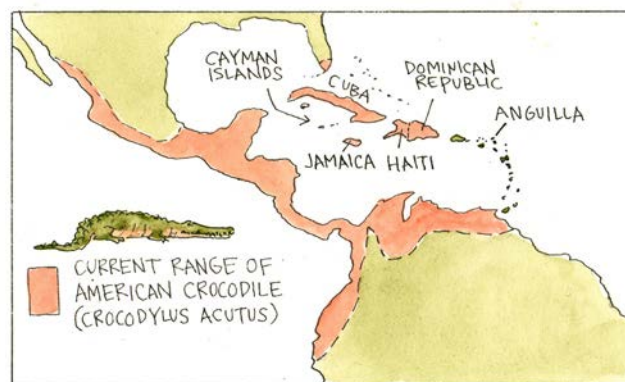


Figure 2. Range of American crocodile relative to location of the island of Anguilla [after map by Thorbjarnarson (2010)]. Credit: Richard J. King, *Sea History*.

American crocodiles are certainly capable of travel from island to island. Balaguera-Reina *et al.* (2020) reported that American crocodiles in 2012 and 2018 likely crossed about 700 km of open water in the Caribbean Sea, remaining in the ocean long enough that the first one arrived with barnacles

on its skin. At present, American crocodiles occur on Cuba and Hispaniola, larger islands in the Caribbean, with the latter less than 600 km west of Anguilla, with Puerto Rico and the Virgin Islands en route. This suggests it is plausible that American crocodiles may have once resided on Anguilla and other islands of the eastern Caribbean.

Records from early European pirates, explorers and naturalists describe crocodilians in other parts of the Caribbean, and they record their own reckless hunting and decimation of crocodile, shark and turtle populations. It is also possible that the indigenous cultures of the region, such as the Taino and the Kalinago communities, who might have numbered in the millions across the Caribbean islands when the Spanish arrived, may have eradicated or at least severely reduced crocodile numbers in some locations.

So, I thought, Captain Bilton's account of the presence and behaviour of crocodiles on Anguilla was probably pretty reliable, an easy story for the magazine. However, that was until further research using Google Books, Archive.org and the Biodiversity Heritage Library, revealed that Bilton's publisher in England, perhaps finding the journal of their ordeal too brief and not worthy of the six-pence cover price, copied this natural history section verbatim from Robert Burton's *The English Empire in America* (Burton 1685). This earlier account had lovable illustrations, including one of a crocodile (Fig. 3).



Figure 3. Illustration of “strange creatures from America”, including this crocodilian, in: Burton, R. (1685). *The English Empire in America*. Credit: public domain.

Okay, so Robert Burton must have visited Anguilla and left this important historical account of the island? Again No. “Robert Burton” was the pen name for editor Nathaniel Crouch, who stole the crocodile description from an even earlier book, *The History of the Caribby-Islands* (de Rocheforth 1666), originally published in French. This account did not place the crocodiles in Anguilla at all, but broadly in the Caribbean and more specifically in the Cayman Islands, the small island group with a well-known history of turtles and crocodiles. When questioned on the possible historical presence of crocodiles in the eastern Caribbean, Frank Mazzotti of the University of Florida, stated: “Maybe yes, but no reliable records” (F. Mazzotti, pers. comm., 4 November 2024).

As this short story demonstrates, historical records may require careful scrutiny and healthy skepticism. Yet as readers of this Newsletter well know, piecing together historical ranges of marine life and our historical relationships to these animals can have huge benefits for management, especially since crocodilians are a flagship species for the conservation of coastal ecosystems (Thorbjarnarson *et al.* 2006).

I would be interested to learn if anyone been compiling historical records of crocodilians in specific locations?

Acknowledgements

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Mexico

10 YEARS CONTRIBUTING TO THE TRAINING OF COCODRILEROS. The management of *in-situ* and *ex-situ* crocodilian populations requires basic knowledge and skills

to ensure the well-being of the species and humans involved. Training will always open doors to learning, making it an excellent strategy for the future of conservation efforts. Management techniques can be complex and risky, especially when there is a fundamental lack of knowledge about the species and its behaviour. Training interested personnel linked to the subject, providing appropriate management techniques that allow them to acquire the necessary skills, has been the main objective of the management and conservation workshops organized by NGO Conservación, Manejo y Aprovechamiento Sustentable de Flora y Fauna Silvestre (COMAFFAS), located in Chiapas, Mexico, and led by Directors Jerónimo Domínguez Laso and Berenice García Reyes.

With an 11-year history as an organization, nearly 100 training events have been held, representing over 3000 hours dedicated to theoretical and practical activities. With the support and collaboration of other experts and multiple venues in different parts of Mexico, Guatemala and Colombia, we have contributed to the training of more than 2500 interested individuals, primarily young people. These workshops have been characterized by their dynamism, prioritizing direct interaction of participants with crocodilians and teamwork.

The passion for crocodilians has brought us together over the years, creating a great environment for knowledge and learning, allowing for comprehensive workshops that have provided valuable information that has undoubtedly influenced the learning of both instructors and trainees. Giving instructors the opportunity to share their knowledge and experiences, the topics covered have been designed to provide basic and important knowledge that motivates participants to delve into the world of crocodilians and their conservation. What has been addressed includes handling and containment techniques, ecology, biometric data collection, veterinary medicine, among other important topics.



Our most recent experience was the training course on “Management of Mexican Crocodilians and Experiences in the Breeding and Study of the Cuban Crocodile”, delivered on 25-27 October 2024, where we collaborated with Gustavo Sosa Rodríguez (Cuba). It was very enriching to train the attendees with the methodologies of each instructor and fully involve them in the process that includes handling live

specimens, from capture, restraint, sample collection and biometric data to safe transport and release in their enclosures. Each participant had the opportunity to choose the methodology that best suits them to achieve their personal research and/or project goals, and that is what is satisfying about this training events: to lay the groundwork for promoting good crocodilian managers.



This experience leaves us with great learning and allows us to continue valuing every day this pleasant opportunity to live and do what we love, sharing knowledge with new generations, who will be the guardians of the future of *Crocodylia*.

This journey continues, and it is with great pleasure that we announce the upcoming workshop on “Management and Conservation of Crocodylia in Latin America” on 19-22 February 2025, to be held in Chiapas, Mexico. For more information, please check the social media of COMAFFAS (www.facebook.com/comaffas.ac; @comaffas.vidasilvestre).

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South Asia & Iran

India

FLOODS, FEARS, AND ESCAPES OF MUGGER

CROCODILES AT VADODARA CITY, GUJARAT, INDIA. The highly human-populated city of Vadodara, in Gujarat, India, is known by its nickname of “Makara City” (‘makara’ is the Sanskrit word for water monster; Vyas 2024). The name refers to the city’s special identity due to the high number of Mugger crocodiles (*Crocodylus palustris*) inhabiting the Vishwamitri River that flows through it (Vyas 2010, 2023; Pagdand 2019). The Mugger population is estimated to comprise more than 400 individuals of various sizes as per the last count (Forest Department 2020). The large number of Muggers existing in the city is possibly one of the most notable examples of co-existence of large carnivorous reptiles with humans in an urban environment.

Recently, Vadodara experienced three floods within two months, on 24 July, 26 August and 25 September 2024, as a result of high rainfall, the effects of which were exacerbated by serious flaws in the city’s disaster management and urban planning. During these events, Muggers followed the flood waters out of the Vishwamitri River and entered nearby residential and slum areas. Although a good number of Muggers were rescued in the July and September floods, their numbers increased significantly during the more serious August flood. Water levels in the Vishwamitri River rose above dangerous marks on all three occasions, but on 26 August 2024 levels of flooding reached over 11.3 m, some 3.8 m above the danger mark of 7.5 m, and low-lying parts of the city were almost entirely submerged for two days.

The presence of Muggers exacerbated the problems being faced by the people of Vadodara, who were already panicked due to the heavy floods. Citizens reported Muggers from different parts of the city, as well as in nearby villages. Local animal welfare volunteer groups and forest department staff rushed to mitigate potential conflict between humans and Muggers (Fig. 1).



Figure 1. Local crowd and largest Mugger (3.8 m TL) rescued from water-logged slums of Vadodara City after floods. Photograph: Jignesh Parmar.

Confirmed records indicate that 75 Muggers of various sizes (0.3 to 3.8 m TL) were captured by various agencies (eg Forestry), NGOs and volunteers (Fig. 2). The involvement of volunteers in the capture and release of Muggers back to appropriate locations in the river shows that local people are willing to assist these potentially dangerous animals (Fig. 3). Other reptiles were also rescued, including over 100

non-venomous (including 9 Indian Rock Pythons *Python molurus*) and venomous (various species) snakes, and five large Ganges soft-shell turtles (*Aspideretes gangeticus*).



Figure 2. Adult Mugger rescued at night by volunteers. Photograph: Hemant Vadhavana.



Figure 3. Sub-adult Mugger rescued by local volunteers. Photograph: Hemant Vadhavana.

However, not only wild Muggers were involved in the flooding event, with 10 captive Muggers (2 hatchlings, 3 sub-adults, 5 adults) from the local zoo escaping from captivity. This included a 3.6-m adult male Mugger which had been captured on 11 July 2020 (Fig. 4) from Madevpura village, Waghodiya Vadodara, located on the banks of the Dev River (a tributary of the Dhadhar-Vishwamitri River system). This crocodile was responsible for a fatal attack on a 54-year-old woman on 3 July 2020 (Anon 2020). Zoo staff were relieved that four adult Gharial (*Gavialis gangeticus*) were unable to escape from their enclosure, which is next to the Mugger’s open enclosure at the zoo.

In the past, zoo authorities have faced similar experiences and problems with Muggers escaping from the zoo during floods (Vyas 2010; Vyas and Bhatt 2004). There are also other cases of crocodile species escaping from zoos/farms that faced floods (Webb 2012). We are unaware as to whether the escaped zoo crocodiles in this case were recaptured or not. However, improved design of enclosures to prevent escapes during flooding may be worth considering.

The situation with Mugger crocodiles inhabiting the river within urban pockets of Vadodara emphasizes the acceptance



Figure 4. Large Mugger (3.65 m) captured near Madevpura Village, on the Dev River in July 2020 (see text). Photograph: Hemant Vadhavana.

of locals to co-exist with large predators, even though frequent direct and indirect interactions occur in the area (eg during the wet season crocodiles may move into urban areas). It demonstrates the great tolerance of the people of Vadodara.

We received news of Mugger rescues not only from the city, but also from other parts of the district, especially small towns (eg Padara, Itola, Karjan, Amod, Janmbusar) and villages (eg Divalipura, Shahpura, Naliyar, Batrisi-Talaw, Vadiya, Manjula-Vasana, Miyagam). All these towns and villages are located on the banks of the Vishwamitri-Dhadhar River system. Mugger rescues from these rural areas indicate that the population of the species is gradually increasing in the river system, and measures are needed to mitigate direct conflicts between humans and Muggers.

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MORPHOMETRY OF SKULL OF A LARGE MALE ESTUARINE CROCODILE FROM BHITARKANIKA NATIONAL PARK, ODISHA, INDIA. Various authors have reported measurements of the skulls of large Estuarine crocodiles (*Crocodylus porosus*) (eg Kar 2006a,b,c; Manolis 2006; Webb and Messel 1978), including the world's largest skull from the Dhamara River (Bhitarkanika) of 1926. Here, I present information on the skull of very dark coloured and white-faced male of 5.6 m length, that lived in Chintamani jora (= creek), which is associated with the Thanapati-Bhitarkanika River system of Bhitarkanika National Park (BNP). The upper end of this creek gradually narrows and ends near the saline gherry at the Ragadapatia village. This male crocodile was named "Chintamani" after this important creek, which has a network of small creeklets, good forest cover and a rich fish resource associated with it.

I first sighted Chintamani in January 1976, when he was around 4.7-4.9 m TL. He was considered a highly territorial male, and I observed him basking, feeding and exhibiting territorial behaviour from time to time since that initial sighting. He maintained a territory of around 2.5 km within the creek, and although appearing tolerant of crocodiles of other size classes, he was intolerant of male crocodiles of similar or larger sizes.

At times, people residing in villages bordering BNP (Kar 2024b) would enter this creek illegally for fishing, mainly at night during full moon and new moon tide phases (when maximum fish flow from the sea into tidal rivers/creeks occurs). At times, they were also setting traps for herbivores such as Spotted deer (*Axis axis*) and wild boar (*Sus scrofa*) near and around Chintamani's territory. Chintamani was very much intolerant of these intruding fishermen, and had attempted attacks on them several times.

In spite of efforts by Protected Area (PA) Management to make people aware of regulations regarding entry into prohibited areas of BNP for fishing, etc., it appears to have had little/no impact on the attitude of those people. In 1988, over a period of some three months, Chintamani killed three fishermen who



Figure 1. Skull of 'Chintamani'. Photograph: Sudhakar Kar.

had secretly ventured into the creek for fishing. It is unclear whether reasons for the attacks were motivated by territorial defence or for food.

Nonetheless, as a result of these fatal attacks, fishermen of different localities combined their efforts to kill Chintamani. They succeeded, and in September 1988 they killed Chintamani by netting, leaving his dead body in the creek. Chintamani's putrefied body was recovered by patrolling park staff after a few days. Sadly, the right side of Chintamani's skull (lower and upper jaws) was damaged with an axe (see Fig. 1). Measurements of Chintamani's skull are in Table 1.

Table 1. Morphometric measurements of Chintamani's skull (in cm).

Width of Cranial Platform (HPP)	17.0
Cranial Platform Midpoint Width (HMP)	14.5
Maximum Head Width (HMW)	39.5
Interocular Width (HIO)	7.5
Snout-Eye Length (HSE)	44.5
Total Head Length (HTL)	66.0
Mandibular length	78.5
Total Body Length (TBL)	560

Chintamani's skull is housed at the Crocodile Research Centre at Dangmal, within BNP, for display and further study, together with other skulls from Estuarine crocodiles of various sizes.

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I am thankful to the Chief Wildlife Wardens, Odisha and Wildlife Wardens of Athagarh Forest Division as well as Wildlife Wardens of the Bhitarkanika Mangrove (Wildlife) Division, Chandabali/Rajnagar for extending support to conduct study on ecology and biology, and also captive

populations of Estuarine crocodiles in Bhitarkanika Mangrove ecosystem since July 1975.

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- PREDATION OF A HATCHLING MUGGER (*CROCODYLUS PALUSTRIS*) BY A CHANGEABLE HAWK-EAGLE (*NISAETUS CIRRHATUS*), PILIBHIT, INDIA. The medium-sized Changeable Hawk-Eagle (*Nisaetus cirrhatus*) is the most widespread of the Family

Accipitridae, ranging from India eastwards through Southeast Asia to the Philippines and Greater Sundas (Rasmussen and Anderton 2005; Grimmett *et al.* 2013). Of the five recognized subspecies (*N. c. cirrhatus*, *N. c. ceylanensis*, *N. c. limnaeetus*, *N. c. andamanensis*, *N. c. vanheurni*; GRIN 2016), *N. c. cirrhatus* occurs in peninsular India, ranging from the Gangetic plain southwards throughout the rest of the country (Naoroji 2006).

This raptor hunts various animals, including birds, small to medium-sized mammals, reptiles, amphibians and insects (Clark *et al.* 2020; Pande *et al.* 2018), and has also been reported scavenging on dead deer and monkeys (Dharmakumarsinhji 1955; Naoroji 2006; Bhandari and Goyal 2018). Here, we present a new item in the species' diet menu based on accidental observation with photographic evidence.

In the last week of December 2024, the first author (RS) visited Pilibhit Tiger Reserve (PTR), Pilibhit District, Uttar Pradesh, India (28°8'0" to 28° 50'0" N; 79° 53'02" to 80° 18'03" E). PTR forms part of the Terai Arc Landscape in the upper Gangetic Plain Biogeographic Province, and is one of the important habitats for the Bengal Tiger (*Panthera tigris*) due to its geographical location and connection to several other tiger habitats within the state (Kishanpur Wildlife Sanctuary, Dhudhwa National Park, Corbett National Park) and outside (Shuklaphanta National Park, Nepal) (Chanchani *et al.* 2024).

During his visit to the motor vehicle track of the Pakki Patri, Tourist Zone 2, he spotted a medium-sized raptor perched on the mid-canopy of a large wild Fig tree (*Ficus carica*) with an unidentified reptile hanging from its talons. At first sight, the prey was thought to be a monitor lizard (*Varanus bengalensis*; Naoroji and Schmitt 2007; Karaunarthna *et al.* 20217), but more careful observation through a telephoto lens indicated it was an adult Changeable Hawk-Eagle with a hatchling crocodile (Fig. 1). Later examination of photographs allowed the prey to be identified as a 45-50 cm hatchling Mugger crocodile (*Crocodylus palustris*) (eg scale pattern of hind feet, head, tail and dorsal scutes were clearly visible; Fig. 1).



Figure 1. Adult Changeable Hawk-Eagle with Mugger prey at Pilibhit Tiger Reserve. Photograph: Rohan Sharma.

A literature search revealed a few bird species reported to specifically predate Mugger hatchlings, including Black-necked Stork (*Ephippiorhynchus asiaticus*), Painted Stork (*Mycteria leucocephala*), Purple Heron (*Ardea purpurea*), Pariah Kite (*Milvus migrans govinda*), Grey Heron (*Ardea cinerea*) and Brown Fish-Owl (*Ketupa zeylonensis*) (Somaweera *et al.* 2013; Vyas 2019; Vyas and Singh 2020; Tanna *et al.* 2024) Singh and Vyas 2024). Eighteen species of raptor are reported as predated and/or consuming hatchling/ juvenile crocodiles (Gopi and Pandav 2006; Somaweera *et al.* 2013; Vyas 2019; Singh and Vyas 2024). Now, the Changeable Hawk-Eagle can join this list of predators on Muggers.

We do not know how the hatchling Mugger was taken, whether it was situated on land or in the water, or whether it was alive or dead when taken. Given the time of year (winter), a possibility is that the Mugger was basking at the time. Muggers inhabit various surrounding swamp habitats, and the Gomti River (a northern tributary of the Ganges River) originates from PTR and is the catchment of several other small rivulets, namely Sharda, Chuka and Mala Khannot. All of these forest river streams represent good habitats for Muggers.

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crocodile (*Crocodylus siamensis*) is regarded as one of the most critically endangered crocodylians in the world (Platt *et al.* 2019). During the past 50-70 years, wild populations of *C. siamensis* throughout mainland Southeast Asia have plummeted in the wake of illegal hunting for skins and meat, government-sponsored extermination programs, habitat loss, and over-collecting to stock commercial crocodile farms (Platt *et al.* 2019). Fewer than 1000 adult *C. siamensis* now survive in the wild, and most populations are small, fragmented, and of questionable reproductive viability (Platt *et al.* 2019).

The conservation situation is particularly acute in Lao PDR (hereafter Laos) where potentially viable, albeit fragmented populations of wild *C. siamensis* survive in Attapu, Khammouane, Salavan, and Savannakhet Provinces (reviewed by Stuart and Platt 2023). Despite being legally protected as a “Prohibited Category I Species” (hunting and trade is strictly prohibited), Siamese crocodiles are threatened by deliberate killing for food and to protect people and livestock, collection of eggs for domestic consumption, incidental take in fishing gear, and most importantly, habitat loss (Bezuijen *et al.* 2013; Platt *et al.* 2019).

Since 2011, Wildlife Conservation Society (WCS) in collaboration with the Government of Laos has been working to restore a globally significant population of *C. siamensis* in the Xe Champhone wetland ecosystem of Savannakhet Province in central Laos. We herein report on progress towards achieving that objective during 2023-2024.

Xe Champhone Wetland Ecosystem

The Xe Champhone Wetlands (XCW; 16.3836°N, 105.2147°E) are located in the floodplain of the Champhone and Xangxoy rivers, which in turn drain into the Mekong River. The XCW encompass 45,000 ha of seasonally inundated natural and anthropogenic wetlands, agroecosystems (primarily rice fields), scrublands, and forests. Approximately 12,400 ha of the XCW is now administered as the Xe Champhone Ramsar Site (established in 2010), which includes two core areas totaling 2550 ha (IUCN 2011). Critical crocodile nesting habitat identified during our previous surveys (Platt *et al.* 2014) was taken into consideration when designating these core areas (IUCN 2011). The XCW are within the Mekong Plain physiographic province and experience a tropical monsoonal climate with a wet season extending from late May through October; peak rainfall and flooding occurs in September and October (Platt *et al.* 2018). The physical environment, vegetation, and social setting of the XCW are discussed in greater detail elsewhere (IUCN 2011; Quoi 2017; Platt *et al.* 2018b).

The XCW hosts what is probably the largest remaining wild population of Siamese crocodiles in mainland Southeast Asia (Platt *et al.* 2022). Based on nest counts made in 2022, we estimated the number of crocodiles inhabiting the XCW to range between 70 and 225 individuals (Platt *et al.* 2022). Crocodiles in the XCW are afforded *de facto* protection stemming from the local belief that crocodiles are the living embodiment of the spirits of dead ancestors, and anyone

East & Southeast Asia

Lao PDR

PROGRESS TOWARDS RESTORING A VIABLE POPULATION OF THE CRITICALLY ENDANGERED SIAMESE CROCODILE TO THE XE CHAMPHONE WETLANDS IN LAO PDR (2023-2024). The Siamese

harassing, harming, or killing a crocodile risks supernatural retribution in the form of misfortune, illness, or even death (Baird 2001; Bezuijen *et al.* 2013; Platt *et al.* 2018a). The widespread existence of these beliefs probably explains the continued persistence of *C. siamensis* in the XCW given that populations elsewhere in Laos have largely been eliminated (Platt *et al.* 2018a).

Crocodile Nest Surveys and Egg Collection

Our field observations indicate that *C. siamensis* in central Laos begin nesting in early to mid-May, shortly before the onset of heavy rains signaling the arrival of the annual monsoon, and nesting continues through early July (Platt *et al.* 2022, unpubl. data). Given this reproductive phenology, we task Village Conservation Teams (VCTs) with searching for nests from mid-May through early August. Each VCT consists of 5-20 locally recruited cadres, each of whom receives a modest monthly stipend for participating in the project (Platt *et al.* 2022). Many team members have been affiliated with the project since its inception in 2011, and consequently have accrued considerable local knowledge of crocodile nesting habits.

Teams focus on microsites used by nesting females in previous years, but also search other potential nesting habitat. A significant number of nests are opportunistically found by team members engaged in routine livelihood activities (eg fishing, harvesting snails, cultivating rice fields, etc.). Other villagers who find crocodile nests are asked to inform the local VCT. When a nest is located, VCTs immediately notify the WCS Field Office in Savannakhet and we make arrangements to travel to the site and collect the clutch. During 2022, we began using a small quadcopter drone (DJI Mavic 3 Fly More Combo™) to search for crocodile nests (Platt *et al.* 2023). The drone has proven especially useful when surveying difficult-to-access, heavily vegetated oxbow lakes.

Upon being notified of an active crocodile nest by VCTs, we make every effort to recover the clutch as quickly as possible (usually within 24 hours) to reduce the likelihood of losses to poachers, predators, or flooding. Our egg collection protocols are described in detail by Platt (2021). To briefly summarize, we open the nest mound to expose the clutch and carefully remove the eggs. The upward-facing surface of each egg is marked with a pencil to ensure that proper orientation can be maintained during all phases of the collection process. We determine if eggs are viable based on the presence of an opaque band on the eggshell.

Each egg is then weighed and measured (length and width) before being placed in a styrofoam box containing nesting material for transport to an incubation facility in either Tan Soum or Dongyanong villages. In accordance with local beliefs, VCTs often request that we leave a small number of eggs (1-5) in the nest mound to avoid offending the female crocodile. Depending on where a nest is located, transporting the eggs to an incubation facility can involve lengthy trips over deeply rutted roads. Care is therefore exercised to minimize jarring and vibrations that could damage the

developing embryos. In 2024, we deployed camera traps at four nest mounds after collecting the clutch and retrieved these units on 12 and 14 August 2024.

We found 6 and 8 active crocodile nests in 2023 and 2024, respectively (Table 1). All of these nests were constructed on floating mats of vegetated peat, which appear to be critical nesting habitat for crocodiles in the XCW (Fig. 1). We encountered aggressive females actively defending two nests (14.2%); one of these females (identified by a unique series of notched tail scutes) was an individual hatched on 16 August 2013, head-started from 2013-15, and released in March 2015 (Fig. 2). To our knowledge, this is only the second confirmed instance of nesting by a known-age, head-started and translocated female Siamese crocodile (see also Platt *et al.* 2024). Using the drone, we observed 9 females (64.2%) in wallows adjacent to the nest, which fled upon our approach (Fig. 3). No females were observed at three nests (21.4%), although tracks, trails, and scat suggested females were nonetheless in attendance. Camera trap imagery from four nests suggested females remained in attendance throughout the incubation period and engaged in nest repair behaviour after the clutch was collected (Fig. 4).

Table 1. Siamese crocodile nests located in the Xe Champhone Wetlands of Savannakhet Province, Lao PDR during 2023 and 2024. Nests are presented by location in order of collection. CS= clutch size; VE (%)= number of viable eggs in the clutch followed by percent in parentheses; H= number of hatchlings produced followed by hatch rate as a percentage. The number of viable eggs incubated is generally less than CS because one or more eggs were left in these nest mounds at the request of the Village Conservation Teams (see text). Hatch rate (HR) was calculated based on number of viable eggs incubated in each clutch.

Year/Location	CS	VE (%)	Incubated	HR (%)
2023				
Kout Kouang	27	26 (96.6)	26	16 (61.5)
Xe Hauk (1)	19	17 (89.4)	16	11 (68.7)
Kout Mak Pheo	26	19 (73.0)	18	7 (38.8)
Xe Hauk (2)	26	23 (88.4)	22	5 (22.7)
Kout Koke	22	22 (100.0)	22	15 (68.1)
An Talong	15	6 (40.0)	6	0 (0.0)
2024				
Xe Hauk (1)	39	36 (92.3)	34	29 (85.3)
Xe Hauk (2)	29	29 (100.0)	25	22 (88.0)
Kout Mak Pheo (1)	37	37 (100)	35	27 (77.1)
Kout Mak Pheo (2)	30	29 (96.6)	25	19 (76.0)
Lao Noth	32	32 (100)	30	29 (96.6)
Kout Koke	23	23 (100)	22	13 (59.0)
Kout Kouang	18	14 (77.7)	14	11 (78.6)
An Talong	18	10 (55.5)	0	NA
Totals (2023-2024)	361	323 (89.4)	295	204 (69.1)



Figure 1. Siamese crocodile nest on a vegetated mat of floating peat in the Xe Champhone Wetlands, Lao PDR. This nest was one of 14 found during 2023 (N= 6) and 2024 (N= 8). Floating peat mats are critical nesting habitat for Siamese crocodiles in the Xe Champhone Wetlands.



Figure 2. Female Siamese crocodile actively defending a nest was identified by a series of notched tail scutes (June 2024). This female was hatched from an egg collected in June 2013, head-started for two years, and released in March 2015.



Figure 3. Drone imagery of a female Siamese crocodile in a wallow adjacent to an active nest. The female fled upon approach of the Village Conservation Team.

Mean (± 1 SD) clutch size during the two nesting seasons (2023 and 2024) was 25.7 ± 7.7 eggs (N= 14; range= 15 to



Figure 4. Camera trap imagery of a female Siamese crocodile engaging in nest repair behaviour 30 days after her clutch had been collected by a Village Conservation Team.

39 eggs). Pooling our most recent data with those collected in previous years (2019-2022; Platt *et al.* 2022) gives a mean clutch size of 27.1 ± 9.1 eggs (N= 24; range= 12 to 55 eggs). Of the 135 eggs examined in 2023, 110 (81.4%) proved viable. In 2024, we examined 226 eggs, of which 210 (93.0%) were viable. We collected clutches for incubation from 6 and 7 nests in 2023 and 2024, respectively.

Given the limited capacity of our head-starting facilities, in 2024 we left one clutch in the nest to undergo natural incubation. When we initially opened this nest, 8 eggs were obviously decomposing, while 10 eggs appeared viable; however, according to the VCT the latter eggs failed to hatch. We speculate this clutch may have experienced multiple bouts of prolonged submergence during wet season flooding resulting in embryonic death (eg Joanen *et al.* 1977).

Incubation

In 2023, we used two methods to incubate crocodile eggs: 1) artificial nest chambers and 2) styrofoam boxes. We constructed artificial nest chambers by covering a wooden frame (ca. 1 m \times 1 m \times 1 m) with fine-mesh wire netting and fitting a hinged top. The incubation media included material collected from the nest, dried bamboo leaves, rice straw, and other vegetative detritus, which we kept moist (either by rainfall or supplemental watering) but not wet. We placed the incubation chambers in an exposed location with no overhead tree cover to mimic the natural environment of most nests (Platt *et al.* 2014). We also incubated eggs in styrofoam boxes (49 cm \times 27 cm wide \times 33 cm high). We filled the boxes with moist sand to a depth of about 10 cm, partially buried each egg in the sand, and then covered the clutch with nest material and dried leaves. Five ventilation holes (ca. 2.5 cm in diameter) in the box and lid allowed for airflow. The incubation media was moistened as needed. We kept the egg-filled boxes in vacant rooms of village administration buildings in Tan Soum and Dongyanong, and incubation occurred under ambient air temperatures (Fig. 5). For the first four clutches (Nests 1-4), we divided the clutch equally between artificial nest chambers

and styrofoam boxes. We incubated eggs from two additional clutches (Nests 5-6) only in styrofoam boxes.



Figure 5. Siamese crocodile eggs collected in the Xe Champhone Wetlands are incubated in styrofoam boxes kept in the village administration office at Tan Soum. Note the holes in styrofoam boxes that ensure adequate aeration of the incubating eggs.

Given the mediocre hatching success in 2023 (see below), during 2024 we discontinued the use of artificial nest chambers, incubated eggs only in styrofoam boxes, and slightly modified our incubation protocol. Rather than partially burying each egg in sand, we first saturated the sand with water, placed plant material collected from the nest in a layer atop the sand, positioned the eggs on this material, and then used more nesting material to cover the clutch. We also cut additional air holes (ca. 2.54 cm square) in the box (14 in the box and three in the lid) to improve aeration. We monitored the condition of the nesting material throughout the incubation period and added water as needed. As in previous years, we kept the styrofoam boxes in village administration buildings and incubation occurred under ambient conditions. Upon emerging from the egg, we permanently marked each hatchling by notching a unique combination of single and double caudal scutes (Rainwater *et al.* 2007).

Hatching dates ranged from 21 July to 7 September in 2023, and 19 July to 13 September in 2024, with considerable differences in hatching success between years (Table 1). In 2023, we incubated 110 viable eggs; this includes 41 eggs incubated in artificial nesting chambers and 69 eggs incubated in styrofoam boxes. Of these, a total of 54 (49.0%) eggs hatched, including 7 of 41 eggs (17.0%) and 47 of 69 eggs (68.1%) incubated in artificial nest chambers and styrofoam boxes, respectively. In 2024, we incubated 185 viable eggs in styrofoam boxes, of which 150 (81.0%) successfully hatched. The disparity in hatching rates between 2023 and 2024, strongly suggests that incubating eggs in styrofoam boxes using our modified incubation protocols yields greater hatching success. For this reason, we henceforth intend to incubate eggs only in styrofoam boxes.

Head-starting and Release

Head-starting is the process of rearing juvenile reptiles in captivity through their most vulnerable period (Tuberville *et al.* 2021). Head-starting allows juveniles to reach larger body size-classes more quickly when compared to similar-aged cohorts living under natural conditions, presumably making them less vulnerable to predation once released into the wild (Tuberville *et al.* 2021; Buhlmann *et al.* 2024). We conduct head-starting of hatchling crocodiles in two batteries of concrete grow-out pens constructed in Tan Soum Village during 2012-13 (Platt *et al.* 2014). Each battery contains four pens (2 m wide \times 3 m long \times 1.1 m high) with approximately equal areas of land and water. Cover boards and water hyacinths (*Pontederia crassipes*) are placed in the pens to provide concealment for young crocodiles. A second head-starting facility was constructed in Dongyanong Village prior to the 2023 nesting season. This facility is similar to the one in Tan Soum Village, albeit smaller (single battery containing three pens, each ca. 2 m wide \times 3 m long \times 1.1 m high).

At both facilities, VCT members are tasked with feeding crocodiles a variety of locally sourced fresh prey, including fish, eels, frogs, and golden apple snails (*Pomacea canaliculata*). Because young crocodiles lack the jaw strength necessary to crush apple snails, the shells are cracked before being offered to them as food. The water in each grow-out pen is changed at least twice weekly. We collect morphometric data from the cohorts every 1-2 months and segregate similar-sized individuals into different grow-out pens according to total length (TL). This practice is designed to lessen the competitive impact of dominant individuals on smaller members of the cohort. Crocodiles are head-started for approximately 30 months before being transitioned into the wild.

As described previously (Platt *et al.* 2014, 2022), we use a “soft-release” strategy to ease the transition of head-started crocodiles from captivity into the wild. Soft-release strategies entail the temporary confinement of animals in enclosures at the release site, a practice designed to familiarize the animals with local habitats, curtail post-release wandering, and increase the likelihood that stable territories will be established (Letty *et al.* 2007). Although crocodilian-specific data on the efficacy of “soft-release” appear lacking in the peer-reviewed scientific literature, pre-release confinement has been demonstrated to dramatically increase site fidelity among other translocated reptiles, including chelonians and squamates (Tuberville *et al.* 2005; Knox and Monk 2014; McCoy *et al.* 2014).

We erected a temporary acclimation pen for the release of head-started crocodiles into Phai Cheo (Tan Soum) Reservoir in late February 2023 and 2024. In 2024 we expanded our release efforts to also include Kout Kouang, an oxbow lake near Dongyanong Village. At both sites we constructed pens (6 m \times 12 m) in shallow water (ca. 1.5 m deep), each consisting of a bamboo framework covered in fine-meshed plastic netting and secured to wooden posts driven into the substrate. The base of the netting was buried in the substrate

to discourage crocodiles from escaping prematurely by burrowing beneath the fence. Floating bamboo platforms were placed in the pens to provide sites for basking and feeding. VCT members supplied food (fish, eels, and apple snails) three times weekly throughout the penning period.

We measured and determined the sex of the 2020 (N= 31) and 2021 (N= 39) cohorts before transferring these crocodiles into the acclimation pens (Fig. 6). The mean (\pm 1 SD) and median TL of the 2020 cohort were 75.2 ± 13.8 cm and 73.0 cm, respectively (range= 73.0 to 98.0 cm). The cohort consisted of 3 males and 28 females (1 male: 9.3 females), all released at Phai Cheo (Tan Soum). The mean (\pm 1 SD) and median TL of the 2021 cohort were 74.1 ± 9.6 cm and 73.0 cm, respectively (range= 54.0 to 99.0 cm). The cohort consisted of 25 males and 14 females (1 male: 0.5 females); 17 were released at Phai Cheo (Tan Soum) and 20 at Kout Kouang (Dongyanong), while the two smallest members of the cohort were retained for an additional year of head-starting.



Figure 6. Head-started juvenile Siamese crocodile being released into an acclimation pen at Phai Cheo Reservoir near Tan Soum Village.

Table 2. Numbers of headed-started Siamese crocodiles released into the Xe Champhone Wetlands, Lao PDR (2013-2015 and 2022-2024). The 2021 cohort consisted of 39 crocodiles, but the two smallest individuals were retained for an additional 12 months of head-starting.

Cohort	Number Released	Date of Release
2011	19	March 2013
2012	21	March 2014
2013	15	March 2015
2019	47	March 2022
2020	31	March 2023
2021	37	March 2024
Total	170	

The wariness of the young crocodiles, combined with water depth and aquatic vegetation makes monitoring the cohort after release into the pen challenging. Furthermore, we have to date been unable to construct escape-proof enclosures. Typically, crocodiles begin to escape (presumably by burrowing beneath the fence) within 1-2 weeks of being placed in the acclimation pens and by the onset of the wet season (mid-May) the majority have absconded (Platt *et al.* 2014, 2022). By the end of May, we liberate any crocodiles remaining in the enclosures and then dismantle the pens. To date, we have released 170 head-started crocodiles in the XCW (Table 2) and 274 additional crocodiles are currently being head-started for future release (Table 3).

Table 3. Cohorts of young Siamese crocodiles now being head-started for release in the Xe Champhone Wetlands of Lao PDR.

Cohort	Number	Scheduled Date of Release
2021	2	March 2025
2022	80	March 2025
2023	54	March 2026
2024	138	March 2027
Total	274	

Population Monitoring

Given the difficulty of detecting crocodiles during nocturnal spotlight counts in heavily vegetated habitats, and the limitations of camera trapping and track and sign surveys, annual nest counts are the most appropriate method for monitoring long-term population trends of Siamese crocodiles and evaluating conservation outcomes in XCW (Platt 2021). Nest counts are a valuable tool in crocodilian managements programs worldwide and have been successfully employed to monitor populations of both hole- and mound-nesting species (eg McNease *et al.* 1994; Rainwater and Platt 2009). Trends in nest count data provide a statistically rigorous means to assess the numerical response of populations over time (Nichols 1987; McNease *et al.* 1994). Furthermore, if the proportional representation of sexually mature females in the population can be determined, nest counts are useful for estimating population size (Chabreck 1966; Nichols 1987; Webb *et al.* 1989). That said, we currently lack a sufficient number of years of nest count data to statistically detect population trends through linear regression. However, if we assume breeding females constitute 4-13% of the population (Webb *et al.* 1989), our nest count from 2024 (Table 1) suggests the number of crocodiles inhabiting the XCW is between 60 and 200 individuals. As such, this population is of global conservation significance and ranks among the largest known wild population of Siamese crocodile anywhere in mainland Southeast Asia.

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- ESTABLISHING A CONSERVATION BREEDING PROGRAM FOR SIAMESE CROCODILES AT THE LAO CONSERVATION TRUST FOR WILDLIFE, LAO PDR. The Lao Conservation Trust for Wildlife (LCTW) is the first Lao-registered NGO based in Lao PDR. Its mission is to work jointly with key stakeholders in conservation, both within Laos and internationally, to address illegal wildlife trade. They rescue, rehabilitate and release native Lao wildlife affected by illegal trade, and build animal welfare and conservation capacity through engagement and outreach across Lao PDR.
- Established in 2018, LCTW took over management of Lao Zoo, the country's national zoo, based in Ban Keun, around 60 km north of Vientiane. In taking over management of the zoo, LCTW also established ownership of all existing zoo animals, including a group of around 100 crocodiles. Although listed as Siamese crocodiles (*Crocodylus siamensis*), due to the poor record-keeping at the time and the tendency for crocodile farms to favour hybrids as a better production animal (Chavananikul *et al.* 1994; Thang 1994; Fitzsimmons *et al.* 2002; Jelden *et al.* 2008), the genetic makeup of these crocodiles was uncertain.
- In 2009, based on visual characteristics, a group of 26 crocodiles housed at the former zoo had been identified as being potentially pure *C. siamensis* (Platt and Horne 2013). On the basis of microsatellite analysis, 12 of them were confirmed to be pure *C. siamensis*, and have been housed separately for breeding purposes since April 2022 (Flewitt *et al.* 2025). This group produced one successful clutch in July 2023, with 9 offspring surviving until February 2024, when they were sent to our conservation partner WCS-Laos in preparation for release to the wild. This group of hatchlings was studied during this time, and a paper documenting differences in their growth and survival based on their rearing protocols is currently in review.
- It was recommended by Platt and Horne (2013) that the remainder of the group also be tested as a matter of urgency, to allow their inclusion into a secure breeding program. In late 2023, a grant was secured through the Asian Species Action Partnership to fund full genomic sequencing of all specimens housed at LCTW, including the previously tested individuals. In December 2023/January 2024, tissue samples were taken from all specimens. DNA was extracted from the samples and amplified in Laos, and later exported to the USA for further analysis. Results received in June 2024 indicated that 75 crocodiles were pure *C. siamensis*, and 11 were hybrids. A management decision was made to euthanize the hybrids, enabling us to focus on breeding pure specimens. The resulting group of 75 crocodiles (16M, 59F) may be the largest known confirmed captive population of this species anywhere in the world (Fig. 1).
- The timing of these results also coincided with a move to a new site for LCTW. Moving all adult crocodiles took place in June 2024, which is in the middle of the nesting season for this species (Platt *et al.* 2019). Once the enclosures were cleared of adult crocodiles, staff had the unique opportunity



Figure 1. Adult Siamese crocodiles.

to excavate the existing nests, remove the eggs, and take them to the new site for incubation and rearing. It is thought that any hatchlings from previous years, bar the one successful clutch (see above), had been predated by conspecifics. While checking the first emptied enclosure on 25 June, hatchling calls could be heard from inside one of the nests. The team quickly and carefully excavated the nest, where actively hatching crocodiles were found.

This nest yielded more than 100 eggs (presumably from two separate clutches), with many hatching or having hatched soon after being excavated. Fifteen partially hatched hatchlings were dead, and there were also some non-viable eggs. This nest could have begun hatching up to 48 hours before it was located by staff, as this is when the female was removed from the enclosure. It is presumed that the hatchlings could not break free from the compacted earth making up the nest, so without the mother's assistance, the earliest hatchlings unfortunately perished.



Figure 2. Hatching eggs.

On realizing that there may be more hatchlings at risk, the

team quickly checked all enclosures for any remaining nests. In the 48 hours since the last crocodiles were moved to LCTW's new site, several of the nests had already been targeted by poachers who most likely knew the crocodiles had been moved and security was low at LCTW's old site. Staff successfully excavated all remaining nests, several of which were also in the process of hatching (Fig. 2). Unhatched eggs were placed in incubation boxes for the remainder of their incubation.

Over the coming weeks, eggs continued to hatch, resulting in a total of 63 hatchlings for the 2024 breeding season. This is the most successful year for LCTW's breeding program. Given the wild population in Laos is estimated to contain less than 100 individuals, this number represents a potentially huge boost for the species' survival, with all hatchlings destined for release in the future. At the time of writing (December 2024), at least 56 hatchlings had survived, with most appearing to grow well. The hatchlings are housed in a custom-built enclosure designed to minimize their contact with humans and to maintain their natural fear of humans, hopefully aiding their survival in the wild. Once these animals reach approximately 1 m in length, we hope to send them to WCS-Laos for release as part of its community Siamese crocodile breeding project (see Platt *et al.* 2024).

With all 75 adults now part of this breeding program, LCTW has a huge potential to assist with re-populating this species in the wild. It is hoped that we have a similar level of success each breeding season, enabling the wild numbers to be boosted dramatically over the coming years. One setback to this, however, is that with the move to the new site, a new enclosure had to be built quickly due to the unforeseen circumstances of the move. This enclosure does not have any separated areas to allow for breeding pairs/females to be separated from conspecifics, meaning predation on future hatchlings would also be likely without any intervention. In future breeding seasons, the eggs must be removed by staff and incubated separately to prevent predation. Hatchlings at LCTW thrived significantly better when left with their mother for the first few months of life (Flewitt *et al.* 2025) (Fig. 3). It is hoped that funds can be raised in the near future to allow modifications to the new enclosure, improving its ability to facilitate the successful breeding and hatching of this critically endangered species.



Figure 3. Female Siamese crocodiles with hatchlings.

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Recent Publications

Heard, D. (2025). Crocodylians (Crocodiles, Alligators, Caiman, and Gharial). Pp. 423-436 in *Zoo Animal and Wildlife Immobilization and Anesthesia, Third Edition*, ed. by G. West, D. Heard and N. Caulkett. John Wiley & Sons Inc.: Hoboken, New Jersey, USA.

Vliet, K.A. and Anderson, G. (2025). Crocodylian capture and restraint. Pp. 437-450 in *Zoo Animal and Wildlife Immobilization and Anesthesia, Third Edition*, ed. by G. West, D. Heard and N. Caulkett. John Wiley & Sons Inc.: Hoboken, New Jersey, USA.

Delbosc, N.C., Boyer, N., Mathevon, N. and Grimault, N. (2024). Crocodile mothers' response to hatching calls. *Animal Behaviour* (<https://doi.org/10.1016/j.anbehav.2024.11.018>).

Abstract: In animal species with parental care, caregivers' investment is often driven by offspring solicitation signals. Previous studies, particularly in birds and mammals, show that parents modulate their response to these signals according to characteristics such as their intensity and number per unit of time. In crocodylians, mature embryos still in the egg emit hatching calls perceived by other embryos and by the adult guarding the nest. These calls help to synchronize hatching within the nest and encourage the adult to dig the nest and help the young to hatch. However, the embryos do not

start calling all at once, and it can take several hours or even days after embryos have started to vocalize before the adult digs the nest. When and why does the crocodile parent decide to respond to the hatching calls of its offspring? Here we show that Nile crocodile, *Crocodylus niloticus*, mothers only start digging their nests if the hatching calls are emitted in a sustained manner by the offspring. While females react with head and body orientation movements to isolated calls, only continuous bursts of calls lasting several tens of seconds induce digging behaviour. This high response threshold on the part of the mothers probably limits the untimely digging up of eggs that may not have reached full maturity, thus avoiding damaging them, and is likely to favour the synchronization of offspring hatching. Overall, this study suggests that the parental response of Nile crocodiles to offspring solicitations is not necessarily linearly correlated with the number of begging signals received but may require a sufficient number of begging signals to exceed a threshold.

do Val, H.G.P. (2024). A review of anatomical adaptations in the middle ear of living aquatic tetrapods. *Revista da Biologia* (doi:10.11606/issn.1984-5154.v24p1-8).

Abstract: Tetrapods have evolved from aquatic vertebrates and have conquered and diversified in the terrestrial habitat. While most species have well adapted to inland forms, some of them have returned to the aquatic environment due to increasing competition on Earth's surface. Studies regarding these species have been focused on hearing anatomy and auditory processes, neglecting the adaptations developed throughout evolution to compensate for pressure in the middle ear during dives. This review compiles the available information of mechanisms employed by tetrapods to prevent middle ear barotrauma underwater and how these processes have changed during evolution. The results show that throughout the evolution process, different lineages have developed distinct, and occasionally shared, mechanisms to avoid middle ear barotrauma underwater. Also, the results evince the lack of information on some Tetrapods lineages regarding middle ear evolution, from unique species, such as the Galápagos marine iguana, to marine mammals.

Resumo: Os tetrápodes evoluíram de vertebrados aquáticos e conquistaram e se diversificaram no ambiente terrestre. Enquanto algumas espécies se adaptaram à vida na terra, alguns táxons retornaram ao ambiente aquático devido à grande competição na superfície terrestre. Estudos realizados com espécies de tetrápodes aquáticos normalmente focam na anatomia e processos auditivos, negligenciando as adaptações desenvolvidas ao longo da evolução para compensar a diferença de pressão no ouvido médio durante mergulhos. Essa revisão compila informações sobre os mecanismos usados pelos tetrápodes para prevenir o barotrauma do ouvido médio e como esses processos se modificaram durante a evolução. Os resultados demonstram que ao longo da evolução, diferentes táxons e linhagens desenvolveram mecanismos diferentes, e ocasionalmente compartilhados, para evitar o barotrauma do ouvido médio no meio aquático. Os resultados também indicam que há falta de informações acerca das adaptações ao hábito de vida aquático em diversas espécies, desde as formas mais únicas, como a iguana marinha de Galápagos, aos mamíferos marinhos.

Shadiack, A. and Banks, J.B. (2024). A retrospective data analysis on marine animal injuries at a large, multi-site medical system. *HCA Healthcare Journal of Medicine* 5: 6.

Abstract: With increasing numbers of human-animal interactions, there has been an increase in animal-related injuries. While canine bites are the most commonly reported animal injury, little data exists in regard to the other classes of animals, particularly marine life. The last comprehensive report on injuries related to noncanine bites and stings seen in emergency departments (EDs) across the US was between 2011 and 2015. We performed a retrospective analysis from 2014-2019 on marine injuries from a large hospital network with over 180 hospitals, 100 freestanding EDs, and 170 urgent care centers to

provide an update on the volume and greatest contributors to these types of injuries being treated in US hospital EDs. We used existing, de-identified data from HCA's EDW using Teradata SQL. All data were descriptive. Of the 4092 patients aged 18 and older included in this study; 2692 were male (65.8%) and 1400 were female (34.2%). Of the total, 4010 (98.0%) patients were discharged home, 15 (0.4%) were admitted, 66 (1.6%) were classified as other, and 1 (0.02%) was referred to long-term care. The majority of injuries were caused by stingrays (1196, 29.23%), catfish (974, 23.8%), jellyfish (421, 10.3%), and other fish (541, 13.2%). The majority of injuries from all encounters occurred on the foot (1449, 35.4%) and hand (1181, 28.9%). The second and third quarters of each year were found to have the highest number of injuries (1290, 31.5% and 1742, 42.5%, respectively). Our results demonstrated that the majority of injuries were due to stingrays, jellyfish, and small fish, specifically catfish. As expected, the majority of injuries occurred on hands and feet. They occurred mostly during the summer.

Parker, M.R. and Fitzgerald, L.A. (2024). Using life history to predict outcomes of conservation translocations of herpetofauna. *Animal Conservation* (doi:10.1111/acv.13009).

Abstract: Suites of coevolved traits related to reproduction and demography enable species to persist in the face of environmental change. In the case of biological invasions, the suite of life history traits, "life history strategies," can be linked to successful establishment after an introduction. Conservation translocations share many similarities with biological invasions, yet studies examining the relationship between life history and translocation outcome are scarce. We collected data on key life history traits for all herpetofauna profiled in the IUCN Global Conservation Translocation Perspectives series to examine how life history can predict outcomes and difficulties of conservation translocations. For reptiles, our model showed that age at maturity showed a significant positive association with higher probabilities of more successful outcomes, while increased clutch/litter size and lifespan predicted less successful outcomes. We found no relationship between any life history trait and translocation outcome for amphibians. Our results showed that difficulties with conservation translocations are related more to phylogeny than life history. Amphibian translocations faced more difficulties due to the physical environment of release sites, but reptile translocations experienced more socio-political difficulties. These relationships provide important insights for conservation practitioners that can be used in the feasibility and planning stages of translocations to anticipate and avoid challenges facing this complex and increasingly common form of conservation intervention.

do Val, H.G.P., Passos, L.F., Gama, G.M., Rodrigues, F.H.G. and Coutinho, M.E. (2024). Nesting ecology of Black caimans, *Melanosuchus niger* (Spix 1825) (Crocodylia: Alligatoridae), in the Lago do Cuniã Extractive Reserve, Amazon, Brazil. *Reptiles & Amphibians* 31: e21646.

Abstract: The reproductive success of a population is the expression of life history traits such as fecundity and fertility, which are strongly affected by ecological factors. We investigated the use of nesting sites by female Black Caimans, *Melanosuchus niger* (Spix 1825) during three consecutive nesting seasons from 2019 to 2021 at Lago do Cuniã Extractive Reserve in the southwestern Brazilian Amazon. We examined factors influencing nesting ecology such as chamber temperature and applied multiple linear regressions to test hypotheses related to reproductive trade-offs between different variables, such as female, egg, and clutch sizes. We identified trade-offs between egg width, hatchling size, and clutch size, suggesting that larger clutches contain smaller eggs, resulting in smaller hatchlings. A better understanding of crocodilian reproductive strategies and trade-offs are essential to predict the viability of populations and to foster conservation initiatives at the Lago do Cuniã Reserve, where caimans are currently subjected to a sustainable harvesting management plan.

Resumo: O sucesso reprodutivo de uma população abrange fatores ecológicos e biológicos, como fecundidade e fertilidade, história de vida e razão sexual. No presente estudo nós avaliamos o uso de áreas de nidificação por fêmeas de jacaré-açu (*Melanosuchus niger* Spix 1825) durante 2019-2021 na Reserva Extrativista Lago do Cuniã, os fatores que influenciam a ecologia de nidificação como a temperatura do ninho e os trade-offs reprodutivos que influenciam a biometria das ninhadas. Usamos regressões lineares, múltiplas e GLMM para testar as diferentes hipóteses. Trade-offs importantes foram encontrados entre largura dos ovos/tamanho da ninhada e o tamanho dos filhotes, sugerindo que ninhadas maiores produziram ovos menores, porém com embriões maiores. Essas informações são essenciais para um melhor entendimento acerca das estratégias reprodutivas utilizadas pelas fêmeas reprodutivas e seus efeitos sobre a viabilidade da população na Reserva.

Young, B.A., Cramberg, M. and Young, O.G. (2024). The velar chord and dynamic integration of the gular valve in crocodylians. *The Anatomical Record* (doi: 10.1002/ar.25608).

Abstract: Crocodylians evolved a unique gular valve that is capable of creating a water-tight seal between the oral and pharyngeal cavities, allowing the animal to safely submerge with an open mouth. The gular valve has traditionally been described as consisting of two separate parts: an active mobile ventral portion (consisting of the tongue and portions of the hyolingual apparatus) and a dorsal portion, which is a static fold on the hard palate (often termed the palatal velum). The results of the present study argue that the two portions of the gular valve are functionally integrated, not separate, and that the dorsal portion (herein the dorsal gular fold) is a dynamic element the shape and tension of which are influenced by active and passive forces. Using gross dissection, histology, and DiceCT, the present study documents a previously underscribed component of the gular valve, the velar chord, which links the hyolingual apparatus to the dorsal gular fold, functionally integrating the two halves of the gular valve. Through endoscopic videography and a variety of manipulations on living crocodylians, this study demonstrates that changes in the tension on the velar chord directly alter the shape and tension of the dorsal gular fold. The shape changes observed in the dorsal gular fold could be accommodated by a shallow depression in the ventral surface of the palatine bones, herein termed the velar fossa. The velar fossa is a prominent feature of *Alligator mississippiensis* and was observed in other crocodylians; however, a survey of living and fossil crocodylians demonstrated that the velar fossa is not a universal feature in this clade. Understanding the functional linkage between the dorsal and ventral portions of the gular valve has implications beyond the dive reflex of crocodylians, since active manipulation of the dorsal gular fold likely plays a role in a variety of behavioral and physiological processes such as deglutition and vocalization.

Eugenia, P.M., Bona, P., Siroski, P. and Chinsamy, A. (2025). Analyzing the life history of caimans: The growth dynamics of *Caiman latirostris* from an osteohistological approach. *Journal of Morphology* 286: e70010.

Abstract: Skeletochronology and growth dynamics are intensively investigated in vertebrate osteohistology. These techniques are particularly important for interpreting the life history of long-lived species, such as crocodylians. To understand the longevity, growth dynamics, sexual maturity, and sexual dimorphism of caimans we studied an almost complete ontogenetic series of captive and wild specimens of *Caiman latirostris* from different localities of Argentina. We identified both cyclical and noncyclical growth marks in juvenile caimans, and we suggest that the latter are associated with environmental stress. By overlapping the growth marks of different individuals, we were able to estimate the minimum age of each specimen. Variations in growth rate are evident in different bones, with the femur and scapula having the highest growth rates, while the fibula and pubis have much slower growth rates.

We were able to determine the approximate age of sexual maturity from growth curves deduced from osteohistology, which concurred with those assessed in ecological studies. Additionally based on the growth curves we were able to document different growth dynamics which may be related to sexual dimorphism. This study provides valuable insights into the life history and ecological dynamics of crocodylians, shedding light on their growth patterns, attainment of sexual maturity, and the influence of environmental factors on growth. Furthermore it documents the intraspecific and interelemental osteohistological variation in crocodylians and has direct implications for studies that assess the life history of extinct archosaurs and other sauropsids.

Zdunek, P., de Wit, T., Toh, A.K.J., Harold, G. and Seah, B. (2024). Predation of an adult Nile monitor (*Varanus niloticus* Linnaeus, 1758) by a Nile crocodile (*Crocodylus niloticus* Laurenti, 1768) in South Africa with other records of interactions between monitor lizards and crocodylians. *Biawak* 16(1): 20-23.

Abstract: Large adult varanid lizards do not have many natural predators. Observations of direct predation of adult monitor lizards by crocodylians are rarely documented, and examination of stomach or fecal contents cannot accurately distinguish between cases of active hunting or scavenging. Here, we report a case of predation on an adult Nile monitor (*Varanus niloticus*) by an adult Nile crocodile (*Crocodylus niloticus*) observed in South Africa. In addition, we briefly discuss other interactions between crocodiles and varanids. Observations of this kind can expand what is known about the relationships between these taxa.

Thongdee, M., Chaiwattananrungruengpaisan, S., Ketchim, N., Sangkachai, N., Arya, N., Sirimanapong, W., Wiriyarat, W., Puthavathana, P. and Paungpin, W. (2025). Evidence of avian and human influenza A virus infection in farmed Siamese crocodiles (*Crocodylus siamensis*) in Thailand. *PLoS ONE* 20(1): e0317035.

Abstract: Crocodylians are susceptible to a range of virus infection including influenza A virus (IAV). However, little is known about the ecology and epidemiology of IAV in crocodile species. This study aimed to investigate IAV infection in farmed Siamese crocodiles in central Thailand. We collected plasma samples and pharyngeal swab samples from Siamese crocodiles residing in 13 crocodile farms in 9 provinces of central Thailand during 2019. Additional archival plasma samples of Siamese crocodiles collected in 2012 and 2018 were also included in the study. Plasma samples were screened for influenza A antibodies by a hemagglutination inhibition (HI) assay and positive were evaluated by a cytopathic effect/hemagglutination based-microneutralization (MN) assay. Swab samples were tested for influenza viral RNA by a real-time RT-PCR assay targeting the influenza matrix (M) gene. Among 246 tested plasma samples, the overall seroprevalence of antibodies against IAV in farmed Siamese crocodiles was 17.5% (43/246). The most common hemagglutinin (HA) subtype was H2 (46.5%, 20/43) followed by H9 (39.5%, 17/43), human H1 (14%, 6/43) and H1 (7%, 3/43). Multiple HA subtypes were also detected in 7% (3/43) of infected crocodiles with combination of H1 and H2 subtypes. All 126 tested swab samples were negative for influenza viral RNA. In addition, we demonstrated the ability of wild-type IAV subtypes (H1, H2, H9 and human H1) to infect primary Siamese crocodile fibroblast cells. To our knowledge, this is the first report of serological evidences of avian and human IAV infection in Siamese crocodiles. Our findings highlighted the role of crocodile species in the ecology of IAV particularly the potential to serve as the reservoir or mixing vessel for the viruses that significantly threaten both human and animal health.

Teampanpong, J., Thungsen, M., Saisamorn, A. and Duengkae, P. (2024). Understanding human dimensions of Siamese Crocodile reintroduction in Kaeng Krachan National Park, Thailand. *Journal of Wildlife and Biodiversity* 8(4): 193-219

Abstract: Siamese Crocodiles (*Crocodylus siamensis*) are critically endangered, with populations in only four countries, including Thailand. Despite existing reintroduction know-how, human cohabitants in crocodile habitats hinder their conservation efforts. We surveyed 208 respondents from five villages in Kaeng Krachan National Park (KKNP) to understand human dimensions toward Siamese crocodile reintroduction and conservation. While respondents generally had positive attitudes towards the crocodiles, fear of attacks by farm-bred crocodiles remained a major obstacle. A soft release of farm-bred crocodiles was deemed acceptable, though concerns about potential human-crocodile interactions persisted. By aligning these findings with IUCN SSC guidelines on human-wildlife conflict and coexistence, we emphasize the importance of addressing all levels of potential human-crocodile conflicts (HCC) in KKNP. Essential actions include building trust, creating benefits, practicing good governance, integrating traditional knowledge into reintroduction planning, resolving existing conflicts through community-led solutions, and devising a political ecology of crocodile conservation for acceptable strategies for managing HCC. To support sustainable crocodile reintroduction in KKNP, we recommend engaging unemployed males, fishermen, or temporary employers as citizen scientists, transparently communicating the reintroduction process to stakeholders, and implementing conservation education campaigns. Long-term socio-ecological monitoring is vital for sound decision-making, managing conflicts, and measuring reintroduction success.

Munson, E., Burbick, C.R., Lawhon, S.D., Krueger, T. and Ruiz-Reyes, E. (2024). Valid and accepted novel bacterial taxa isolated from non-domestic animals and taxonomic revisions published in 2023. *Journal of Clinical Microbiology* (doi: 10.1128/jcm.01042-24).

Abstract: Continued investigation into the bacteria associated with non-domestic animals provides important information for recognizing normal flora, assessing the health status of these unique species of animals, and identifying new or emerging pathogens of concern. In this summary of novel taxa and taxonomic revisions, considerable additions have been made toward understanding fecal and mucosal flora in multiple wild animal species. In addition, novel pathogenic bacteria are discussed, including multiple *Chlamydia* spp. causing disease in a hawk and crocodile, two *Corynebacterium* spp. causing oral lesions in penguins and a lesser-known genus, *Mergibacter* within Family Pasteurellaceae, causing disease in multiple wild bird species. Finally, a few revisions to bacteria isolated from normal non-domestic animal body sites are mentioned.

Stratev, D., Strateva, M. and Fasulkova, R. (2024). Histological structure and physicochemical indicators of frozen crocodile meat. *Food Science and Applied Biotechnology* 7(2): 182-194.

Abstract: The objective of the present study was to determine the changes in the histological structure and some physicochemical indicators of frozen crocodile meat. Vacuum packs of frozen crocodile meat stored at -18°C for 18 months were purchased from retail stores. Histological sections were stained by hematoxylin-eosin and Masson's trichrome staining methods. Physicochemical indicators and fatty acid composition were determined by standard methods. The histological study proved clear morphological changes in the structural components of the muscles. Physicochemical analysis showed 21.90% protein content, 6.09% lipid content, 69.56% water content, and 1.09% ash content. The largest was the amount of monounsaturated fatty acids (47.45%), followed by saturated (36.39%) and polyunsaturated fatty acids (16.53%). More studies on the histological structure and physicochemical parameters of other members of the order Crocodylia are needed to gather data on the nutritional value and biological wholesomeness of the meat from these species.

Hilevski, S., Cordero, T., Moleón, M.S., Cabaña, E., Belotti, M. and Siroski, P. (2024). Serum biochemical profile, intestinal and liver histomorphometry of captive Broad-snouted caiman (*Caiman latirostris*) fed with a diet enriched with soybean (*Glycine max*). *Journal of Animal Physiology and Animal Nutrition* (doi: 10.1111/jpn.14050).

Abstract: The impact of plant-based diets on crocodylians is unclear. Serum profiles and histomorphometry provide valuable insights into their nutritional and physiological status. This study aims to elucidate the impact of three levels of soybean meal substitution combined chicken by-product 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-eight 6-month-old broad-snouted caimans were assigned to three dietary groups (0%, 25%, 40% soybean meal). Over a period of 90 days, data on growth, food consumption, serum biochemical analysis, intestinal and hepatic morphometry were recorded. The results showed that diets containing higher levels of soybean meal did not significantly affect growth, feed intake or serum profiles of total protein, albumin and cholesterol. 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 serum glucose and triglyceride profiles and hepatic lipid accumulation without affecting macronutrient digestion and absorption, considered beneficial for the caiman's health. This study provides valuable insights into the inclusion of soybean meal in the diet of *C. latirostris* and its effects on the intestines, liver, and physiology. It also highlights the importance of considering nutritional management as a key tool in improving the well-being and health of crocodylians in captivity.

Castillo-Rodríguez, N., Saldarriaga-Gómez, A.M., Antelo, R. and Vargas-Ramírez, M. (2024). First genetic evaluation of a wild population of *Crocodylus intermedius*: New insights for the recovery of a Critically Endangered species. *PLoS One* 19(10): e0311412.

Abstract: During the second third of last century, the Orinoco Crocodile (*Crocodylus intermedius*) underwent a hunting process driven by the demand from the North American, European, and Japanese leather industry, resulting in a sharp decline of its populations. Currently, only two known remaining populations of this Critically Endangered species persist in the Colombian Orinoquía: in the Guayabero-Duda-Lozada and the Cravo Norte-Ele-Lipa River systems. The latter has been the only population subject of study, including recent surveys and local conservation initiatives such as egg and hatchling ranching. Despite suggestions for population recovery based on the observed increase in clutches in the area, information regarding its genetic status has been pending assessment. This research aims to provide a genetic characterization of this remaining population and to evaluate the diversity recovered during a period of the egg ranching initiative. For this purpose, we utilized variable molecular markers, specifically 17 microsatellite loci, nuclear DNA. Despite revealing intermediate levels of genetic diversity, we identified an effective population size of 11.5-17, well below the minimum values proposed for short-term subsistence. While no evidence of inbreeding was found, it is acknowledged as a potential risk based on the population's history. Additionally, we detected a historical bottleneck possibly influenced by arid periods affecting the region since the Pleistocene. While the evaluated population presents a unique opportunity for *C. intermedius* conservation, it also exposes a high risk of entering the extinction vortex. The primary action to be taken is to support the egg and hatchling ranching program, which successfully recovered most of the genetic diversity present in the population.

de Lima Franco, D., de Almeida Coelho, A.G. and da Silva, A.J. (2024). First report of predation of a smooth-fronted caiman (*Paleosuchus trigonatus*) by a Neotropical otter (*Lontra longicaudis*). *Acta Amazonica* 54: e54bc23340.

Abstract: *Lontra longicaudis* is a semi-aquatic predator which mainly feeds on fish and crustaceans, but which can opportunistically predate mammals, birds, and reptiles. In the Amazon, this species is sympatric with *Paleosuchus trigonatus*, one of the smallest species of crocodylians, whose possible means of defense is a very rigid skin, which causes adults to have few predators. Here we report the first documented case of predation of *P. trigonatus* by *L. longicaudis*.

Ogungbile, P., Ajibare, A., Akinola, O.M. and Ekanade, C.T. (2024). Health risk assessment of heavy metals in the consumption of bushmeat obtained from Epe, southwest Nigeria. *Polytechnica* 7(8) (<https://doi.org/10.1007/s41050-024-00051-5>)

Abstract: Over the years, bushmeat has been a complementary source of nourishment for people throughout the world yet there is limited understanding of the levels of heavy metal contamination in bushmeat from the Epe region specifically. This study evaluated the potential carcinogenic and non-carcinogenic health risks found in bushmeat obtained from Epe, Southwest, Nigeria. Carcasses of Antelope (*Antilope cervicapra*), Alligator (*Alligator mississippiensis*), Roan Antelope (*Hippotragus equinus*), Grasscutter (*Thryonomys swinderianus*), Hedgehog (*Atelerix albiventris*), Squirrel (*Xerus erythropus*), Bush buck (*Tragelophus scriptas*), Porcupine (*Atherurus africanus*), Python (*Python sebae*) and Duiker (*Sylvicapra grimmia*) were sourced from the study area. The carcasses were chemically analyzed for Mn, Fe, Cu, Zn, Cd, Pb, and Ni. The hazard index (HI) of heavy metals in the meats indicated that human consumers of Alligator carcasses are most at risk of increased systemic adverse health impacts due to its high value greater than one (7.36). The target cancer risk (TR) however showed that consumers of all other bushmeat types were not at risk of exposure to carcinogens such as Pb and Cd while Ni in Antelope (8.89×10^{-3}), Alligator (1.41×10^{-2}), Roan Antelope (8.15×10^{-3}) and squirrel (6.46×10^{-3}) all indicated low-moderate cancer risks. There is therefore no immediate risk of cancer from consuming such meats. Consequently, better monitoring and control of pollution inducing activities in the study area must be done to limit any rise in heavy metal concentrations and its associated health hazards. A further recommendation is for the introduction of more regulations requiring bushmeats as well as other food stuffs to be properly screened for contaminants before being consumed.

Pritz, M.B. (2024). Glutamic acid decarboxylase immunoreactivity in the olfactory bulb of a reptile. *NeuroReport* 35(14): 921-924.

Abstract: The objective is to determine the distribution of glutamic acid decarboxylase (GAD) in the olfactory bulb of a crocodylian, *Caiman crocodylus*. Avidin-biotin immunohistochemical methodology using a polyclonal antibody to GAD raised in sheep was employed. The following controls were used: substitution of the primary antibody with preimmune sheep serum at concentrations equal to that of the primary antibody; omission of the primary antibody; and omission of the primary antibody and biotinylated rabbit antisheep immunoglobulin. No GAD (+) cells were observed in the control sections. Based on cell and fiber staining, the layering and neuronal organization of the olfactory bulb in *Caiman* were similar to other vertebrates, including other reptiles. The following elements were GAD (+): granule cells, certain neurons in the outer plexiform layer, periglomerular neurons, and the glomeruli themselves. GAD (+) puncta were present throughout the olfactory bulb. In conclusion, these results in *Caiman* were similar, in part, to comparable studies in mammals and birds. Taken together, these data indicate that crocodiles not only have a similar pattern of layers that other amniotes possess but also that the immunocytochemical signatures of certain elements of the olfactory bulb are likewise

shared.

Bustard, H.R. and Maharana, S. (2023). Fifty years of Gharial (*Gavialis gangeticus*) conservation in Odisha, India. *Cheetal* 60(2): 33-40.

Abstract: The Odisha Forest Department is to be congratulated on successfully restoring a population of six adult Gharials to Satkosia Gorge in the Mahanadi River. A nest has been laid annually, since 2021 and successfully hatched in each of the three years after an absence of nesting for 40 years is a further achievement indicating that total protection to the Gorge has been successfully achieved.

Deem, V.R., Cleary, M. and Steen, D.A. (2024). Perceptions and tolerance of American crocodiles and their management by South Florida residents. *The Journal of Wildlife Management* (<https://doi.org/10.1002/jwmg.22672>).

Abstract: The American crocodile (*Crocodylus acutus*) is a federally and state-protected species classified as threatened by the United States Fish and Wildlife Service and the State of Florida; however, its population has increased since gaining legal protection in 1967. Concurrently, the number of reported human-crocodile conflicts has also increased, analogous to known conflicts surrounding other large (typically terrestrial) predators recovering from historical population declines. Although biology and ecology are the foundation of effective wildlife management strategies, human dimensions need to be considered to develop realistic and attainable conservation objectives. To better understand how South Florida residents perceive American crocodiles and their management, we used a mixed-mode internet and mail survey. We obtained survey data from 28 May 2021 to 20 September 2021 from people living within the range of the American crocodile in Florida. There was little variation in opinions of 6 management actions presented for consideration under each of 3 different human-crocodile interaction scenarios. The strongest consensus was around euthanizing a crocodile (highly unacceptable under all 3 scenarios) with the management action of leaving the crocodile alone and monitoring the situation showing the least amount of consensus and shifting from slightly acceptable to slightly unacceptable the closer a hypothetical crocodile was in proximity to a resident's private property. Regression modeling showed respondents who were older, female, and those with children at home were less likely to prefer an increase in the crocodile population. Respondents who perceived more benefits from crocodiles and less risk from them tended to be relatively knowledgeable about crocodiles, had higher trust in the Florida Fish and Wildlife Conservation Commission (FWC), and were more likely to prefer a larger crocodile population. Further, spatial mapping revealed variation in tolerance for crocodiles and trust in FWC's ability to manage them. We reveal opportunities for targeted education and outreach efforts with the potential to affect tolerance of a large reptilian carnivore in a region experiencing rapid human development.

Cossette, A.P. and Tarailo, D.A. (2024). Crocodylian diversity during the early Eocene climatic optimum in the Golden Valley Formation of North Dakota, U.S.A. *Journal of Vertebrate Paleontology* ([doi: 10.1080/02724634.2024.2403579](https://doi.org/10.1080/02724634.2024.2403579)).

Abstract: Rich bone beds from the lower Eocene strata of the Golden Valley Formation of Stark County, North Dakota reveal a speciose sympatric crocodylian fauna. However, analyses demonstrate limited phylogenetic diversity among these co-occurring taxa, and of the four species known for the locality, three are alligatorids and one is a crocodyloid. Phylogenetic hypotheses recover *Chrysochampsia mylnarskii* as a late lived member of Brachychampsini - a stem-based clade including *Brachychampsia montana* and all alligatorids more closely related to it than to *Caiman crocodylus* or *Alligator mississippiensis* - and a new genus and species, *Ahdeskatanka*

ruslanddeutsche groups with species of *Allognathosuchus*. The crocodylians, partitioned by body size and plan, would have occupied an array of ecological niches and feeding strategies. Whereas the large-bodied alligatorid *Chrysochampsia mylnarskii* preserves a generalist morphology, *Ahdeskatanka ruslanddeutsche* bears a short, broad snout and globular distal teeth. Contemporaneous with a peak in alligatoroid diversity during this interval, *Ahdeskatanka ruslanddeutsche* is an exemplar of a radiation of small-bodied alligatorids with crushing dentition and preserves the ancestral alligatorid feeding strategy. Trophic dynamics of the locality diverge from modern environments and the abundant crocodylians may have filled the ecological niche of large mammalian carnivores conspicuously absent here. This alligatorid-rich crocodylian fauna evolved in swampy lowlands and meandering streams flanked by subtropical forests during one of the hottest sustained intervals in Earth history. The lush, highly productive ecosystems preserved in the Golden Valley Formation inform the evolutionary history of North American alligatorids and preserve significant biodiversity following the Paleocene-Eocene Thermal Maximum.

Shankar, V.S., Puri, N. and Prabakaran, N. (2024). Correction to: Snowballing trends of saltwater crocodile conflicts in Andaman Islands: a mounting concern for conservation and sustainable coexistence. *European Journal of Wildlife Research* 70: 107 (<https://doi.org/10.1007/s10344-024-01857-5>).

The original article has been corrected.

Li, P., Liu, P., Zang, D., Li, C., Wang, C., Zhu, Y., Liu, M., Lu, L., Wu, X. and Nie, H. (2024). Genome-wide identification and expression analysis of the BTB Gene Superfamily provides insight into sex determination and early gonadal development of *Alligator sinensis*. *International Journal of Molecular Science* 25: 10771.

Abstract: The BTB gene superfamily is widely distributed among higher eukaryotes and plays a significant role in numerous biological processes. However, there is limited knowledge about the structure and function of BTB genes in the critically endangered species *Alligator sinensis*, which is endemic to China. A total of 170 BTB genes were identified from the *A. sinensis* genome, classified into 13 families, and unevenly distributed across 16 chromosomes. Analysis of gene duplication events yielded eight pairs of tandem duplication genes and six pairs of segmental duplication genes. Phylogenetics shows that the AsBTB genes are evolutionarily conserved. The cis-regulatory elements in the AsBTB family promoter region reveal their involvement in multiple biological processes. Protein interaction network analysis indicates that the protein interactions of the AsBTB genes are centered around CLU-3, mainly participating in the regulation of biological processes through the ubiquitination pathway. The expression profile and protein interaction network analysis of AsBTB genes during sex differentiation and early gonadal development indicate that AsBTB genes are widely expressed in this process and involves numerous genes and pathways for regulation. This study provides a basis for further investigation of the role of the BTB gene in sex differentiation and gonadal development in *A. sinensis*.

Melkersson, K-G., Li, H. and Rask-Andersen, H. (2024). First photon-counting detector computed tomography in the living crocodile: A 3D-imaging study with special reference to amphibious hearing. *Frontiers in Cell and Developmental Biology* 12 (doi: 10.3389/fcell.2024.1471983).

Abstract: Crocodiles are semi-aquatic animals well adapted to hear both on land and under water. Currently, there is limited information on how their amphibious hearing is accomplished. Here, we describe, for the first time, the ear anatomy in the living crocodile using photon-counting detector computed tomography (PCD-CT) and 3D rendering. We speculate on how crocodiles, despite their closed

ear canals, can use tympanic hearing in water that also provides directional hearing. A Cuban crocodile (*Crocodylus rhombifer*) underwent photon-counting detector computed tomography (PCD-CT), under anesthesia and spontaneous respiration. In addition two 7-month-old *C. rhombifer* and a juvenile Morelet's crocodile (*Crocodylus moreletii*) underwent micro-computed tomography (μ CT) and endoscopy. One adult Cuvier's dwarf caiman (*Paleosuchus palpebrosus*) was micro-dissected and video-recorded. Aeration, earflap, and middle ear morphology were evaluated and compared after 3D modeling. PCD-CT and μ CT with 3D rendering and segmentation demonstrated the anatomy of the external and middle ears with high resolution in both living and expired crocodiles. Based on the findings and comparative examinations, we suggest that the superior earflap, by modulating the meatal recess together with local bone conduction, may implement tympanic hearing in submerged crocodiles, including directional hearing.

Lemos de Arruda, M. (2024). The Art of Origami as a Tool to Raise Awareness about the Reptiles of Rio Grande do Sul through Environmental Education. BSc thesis, Universidade do Rio Grande do Sul, Brazil.

Abstract: All the content that comprises Environmental Education was discussed for many years before the term was adopted in the 1960s. It was in the 1970s that Environmental Education began its process of internationalization, at the same time that the world was becoming increasingly industrialized. From then on, during the following decades, meetings, events and programs were created to create rules and guidelines to define objectives and strategies to be achieved by Environmental Education. Meanwhile, in Brazil, agencies and policies were created as a result of world events. Numerous concepts were developed to try to define what Environmental Education would be, all with different interpretations. A very useful tool that can be used in Environmental Education is origami. The Japanese art of paper folding has proven to be very beneficial in the pedagogical context by improving the learning of diverse content when applied, in addition to improving psychosomatic and neurogenic characteristics. The application of origami in an activity that seeks to raise awareness about the conservation of a group of animals, for example reptiles, is very valid. Reptiles tend to be seen as disgusting and dangerous by a large part of the population. Some species are victims of death simply due to prejudice, so any attempt to bring people closer to these animals and educate them is of utmost importance. Given this scenario, this work seeks to produce environmental education material that uses origami as a playful/pedagogical tool in favor of the conservation of reptiles in Rio Grande do Sul and to raise awareness among the population. The methodology was based on the selection of reptile species from Rio Grande do Sul that include the main groups. The selected species were: *Caiman latirostris*, *Chelonia mydas*, *Trachemys dorbigni*, *Oxyrhopus rhombifer*, *Xenodon dorbignyi* and *Liolaemus arambarensis*. Three pages of material were created for each species, the first as a cover, the second with information about the species and the third with the origami model. The work aims to help connect people with reptiles, through information and origami so that the view of them is demystified, resulting in greater preservation.

[A arte do origami como ferramenta na conscientização sobre os répteis do Rio Grande do Sul através da educação ambiental]

Resumen: Todos os conteúdos que compreendem a Educação Ambiental eram discutidos por muitos anos antes de o termo ter sido pautado na década de 60. Foi a partir da década de 70, que a Educação Ambiental começou seu processo de internacionalização, no mesmo período em que o globo se tornava cada vez mais industrializado. A partir disso, durante as próximas décadas, encontros, eventos e programas foram sendo criados para criar regras e diretrizes para definirem objetivos e estratégias a serem atingidos pela EA. Enquanto isso, no Brasil, eram criados órgãos e políticas em decorrência dos eventos mundiais. Inúmeros conceitos foram

elaborados para tentar definir o que seria Educação Ambiental, todos com interpretações diferentes. Uma ferramenta muito útil que pode ser usada na EA é o origami. A arte de dobrar papel japonesa se mostrou muito benéfica no contexto pedagógico ao melhorar a aprendizagem de conteúdos diversos quando aplicado, além de melhorar características psicossomáticas e neurogênicas. A aplicação do origami em uma atividade que busca aumentar a conscientização acerca da conservação de um grupo de animais, por exemplo os répteis, é muito válida. O grupo dos répteis tende a ser visto como asqueroso e perigoso por grande parte da população. Algumas espécies são vítimas de morte apenas por preconceito, portanto qualquer tentativa de aproximar as pessoas desses animais e educá-las é de suma importância. Diante desse cenário, o presente trabalho busca produzir um material de Educação Ambiental que utilize o origami como ferramenta lúdica/pedagógica em prol da conservação dos répteis do Rio Grande do Sul e conscientização da população. A metodologia foi baseada na escolha de espécies de répteis do Rio Grande do Sul que contemplem os principais grupos. As espécies selecionadas foram: *Caiman latirostris*, *Chelonia mydas*, *Trachemys dorbignyi*, *Oxyrhopus rhombifer*, *Xenodon dorbignyi* e *Liolaemus arambarensis*. Para cada espécie foram criadas três páginas de material, a primeira como capa, a segunda com informações sobre a espécie e a terceira com o modelo de origami. O trabalho pretende auxiliar na conexão das pessoas com os répteis, através de informações e das dobraduras para que a visão sobre eles seja desmistificada, resultando em uma maior preservação.

Mascarenhas-Junior, P.B., Barboza, R.S.L., Caminha, M., Lucena, G., Rodrigues, C.F., Simões, P.I. and de Sousa Correia, J.M. (2024). GPS-telemetry as a method to assess nest attendance by a female broad-snouted caiman *Caiman latirostris*. *Herpetological Journal* 34: 237-243.

Abstract: Crocodylians exhibit parental care, guarding their eggs during incubation to ensure offspring survival. We present the first description of nest attendance of a wild broad-snouted caiman using GPS-telemetry. During the reproductive season of 2022, we tracked a 1.8-metre female in the Tapacurá reservoir, a water source bordered by Atlantic Forest remnants and human settlements in north-eastern Brazil. Telemetry data revealed that 75.8% of the female's position records were near the nest, suggesting parental care and nest protection. However, the female periodically returned to water. We observed no differences in proximity to the nest between day and night-time, which could be possibly related to different egg predators in the area foraging at different times of the day. Furthermore, the period when the nest was unattended could be associated with either feeding activities or avoidance of human presence. This research brings light on an important part of the reproductive behaviour of broad-snouted caimans in their natural environment, highlighting the importance of GPS-telemetry as a tool for monitoring reproductive behaviour of crocodylians, while contributing to understanding their biology under human-influenced settings.

Joel, T.J., Gomez, P.L.A., Gautam, S., Likhith, B., Mary, C.R.D., Upadhyay, R. and Abhilash, P. (2024). Unveiling the microbial symphony: Exploring emerging contaminants in zoological environments for enhanced animal welfare. *Aerosol Science and Engineering* (<https://doi.org/10.1007/s41810-024-00261-5>).

Abstract: The quantification of bioaerosols and particulate matter within zoo enclosures is a critical yet underexplored area, particularly given the global role of zoological environments in wildlife conservation, research, and public education. Zoos, which host a diverse array of wildlife and attract millions of visitors annually, are complex ecosystems where multiple sources of air pollution converge. This study aimed to systematically assess the prevalence of bacterial aerosols within various animal enclosures, including those of Tigers, Lions, Leopards, Rheas, Deer, Hippos, Ostriches, Crocodiles, and Owls. Utilizing a six-stage Andersen impactor, bioaerosol samples were collected to determine the

concentration and dispersion of airborne microorganisms, while the DustTrak Aerosol Monitor was employed to measure levels of particulate matter (PM₁₀, PM_{2.5}, and PM₁), carbon dioxide (CO₂), and formaldehyde (HCHO). The findings revealed distinct bacterial population peaks across different locations and animal species, highlighting significant variations in airborne bacterial levels within the sampled enclosures. Gram staining identified a predominance of Gram-negative bacteria, which poses broader implications for understanding the transmission of pathogens and antibiotic resistance in confined environments. Notably, this study provides a foundational framework for evaluating bacterial resistance to antibiotics in zoological settings, contributing to the global discourse on antimicrobial resistance (AMR). The insights gained underscore the necessity of judicious antibiotic use to safeguard both animal health and broader public health. Given that animals are substantial generators of bioaerosols, this research emphasizes the importance of stringent maintenance of enclosures and their surroundings, alongside the optimization of microclimatic conditions to mitigate health risks. By shedding light on the microbial dynamics in zoo environments, this study calls for proactive, globally informed measures to ensure the welfare of animals and the health of visitors, thus advancing the broader understanding of bioaerosol management in complex, human-animal interaction spaces.

Vasconcelos, B.D., Camurugi, F., Mudrek, J.R., Brandão, R.A. and Santana, D.J. (2024). Rivers and spatial distance are drivers of genetic diversity in the south American dwarf caiman (*Paleosuchus palpebrosus*). *Journal of Zoology* (<https://doi.org/10.1111/jzo.13226>).

Abstract: The distribution of species and the way that lineages are structured are the result of intrinsic historical processes of the species and their relationships with landscape features. *Paleosuchus palpebrosus* is one of the smallest crocodylians in the world and has a wide geographic distribution in South America, occurring in different habitats. Here, we analyzed mitochondrial cytochrome b sequences of 227 individuals, investigated how elements of landscape heterogeneity impact genetic differentiation, and evaluated the evolutionary and phylogeographic history of the species. Thus, we hypothesized that landscape structures, such as aridity and slope, should act as resistance surfaces to population connectivity, while rivers could mediate the dispersion of the species as a conductor of the gene flow. The analyses recovered three main lineages of *P. palpebrosus*. While most of the observed genetic variation was explained by geographic resistance distance, river connectivity had a smaller contribution for the observed variation. We also found a recent history with limited genetic divergence throughout the wide distribution of the species. Our findings highlight the main drivers for the evolutionary history of the species and how landscape features can shape the diversification, especially if we consider rivers as a facilitator of gene flow.

Resumo: A distribuição das espécies e a forma como as linhagens se estruturam é resultado de processos históricos intrínsecos das espécies e de suas relações com as características da paisagem. *Paleosuchus palpebrosus* é um dos menores crocodylianos do mundo e possui ampla distribuição geográfica na América do Sul, ocorrendo em diferentes condições de habitat. Aqui, analisamos sequências mitocondriais do citocromo b de 227 indivíduos e investigamos como elementos da heterogeneidade da paisagem impactam a diferenciação genética e avaliamos a história evolutiva e filogeográfica da espécie. Nossa hipótese é que estruturas da paisagem, como aridez e declividade deveriam atuar como superfícies de resistência à conectividade populacional, enquanto os rios poderiam mediar a dispersão das espécies como condutores do fluxo gênico. As análises recuperaram três linhagens de *P. palpebrosus*. Enquanto a maior parte da variação genética observada foi explicada pela distância de resistência geográfica, a conectividade dos rios teve uma contribuição menor para a variação observada. Também encontramos uma história recente com divergência genética limitada em toda a ampla distribuição da espécie. Nossas

descobertas destacam os principais impulsionadores da história evolutiva das espécies e como as características da paisagem podem moldar a diversificação, especialmente se considerarmos os rios como facilitadores do fluxo gênico.

Meyer-Rochow, V.B. (2024). Polarization sensitivity in reptiles: An update. Pp. 287-298 in *Polarization Vision and Environmental Polarized Light*, ed. by G. Horváth. Springer: Cham.

Abstract: Somewhat questionable evidence in support of reptilian polarization sensitivity (PS) has come from field and laboratory observations on the behaviour of a few species of marine and freshwater turtles. More convincing are conclusions based on PS-aided orientation primarily in the lizards *Uma notata*, *Tiliqua rugosa* and species of the genus *Podarcis*. It is suggested that submersed hunters like, for instance, sea snakes ought to be included in examinations for PS since contrast enhancement by PS underwater could bestow some benefits to them during food procurement. Moreover, certain terrestrial snakes such as rainbow boas, sunbeam and indigo snakes are highly iridescent, and courtship displays in certain species of lizards could also contain signals for which the presence of PS would be advantageous. However, unambiguous polarization signals have not yet been demonstrated in any species. Results based on electrophysiological recordings to demonstrate PS in photoreceptors of the lateral eyes or the pineal organs' parietal eye are also scant, but a connection between PS and magnetoreception, as in amphibians and birds, is increasingly regarded as a feature present in numerous reptilians. The earlier literature on reptilian PS has been covered by Horváth and Varjú (*Polarized Light in Animal Vision - Polarization Patterns in Nature*. Springer: Heidelberg, Berlin, New York, 2004) and Meyer-Rochow (*Polarized Light and Polarization Vision in Animal Sciences*. Springer: Heidelberg, Berlin, New York, 2014).

Bronzati, M., Vieceli, F.M., Botezelli, V.S., Godoy, P.L., Montefeltro, F.C., Nassif, J.P.M., Luzete, J., Ribeiro, D., Yan, C.Y.I., Werneburg, I. and Kohlsdorf, T. (2024). Deep-time origin of tympanic hearing in crown reptiles. *Current Biology* S0960-9822(24): 01282-X.

Abstract: The invasion of terrestrial ecosystems by tetrapods (c. 375 million years [Ma]) represents one of the major evolutionary transitions in the history of life on Earth. The success of tetrapods on land is linked to evolutionary novelties. Among these, the evolution of a tympanic ear contributed to mitigating the problem of an impedance mismatch between the air and the fluid embedding sound-detecting hair cells in the inner ear. Pioneering studies advocated that similarities in the tympanic ear of tetrapods could only result from a single origin of this structure in the group, an idea later challenged by paleontological and developmental data. Current evidence suggests that this sensory structure evolved independently in amphibians, mammals, and reptiles, but it remains uncertain how many times tympanic hearing originated in crown reptiles. We combine developmental information with paleontological data to evaluate the evolution of the tympanic ear in reptiles from two complementary perspectives. Phylogenetically informed ancestral reconstruction analyses of a taxonomically broad sample of early reptiles point to the presence of a tympanic membrane as the ancestral condition of the crown group. Consistently, comparative analyses using embryos of lizards and crocodylians reveal similarities, including the formation of the tympanic membrane within the second pharyngeal arch, which has been previously reported for birds. Therefore, both our developmental and paleontological data suggest a single origin for the tympanic middle ear in the group, challenging the current paradigm of multiple acquisitions of tympanic hearing in living reptiles.

Thurrow Schulz, E., Aranha da Costa, E., Dias Lansarin, T., Eucareus von Laer, A. and Teresinha França, T. (2025). Anti-*Leptospira* spp. antibody test in noncaptive reptiles from urban and peri-urban areas

in Brazil's extreme South. *Ciencia Rural* 55(1): e20240067

Abstract: The state of Rio Grande do Sul has a great diversity of reptile species distributed throughout its territory. Due to human actions, such as habitat fragmentation, these animals have been frequently observed in urban and peri-urban environments. This facilitates the spread of pathogens between animals and humans, posing a unique health risk, as many diseases are considered zoonoses. Leptospirosis is among the most common zoonoses in the world and is caused by pathogenic species of bacteria of the genus *Leptospira*. The role of reptiles in the cycle of this disease is yet unknown. However, serological studies have demonstrated positivity for antibodies against *Leptospira* spp. in tortoises and snakes, which may indicate that these animals act in maintaining the pathogen in the environment. This observed the presence of anti-*Leptospira* antibodies in rescued reptiles taken to the Center for Rehabilitation of Wild Fauna and Screening Center for Wild Animals at the Universidade Federal de Pelotas (NURFS-CETAS/UFPEL). Samples were collected from 55 animals (39 *Trachemys dorbignii*; 3 *Philodryas patagoniensis*; 3 *Caiman latirostris*; 3 *Salvator merianae*; 2 *Acanthochelys spixii*; 2 *Phrynops hilarii*; 2 *Hydromedusa tectifera*; 1 *Philodryas aestiva*) from August 2022 to December 2023 and tested for 12 reference serovars. Two animals demonstrated positivity, one for the pathogenic serovar Pyrogenes and the other for the pathogenic serovar Canicola. This result reflected the importance of different species besides mammals as potential reservoirs and responsible for maintaining leptospirosis in the environment.

[Pesquisa de anticorpos anti-*Leptospira* spp. em répteis de vida livre de áreas urbanas e periurbanas do extremo sul do Brasil]

Resumen: O Rio Grande do Sul possui uma grande diversidade de espécies de répteis distribuídos por todo o Estado. Devido às ações antrópicas, como a fragmentação de habitats, estes animais vêm sendo observados com frequência no meio urbano e periurbano. Isso facilita a disseminação de patógenos entre animais e seres humanos, sendo um risco a saúde única, visto que muitas doenças são consideradas zoonoses. A leptospirose está entre as zoonoses mais comuns do mundo e é causada pelas espécies patogênicas da bactéria do gênero *Leptospira*. Ainda não se sabe o papel dos répteis no ciclo da doença, porém, estudos sorológicos demonstraram positividade para anticorpos contra *Leptospira* spp. em cágados e serpentes, o que pode indicar que estes animais atuam na manutenção do patógeno no ambiente. O objetivo deste estudo foi observar a presença de anticorpos anti-*Leptospira* em répteis oriundos de resgate e levados ao Núcleo de Reabilitação da Fauna Silvestre e Centro de Triagem de Animais Silvestres da Universidade Federal de Pelotas (NURFS-CETAS/UFPEL). As amostras foram coletadas de 55 animais (39 *Trachemys dorbignii*; 3 *Philodryas patagoniensis*; 3 *Caiman latirostris*; 3 *Salvator merianae*; 2 *Acanthochelys spixii*; 2 *Phrynops hilarii*; 2 *Hydromedusa tectifera*; 1 *Philodryas aestiva*), durante o período de agosto de 2022 a dezembro de 2023, e testadas para 12 sorovares de referência. Dois animais demonstraram positividade, um deles para o sorovar patogênico Pyrogenes e outro para o sorovar patogênico Canicola. Este resultado demonstra a importância de outras espécies, além dos mamíferos, como potenciais reservatórios e responsáveis pela manutenção da leptospirose no ambiente.

Delbosc, N.C., Boyer, N., Mathevon, N. and Grimault, N. (2024). Sound and vibration control crocodile hatching. *Behaviour* 161(10): 769-795.

Abstract: The birth of a baby or the hatching of an egg are moments when the risk of predation is particularly high. In oviparous species where clutches contain many eggs, one strategy for limiting predation is based on mechanisms that synchronise hatching, which reduces the individual risk of being targeted and may allow hatchlings to emerge under parental protection. These mechanisms involve communication signals between eggs and between eggs and parents. While previous studies in various species have shown

the importance of sound and vibration signals in these exchanges, how embryos integrate this information remains poorly understood. Here we show that crocodile embryos respond differently to calls emitted by siblings (hatching calls) and to vibrations mimicking parental intervention (rubbing and scratching the shell) or the presence of a predator, suggesting that these two stimuli carry different information. Through playback experiments, we confirm that hatching calls elicit vocal responses and synchronous hatching in mature embryos, while embryos hatch earlier when they perceive vibrations. Our study underlines that the control of hatching by external factors can rely on differential apprehension of multiple sensory inputs by embryos.

Bollinger, T.R. (2024). The Health and Genetic Structure of American Alligators (*Alligator mississippiensis*) in Texas. PhD thesis, Texas Tech University, Lubbock, Texas, USA.

Abstract: American alligators (*Alligator mississippiensis*) are the most populous megafaunal predators of the southeastern United States. Within their order of Crocodylia, they also represent a major American conservation success story given their population recovery from late 19th to mid-20th century overharvests, which was facilitated by innovative state to federal wildlife management practices that treated the alligator as a natural resource. These practices have been used as conservation models for other crocodylian species in the decades since the alligator's recovery, while sustainable use of alligators (eg hunting, ranching, farming, ecotourism) has expanded to nine US states and intensive research on alligator biology has extended beyond the species' strongholds of Louisiana and Florida. My project attempted to quantify the population genetic structure, individual body condition, and toxicology of alligators in Texas, which represents the westernmost edge of the species' distribution. I focused on the Houston metropolitan area of the Texas Gulf Coast where much of the alligator population in the state resides. Specifically, I examined Texas alligators for potential infraspecific units, often referred to as Evolutionarily Significant Units, Management Units, or Demographic Units, as well as to deduce the potential effects, if any, of protected areas (PAs) on Texas alligator gene flow and individual health. I hypothesized that PA enforcement of management practices related to pollution control, wetland hydrology, invasive species control, and general limitations on fishing, boating, and hunting, combined with alligators' inclination to monopolize both nesting habitats and mating opportunities, would encourage alligators to significantly genetically cluster within PAs and improve their individual health relative to alligators outside of PAs. Comparing alligators from a public state park PA, Brazos Bend State Park (BBSP), to both harvested and live alligators from unprotected regions around the Houston metro area, I used genotyping-by-sequencing (GBS) to analyze their population genetic structure, body condition formulas to compare animal relative fatness and, by extension, individual fitness, and inductively coupled plasma-mass spectrometry to examine animal toxicology. Contrary to my expectations, alligators surveyed around Houston appeared to lack genetic structuring around my PA of focus. I found some structuring according to animals' river drainage basin of origin and evidence of gene flow barriers that seemed to correspond to urban infrastructure, but overall, these data were limited by low coverage and high rates of missing data. Protected alligators within BBSP were also statistically indistinguishable from unprotected alligators in terms of body condition, while the former carried statistically greater pollutant loads than the latter in most tissues. These data together argue that alligators in Texas are, for the most part, unstructured at the resolution of GBS markers and that PAs of the size of state parks do not influence alligator health or gene flow. Therefore, wildlife management policies should treat alligators within PAs as extensions of harvested populations in Texas and consider how PAs likely will not "shelter" populations from future habitat disturbances or potential overharvests in the rapidly developing state.

Miir, A., Odume, O.N., Nyakairu, G.W., Odongo, S., Matovu, H., Kato, C.D., Špánik, I., Sillanpää, M., Mubiru, E. and Ssebuge, P. (2024). Per- and poly-fluoroalkyl substances in aquatic ecosystems and wastewater treatment works in Africa: Occurrence, ecological implications, and future perspectives. *Chemosphere* 367 (<https://doi.org/10.1016/j.chemosphere.2024.143590>).

Abstract: The increasing levels of industrialization and urbanization have led to the generation of significant amounts of wastewater and waste products, often containing chemicals like per- and poly-fluoroalkyl substances (PFASs) commonly found in consumer products. PFASs are known for their persistence, ubiquity, and ecotoxicological impacts, raising concerns about potential harm to ecosystems. This paper reports the occurrence and evaluates the ecological risks of PFASs in aquatic ecosystems and wastewater treatment works (WWTWs) across Africa. We reviewed 32 papers published in the period 2009-2024 and identified a total of 35 PFAS compounds in surface waters, wastewater, sediments, fish, crocodiles, and invertebrates. Much of the reported studies came from South Africa, followed by Kenya and Nigeria. PFAS concentrations in Africa were $<0.7-390.0 \text{ ng L}^{-1}$ in surface waters, $0.05-772 \text{ ng g}^{-1} \text{ dw}$ in sediments, and $<0.2-832 \text{ ng L}^{-1}$ in wastewater, while the highest levels in fish and invertebrates were 460.7 and $35.5 \text{ ng g}^{-1} \text{ ww}$, respectively. The PFAS levels were in the same range of data as those reported globally. However, the high concentrations of PFASs in sediments and wastewater suggest areas of point contamination and a growing risk to aquatic ecosystems from effluent discharges. Calculated risk quotients suggested that, in Africa, organisms in river systems face greater risks due to exposure to PFASs compared to those in lakes, while marine organisms might face higher risks compared to freshwater organisms. Future studies should focus on PFAS contamination sources, especially WWTWs, as emerging sources of PFASs in aquatic systems.

Pritz, M.B. (2024). Thalamus of reptiles and mammals: Some significant differences. *Brain Behaviour and Evolution* ([doi: 10.1159/000542100](https://doi.org/10.1159/000542100)).

Abstract: Background: Most studies comparing forebrain organization between reptiles and mammals have focused on similarities. Equally important are the differences between their brains. While differences have been addressed infrequently, this approach can highlight the evolution of brains in relation to their respective environments. Summary: This review focuses on three key differences between the dorsal and ventral thalamus of reptiles and mammals. One is the organization of thalamo-telencephalic interconnections. Reptiles have at least three circuits that transmit information between the dorsal thalamus and telencephalon whereas mammals have just one. A second is the number and distribution of local circuit neurons in the dorsal thalamus. Most reptilian dorsal thalamic nuclei lack local circuit neurons whereas these same nuclei in mammals contain varying numbers. The third is the organization of the thalamic reticular nucleus. In crocodiles, at least, the neurons in the thalamic reticular nucleus are heterogeneous with two separate nuclei each being associated with a different circuit. In mammals, the neurons in the thalamic reticular nucleus, which is a single structure, are homogeneous. Key messages: Transcriptomics and development are suggested to be the most likely approaches to explain these differences between reptiles and mammals. Transcriptomics can reveal which neuron types are 'new' or 'old' and whether neurons and their respective circuits have been re-purposed to be used differently. Examination of the development and connections of the dorsal and ventral thalamus will determine whether their formation is similar or different from what has been described for mammals.

Mika, M. (2024). Parental Care in Crocodiles with Emphasis on Acoustic Communication Between Parent and Young. BSc thesis, Charles University, Prague, Czech Republic.

Abstract: Ectotherms are traditionally considered to have a rather

limited ability and need to care for their offspring compared to endotherms. This is related to lower metabolic demands, higher levels of juvenile development, a greater tendency to r-strategy, physiological adaptations, but also a more restricted social life. One exception, however, is the Crocodylia group, in which there is increasing evidence of a rich parental life. In this undergraduate thesis, I aim to summarize all available literature on parental care in crocodylians. In addition to the widespread building, visiting and defending of nests, crocodiles are known to actively assist in the actual hatching of the young. The chicks acoustically signal from the egg towards the parent, and this form of vocal communication often plays an absolutely crucial role in the successful completion of incubation in the form of hatching. However, parental care is far from over. Many crocodylian species actively guard their young in so-called nurseries. Here, acoustic communication between parent and cub is still involved. The direction from parent to cub is usually one of warning or summoning. In the direction of the cub, so-called distress calls come in the event of a serious threat. The aim of my bachelor's thesis was to collect all the parental care data from all the described crocodylian species in order to subsequently map the different types of parental care onto a phylogenetic tree. This makes it possible to follow the distribution of all types of crocodylian parental care within each family and to consider the evolution of this behaviour in the whole group. I have also enriched the paper with my own observations from the crocodile zoo in Protivín and thus it contains completely new unpublished data. In addition, my several years of experience working with crocodiles also helped me to critically evaluate controversial observations and interpretations occurring not only in the breeding but also in the scientific literature. The results show that most types of parental care are present across the taxon and appear to have been present in the ancestor itself, ie occurring ancestrally at the very base of the crocodylian. Given the phylogenetic position of crocodylians as a sister group to birds, this is consistent within the broader phylogenetic context of the evolution of parental care in Archosauria.

Bell, C., Raynal, R.S., Noble, D.W.A., Schwanz, L.E., Warner, D.A., Pruett, J.E. and Riley, J.L. (2025). The effect of moisture during development on phenotypes of egg-laying reptiles: A systematic review and meta-analysis. *Journal of Experimental Biology* (<https://doi.org/10.1242/jeb.249960>).

Abstract: The embryonic environment is critical for the development of many ectothermic vertebrates, which makes them highly vulnerable to environmental change. Changes in temperature and moisture, in particular, are known to influence embryo survival and offspring phenotypes. While most papers concerning phenotypic development of terrestrial ectotherms focus on the role of temperature on eggs and embryos, the comparatively small number of studies on the effects of substrate moisture are well suited for quantitative analysis aimed at guiding future research. To accomplish this goal, we compiled data from 37 studies on 28 different reptile species and used a meta-analytic approach to quantify the effect of substrate moisture on several offspring outcomes: hatching success (survival), incubation duration, hatchling mass and length, and sex ratio. We found that substrate moisture had a small effect across most traits but significantly affected body size (ie length and mass), with wetter conditions producing longer and heavier hatchlings. Temperature also moderated the effect of moisture on hatching success; with higher temperatures resulting in lower success. Additionally, the effect of moisture on hatching success and hatchling mass was enhanced by larger differences in moisture concentration between treatments, yet the effect was small. Lastly, substrate moisture affected sex ratio in turtles, but not in other squamates. Overall, these analyses provide a foundation for further research investigating the effects of moisture on oviparous reptile development. Increasing the diversity of environmental variables for which we understand their impact on animal phenotype will be beneficial in an era with wide-ranging global change.

Iijima, M., Munteanu, V.D. and Blob, R.W. (2024). Variations in humeral and femoral strains across body sizes and limb posture in American alligators. *Journal of Experimental Biology* 227(24) ([doi:10.1242/jeb.249211](https://doi.org/10.1242/jeb.249211)).

Abstract: Bone loading is a crucial factor that constrains locomotor capacities of terrestrial tetrapods. To date, limb bone strains and stresses have been studied across various animals, with a primary emphasis on consistent bone loading in mammals of different sizes and variations in loading regimes across different clades and limb postures. However, the relationships between body size, limb posture and limb bone loading remain unclear in animals with non-parasagittally moving limbs, limiting our understanding of the evolution of limb functions in tetrapods. To address this, we investigated *in vivo* strains of the humerus and femur in juvenile to subadult American alligators as they walked with various limb postures. We found that principal strains on the ventromedial cortex of the femoral midshaft increased with larger sizes among the three individuals displaying similar limb postures. This indicates that larger individuals experience greater limb bone strains when maintaining similar limb postures to smaller individuals. Axial and shear strains in the humerus were generally reduced with a more erect limb posture, while trends in the femur varied among individuals. Given that larger alligators have been shown to adopt a more erect limb posture, the transition from sprawling to erect limb posture, particularly in the forelimb, might be linked to the evolution of larger body sizes in archosaurs, potentially as a means to mitigate limb bone loading. Moreover, both the humerus and femur experienced decreased shear loads compared with axial loads with a more erect limb posture, suggesting proportional changes in bone loading regimes throughout the evolution of limb posture.

Beatty, A.R. Flint, M., Flint, J., Gemensky-Metzler, A.J., Diaz-Campos, D., van Balen, J.C. and Newbold, G. (2024). Assessment of ophthalmic diagnostic parameters, conjunctival flora, and pharmacologic dilation of a large population of juvenile American alligators (*Alligator mississippiensis*). *Journal of Zoo and Wildlife Medicine* 55(4): 868-877.

Abstract: American alligators (*Alligator mississippiensis*) are an important apex predator of semiaquatic habitats of the southern United States. Commercial alligator farming has grown in the last several decades, leading to a need to understand the health conditions that affect this species to ensure appropriate management and welfare. The aims of this study were 1) to establish and describe normative data including results of common ophthalmic diagnostic tests and conjunctival flora, 2) document ocular pathology in this population, and 3) assess the effect of topical rocuronium bromide and 10% phenylephrine for facilitating pharmacologic mydriasis. A total of 165 juvenile American alligators were evaluated in this study. Assessment included palpebral fissure length (PFL), intraocular pressure (IOP), strip meniscometry (SM), central corneal thickness (CCT), anterior segment examination, and bacterial and fungal culture sampling of the conjunctiva. Topical rocuronium bromide (RB) and 10% phenylephrine (PE) were applied to the right eye (OD) of eight individuals, and pupil diameter (PD) of both eyes measured at regular time intervals. Mean (\pm standard deviation [SD]) PFL was 10.55 ± 1.47 mm, IOP was 8.16 ± 1.48 mmHg, CCT was 150.06 ± 8.25 μ m, and SM was 3.42 ± 2.07 mm/5 s. Culture results stress the importance of proper handling protocols in crocodylians given the high number of opportunistic pathogens isolated from the conjunctiva, as well as the first report of isolation of *Lactococcus garvieae* in this species. Acquired ophthalmic lesions, likely traumatic, were recorded and no congenital anomalies were observed. Topical administration of RB and PE resulted in a significant increase in nonilluminated pupil diameter (PD) starting at 20 min, and maximum dilation was achieved at 90 min. Fundic examination was achievable, and no adverse systemic effects were noted. This study contributes to a growing body of knowledge regarding ocular health of American alligators.

Barham, K.E., Dwyer, R.G., Frere, C.H., Bentley, L.K., Baker, C.J., Campbell, H.A., Irwin, T.R. and Franklin, C.E. (2024). Cooling down is as important as warming up for a large-bodied tropical reptile. *Proceedings of the Royal Society B: Biological Sciences* 291(2034) (doi: [10.1098/rspb.2024.1804](https://doi.org/10.1098/rspb.2024.1804)).

Abstract: An ectotherm's performance and physiological function are strongly tied to environmental temperature, and many ectotherms thermoregulate behaviourally to reach optimum body temperatures. Tropical ectotherms are already living in environments matching their thermal tolerance range and may be expected to conform to environmental temperatures. We tracked the body temperatures (T_b) of 163 estuarine crocodiles across 13 years and compared T_b of 39 crocodiles to water temperature gathered using fish-borne sensors (T_w) across 3 years (2015-2018). While T_b largely conformed closely to T_w , we found inter- and intra-individual differences in relative body temperature ($T_b - T_w$) that depended on sex and body size as well as the time of day and year. Deviations from T_w , especially during the warm parts of the year, suggest that thermoregulatory behaviour was taking place: we found patterns of warming and cooling events that seemed to mediate this variation in T_b . Thermoregulatory behaviour was observed most frequently in larger individuals, with warming events common during winter and cooling events common during summer. By observing free-ranging animals across multiple years, we found that estuarine crocodiles show yearly patterns of active cooling and warming behaviours that modify their body temperature, highlighting their resilience in the face of recent climate warming. Our work also provides the first evidence for thermal type in large-bodied reptiles.

de Los Angeles Cordero Gil, T., Moleón, M.S., Marelli, B.E. and Siroski, P.A. (2024). Host defense peptides in crocodilians - A comprehensive review. *Peptides* 182 (doi: [10.1016/j.peptides.2024.171312](https://doi.org/10.1016/j.peptides.2024.171312)).

Abstract: Amphibians and reptiles, like all animals, are prone to periodic infections. However, crocodilians stand out for their remarkable ability to remain generally healthy and infection-free despite frequent exposure to a wide variety of microorganisms in their habitats and often sustaining significant injuries. These animals have evolved highly active immune mechanisms that provide rapid and effective defense. This is evidenced by the superior hemolytic capacity of their plasma compared to that of other organisms. To date, several host defense peptides (HDPs) have been identified in crocodilians, including cathelicidins, beta-defensins, hepcidins, leucrocins, hemocidins, and omwaprins. These peptides exhibit potent and broad-spectrum antimicrobial, antibiofilm, antifungal, and anticancer activities. Due to the relatively low but diverse evolutionary rate of crocodilians, the HDPs found in this species offer valuable insights into proteins and mechanisms of action that are highly conserved across many animals related to immune defense. The potential applications of HDPs in modern medicine represent a promising strategy for developing new therapeutic agents. Their novelty and the vast variability with which peptide sequences can be designed and modified expand the field of application for HDPs almost infinitely. This review addresses the urgent need for innovative and more effective drugs to combat the rise of antimicrobial-resistant infections and evaluates the potential of crocodilian HDPs. It presents recent advances in the identification of crocodilian HDPs, particularly antimicrobial peptides (AMPs), including previously underexplored topics such as the sequential and structural conformation of different peptide types in crocodilians and the use of bioinformatics tools to enhance native peptides.

Kruise, A.O., Markusen, L.D., Grøndahl, C. and Olsen, L.H. (2024). Sedation and general anaesthesia of crocodilians: a systematic review. *Acta Veterinaria Scandinavica* 66(1) (doi: [10.1186/s13028-024-00779-1](https://doi.org/10.1186/s13028-024-00779-1)).

Abstract: Sedation and general anaesthesia of crocodilians pose

unique challenges due to their aggressive nature, poikilothermic physiology, and specific anatomical and physiological characteristics, all factors that complicate crocodilian anaesthesia. This review aimed to systematically review the literature regarding sedation and general anaesthesia of crocodilians with focus on efficacy and impact on vital parameters. A systematic literature search was performed according to PRISMA guidelines on May 2, 2023 in the databases Embase, PubMed, Scopus and Web of Science. Publications were excluded based on predefined exclusion criteria, which encompassed non-standard publications and publications unrelated to crocodilians, with fewer than five animals and/or with insufficient data on sedation and general anaesthesia. Five key factors were used to evaluate the strength of evidence: number of included animals, study design, definition of recovery time, blinded assessment of recovery and conflict of interest. Ten publications were included in this systematic review. Drugs used included alpha-2-adrenoceptor agonists, dissociative anaesthetics, benzodiazepines, neuromuscular blocking agents, propofol, alfaxalone, and inhalant gasses. The studies included in total 55 *Alligator mississippiensis*, 110 *Crocodylus porosus*, 15 *Crocodylus johnstoni*, and 15 *Crocodylus niloticus*. Factors such as temperature, administration route, dose, species, and age influenced protocols for sedation and general anaesthesia of crocodilians. The studies included used five different study designs. Only one study included a control group, done on retrospectively collected data. Blinded recovery assessments and declarations of no conflict of interest were noted in some studies. The use of four distinct recovery definitions posed challenges to comparability in this systematic review. The studies reported that medetomidine provided stable and reversible sedation, although it depressed heart rate. Alfaxalone was less stable outside the optimal temperature range. Intubation and inhalation anaesthesia were effective, and adrenaline reduced the length of the recovery period. Overall, the review provides valuable insights for veterinarians, researchers, and wildlife professionals involved in sedation and general anaesthesia of the crocodilian species, however, the literature is limited, and further research is needed to improve evidence-based medical management.

Walter, C., Carroll, J., Cramberg, M., Houser, J.J., Loguda-Summers, D. and Young, B.A. (2024). Forces acting on the foot of the American alligator (*Alligator mississippiensis*) during pedal anchoring. *Biology* 13(12) (doi: [10.3390/biology13121062](https://doi.org/10.3390/biology13121062)).

Abstract: This study was undertaken to explore the forces acting on the pes during pedal anchoring and to discern if pedal anchoring required the activation of the intrinsic pedal musculature. Replica feet equipped with strain gauges were moved over mud substrate, mimicking locomotion and pedal anchoring. Quantification of the substrate tracks demonstrated that they were similar to those made by freely moving *Alligator*, that the locomotor and pedal anchoring tracks were significantly different, and that the composition of the artificial feet significantly altered the tracks. Strain gauges revealed significantly different forces at different locations (eg digit vs. heel) on the pes and between locomotor and pedal anchoring motions. Collectively, the results of the present study demonstrate that the forces acting on the pes during pedal anchoring are different from those during locomotion. Furthermore, varying the composition of the feet used in this study demonstrated the importance of flexion at the metatarsal/phalangeal joints. Resistance to this flexion in living crocodylians requires active muscle contraction, meaning that pedal anchoring is an active, not passive, behavior. These results offer the first insights into the mechanics of pedal anchoring and demonstrate how technologies like 3D printing can be applied to established problems like fossil trackways.

Weber, M., Weber, K., Winkler, D.E. and Tütken, T. (2025). Calcium and strontium isotopes in extant diapsid reptiles reflect dietary tendencies-a reference frame for diet reconstructions in the fossil record. *Proceedings of the Royal Society B: Biological Sciences* 292(2038) (doi: [10.1098/rspb.2024.2002](https://doi.org/10.1098/rspb.2024.2002)).

Abstract: Dietary preferences of extant reptiles can be directly observed, whereas diet reconstruction of extinct species typically relies on morphological or dental features. More specific information about the ingested diet is contained in the chemistry of hard tissues. Stable isotopes of calcium and strontium show systematic fractionations between diet and skeletal bioapatite, which is applied for diet and trophic-level reconstructions of extant and extinct vertebrate species. Here, we present the first comprehensive analysis of stable calcium and strontium isotopes of bones and teeth from 28 extant reptiles, including lepidosaurs and archosaurs (crocodilians) with distinct herbivorous to faunivorous feeding behaviour, establishing a dietary reference frame. Both calcium and strontium isotopes exhibit systematic offsets between dietary groups, with insectivores having the highest, herbivores intermediate and carnivores the lowest calcium and strontium isotope values. Although the isotopic trophic-level effect is similar to mammals, the absolute calcium isotope values in reptiles are more positive in each diet category. Combining isotopic data with dental microwear texture analysis enables a refined understanding of reptile feeding ecology and the identification of durophagous diets. This toolbox opens new possibilities for improved dietary reconstructions of extinct taxa, such as dinosaurs and other non-mammalian species in the fossil record.

Barboza, R.S.L., de Sousa Correia, J.M., Souto, A. and Schiel, N. (2024). Disturbed areas promote more parental care and less nesting preference in females of broad-snouted caiman (*Caiman latirostris*). *Animal Welfare* 33: e56.

Abstract: The successful survival of crocodilian hatchlings is largely dependent upon nest care by females. Nonetheless, it is crucial to understand how environmental degradation affects nest site selection and parental behaviour in female crocodilians. Therefore, our objective was to evaluate the relationship between anthropogenic disturbances and nesting behaviour in free-living broad-snouted caiman (*Caiman latirostris*). We compared nests in a disturbed and a non-disturbed area, and anticipated differences in nest density, hatching success, female size, egg number and biomass, and parental care behaviour. We monitored 44 nests over four years in Brazil, covering 58.25 km, in a disturbed area (n= 8) and a non-disturbed area (n= 36). According to our findings, nest density was significantly higher in the non-disturbed area (1.31 nests per linear km) compared to the disturbed area (0.25 nests per linear km). However, there was a significantly higher frequency of parental care behaviour (86%) in the disturbed area compared to the non-disturbed area (34%). The other factors studied showed no statistical difference between the two areas. The results indicate that females prefer to nest in healthier, preserved environments, away from anthropogenic disturbances. Yet, presumably at the cost of extra energy expenditure, increased parental care appears to buffer against a reduction in hatching success. Despite the behavioural buffer, the clear preference for non-disturbed nesting and nursery locations underscores the need to identify and protect the remaining non-disturbed areas inhabited by these animals. Our findings suggest that these measures should positively impact the welfare and protection of *C. latirostris* and other crocodilian species.

Faure-Brac, M.G. (2024). Pseudosuchian thermometabolism: A review of the past two decades. *Anatomical Record* (doi: 10.1002/ar.25609).

Abstract: Pseudosuchia, one of the two main clades of Archosauria, is today only represented by some 20 extant species, the crocodilians, representing only a fraction of its extinct diversity. Extant crocodilians are ectotherms but present morphological and anatomical features usually associated with endothermy. In 2004, it was proposed that pseudosuchians were ancestrally endothermic and the features observed in extant crocodilians are the remains of this lost legacy. This contribution has two parts: the first part covers 20 years of studies on this subject, first exploring the evidence for

a loss of endothermy in extant crocodilians, before covering the variety of proxies used to infer the thermophymetabolic regime of extinct pseudosuchians. In the second part, the quantitative results of these previous studies are integrated into a comprehensive ancestral state reconstruction to discuss a potential scenario for the evolution of thermometabolism. Pseudosuchian endothermy would then have been lost close to the node Crocodylomorpha. The end-Triassic mass extinction is proposed to have played the role of a filter, leading to the extinction of endothermic pseudosuchians and the survival of ectothermic ones. This difference in survival in Pseudosuchia is compared to those of dinosaurs, and difference in their metabolism is also considered. Pseudosuchian endothermy might have been of a different level than the dinosaurian one and more studies are expected to clarify this question.

Badial, P.R., Laovechprasit, W., Laue, C., Stacy, B.A., Stanton, J.B., Subramaniam, K. and Ossiboff, R.J. (2024). Piscichuvirus-associated meningoencephalomyelitis in a free-ranging American alligator (*Alligator mississippiensis*). *Veterinary Pathology* (doi: 10.1177/03009858241300559).

Abstract: The American alligator (*Alligator mississippiensis*) is a keystone species of the southeastern United States. In December of 2022, a free-ranging American alligator was found stuporous and tetraparetic. On postmortem evaluation, lesions were limited to the central nervous system, consisting of prominent perivascular cuffs of lymphocytes and histiocytes that extended into the surrounding neuroparenchyma along with gliosis. Next-generation sequencing of the affected brain identified the presence of a piscichuvirus closely related to the freshwater turtle neurovirus 1 (FTuNV-1) recently reported in an alligator snapping turtle with similar microscopic lesions. *In situ* hybridization using zz-probes that recognize FTuNV-1 identified widespread hybridization signal in neurons and glial cells in the alligator's brain and spinal cord. This case represents only the second association of piscichuviruses with vertebrate disease. Moreover, it highlights the potential for disease transmission between different orders (Crocodylia and Testudines) of free-ranging aquatic reptiles that share similar habitats in the United States.

Santos-Durán, G.N., Cooper, R.L., Jahanbakhsh, E., Timin, G. and Milinkovitch, M.C. (2025). Self-organized patterning of crocodile head scales by compressive folding. *Nature* 637(8045): 375-383.

Abstract: Amniote integumentary appendages constitute a diverse group of micro-organs, including feathers, hair and scales. These structures typically develop as genetically controlled units¹, the spatial patterning of which emerges from a self-organized chemical Turing system^{2,3} with integrated mechanical feedback^{4,5}. The seemingly purely mechanical patterning of polygonal crocodile head scales provides an exception to this paradigm⁶. However, the nature and origin of the mechanical stress field driving this patterning remain unclear. Here, using precise *in ovo* intravenous injections of epidermal growth factor protein, we generate Nile crocodile embryos with substantially convoluted head skin, as well as hatchlings with smaller polygonal head scales resembling those of caimans. We then use light-sheet fluorescence microscopy to quantify embryonic tissue-layer geometry, collagen architecture and the spatial distribution of proliferating cells. Using these data, we build a phenomenological three-dimensional mechanical growth model that recapitulates both normal and experimentally modified patterning of crocodile head scales. Our experiments and numerical simulations demonstrate that crocodile head scales self-organize through compressive folding, originating from near-homogeneous skin growth with differential stiffness of the dermis versus the epidermis. Our experiments and theoretical morphospace analyses indicate that variation in embryonic growth and material properties of skin layers provides a simple evolutionary mechanism that produces a diversity of head-scale patterns among crocodilian species.

Zhong, H., Shao, X., Cao, J., Huang, J., Wang, J., Yang, N. and Yuan, B. (2024). Comparison of the distribution patterns of microsatellites across the genomes of reptiles. *Ecology and Evolution* 14(11): e70458.

Abstract: Microsatellites or simple sequence repeats (SSRs) are prevalent across various organisms' genomes. However, their distribution patterns and evolutionary dynamics in reptile genomes are rarely studied systematically. We herein conducted a comprehensive analysis of SSRs in the genomes of 36 reptile species. Our findings revealed that the total number of SSRs ranged from 1,840,965 to 7,664,452, accounting for 2.16%-8.19% of the genomes analyzed. The relative density ranged from 21,567.82 to 81,889.41 bp per megabase (Mbp). The abundance of different SSR categories followed the pattern of imperfect SSR (I-SSR) > perfect SSR (P-SSR) > compound SSR (C-SSR). A significant positive correlation was observed between the number of SSRs and genome size ($p=0.0034$), whereas SSR frequency ($p=0.013$) or density ($p=0.0099$) showed a negative correlation with genome size. Furthermore, no correlation was found between SSR length and genome size. Mononucleotide repeats were the most common P-SSRs in crocodylians and turtles, whereas mononucleotides, trinucleotides, or tetranucleotides were the most common P-SSRs in snakes, lizards, and tuatara. P-SSRs of varying motif sizes showed nonrandom distribution across different genic regions, with AT-rich repeats being predominant. The genomic SSR content of the squamate lineage ranked the highest in abundance and variability, whereas crocodylians and turtles showed a slowly evolving and reduced microsatellite landscape. Gene ontology enrichment and Kyoto Encyclopedia of Genes and Genomes pathway analyses indicated that genes harboring P-SSRs in the coding DNA sequence regions were primarily involved in the regulation of transcription and translation processes. The SSR dataset generated in this study provides potential candidates for functional analysis and calls for broader-scale analyses across the evolutionary spectrum.

DeLeeuw, H., Cramberg, M., Dille, M., Pick, E., Thompson, M. and Young, B.A. (2024). Anatomy of spinal CSF loss in the American alligator (*Alligator mississippiensis*). *Journal of Anatomy* (doi: 10.1111/joa.14177).

Abstract: A variety of anatomical techniques, imaging modalities, dyes and contrast agents, were used to document the mechanisms/routes whereby spinal cerebrospinal fluid (CSF) would move beyond the confines of the spinal dura in the American alligator, *Alligator mississippiensis*. Three pathways for CSF loss were identified: spinal arachnoid granulations, perineural flow along the spinal nerves, and lymphatic drainage (both along the surface of the dura and at the venous plexus surrounding the spinal ganglion). These same three pathways for spinal CSF loss have been documented in mammals, suggesting that they may be a common feature of (at least) amniotes. Crocodylians, including *A. mississippiensis*, have the largest epidural venous sinus system of any vertebrate, the present study suggests that, as in mammals, the venous complex of the alligator plays a direct role in regulating the absorption of CSF from the spinal compartment.

Weiss, B.M., Dollman, K.N., Choiniere, J.N., Browning, C. and Botha, J. (2024). The osteohistology of *Orthosuchus stormbergi* using synchrotron radiation microcomputed tomography. *Journal of Anatomy* (doi: 10.1111/joa.14166).

Abstract: *Orthosuchus stormbergi* was a small-bodied crocodyliform, representative of a diverse assemblage of Early Jurassic, early branching crocodylomorph taxa from the upper Elliot Formation of South Africa. The life history of these early branching taxa remains poorly understood, with only sparse investigations into their osteohistology, yet species like *Orthosuchus* have potential to inform about the macroevolution of growth strategies on the stem leading to crown crocodylians. In order to elucidate the growth

patterns of *Orthosuchus*, we used propagation phase contrast X-ray synchrotron micro-computed tomography to virtually image the osteohistology of the postcrania of two specimens, including multiple elements from the type (SAM-PK-K409), and the femur of a referred specimen (BP/1/4242). In total, we scanned nine mid-diaphyseal sections of the humerus, radius, ulna, radiale, femur, tibia, fibula, and a rib. We then compared our results to osteohistological sections of crocodylomorph taxa from the published literature. Our results show that the most predominant bone tissue type in *Orthosuchus* is lamellar, with a few patches of woven and parallel-fibred bone. The type specimen contains four to five lines of arrested growth and the hindlimb elements present outer circumferential lamellae, whereas the referred specimen contains six to seven. Both specimens grew at similar rates, reaching adult skeletal body size at year four or five. The sectioned bones, most notably the radius and ulna, are comparatively thick walled and compact. Our virtual osteohistological sections are one of the first for an early branching crocodyliform, and the broad sample of skeletal elements makes *Orthosuchus* a key anchor point for understanding the plesiomorphic life history traits of the clade.

Andersen, D.K., Fischer, G.A. and Combrink, L. (2024). The alligator and the mosquito: North American crocodylians as amplifiers of West Nile Virus in changing climates. *Microorganisms* 12(9) (doi: 10.3390/microorganisms12091898).

Abstract: In an age of emerging zoonoses, it is important to understand the intricate system of vectors and reservoirs, or hosts, and their relation to humans. West Nile Virus (WNV) has been detected in a myriad of nonhuman hosts. Transmission of the virus to humans is reliant on amplified seroprevalence within the host, which occurs primarily in birds. However, recent studies have found that other animal groups, including crocodylians, can obtain seroprevalence amplification to levels that make them competent hosts able to transmit WNV to mosquitoes, which can then transmit to humans. Climate change could exacerbate this transmission risk by shifting the distributions of mosquito vectors towards novel geographic ranges. Here, we use maximum entropy models to map the current and future distributions of three mosquito vector species and four crocodylian species in North America to determine the emerging risk of WNV outbreaks associated with changing climates and WNV associated with crocodylians in North America. From our models, we determined that one mosquito species in particular, *Culex quinquefasciatus*, will increase its distribution across the ranges of all crocodylian species in all tested climate change scenarios. This poses a potential risk to public health for people visiting and living near crocodylian farms and high-density natural crocodylian populations.

Mwalwimba, I.K., Manda, M. and Ngongondo, C. (2024). The role of indigenous knowledge in disaster risk reduction and climate change adaptation in Chikwawa, Malawi. *Jamba* 16(2) (doi: 10.4102/jamba.v16i2.1810).

Abstract: The role of indigenous knowledge in disaster risk reduction (DRR) and climate change adaptation cannot be underestimated. It acts as a preparedness and response tool to climate change-related impacts such as floods, droughts and strong winds. However, inadequate studies about indigenous knowledge in Malawi is a major challenge when dealing with extreme climatic conditions. Learning from indigenous knowledge systems, by investigating first what local communities know and have, can improve the understanding of local conditions and can provide a productive context for activities designed to help communities reduce vulnerability to climate change impacts. This paper assessed the role of indigenous knowledge systems in DRR and climate change variability and adaptation strategies in Chikwawa district. The study used a participatory research approach involving interactive research methods such as focus group discussions (FGDs), key informant interviews and participant observations. Data from key informants

and FGDs were analysed thematically. The study revealed various indigenous knowledge which communities in the Chikwawa district use to respond to climate-related impacts such as floods. Some of these include hippopotamus relocating from the river to the village, extreme hissing of pythons in nearby forests, buffaloes and zebras wreaking havoc in the villages and crocodiles flocking to the village. The study concludes that indigenous knowledge provides the basis for problem-solving approaches for local communities, hence, a need to document it at a wider scale.

O'Malley, A., Ray, J.M., Kitlas, P., Ruethers, T., Kapingidza, A.B., Cierpicki, T., Lopata, A., Kowal, K. and Chruszcz, M. (2024). Comparative studies of seafood and reptile α - and β -parvalbumins. *Protein Science* 3(12): e5226.

Abstract: Small calcium-binding proteins such as parvalbumins (PVs) are major seafood and fish allergens. However, the impact of structural changes on their capacity to bind IgE has not been studied in detail. Therefore, fish and reptilian PVs, as well as human α -PV, were selected for biochemical, structural, and IgE binding studies. Likely due to their high solubility, crystallization proved difficult, so additional techniques were used to promote crystallization of the proteins. Novel crystal structures were determined for human PV, cod allergen Gad m 1.0201, saltwater crocodile allergen Cro p 1.0101, and the α -PV from thornback ray. β -PVs are considered the major fish allergens, while α -PVs are rarely categorized as allergens. To explain these differences, the results of structural and IgE binding studies were combined. This approach allowed us to provide new insight into IgE binding epitopes present on PVs, focusing on cross-reactivity among the selected α - and β -PVs. In addition, we have shown that these proteins display remarkable thermal stability across a range of pH conditions, which is relevant in the case of food allergens and food processing. Moreover, it is shown that the presence of calcium cations is critical for stability of the studied PVs via their protein folding, which has an impact on the formation of IgE binding epitopes. These studies shows the stability of fish and reptile PV allergens, and it allows for further evaluation of their IgE cross-reactivity.

de Souza Ezidio, P.A. (2024). Comparacao nutricional e sensorial de quibes elaborados com carne de jacare do pantanal (*Caiman yacare*), aves e bovinos. *Revista Eletrônica Interdisciplinar* 16(3): 435-449.

Abstract: In particular, the Pantanal alligator (*Caiman yacare*) is a great source of animal protein in human food, has high biological value, high digestibility, low cholesterol values and demonstrates technological potential for the elaboration of derivatives. With that, the objective was to make kebabs with alligator meat, chicken and beef in order to compare them in the formulation, verifying the variation of the physical-chemical characteristics and their acceptance by potential consumers, with the aid of sensory tests. There was no significant difference ($P>0.05$) between the formulations for the values of moisture, carbohydrates and value in raw kebabs. There was a significant difference ($P<0.005$) for Ph values, with alligator kibbeh presenting the Ph value closest to neutrality. The bovine kibbeh obtained greater acceptance differing from the others ($P<0.05$) for the attributes color aroma, flavor and overall impression. Chicken and alligator kebabs did not differ significantly ($P>0.05$) for the same attributes. It can be concluded that the use of alligator meat for the elaboration of meat products is sensorially viable. The replacement of beef, commonly used in the preparation of traditional kibbeh, with alligator meat, was satisfactorily pleasing to the taste of consumers, but more research to improve products must be conducted.

Resumo: Em especial, o jacaré-do-Pantanal (*Caiman yacare*) é uma ótima fonte de proteína de origem animal na alimentação humana, possui alto valor biológico, alta digestibilidade, baixos valores de colesterol e demonstra potencial tecnológico para a elaboração de derivados. Com isso objetivou-se a confecção de quibes com carne

de jacaré, frango e bovina a fim de compará-los na formulação, verificando a variação das características físico-químicas e suas aceitações junto aos potenciais consumidores, com auxílio de testes sensoriais. Não houve diferença ($P>0,05$) significativa entre as formulações para os valores de umidade, carboidratos, lipídios e valor calórico nos quibes crus. Houve diferença significativa ($P<0,005$) para os valores de pH, sendo que o quibe de jacaré apresentou o valor de pH mais próximo a neutralidade. O quibe bovino obteve maior aceitação diferindo dos demais ($P<0,05$) para os atributos cor aroma, sabor e impressão global. O quibe de frango e de jacaré não diferiram significativamente entre si ($P>0,05$) para os mesmos atributos. Pode-se concluir que a utilização de carne de jacaré para elaboração de produtos cárneos é sensorialmente viável. A substituição da carne bovina, comumente utilizada no preparo do quibe tradicional, pela carne de jacaré, foi satisfatoriamente agradável ao paladar dos consumidores, porém mais pesquisas para aprimoramento dos produtos devem ser conduzidas.

Campos, Z., Magnusson, W.E. and Mourao, G. (2024). Reproduction and displacements of known-age caimans *Caiman yacare* in the Pantanal of Brazil. *The Herpetological Bulletin* 170 (<https://doi.org/10.33256/hb170.713>).

Abstract: We recaptured 26 female and 24 male Pantanal caimans *Caiman yacare* of known-age up to 36 years after marking. The relationship between clutch size and age for known-age females was highly variable although one female captured multiple times between 18 and 26 years of age showed little variation in clutch size. Captured known-age females attending nests varied from 73 cm to 89 cm snout-vent length and from 9 to 36 years old. These females continued to grow long after their first capture, so cessation of growth does not appear to be related to reproduction. Most known-age animals were recaptured within 10 km of where they hatched, but usually on a different ranch, so ranches cannot be used as autonomous management units. Our data indicate that the ratio of snout-vent length (SVL) at first reproduction (73 cm) to mean asymptotic SVL reported for this species (85.7 cm SVL) is much higher in female Pantanal caimans (0.85) than has been reported for most other reptiles (0.7).

Paiva, A.L.S., Godoy, P.L., Dunne, E.M., Farnsworth, A., Valdes, P.J., Lunt, D.J., Klein, W., Langer, M.C., Hsiou, A.S. (2024). The role of climate on the emergence of giant caimanines (Crocodylia, Alligatoroidea) from the Miocene western Amazonian region. *Palaeogeography, Palaeoclimatology, Palaeoecology* 656 (<https://doi.org/10.1016/j.palaeo.2024.112582>).

Abstract: Extant caimanines include the six modern species of caimans, which occur predominantly in South and Central America and are mostly medium-sized crocodylians. Nevertheless, the fossil record of the group reveals a significantly higher diversity, with remarkable body size variation. In particular, the giants *Purussaurus* and *Mourasuchus*, from the Miocene western Amazonian region, are two of the most prominent representatives. Previous work has demonstrated a correlation between the body size of crocodylians and abiotic factors throughout the Cenozoic; however, this relationship is poorly understood, particularly within the Caimaninae lineage. Here, we explore evolutionary body size patterns within Caimaninae, investigating the potential influence of climatic factors. Using a phylogenetically-informed method, we estimated the body size of 33 caimanine specimens, coupled with climatic variables from a General Circulation Model to reconstruct deep-time patterns. Our results indicate that giant Miocene caimanines are restricted to warmer conditions, with significantly less seasonal temperature variation. This suggests that the unmatched climatic conditions of the Miocene western Amazonian region possibly allowed the emergence of unique palaeoecosystems, favouring the sustenance of these very large crocodylians.

Mascarenhas-Junior, P.B., Strickland, B.A., Heithaus, M.R., Correia, J.M.S. and Simões, P.I. (2024). Habitat use and movement patterns of broad-snouted caimans (*Caiman latirostris*) in an impacted Atlantic forest environment in Brazil. *Animal Biotelemetry* 12: Article number 31.

Abstract: Animal habitat use can be influenced by a suite of factors including intraspecific interactions and resource availability. The broad-snouted caiman (*Caiman latirostris*) is the largest crocodylian species distributed in freshwater environments of the Brazilian Atlantic Forest, where it inhabits many types of human-impacted and preserved habitats. Despite their ability to occupy ecologically different water bodies, little is known about their movement patterns and their habitat use. We investigated the variation in movements and space use of adult caimans relative to sex, body condition, and environmental conditions in northeastern Brazil. We conducted long-term capture surveys from 2013 to 2022 and used GPS telemetry from 2021-2022 (n=12 individuals) to assess movement patterns and home ranges of caimans and their habitat use based on Brownian Bridge Movement Modeling (BBMM) and Generalized Linear Mixed Modeling (GLMM). Females ranged farther from reservoir's forested margins, exploring a greater diversity of habitats during the wet/non-reproductive season. During the dry/reproductive season, females remained close to nesting sites within forest fragments. The body condition of caimans did not change significantly over the wet and dry season, indicating that resources are available year-round. Caimans moved more at night than during daytime, likely due to nocturnal foraging and possibly avoiding periods of increased human activity. Female movement rates were positively associated with rainfall, in a pattern likely linked to nest attendance in the dry season. Male movement was positively correlated with reservoir volume in the wet season, possibly due to increased availability of habitats in comparison to dry periods and to decreased overlap with territories controlled by other males. Home ranges estimated as 95% utilization distributions were relatively small in both sexes, averaging 0.64 km² (range: 0.001-1.4 km²), as were their core areas estimated as 50% utilization distributions, which averaged 0.12 km² (range: 0.0003-0.12 km²). Small core areas may indicate that caimans remain most of their time in a specific habitat, suggesting abundant resource availability or territoriality. Our work reveals the complexity of social interactions and how caimans select their habitats in a highly altered environment.

Venegas-Anaya, M., Cruz, G., Aguilar, M., Kruguer, C., Correa, J. and González-Jáuregui, M. (2024). Percepción de riesgo y conocimiento popular sobre los caimanes y cocodrilos (*Caiman crocodilus* y *Crocodylus acutus*) en diez comunidades riverleñas de la Provincia de Darién, Panamá. Pp. 181-187 in *Proceedings of 9th International Engineering, Sciences and Technology Conference (IESTEC)*, Panama City, Panama (doi: [10.1109/IESTEC62784.2024.10820306](https://doi.org/10.1109/IESTEC62784.2024.10820306)).

Abstract: Two species of the order Crocodylia inhabit Panama: *Caiman crocodilus fuscus* (spectacled caiman) and *Crocodylus acutus* (American crocodile). Over the past 20 years, many of these reptile populations have shown considerable recovery. The increasing population density and coexistence with humans in shared habitats present a conservation challenge, as human-crocodile conflicts tend to escalate. In Panama, specifically in the province of Darién, there are no official records on human-crocodile encounters. The lack of studies on residents' perception and knowledge regarding the ecology and biology of crocodiles and caimans impedes species conservation efforts. This research aims to qualitatively assess the level of knowledge and risk perception among inhabitants of ten communities in the Province of Darién, who regularly coexist with caimans and crocodiles. This was achieved through the on-site administration of a semistructured survey. During the dry season of 2023, 63 surveys were conducted among adult residents of both genders and various ethnicities in 10 locations. All respondents correctly identified the two species of crocodylians based on morphology; 75% were knowledgeable about

the habitats of each species; 88% were aware of their dietary habits, although 18% incorrectly mentioned that they feed on humans; only 40% knew the nesting habits of American crocodiles and caimans; 66% admitted to consuming caiman or American crocodile meat; 89% engage in daily activities within crocodile habitats; 55% reported personal experiences or heard of others encountering issues with American crocodiles or caimans, including five direct attacks on humans within the past five years.

Piras, I.M., Bezuidenhout, A., Díaz-Delgado, J., Slawski, D. and Kelly, P.A. (2024). Supplemental Materials: Pathology of "double scale" skin defect in farmed American alligators (*Alligator mississippiensis*) and the possible association with hepatic fibrosis. (<https://pdfs.semanticscholar.org/1000/9fc4604925b12e98df147214d9cbd590eb87.pdf>).

Tavares de Souza, M., Zocca, C., Barreto-Lima, A.F. and Barbosa Ferreira, R. (2024). Global distribution of crocodylians revealed by citizen scientists. *Herpetological Conservation and Biology* 19(3): 497-506.

Abstract: The conservation of crocodylians requires collaborative efforts on data collection, such as alliances between scientists and citizens. Citizen science emerges as an effective tool, engaging a larger audience than conventional scientific data collection methods. We compiled data of crocodylians recorded by citizen scientists through the iNaturalist platform on a global scale to evaluate the number of observations of crocodylians across families, genera, and species, geographic distribution and the number of observations and users of iNaturalist over time. The final dataset comprised 63,530 observations from 21,885 observers, documenting 27 crocodylian species from 9 genera and 3 families. Notably, the American alligator (*Alligator mississippiensis*; n= 40,473; 64%) and the American crocodile (*Crocodylus acutus*; n= 6209; 10%) had the highest number of observations. Regarding conservation status, 11 (41%) species are threatened with extinction according to the International Union for Conservation of Nature, with seven (26%) classified on the Red List as Critically Endangered (CR), one (4%) as Endangered (EN) and three (11%) as Vulnerable (VU). The dataset included observations from 87 countries, with the USA (n= 41,824; 66%) contributing the highest number of observations and Brazil and Colombia (n= 6 species; 22%, each) contributing the highest number of species. Temporal analysis revealed that the number of observations increased in 2016 (n= 2365) and reached a mean of 7758 observations per year from 2016 to 2022. Our study demonstrated that data derived from citizen scientists provides valuable insights into the spatial and temporal distribution of crocodylians globally.

Wen, Y., Lu, L., Li, C., You, F., Xu, Y., Nie, H. and Wu, X. (2024). Using lentiviral to investigate the effect of novel candidate gene MAEL identified by RNA-seq on sex differentiation in the Chinese alligator (*Alligator sinensis*). *Aquaculture Reports* 39 (<https://doi.org/10.1016/j.aqrep.2024.102528>).

Abstract: The sex differentiation of Chinese alligator displays temperature-dependent sex determination, which occurs in the temperature-sensitive period (TSP) of embryonic development. Despite studies identifying genes involved in sex determination in the Chinese alligator, the complex mechanisms underlying their role remain a scientific mystery awaiting further exploration. In this study, before and after sex differentiation, six sampling points, FPT (F1-F6) and MPT (M1-M6), were established to explore TSP, candidate genes for sex differentiation, and lentivirus validation. We discovered that F4-vs-F5 and M4-vs-M5 exhibited the highest number of differential genes, with distinctive morphological characteristics of oocytes and spermatotubules during the F5 and M5 stages, respectively. Consequently, we speculate that the TSPs are F4 and M4. Through RNA-seq analysis, we identified genes

potentially, such as MAEL, influencing sex differentiation and constructed lentivirus to explore its mechanism. LV-MAEL-shRNA and LV-MAEL-OE successfully invaded the gonads of Chinese alligator *in vitro* and *in vivo* experiments. knockdown of MAEL can reduce the male sex determining gene *Dmrt1* by about 70 %. These findings suggest that MAEL, acting as a transcription factor, may play a role in sex determination by regulating *Dmrt1*. This study advances understanding of sex determination in Chinese alligator, establishing a foundation for future research.

Coelho, M.C. and Poça da Silva, J.B. (2024). The alligator battles on Mexiana Island by Gottfried Hagmann. *Boletim do Museu Paraense Emílio Goeldi. Ciências Humanas* 19(3): e20230098.

Abstract: This work presents an unpublished report in Portuguese authored by Gottfried Hagmann about alligator hunting on Mexiana Island, published while he was a zoologist at the Goeldi Museum. Hagmann accompanied by Joseph Schönmann and Manoel de Pinto Lima Guedes, respectively, the zoology preparator, and the botany preparator of the same institution, conducted an expedition to Mexiana island for three months throughout 1901. The travel memoirs resulting from the expedition, provides us details of the brutal alligator hunting on Mexiana Island, revealing the techniques, culture and knowledge of the local inhabitants. At the same time, this document allows us to understand the author's conceptions and contradictions regarding the conservation of Amazonian fauna.

As batalhas com jacarés na ilha de Mexiana, por Gottfried Hagmann

Resumo: Este trabalho apresenta um relato inédito em português de Gottfried Hagmann sobre a caça de jacarés na ilha de Mexiana, publicado quando era auxiliar de zoologia do então Museu Goeldi. Hagmann, acompanhado de Joseph Schönmann e de Manoel de Pinto Lima Guedes, respectivamente, preparador da seção de zoologia e preparador de botânica da mesma instituição, realizou uma expedição pela mencionada ilha durante três meses, ao longo de 1901. A memória de viagem, fruto dessa expedição, oferece-nos detalhes da brutal caçada aos jacarés na ilha de Mexiana, revelando as técnicas, a cultura e o conhecimento dos habitantes locais. Ao mesmo tempo, esse documento permite-nos compreender as concepções e contradições do autor sobre a conservação da fauna amazônica.

Castillo-Peñarredonda, C.J., Tovar-Márquez, J. and Diaz-Perez, J. (2024). Land-cover changes affect the diversity of amphibians and reptiles in a rural landscape of the Colombian Caribbean region. *Acta Zoologica Mexicana* 40 (<https://doi.org/10.21829/azm.2024.4012611>).

Abstract: Land cover changes resulting from agricultural expansion and cattle ranching are the primary factors influencing the diversity of amphibian and reptile communities. In this study, we assessed the variation in the diversity of amphibians and reptiles across four land-cover types (ponds, grasslands, temporary crops, and secondary vegetation) in a rural landscape in the Colombian Caribbean region. Amphibians and reptiles were sampled through visual encounter surveys between April and August 2018. A total of 19 species of amphibians (frogs and toads) and 23 species of reptiles (14 lizards, 7 snakes, 1 turtle, and 1 alligator) were recorded. Species diversity differed among land covers, for both amphibians and reptiles. Amphibian diversity was higher in ponds and lower in grasslands, whereas reptile diversity was higher in secondary vegetation and lower in temporary crops. Our results suggest that the maintenance of ponds and secondary vegetation could be important for the conservation of herpetofauna in rural landscapes where anthropogenic activities such as agriculture and cattle ranching predominate.

Resumen: Los cambios en la cobertura del suelo debido a la expansión agrícola y ganadera son las principales causas que influyen

en la diversidad de las comunidades de anfibios y reptiles. En este estudio, evaluamos la variación de la diversidad de anfibios y reptiles en cuatro tipos de cobertura del suelo (jagüeyes, pastizales, cultivos transitorios y vegetación secundaria) en un paisaje rural de la región Caribe colombiana. Los anfibios y reptiles fueron muestreados a través del método de relevamiento por encuentros visuales entre abril y agosto de 2018. Se registró un total de 19 especies de anfibios (ranas y sapos) y 23 especies de reptiles (14 lagartos, 7 serpientes, 1 tortuga y 1 caimán). La diversidad de especies difirió entre las coberturas del suelo, tanto para anfibios como para reptiles. La diversidad de anfibios fue mayor en los jagüeyes y menor en los pastizales, mientras que la de reptiles fue mayor en la vegetación secundaria y menor en los cultivos transitorios. Nuestros resultados sugieren que el mantenimiento de jagüeyes y vegetación secundaria podría ser importante para la conservación de la herpetofauna en paisajes rurales donde predominan actividades antropogénicas como la agricultura y la ganadería.

Meaza, I., Williams, A.R., Wise, S.S., Lu, H. and Pierce, J.W. (2024). Carcinogenic mechanisms of hexavalent chromium: From DNA breaks to chromosome instability and neoplastic transformation. *Current Environmental Health Reports* 11: 484-546.

Abstract: Hexavalent chromium [Cr(VI)] is a well-established human carcinogen, yet the mechanisms by which it leads to carcinogenic outcomes is still unclear. As a driving factor in its carcinogenic mechanism, Cr(VI) causes DNA double strand breaks and break-repair deficiency, leading to the development of chromosome instability. Therefore, the aim of this review is to discuss studies assessing Cr(VI)-induced DNA double strand breaks, chromosome damage and instability, and neoplastic transformation including cell culture, experimental animal, human pathology and epidemiology studies. Recent findings confirm Cr(VI) induces DNA double strand breaks, chromosome instability and neoplastic transformation in exposed cells, animals and humans, emphasizing these outcomes as key steps in the mechanism of Cr(VI) carcinogenesis. Moreover, recent findings suggest chromosome instability is a key phenotype in Cr(VI)-neoplastically transformed clones and is an inheritable and persistent phenotype in exposed cells, once more suggesting chromosome instability as central in the carcinogenic mechanism. Although limited, some studies have demonstrated DNA damage and epigenetic modulation are also key outcomes in biopsies from chromate workers that developed lung cancer. Additionally, we also summarized new studies showing Cr(VI) causes genotoxic and clastogenic effects in cells from wildlife, such as sea turtles, whales, and alligators. Overall, across the literature, it is clear that Cr(VI) causes neoplastic transformation and lung cancer. Many studies measured Cr(VI)-induced increases in DNA double strand breaks, the most lethal type of breaks clearly showing that Cr(VI) is genotoxic. Unrepaired or inaccurately repaired breaks lead to the development of chromosome instability, which is a common phenotype in Cr(VI) exposed cells, animals, and humans. Indeed, many studies show Cr(VI) induces both structural and numerical chromosome instability. Overall, the large body of literature strongly supports the conclusion that Cr(VI) causes DNA double strand breaks, inhibits DNA repair and chromosome instability, which are key to the development of Cr(VI)-induced cell transformation.

Laitman, J.T. and Smith, H.F. (2025). Nothing “pseudo” about the Pseudosuchia - members of this extraordinary clade thunder again into the pages of *The Anatomical Record*. *The Anatomical Record* 2025 ([doi: 10.1002/ar.25615](https://doi.org/10.1002/ar.25615)).

Gao, Z., Guo, Y., Sun, S., Guan, X., Zhang, Y., Yun, Z., Yang, Y., Sun, J., Ren, H. and Gao, H. (2025). Tough trilayer composite hydrogel inspired by crocodile skin structure for flexible sensors. *ACS Applied Polymer Materials* 7(1): 175-186.

Abstract: As a high-performance polymer material, conductive

hydrogels are widely employed in the fields of motion monitoring, electronic skin, and energy storage devices, which rely on flexible materials, including hydrogel, elastomer, and composite hydrogel. However, preparing a composite hydrogel with excellent mechanical properties is a great challenge. Inspired by the structure of crocodile skin, a trilayer structure conductive composite hydrogel was prepared. The three layers were Ecoflex elastomer, poly(acrylamide-2-hydroxyethyl methacrylate) (PAAm-HEMA) hydrogel, and graphene/2-hydroxyethyl methacrylate (G/PHEMA) hydrogel, respectively. Covalent bonds were generated by a photochemical reaction between elastomer Eco and the P(AAm-HEMA) hydrogel. Covalent bonds were also formed between the P(AAm-HEMA) hydrogel and G/PHEMA hydrogel by the chemical reaction of N,N'-methylenebis(2-propanamide), which worked as cross-linking agent; hydrogen bonding between these two hydrogels also formed. These physical and chemical interactions provided firm bonding between the layers and prevented interlayer slippage under an external force. The G/PHEMA-P(AAm-HEMA)-Eco composite hydrogel possessed high fracture stress and elongation at break of up to 2.1 MPa and 1305%, respectively. The conductivity of 0.028 S/m was attributed to the incorporation of graphene in the network of the G/PHEMA hydrogel. Based on the excellent mechanical properties and electrical conductivity, this composite hydrogel was applied as a flexible sensor to detect human motion signals. These results indicate that the trilayer G/PHEMA-P(AAm-HEMA)-Eco composite hydrogel represents a promising material, paving the way for innovative applications in next-generation flexible electronic devices.

Fukuda, Y. (2024). Understanding the Movement and Dispersal of Saltwater Crocodiles (*Crocodylus porosus*) within and around Australia. PhD thesis, The Australian National University, Canberra, ACT, Australia.

Abstract: Human-crocodile conflict (HCC) is becoming a conservation challenge worldwide. The saltwater crocodile (*Crocodylus porosus*) is the largest (>6 m total length, >1000kg) and most aggressive living crocodylian species, being responsible for increasing attacks on people and domestic animals in many countries. This species is highly adapted to both freshwater and saline environments and is widely distributed in the Indo-Pacific region. However, their complex movement and dispersal patterns remain largely unknown. In the first chapter, we examined the spatial events implicated in the homing ability of crocodiles that complicate management interventions aimed at reducing HCC. Five large male crocodiles were shifted and released 100-320 km from their capture sites, and three additional ones were released at their capture sites as controls. Translocated crocodiles were more mobile than the controls and moved at sea in the direction of their original capture site. However, they were unable or unwilling to swim around a geographic structure, the Cobourg Peninsula, which prevented homing from being achieved in all five cases. Genetic analysis of tissue samples from nests demonstrated significant genetic structure across the coast and confirmed that the Cobourg Peninsula contributes to genetic differentiation among populations along the coast. The second chapter demonstrated environmental influences on crocodiles' dispersal, which comprised emigration, movement and settlement. We found that both environmental resistance and properties of the source and destination catchments (ie the proportion of breeding habitat which limits carrying capacity) were important factors influencing observed dispersal events. Competition for habitat influences emigration and settlement choices, and environmental resistance to movement occurred, in which high-quality habitat was associated with the greatest environmental permeability. Approximately 42% of crocodiles were migrants from populations other than their sampling locations, and some outstandingly productive populations such as the Goyder River (Arafura Swamp) had a much higher proportion of emigration than immigration. The distance most commonly travelled between source and destination was 150-200 km, although a few travelled much longer distances (600-700 km). The third chapter identified the natal origins of 95

crocodiles caught as problem animals in Darwin Harbour, where habitats suitable for breeding are extremely limited. Population assignments showed most crocodiles came from populations within 200 km, namely the Adelaide and Mary Rivers and Kakadu region as the most significant source (approximately 50%), the Daly, Finnis and Reynolds Rivers as the second (approximately 30%), and Tiwi Islands as the third (approximately 15%). Attributes such as their total length (most commonly 150-180 cm), sex (75% male), and the year of capture (2015-2017) were not significantly correlated to the distance that they travelled to the harbour. Given that most crocodiles found in Darwin Harbour are migrants from multiple sources, we argue that adaptive measures such as removing crocodiles in the defined management zones may be more efficient at reducing risk to public safety than more proactive approaches, such as interfering with populations at the targeted source. The last chapter measured the population structure of crocodiles in Australia and its neighbouring countries. The analyses showed that populations can be separated at the broadest level into Oceania (Australia and New Guinea) and Southeast Asia (Borneo, Java, Peninsular Malaysia, Mindanao, and Sumatra), broadly aligned with Sunda and Sahul shelves of the Last Glacial Maximum. Results suggested that the genetic structure was affected by barriers such as deep straits and high mountains that effectively isolated the populations. We found no genetic evidence of gene flow between Australia and Timor-Leste, which has been posited as a possible explanation for apparently increasing crocodile attacks in Timor-Leste, probably due to the Timor Sea and the strong Indonesian Throughflow. For a more comprehensive mapping of the genetic connectivity across the range, more extensive sampling will be required. The findings from this study shed light on a better understanding of the movement of crocodiles and provided implications for HCC management in Australia and other countries.

Samuel, V.D., Jeevamani, J.J.J., Fukuda, Y., Muruganandam, R., Biswal, M., Ramesh, R. and Purvaja, R. (2025). Managing the recovering saltwater crocodile population in a marine protected area with human-wildlife conflict: A population viability analysis approach. *Journal for Nature Conservation* 84 (<https://doi.org/10.1016/j.jnc.2024.126812>).

Abstract: Prioritizing species recovery and conservation, as well as effective management of human-wildlife conflicts is essential for reducing biodiversity threats. The saltwater crocodile (SWC) is recovering from the brink of extinction in Bhitarkanika Wildlife Sanctuary (BWLS), India and simultaneously human-crocodile conflict is on the rise. Appropriate management measures are needed for the SWC population's long-term sustainability and to alleviate the conflict. We investigated how the SWC population in the sanctuary: behaves in the presence/absence of an ongoing species recovery strategy; and responds to changes in specific demographic and environmental parameters using population viability analysis (PVA). Population growth for the next 100 years (up to the year 2121) under various scenarios was determined and plotted. The PVA simulations on the baseline condition revealed that the SWC population is growing, with no risk of extinction in the next 100 years. The current growth rate was calculated to be 9.37% ($r = 0.0937$) in the absence of stochastic events and 9.93% ($r = 0.0993$) when considering stochastic processes. Even though there is no chance of extinction in the absence of supplementation, the population size may fall below current levels in the next 100 years, underscoring the importance of a long-term supplementing strategy. The habitat's projected carrying capacity (K) may support 1813 SWC (marginally higher than the current population size in 2021 ie 1768 SWC) with an intrinsic growth rate of 0.1756, ensuring conflict levels remain at their current levels. This K value in BWLS may be attributed to the limited availability of potential habitats. The conservation and expansion of SWC-friendly habitats, along with conflict mitigation strategies and ongoing reintroduction programs, appear promising for preserving and maintaining SWC population in the sanctuary.

Panades, X., Galobart, A., Archer, M., Hand, S. and Selles, A. (2024). Australia's oldest crocodile eggshells. *Zubia* 42: 161-166.

Abstract: Mekosuchine crocodiles were a significant clade of endemic predators from Australia during the Cenozoic. Despite there is an abundant skeletal fossil record of this group, there has been no fossil evidence relating to their reproductive biology. Here, we describe Australia's oldest crocodylian eggshells from the early Eocene Tingamarra Local Fauna from Murgon (Australia). These eggshells are tentatively attributed to the genus *Kambara*, copious in the Tingamarra deposits and being the only crocodylian genus described in the area.

Baltazar, C.J., Gamalinda, E., Galolo, A.R., Ombat, L., Baltazar, P., Magallanes, F. and Manalo, R. (2024). Diet analysis of Philippine crocodile *Crocodylus mindorensis* (Schmidt 1935) in Paghungawan Marsh, Barangay Jaboy Pilar, Surigao del Norte, Philippines. *Journal of Ecosystem Science and Eco-Governance* 6(2): 12-21.

Abstract: Siargao Islands in Surigao del Norte have not been part of the historical range of the Philippine Crocodile (*Crocodylus mindorensis*). However, 36 juvenile F2 progeny of this species were successfully introduced in Paghungawan Marsh in 2013, with a supplemental release of 8 yearlings and 21 juvenile crocodiles in 2017. To supplement the current knowledge of this species' biology with essential information on its success in thriving Paghungawan Marsh since its introduction, a study on the diet analysis of this crocodile species was conducted in the area. Through stomach flushing of three *C. mindorensis* individuals captured in the study area, the stomach contents were collected and grouped into four categories: vertebrates (50%), invertebrates (33.33%), inorganic and organic materials (12%), and plant materials (5%). Diet of the three *C. mindorensis* individuals showed food items that vary from Cichliformes (40%), Architaenioglossa (11.67%), Chiroptera (10%), Coleoptera (5%), Decapoda (8.33%), and Hymenoptera (8.33%) which indicates that fishes are their dominant prey. These findings suggest that *C. mindorensis* is a generalist species and seemingly opportunistic. Their diet reflects habitat variability and the available prey items of the established stations. This study highlighted the adaptive capacities of *C. mindorensis* and suggests that if protected and with sufficient prey availability, the population of this endangered species will recover. More dietary composition studies should be done to understand better how this species participates in varied communities.

Kobayashi, H., Chambaro, H., Tabata, K., Ariizumi, T., Phongphaew, W., Ndashe, K., Ndebe, J., Fandamu, P., Kobayashi, S., Ito, N., Sasaki, M., Hang'ombe, B.M., Simulundu, E., Orba, Y. and Sawa, H. (2024). African lineage 1a West Nile virus isolated from crocodiles exhibits low neuroinvasiveness in mice. *Journal of General Virology* 105 (doi 10.1099/jgv.0.002051).

Abstract: West Nile virus (WNV) is a mosquito-borne flavivirus that causes encephalitis in humans and infects crocodiles, resulting in rashes and neurological signs. In Zambia, two distinct lineages of WNV have been detected in neighbouring areas: lineage 2 in mosquitoes and lineage 1a in farmed crocodiles. Considering the risk of direct or vector-mediated WNV transmission from crocodiles to mammals, it is necessary to elucidate the pathogenicity of WNV strains derived from crocodiles. In this study, WNV was successfully isolated from naturally infected farmed crocodiles (Croc110/2019/1/ZM, Croc110). We then investigated its proliferation and pathogenicity in mice in comparison with a WNV isolate from mosquitoes in Zambia (Zmq16) and two reference strains, including one highly pathogenic (NY99) and one low pathogenic (Eg101) strain. Although viral proliferation in Vero and mammalian neuronal cells was comparable among the strains, Croc110 exhibited low cell-to-cell transmission efficiency. *In vivo*, more than 70% of mice (C57BL/6) intracerebrally inoculated with Croc110 displayed neurological signs, and Croc110-infected mice exhibited similarly

high mortality rates as NY99- and Zmq16-infected mice. Meanwhile, comparable virus growth was observed among the strains in the brain. However, the virulence of Croc110 was significantly lower than that of Zmq16 and NY99 following intradermal (ID) and intraperitoneal inoculation. Consistently, Croc110 displayed lower growth than Zmq16 and NY99 in the brain and peripheral tissues after ID inoculation. Our study revealed that the crocodile-derived WNV strain is less neuroinvasive in mice, and it exhibits distinct pathogenicity from the highly pathogenic mosquito-derived WNV strain circulating in Zambia.

Cedillo-Leal, C.N., Barrios-Quiroz, G. and Padilla-Paz, S.E. (2024). Management of non-fatal human-crocodile interactions with *Crocodylus moreletii* in the Laguna del Carpintero, Tampico, Mexico. *ARPHA Preprints* (<https://doi.org/10.3897/arphapreprints.e142593>).

Abstract: Human-crocodile interaction in the Laguna del Carpintero, Tampico, Tamaulipas, Mexico has been a growing concern for the last several years, with homeless people being the most affected in recent years, however, productive people have also been involved. The objective of this document is to describe in detail a case of non-fatal human-crocodile interaction in this lagoon and the response of the SOS Crocodile Tampico working group. To document the case, we collected information on the interaction, the causative crocodile and the affected person. On 8 June 2024, a male person was involved in a non-fatal interaction with a 278 cm long crocodile, which caused a fracture in his left leg, requiring him to be transported to the nearest hospital. This event activated the first response team who provided pre-hospital and hospital care; search and capture of the crocodile involved, as well as the custody, handling and final disposal of the crocodile into captivity. Therefore, we consider that inter-institutional coordination between federal, state, municipal, health and crocodile specialists, integrated as the SOS Crocodile working group, is fundamental to rapidly and efficiently attend the interactions with crocodiles in urban areas.

Pittinger, D., Rogers, G., Reichard-Flynn, W.R., Simpson, E.L., Wizevich, M.C., Keebler, A.M. and Evans, S. (2024). Recognizing primary palaeotopography utilizing ichnofossils and 3D models: Mill Canyon Dinosaur Tracksite, Utah. *Geological Society, London, Special Publications* 556 (<https://doi.org/10.1144/SP556-2024-1>).

Abstract: Preservation and recognition of primary palaeotopography along a bedding surface is often a neglected component in palaeogeographic reconstruction. The Mill Canyon Dinosaur Tracksite (MCDDT) is a spectacular bedding plane exposure with a diverse assemblage of vertebrate ichnofauna. Small-scale 3D photogrammetric and ichnofossil analyses of two areas on the periphery of the MCDDT surface demonstrate the presence of preserved primary palaeotopography. The first area consists of a palaeotopographic bench that drops off to a minimum of c. 0.5-0.6 m. On this bench is at least one resting trace analogous to modern traces of crocodiles documented from topographic highs along rivers and lakes. At the second locality, systematic variations in track morphology indicate that the trackmaker gait was influenced by changes in surface elevation with movement across the ridge, thus affirming that palaeorelief is preserved. The ichnofossils on this Cretaceous bedding surface likely represent months- to years-worth of biological activity.

Qayyum, M., Dharmamony, V., Manoharakrishnan, M., Sindura, S., Sethy, J. and Chatakonda, M.K. (2024). Insights into human-wildlife interactions and community views on mangrove restoration in Kendrapada District, Odisha, India. *Journal of Threatened Taxa* 16(10): 25951-25961.

Abstract: This paper evaluates interactions between humans, Wild Boars, and crocodiles in mangrove ecosystems of the villages of

Benakanda, Bhateni, and South Jambu in Mahakalapada Block in the Kendrapada District of the Indian state of Odisha, using questionnaire surveys. This is an area where mangrove restoration is currently in progress. Using a targeted sampling procedure, 280 respondents representing 14% of the population participated in the study. The results show that negative perceptions differ throughout villages, with a majority of respondents reporting interaction between humans and animals in Bhateni (91%) and South Jambu (98%). The most frequent animal reported to cause harm to crop and livelihoods is Wild Boar (44%). Communities understand the value of mangrove restoration despite facing obstacles brought on by interactions with wildlife. The vast majority of residents (87%) believe that restoration efforts were necessary, and many had taken part in these by themselves, or in conjunction with other communities.

Olunusi, B.O. (2024). Wildlife trade dynamics: exploring bushmeat market with a view toward social and ecological justice in Ibadan Metropolis Nigeria. *Frontiers of Conservation Science* 5: 1401308.

Abstract: This study examines the bushmeat trade in Ibadan Metropolis, Nigeria, through the lens of environmental justice, focusing on sustainable livelihoods and wildlife conservation. Environmental justice in this context seeks to ensure fair economic opportunities for bushmeat marketers, predominantly women (93%), while protecting vulnerable wildlife species. The surveyed marketers - 90% of whom were married - face social inequalities, with only 50% having secondary education and 10% lacking formal education. Most marketers sell bushmeat to household consumers and travelers, raising concerns about the potential spillover of wildlife products beyond Nigeria's borders, with implications for conservation and zoonotic disease risks. ANOVA results show that greater experience leads to higher profits from species like grasscutter (*Thryonomys swinderianus*; $P=0.005$) and Nile monitor lizard (*Varanus niloticus*; $P=0.001$). As key species such as West African crocodile (*Crocodylus suchus*), African leopard (*Panthera pardus*), and ground pangolin (*Manis temminckii*) decline in availability in traditional hunting grounds, this study emphasizes the urgent need for conservation policies that promote sustainable trade practices and provide alternative livelihoods. These strategies would advance the science of environmental justice by reducing pressure on wildlife (ecological justice) while ensuring stable incomes for marketers (social justice).

Battal, Ö., Acar, M., and Uzun, M. (2025). Fashionable sustainable leather. *Journal of Art, Design and Music* 4(1): Article 10.

Abstract: In recent years, there has been a growing interest in the leather industry towards sustainable and innovative alternatives to traditional leather production methods. Alongside this trend, efforts have been made to reduce environmental damage by focusing on natural tanning methods in the production of natural leather, thus adopting more sustainable production techniques. Alternative materials such as apple leather, pineapple leather, banana leather, cactus leather, bacterial cellulose leather and cork leather have emerged as viable options in response to this shift. Additionally, there has been notable development in exotic leather alternatives, with materials like crocodile, puffer fish, and ostrich leather taking the forefront. These exotic leather options not only offer alternatives but also aim to fulfill specific purposes such as habitat conservation, particularly evident in the case of puffer fish leather production. The aim is not only to provide alternative materials but also to ensure environmental sustainability and ethical practices throughout the production process. This article delves into the description of alternative leather options while also providing an analysis of the life cycle of leather. It aims to underscore the importance of discovering innovative and sustainable leather alternatives in reducing the environmental footprint of the leather industry. By considering various materials and utilizing tools such as Life Cycle Assessment (LCA), stakeholders can work towards a more sustainable and

ethical future for leather production.

Arriaga-Mayorga, A., Castelblanco-Martínez, D.N., Aguilera-Miranda, I.D., Velarde-Lemus, J., Niño-Torres, C.A., Blanco-Parra, M.P., Charruau, P. and Islas-Villanueva, V. (2024). Romeo and Juliet: a forbidden love story? A review of hybridization in keystone, aquatic megafauna. *Animal Biodiversity and Conservation* 47.2: 209-225.

Abstract: Hybridization, understood here as the sexual reproduction between individuals of different species, is relatively common in riverine, estuarine, and marine environments. Investigating hybridization in wild populations of aquatic megafauna species provides important insight into their biology, evolution, and conservation. Here, we conducted an extensive and systematic review of published reports of hybrids in keystone, aquatic megafauna, aiming to provide a clear summary of state-of-the-art and hybridization trends in this group. We selected 129 journal articles reporting 80 hybrids in aquatic megafauna. We included mammals (40.3%), turtles (33.3%), crocodylians (17.8%), and elasmobranchs (8.5%) that are widely distributed in oceans and continental waters. Our results showed a clear increase in reports of hybrids involving aquatic megafauna in recent years, possibly reflecting the improvement in molecular techniques. However, this increase could also be a consequence of translocation of organisms and habitat modification by humans, and may have a critical impact on conservation, particularly regarding already depleted populations. Hybridization has directly or indirectly facilitated the extinction of many species, but it has also played a crucial role in the evolution and adaptation of many others. To determine whether hybridization is a natural effect or a collateral effect of anthropic pressures we need to understand its implications on the conservation of aquatic megafauna.

Resumen: La hibridación, entendida aquí como la reproducción sexual entre individuos de diferentes especies, es relativamente común en ambientes fluviales, estuarinos y marinos. El estudio de la hibridación en poblaciones silvestres de especies de megafauna acuática aporta importantes conocimientos sobre su biología, evolución y conservación. Aquí, llevamos a cabo una revisión extensa y sistemática de los informes publicados sobre híbridos en megafauna acuática clave, con el objetivo de proporcionar un resumen claro de la situación actual y las tendencias de la hibridación en este grupo. Seleccionamos 129 artículos de revistas que informan sobre la detección de 80 híbridos en megafauna acuática entre los que se incluyen mamíferos acuáticos (40,3%), tortugas (33,3%), cocodrilos (17,8%) y elasmobrancos (8,5%) que estaban ampliamente distribuidos en océanos y aguas continentales. Nuestros resultados muestran un claro aumento de reportes híbridos en megafauna acuática durante los últimos años, lo cual puede ser un reflejo de los avances en las técnicas moleculares. Sin embargo, esto también puede ser una consecuencia de la translocación de organismos y la modificación del hábitat por parte de los seres humanos y puede tener un impacto crítico en la conservación, especialmente de las poblaciones que ya están empobrecidas. La hibridación ha facilitado directa o indirectamente la extinción de muchas especies, pero también ha desempeñado un papel crucial en la evolución y adaptación de muchas otras. Es necesario determinar si la hibridación en este grupo es natural o un efecto colateral de las presiones antrópicas para comprender sus implicaciones en la conservación de la megafauna acuática.

Dutton, H.R., Bullard, S.A., Brule, J.H. and Kelly, A.M. (2024). Redescription of *Dracovermis occidentalis* (Digenea: Liolopidae) infecting American alligator, *Alligator mississippiensis* from the Bon-Secour River (Mobile-Tensaw River Delta, Alabama, USA) and a revised phylogeny for Liolopidae. *Parasitology Research* 123(326) (<https://doi.org/10.1007/s00436-024-08339-2>).

Abstract: We examined several American alligators, *Alligator*

mississippiensis (Daudin, 1802) (Crocodylia: Alligatoridae) from Louisiana, Alabama, and South Carolina in August 2022. The intestine of one alligator from Alabama was infected by *Dracovermis occidentalis* Brooks and Overstreet, 1978 (Platyhelminthes: Digenea: Liolopidae Odhner, 1912), a seldom collected and incompletely described trematode that lacks a representative nucleotide sequence. Liolopidae comprises 5 genera and 15 species: *Liolope* spp. infect giant salamanders; *Helicotrema* spp. infect turtles and lizards; *Harmotrema* spp. infect snakes; *Paraharmotrema* spp. infect turtles; and *Dracovermis* spp. infect crocodylians. Based on our study of the newly collected specimens and the holotype of *D. occidentalis*, we redescribe *D. occidentalis*, correct errors in its original description, and provide an updated phylogeny for Liolopidae that, for the first time, includes *Dracovermis* Brooks and Overstreet, 1978. Our specimens were identified as *D. occidentalis* by having testes in the posterior 1/3 of the body, a pretesticular cirrus sac, a spined and eversible cirrus, a bipartite seminal vesicle, and a post-acetabular vitellarium. A phylogenetic analysis of the D1-D3 domains of the nuclear large subunit ribosomal DNA (28S) recovered Liolopidae as monophyletic; however, low taxon sampling in the group precludes hypothesis-testing about liolopid-vertebrate cophyly. This is the first collection for morphological study of the type species for *Dracovermis* since the genus was proposed 46 years ago, the first record of a liolopid from Alabama, and the first phylogenetic analysis that includes *Dracovermis*.

Yeong, W.Y., Martelli, P., Chung, T.Y.T., Tsui, H.C.L., Gerussi, T. and Kot, B.C.W. (2024). Ultrasonographic technique and appearance of the coelomic organs in crocodylians. *Frontiers in Marine Science* 11: 1423721.

Abstract: Crocodylians have significant ecological, conservational, and economic roles. They are also commonly raised for commercial purposes and kept as zoological specimens. Although ultrasonography has been used in zoological contexts for health assessments of crocodylians, published studies on a detailed ultrasonography protocol and ultrasonographic anatomy are lacking. This study aimed to establish a standardized ultrasonography protocol and pictorial reference of the ultrasonographic appearances of the coelomic organs of crocodylians. A total of 7 crocodylians comprising 4 different species were included in this study. The crocodylians were manually restrained and underwent a non-contrasted and contrasted computed tomography (CT) scan, followed by an ultrasonography (USG) examination. Ultrasound fusion imaging technique enabled greater confidence in establishing a clear organ localization and correlation between modalities by visualizing the same anatomy from the same view angle. The heart, caudal vena cava, liver, fat body (steatotheca), spleen, stomach, duodenal loops, pancreas, kidneys, testes, ovaries and cloaca were visualized in all species. Longitudinal and transverse images of the coelomic structures were acquired when possible. The ultrasonographic characteristics of the coelomic organs, including transducer positioning, acoustic window and approach, shape, size, marginations, and echo pattern were documented. The findings of this study provided a useful ultrasonographic protocol and anatomical reference of the coelomic organs in crocodylians. Invaluable insights into the practicality and adequacy of ultrasonography in evaluating the coelomic structures of crocodylians as part of health assessment and disease diagnosis were also discussed.

Vetere, A., Capasso, M. and Di Ianni, F. (2025). Sex determination in reptiles: A review. *Animals* 15(2): 168 (<https://doi.org/10.3390/ani15020168>).

Abstract: Reptile biodiversity is rapidly declining, with over 11,733 recognized species across 1226 genera being documented, many of which are endangered. Captive breeding programs play a crucial role in conservation; however, effective management requires accurate sex determination, especially due to the fact that many reptile species exhibit minimal or no sexual dimorphism. When present, sexual

dimorphism manifests as differences such as size, coloration, and morphological features influenced by evolutionary pressures and hormones. Various sex determination techniques are employed due to the lack of external sexual characteristics in many species. These methods include probing, hydrostatic eversion, popping, ultrasound, CT, radiography, contrast radiography, endoscopy, and genotypic sex determination. Accurate sex determination is crucial for the success of captive breeding programs and the conservation of reptile species. Advanced imaging and molecular methods offer promising non-invasive alternatives but may not be universally accessible or effective. An understanding of the unique reproductive anatomy and the use of appropriate sexing techniques are fundamental to establishing breeding groups, preventing aggressive behaviours among groups, and ensuring the long-term survival of endangered reptile populations.

Kabir, A. (2024). Chinese alligator (*Alligator sinensis*) (Fauvel, 1879) (Reptilia: Alligatoridae): Captive breeding as well as its rehabilitation. *International Journal of Research Studies in Zoology* 8(2): 4-6.

Abstract: Captive breeding could be the best option to increase the number of Chinese alligator (*Alligator sinensis*). To visit Beijing Zoo of China, and after getting information on its availability, this urgency came to write this scientific composition. Adequate data on this alligator enhanced to make a review on its captive breeding and rehabilitation for their sustenance in wild. The number of Chinese alligators were increased from 1985 to 1994 (from 735 to 740 individuals). At present their number has been slightly increased (114 plus) than the year 2005.

Mascarenhas-Junior, P.B., de Araújo, C.B.B. and de M. Silva-Junior, E.N. (2025). Predation of non-native Nile Tilapia, *Oreochromis niloticus* (Linnaeus, 1758), by an adult Broad-snouted caiman, *Caiman latirostris* (Daudin, 1801), in an urban stream in northeastern Brazil. *Herpetology Notes* 18: 1-4.

Honegger, R.E. (2024). Das verschollene “Memorandum zum Internationalen Schutz für Krokodile” von 1956 - Eine unbefriedigende Spurensuche. *Sekretar* 24(2): 21-50.

[Editor’s translation of title: The lost “Memorandum on the International Protection of Crocodiles” from 1956 - an unsatisfactory search for clues].

Abstract: In 1955, Friedrich Johann Graf von Medem published a report on the worrying status of crocodile populations in his home of choice, the country of Colombia. Heinz Wermuth at the Zoological Museum in Berlin was so alarmed by this well-founded analysis of the systematic overexploitation of crocodiles that he sent it to Paulus Edward Pieris Deraniyagala at the National Museums in Colombo, Sri Lanka, for translation into English. At the same time, he asked Deraniyagala to support him in formulating a petition for the International Protection of Crocodiles at the International Union for the Protection of Nature (IUPN), based in Brussels. Wermuth was also able to convince Robert Mertens of the Senckenberg Museum in Frankfurt to support his idea. Together they formulated the “Reference to the Urgency of the Protection of Crocodiles throughout the World, 1956” (the memorandum). Heinz Wermuth took over the worldwide mailing to around 180 herpetologists and leading personalities, 140 of whom signed it. Considering the world situation at this time only ten years after World War Two, this was an extremely unique and remarkable international demonstration of solidarity for species conservation in general and the conservation of crocodiles in particular. For some inexplicable reason, the petition did not reach the IUPN or was not welcomed. The IUPN’s efforts at this time primarily aimed at protecting mammals and birds, and landscapes. Endangered amphibians and

reptiles (in the Mediterranean region) were first mentioned in 1959. In 1965, the drafts for eleven data sheets of reptiles, including a single crocodylian (but no amphibian species) were available for the IUCN Red Data Book “Amphibia-Reptilia.” In 1968 and 1970, revised versions were published in ring binder format for easy updating, and 1982 as a book, containing detailed data on threatened species, including several crocodiles. In contrast to the conservationists and museum zoologists interested in crocodile protection, the European leather industry already had detailed morphologic data on crocodile leather as a luxury product before 1968. The leather industry was concerned about the uncontrolled exploitation of the crocodile populations. After 1971, and under the leadership of the IUCN-SSC Crocodile Specialist Group, conservation organizations worldwide developed a better understanding of crocodiles and their protection. Experience with the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has shown that the exploitation of wild populations of crocodiles, combined with strict controls, promotes conservation efforts and has even led to a recovery. Through legal trade, money for conservation measures becomes available and illegal trade is no longer a major threat. The animals are no longer seen as “pests” or competitors, but rather as valuable resources. A result that the four authors of the 1956 petition could not have wished for better. After the individual crocodile populations had recovered, the tourism industry also began to take an interest in crocodiles, similar as for the “Big Five” in Africa. However, human activities in crocodile habitats also lead to conflicts (eg with the American Crocodile, *Crocodylus acutus*, in Costa Rica). In addition, the increasing pollution of water bodies by environmental toxins threatens these long-living armored creatures.

Kaushik, P. and Khurana, S. (2024). Enhanced classification of reptiles and amphibians using deep learning: A comparative analysis of model performance. Pp. 705-709 in 2024 International Conference on Cybernation and Computation (doi: [10.1109/CYBERCOM63683.2024.10803131](https://doi.org/10.1109/CYBERCOM63683.2024.10803131)).

Abstract: Reptiles and amphibians play a very imperative role in the maintenance of balance within ecosystems, given that they play dual roles: as predators and as prey, aside from being indicators of environmental stability. In this paper, researchers present a classification study using convolutional neural networks and transfer learning to identify different species of reptiles and amphibians, focusing on their ecological functions. Advanced deep learning techniques are applied to greatly improve the accuracy and efficiency of image-based species identification against these challenges due to the various appearances and subtle variations among these animals. The constructed classification model reached an accuracy of 84% for all rounds, with Crocodile-Alligators and Turtle-Tortoises performing at their best and hitting precision scores of 0.95 and 0.96, respectively. Conversely, the poorest were Chameleons and Geckos, which obtained 0.76 and 0.66. All macro-averaged measures of precision, recall, and F1-scores are very close to each other and come out to 0.79, 0.78, and 0.78, respectively., thus proving that the model performs quite well across different classes. Results indicate that CNN and transfer learning hold immense potential to increase the classification of reptiles and amphibians. This can help in monitoring and conserving biodiversity. A reliable tool for species identification will contribute towards greater understanding and protecting these vital components of our ecosystems, ultimately aiding the health and stability assessments of environmental conditions.

Anduze, O., Gourier, D., Binet, L., Malergue, A., Grossi, V. and Lattuati-Derieux, A. (2025). Identification, quantification and sourcing of fossil hydrocarbon in ancient Egyptian mummies by V and Ni trace elements. Journal of Analytical Atomic Spectrometry (<https://doi.org/10.1039/D4JA00442F>).

Abstract: Egyptian mummies are often covered with embalming

materials, which are made of complex mixtures of natural organic substances such as vegetable resins, beeswax, animal fats, gums, vegetable oils, as well as bitumen. In this work, we used Proton-induced X-ray emission (PIXE) and Electron Paramagnetic Resonance (EPR) to investigate the potential of certain transition metals, in particular V and Ni, as probes for detecting the presence of bitumen and tracing its origin and alteration in these mummification black matters. PIXE analysis showed that all the mummies studied in this work (birds, ram, crocodile, human), which span a period of about 1000 years and come from different sites in Egypt, have a nearly constant Ni/V ratio close to that of bitumen from the Dead Sea, suggesting a well-defined source of bitumen supply. The same conclusion was reached by EPR analysis of vanadyl porphyrins and carbonaceous radicals. The presence of an excess of radicals in the black matter from several mummies indicates that they probably contain some carbonized organic matter in addition to bitumen. This combined PIXE-EPR methodology is quantitative and sensitive since a few % of bitumen can be non-destructively detected in a mummy sample weighing only a few mg. The combination of these two techniques can provide new information on the thermal history (preparation recipes) and redox history (natural degradation) of these black matters.

Xin, V., Leone, R. and Doshi, D. (2025). “See you later, alligator”: A case of anaphylaxis to alligator meat consumption. *Cureus* 17(1): e77226.

Abstract: *Alligator mississippiensis* meat is an uncommon, exotic dish that has increasingly become easily accessible across the United States. This presents a unique issue for patients with food allergies, as the cross-reactivity of reptile meat with fish and poultry allergy is not well-recognized. While there has been an established connection between those with fish allergy also reacting to reptile meat, it is even less known that poultry allergy may also have cross-reactivity with reptile meat. We present a case of a 25-year-old male patient who is able to consume fish but is allergic to chicken and who consumed alligator meat twice. During the second exposure, the patient experienced an anaphylactic reaction, as he was unaware of the possible cross-reactivity with his poultry allergy.

Pochat-Cottilloux, Y. (2025). A review of the non-semiaquatic adaptations of extinct crocodylomorphs throughout their fossil record. *Anatomical Record* 308(2): 266-314.

Abstract: Crocodylomorphs constitute a clade of archosaurs that have thrived since the Mesozoic until today and have survived numerous major biological crises. Contrary to historic belief, their semiaquatic extant representatives (crocodylians) are not living fossils, and, during their evolutionary history, crocodylomorphs have evolved to live in a variety of environments. This review aims to summarize the non-semiaquatic adaptations (ie either terrestrial or fully aquatic) of different groups from different periods, highlighting how exactly those different lifestyles are inferred for those animals, with regard to their geographic and temporal distribution and phylogenetic relationships. The ancestral condition for Crocodylomorpha seems to have been a terrestrial lifestyle, linked with several morphological adaptations such as an alitrostral skull, long limbs allowing a fully erect posture and a specialized dentition for diets based on land. However, some members of this clade, such as thalattosuchians and dyrosaurids display adaptations for an opposite, aquatic lifestyle, interestingly inferred from the same type of morphological observations. Finally, new techniques for inferring the paleobiology of those extinct animals have been put forward in the last decade, appearing as a complementary approach to traditional morphological descriptions and comparisons. Such is the case of paleoneuroanatomical (CT scan data), histological, and geochemical studies.

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