# Croc Digest

## A Bibliography of Human-Crocodile Interactions
## 4th ed.

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**The Purist**

I give you now Professor Twist,
A conscientious scientist,
Trustees exclaimed, "He never bungles!"
And sent him off to distant jungles.
Camped on a tropic riverside,
One day he missed his loving bride.
She had, the guide informed him later,
Been eaten by an alligator.
Professor Twist could not but smile.
"You mean," he said, "a crocodile."

**Ogden Nash**

# Explanatory notes

This bibliography provides **a first point of reference for researchers interested in human crocodile conflicts** and offers policy makers and practitioners a wide range of information on and approaches to mitigating such conflicts. The material includes papers which include useful information on human-crocodile relations more broadly, but the **focus remains problematic encounters**. Inclusion is not necessarily a recommendation, but a reasonable effort has been made to include only reliable sources.

**Sources**: This bibliography comprises mostly published research, and some grey literature / management programmes. It is not a review of attack incidence (for overviews, see Sideleau 2021 and our section on the IUCN SSC Crocodile Specialist Group website).

**Method**: This is not a systematic review, but involved searching all of the IUCN SSC Crocodile Specialist Group proceedings (Working Group Meetings and Regional Meetings) and Newsletters for the period 2006-22, and a search for HCC-related papers in peer-reviewed journals through searching the online databases SCOPUS, JSTOR and Web of Science (1990-2022), as well as reference sections of papers found. The bias is to English language papers (a handful of key sources in other languages are included). A few key older publications are included. Most publications which are difficult to access have been omitted, and links to online sources are provided where possible. If the article is just an abstract, this is indicated immediately after the title with the text: (abstract).

**Abstracts** or summaries are usually provided, with the exception of some Crocodile Specialist Group Newsletter items which are easily accessible. For commercial journals where copyright is retained, summaries are usually provided rather than the full abstract.

A resource for accessing papers in subscription-only access journals is (besides contacting the authors) Researchgate, and in some cases I've indicated where versions of papers are downloadable. If you're really stuck, contact me (email address below).

Both **IUCN Crocodile Specialist Group** Newsletters and papers in Proceedings are available on the Croc Specialist Group website at: http://www.iucncsg.org/pages/Publications.html
and many CSG papers are now easily accessed from the CSG HCC page at:
http://www.iucncsg.org/pages/Human%252dCrocodile-Conflict.html

**Updates, omissions and corrections**
This 4th edition of the review covers roughly 2006 to June 2022. You are welcome to send additional references to me.

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**Cover photos:** Mrs Brits and the Crocodile, St Lucia Estuary, South Africa, courtesy Nydia Brits.

## Contents




**Above**: Malataj Village, Gujarat, India

## Foreword

The crocodylians are a fascinating and varied order sharing a deep evolutionary history and sophisticated adaptations to their predatory, amphibious lifestyles. They are culturally, economically and ecologically important keystone species inhabiting the wetlands of the tropical and subtropical regions of Africa, the Americas and Caribbean, tropical Asia, China, Australia and Oceania. This bibliography focuses on attempts by conservationists of many backgrounds to grapple with the transdisciplinary challenges of conserving these large, potentially dangerous apex predators. The focus has been on damaging interactions, in particular crocodile attacks, and here the word 'conflict' is often used imprecisely. Crocodylians are not 'in conflict' with us; they may, in the course of pursuing their lives as predators, or in self-defence, inflict lethal or grievous injuries on humans and their domesticated animals, cause damage to fishing gear and structures like dams, and compete for fish. These are *impacts*, and they have indirect impacts too, e.g. fear of crocodylians forcing people to avoid or take long detours around water bodies. Human-crocodilian *conflicts* arise when humans differ over how to deal with such impacts, and whether to tolerate crocodylians or not. What is much less studied, is where humans and crocodylians coexist, and what we can learn from such scenarios. I hope that over coming years this bibliography will gradually accumulate more studies of this dimension of human-crocodylian interactions, while not straying from the core business of dealing with crocodile attacks and associated challenges.

Simon Pooley, London, July 2022

## Human-Crocodilian Coexistence

Crocodile attacks, and conflicts between humans about what to do about them, are an important focus for human-crocodylian interactions studies. However, when we think about what we want, at least for those who want crocodilians to continue to exist on Earth, it is coexistence. This is a much smaller literature at present, though growing. I preface the main list with a few papers focused on coexistence to encourage this.

**Cavalier, R., Pratt, E.N., Serenari, C., Rubino, E.C. 2022. Human dimensions of crocodilians: a review of the drivers of coexistence**. Human Dimensions of Wildlife. 27(4): 380-396.
**Summary**: Many societies struggle to share space with crocodilians, especially in urban and coastal regions. This is an exploratory literature review to identify trends in research and potential principles of human coexistence with crocodilian species within cognitive, spatial, and governance domains. In both increasingly urbanizing areas, and in natural resource dependent rural communities, cognitions proved important in human defence of symbolic and material livelihoods and negotiating human-crocodilian interactions. Further, more attention should be given to greater forces (e.g., rural-urban drift, land use change) influencing interactions. Understanding social-ecological connections are necessary to rethink coexistence.

**Platt, S.,** Oudomxay, T., Outhanekone, and Rainwater, T.R. 2018. **Notes on traditional ecological knowledge and ethnoherpetology of Siamese Crocodiles in Lao PDR**. Newsletter of the CSG, 37(4): 6-11.

**Pooley, S., Bhatia, S., Vasava, A. 2021. Rethinking the study of human–wildlife coexistence**. Conservation Biology 35(3): 784-793.
**Summary**: This paper offers notes towards a definition of coexistence and argues that it is less studied than conflict due to unfamiliarity with relevant methodologies, including qualitative methods, self-reflexivity and ethical rigor, and constraints on funding and time. These challenges are illustrated with examples from fieldwork on crocodiles in India. The authors recommend expanding the scope of inquiries into human–wildlife relations beyond a conflict framing, and going beyond studies of rational behavior and the quantification of costs and benefits of wildlife to humans.

**Skupien**, G.M., Andrews, K.M. and Larson, L.R. **2016. Teaching tolerance? Effects of conservation education programs on wildlife acceptance capacity for the American alligator**. Human Dimensions of Wildlife: An International Journal, 21:3, 264-279. Available at: http://www.tandfonline.com/doi/pdf/10.1080/10871209.2016.1147624
**Abstract**: Growing populations of American alligators (*Alligator mississippiensis*) in human-dominated landscapes present a challenge to wildlife managers concerned with promoting coexistence between humans and alligators. Where structural fixes such as direct removal of animals are not viable options, cognitive fixes such as conservation education programs should be considered. We evaluated the effectiveness of two conservation education programs (classroom-based program, field excursion) on three outcome variables that help define wildlife acceptance capacity for American alligators: beliefs and attitudes, perceived risk, and potential for coexistence. Respondents who took part in both education programs had more positive beliefs and attitudes toward alligators and believed in a greater potential for coexistence than individuals in a control group who did not undergo either intervention. Control group respondents also perceived higher risk from alligators. These data suggest that conservation education programs can impact stakeholder beliefs, attitudes, and perceptions, ultimately influencing acceptance capacity for predators.

See also papers by Kpéra et al. (Benin), Vyas (various on Vadodara, India), Bhattarai et al. (Nepal), Than et al. (Myanmar) Van der Ploeg et al. (Solomon Islands) and especially the section on the Philippines. There are more examples to add, for e.g. from Cambodia.

**For more on human-wildlife coexistence, see the freely downloadable ebook *Understanding Coexistence with Wildlife*, available here.**

## Papers by Region and Country

A great joy of this work is being in the field with friends and colleagues, here (L-R) Niyati Patel, Anirudh Vasava, Simon Pooley, Raju Vyas and Vishal Mistry.

## General References and Resources

**Caldicott, D.G.E.,** Croser, D, Manolis, C., Webb, G., Britton, A. **2005. Crocodile Attack in Australia: an analysis of its incidence and review of the pathology and management of crocodilian attacks in general**. *Wilderness and Environmental Medicine,* **16:**143-159.

**Grigg**, G. and Kirshner, D. **2015. Biology and Evolution of Crocodylians**. CSIRO Publishing. See Chapter 14: Conservation, commercialisation, and conflict.

**Pooley**, A.C., Hines T., Shield J. **1989. Attacks on humans**. Pp. 172-187 *in* Crocodiles and Alligators, ed. by CA Ross and S Garnett. Golden Press Pty. Ltd.: Silverwater, NSW, Australia.

**Ross**, J.P. **2007. Crocodile and alligator safety for field researchers**. Available from the author (for a small consideration).

**Ross**, J.P. **2000**. **Problems of Success: Conservation Consequences of Crocodile-Human Conflict**. Species, 33:50-51.

**Sideleau**, B.M. 2021. A brief overview of crocodilian attacks worldwide for the decade. *Crocodile Specialist Group Newsletter,* 40(4): 4-8.

**Websites**

**IUCN SSC Crocodile Specialist Group**
Human-Crocodile Conflict: http://www.iucncsg.org/pages/Human%252dCrocodile-Conflict.html
Crocodilian attacks: http://www.iucncsg.org/pages/Crocodilian-Attacks.html
http://www.iucncsg.org/pages/Crocodilian-Capacity-Building-Manual-.html

- See section 4.5 by Alan Woodward

**IUCN SSC Human-Wildlife Conflict and Coexistence Specialist Group**
http://www.hwctf.org/resources/document-library

## Africa

Published data of varying quality and quantity exist for 12 of the 30 African countries where attacks are known to occur. The list of countries below does not therefore indicate the actual extent of crocodile attacks by country. More data, as well as reviews of mitigation efforts, are required urgently. The vast majority of reported attacks have been attributed to the Nile crocodile (*Crocodylus niloticus*). West and Central/West Africa in particular has very little published data. There are notable gaps for Uganda, Kenya, Tanzania and Malawi in East Africa, and most data in the south is available for South Africa and Zimbabwe (very recently Zimbabweans have been publishing an encouraging amount). Available data for Namibia and Zambia is dated.

### General

**Fergusson R. 2004. Preliminary analysis of data in the African human-crocodile conflict database**. *Crocodile Specialist Group Newsletter,* 24(4):21–22.

**Fergusson, R. 2004. Local people in crocodilian conservation - the African context**, pp. 302-304 in Crocodiles: Proceedings of the 17th Working Meeting of the IUCN-SSC Crocodile Specialist Group. IUCN: Gland, Switzerland.
**Summary**: Gives brief overviews of: the impacts of growth in human populations and wetland degradation on Africa's crocodiles; the diversity of attitudes held by rural Africans towards crocodiles (seldom positive); 3 phases in attitudes to/management of crocodiles in Africa, precolonial, colonial and post-independence; utilisation of crocodiles; and impacts of HCC and the lack of effective regulation and technical capacity.

**Fergusson, R. A. 2002. Living with a wild predator: managing human-crocodile conflict in Africa**. Crocodile Specialist Group Newsletter, 21:16-20.

**Lamarque** F, Anderson J, Fergusson R, Lagrange M, Osei-Owusu Y, Bakker L. **2009. Human-wildlife conflict in Africa: causes, consequences and management strategies**. FAO Forestry Paper 157, Rome.

**Pooley, S. 2018. Stay a long while, crocodile: mitigating human-crocodylian conflicts**. In Proceedings of the 25th Working Meeting of the IUCN-SSC Crocodile Specialist Group, pp.238-242.
**Summary**: This paper provides a definition of human wildlife conflict which disaggregates direct impacts of wild animals on humans and vice versa, from conflicts over direct impacts. It summarises current guidance on HCC drawing on the literature on *Crocodilus niloticus*, and current CSG guidance. The second section of this paper explains the aims of the new IUCN Task Force on Human Wildlife Conflict, and proposes that CSG members have much to contribute. With this in mind, the paper outlines a draft outline for a guidance document on HCC, as a basis for discussion between CSG members. The paper concludes with a summary of the discussions on HCC at a breakout meeting convened during the Santa Fe CSG Working Group meeting and includes a few notes on developments following the conference.

**Pooley, S. 2017. A cultural herpetology of Nile crocodiles in Africa**. Conservation & Society 14(4): 391-405.
**Abstract**: Human-wildlife conflict is a growing problem worldwide wherever humans share landscapes with large predators, and negative encounters with eight species of the crocodilians is particularly widespread. Conservationists' responses to these adverse encounters have focused on the ecological and behavioural aspects of predators, rather than on the social, political, and cultural contexts, which have threatened their existence in the first place. Few studies have thus far tried to understand the rich, varied, contradictory, and complex relations that exist between particular humans and human societies, and particular predators and groups of predators. It is in the spirit of Brian Morris's explorations of the interactional encounters and co-produced sociabilities that exist between humans and animals in specific places and regions that this paper offers a cultural herpetology (an account of human-crocodile interrelations) of the Nile crocodile (*Crocodilus*

*niloticus* and *C. suchus*) in Africa. It draws on extensive historical documentation of the interactions of humans and crocodiles across Africa to examine how diverse and complex human responses to Nile crocodiles have been, and continue to be, and suggests some implications for improving human-crocodile relations.

**Pooley, S. 2016. The entangled relations of humans and Nile crocodiles in Africa, c.1840-1992**. Environment and History, 22(3): 421-454.
**Abstract**: The nature of European explorers' and hunters' perceptions of the wildlife they encountered during their travels, and how this shaped their responses to it, has been surprisingly little studied. This may in part be because of the wealth of primary material and the dearth of secondary sources. There is much to be gained from a historical exploration of the abundant sources on Europeans' encounter with wildlife, notably during the height of colonial exploration and adventuring in Africa. This review focuses on the Nile crocodile (*Crocodylus niloticus*) in Africa. Crocodiles had a major impact on European travellers, elicited extreme reactions and reveal an irrational difference in attitudes to large mammalian predators, as opposed to reptilian. The oft-repeated statement that Nile crocodiles kill more humans and are more hated than any other predator (or even, all other predators) in Africa is still current. The expansion of human settlement and activities into the habitats of crocodiles and increasing demands on water supplies is resulting in escalating conflicts and some experts regard crocodiles as a 'growing threat to rural livelihoods and development'. If these important apex predators of the continent's waterways are to be conserved, then a good place to start then a good place to start is with an exploration of the long history of human-crocodile interactions that have shaped expert and public perceptions of crocodiles.

**Pooley, S., 2015. Using predator attack data to save lives, human and crocodilian**. Oryx: The International Journal of Conservation, 49, 581-583.
**Abstract**: As human populations grow and transform undeveloped terrestrial and aquatic habitats, human–wildlife conflict inevitably increases. This is particularly problematic for large predators and the humans who live alongside them. Relatively little research has been conducted on alleviating adverse human encounters with one of the most significant predator species in Africa, the Nile crocodile *Crocodylus niloticus*. This short communication raises questions about some of the general statements made to explain the incidence of attacks by crocodiles. Some of the limitations of the data on such attacks are considered, with recommendations on what kinds of data are required. Data collection and analysis, and how they can inform more effective mitigation efforts, are discussed.

The following review article contains interesting details, but has several limitations. I feel I should mention it as it claims to survey HCC concerning Nile crocodiles across Africa and Madagascar (*C. niloticus* – but doesn't recognise *C. suchus*). There are factual and organisational issues and omissions in sources which should have been picked up – I've not named the authors, who were not well served by the review process. Details: **2018**. **The human crocodile conflicts and the sustainable conflict resolutions review**. International Journal of Environmental Sciences & Natural Resources, 13(2).

## West and Central Africa

Most attacks in this region are attributed to the West African crocodile *Crocodylus suchus*.

### BENIN

**Adje**, B.C. **2011. Possible effect of climate change on crocodile distribution and risk of human crocodile conflict in southern Benin**. Crocodile Specialist Group Newsletter 30 (1): 6-7.

**Kpéra**, G.N., Mensah, G.A., Aarts, M.N.C., Tossou, C.R. and van der Zijpp, A.J. **2016. Innovation platform as a conducive space for reducing human-crocodile conflicts in agro-pastoral dams in Benin**. Pages 42-52 in

Proceedings of the 24th Working Meeting of the IUCN-SSC Crocodile Specialist Group in Skukuza, South Africa. IUCN: Gland, Switzerland.
**Abstract**: Agro-pastoral dams (APDs) - water reservoirs constructed in Benin to provide water for livestock and for agricultural development - face several conflicts including human-crocodile conflicts. The research aimed to reduce conflicts and to find way for optimal use and management of APD ecosystem services for the benefit of all the stakeholders involved including crocodiles. The research was built on the Integral Ecology framework, which helps to develop an integral understanding taking into account institutional, technical, socioeconomic, and environmental dimensions of APD's problems. Comparative case studies of the use and management of three APDs in northern Benin were explored from an interdisciplinary perspective. Several technical and institutional constraints hamper the use and the management of APDs that are used for multiple purposes. The involvement of human and non-human stakeholders (crocodiles and livestock) makes an APD a complex system, impeding agreement on common rules for their management. The fear that crocodiles engender and crocodiles' negative effects on local livelihoods and people's tranquillity make all stakeholders to frame the presence of crocodiles as problematic. While some inhabitants (more tolerant towards crocodiles) have constructed informal rules and socially rooted practices that assist them to live in peace with crocodiles, other stakeholders have constructed particular informal institutions that allow them to deny formal rules and thus kill them.

**Kpéra**, G.N., Aarts, N., Tossou, R.C., Mensah, G.A., Saïdou, A., Kossou, D.K., Sinsin, B., and van der Zijpp, A.J. **2014. 'A pond with crocodiles never dries up': a frame analysis of human–crocodile relationships in agro-pastoral dams in Northern Benin**, International Journal of Agricultural Sustainability, 12:3, 316-333.
**Abstract**: Crocodiles share ecosystem services with local communities in agro-pastoral dams in Northern Benin. Using a comparative case study conducted in three villages and a framing perspective, this study aims to elucidate how stakeholders frame the presence of crocodiles, and how they use formal and informal institutions to deal with them. Further investigation is merited to determine whether or not crocodiles behave less aggressively when dealt with according to specific institutions. Intensive communication among stakeholders in the three villages is recommended to exchange experiences and ideas that may support a peaceful human–crocodile relationship inspired by existing institutional solutions.

**Kpéra**, G.N., Mensah, G.A., Sinsin, B.A., Tossou, R., Eilers, K., Van der Zijpp, A. and N. Aarts. **2010. Human-crocodile interaction: empowerment of local people to deal with crocodiles around agropastoral dams in northern Benin**. Actes du 2ème Congrès du Groupe des Spécialistes des Crocodiles sur la promotion et la conservation des crocodiliens en Afrique de l'Ouest ténu à Nazinga, Burkina Faso du 2-6 Mars 2010, pp.135-144.

**BURKINA FASO**

**Bathiono, Y., 2007**. **Les crocodiles au Burkina Faso: diagnostic situationnel et perspectives communication** au Premier Congres des Spécialistes des Crocodiles des Pays de L'Afrique de L'Ouest. In Proceeding of 1st Workshop of the West African Countries on Crocodilian farming and conservation 13-15 November 2007, La Tapoa Regional Parc W, Niger, pp.54-64. IUCN, Gland, Switzerland.

**MAURITANIA / SENEGAL**

**Brito**, J.C., Campos, J.C., Gonçalves, D., Martínez-Freiría, F. **2011**. **Status of Nile crocodiles in the lower Senegal River basin (Mauritania/Senegal)**. Newsletter of the Crocodile Specialist Group, 30 (1): 7-10.

**NIGERIA**

**Akani, G.C.** and L. Luiselli. **2001. A survey of the cultural attitudes of people towards reptiles in the Niger Delta, Nigeria: implications for conservation**. Herpetol. Bull. 75: 19-24.

# North, East and Southern Africa

## BOTSWANA

**Pozo, R.A., LeFlore, E.G., Duthie, A.B., Bunnefeld, N., Jones, I.L., Minderman, J., Rakotonarivo, O.S. and Cusack, J.J. 2020. A multispecies assessment of wildlife impacts on local community livelihoods.** Conservation Biology, Early View: https://doi.org/10.1111/cobi.13565
**Summary**: Most studies reporting on human–wildlife impacts and the strategies used to mitigate them focus on a single species, thus oversimplifying often complex systems of human–wildlife interactions. We sought to characterize the spatiotemporal patterns of impacts by multiple co-occurring species on agricultural livelihoods in the eastern Okavango Delta Panhandle in northern Botswana through the use of a database of 3264 wildlife-incident reports recorded from 2009 to 2015 by the Department of Wildlife and National Parks. This study looked at 8 species, including Nile crocodile (*C. niloticus*), which were implicated in 429 cases of livestock loss and 1 of property damage. A time series of annual frequency of reports for all the species (2009-15) is provided, as well as annual impact peaks, with crocodiles exhibiting a bimodal distribution with low points in May and July and high points in October and February/March is some villages.

**Thomas**, G.D. and Leslie, A.J., **2006. Human-crocodile conflict (Nile crocodile: *Crocodylus niloticus*) in the Okavango Delta, Botswana** (abstract). Proceedings of the 18th Working Group Meeting of the IUCN Crocodile Specialist Group, p.83. IUCN, Gland, Switzerland.

**Thomas**, G.T. **2006. Human–crocodile conflict (Nile crocodile: *Crocodylus niloticus*) in the Okavango Delta, Botswana**. M.Sc. Thesis, University of Stellenbosch, South Africa.
**Summary**: The extent and severity of HCC in the Okavango Delta, Botswana, was investigated through completing questionnaires with the aid of translators in 35 villages surrounding this unique inland delta in the Ngamiland District of Botswana (N=482). Perceptions towards crocodiles, the degree of utilization of river resources and traditional beliefs of the local people were also investigated. Mitigation measures combining both prevention and reactive techniques are provided for policy amendments and for communities for the long-term resolution of HCC. The gradual phasing-out of monetary compensation (which is currently practiced in Botswana), together with regulations restricting use of open access water of the Okavango Delta is recommended. Policy instruments and various incentives (for communities) will aid in policy implementation and thus facilitate the future coexistence of man and crocodile in the Okavango.

## ESWATINI (see SWAZILAND)

## ETHIOPIA

**Adugna, Chala**, Solomon Kiros, Tadesse Dejene, Tsehaye Asmelash and Kiros M. Hadgu. **2017. Distribution and habitat suitability of Nile crocodile (*Crocodilus niloticus*, L. 1768) in Tekeze River Dam, Tigray, Ethiopia**. International Journal of Biodiversity and Conservation Vol. 9(12), pp. 350-362.
**Abstract**: Understanding the spatial distribution and habitat utilization by animals play a significant role in wildlife conservation and habitat management for the benefits of both animals and communities living close to protected areas. This study was conducted to identify the distribution and habitat use of *Crocodilus niloticus* in Tekeze River Dam through qualitative and quantitative surveys based on diurnal survey, semi-structured questionnaire and geographic information system (GIS) spatial analysis methods. The Tekeze River Dam representing the study area was divided into seven stratified river stratum. All spatial data were recorded and analyzed using ArcGIS 10 software. The distribution revealed that *C. niloticus* were registered along the main river stretch and its tributaries. Majority of *C. niloticus* prefer riverbanks, shallow water depth

and rocky ground to perform their activity patterns. Along the 71.2 km² of the study area delineated for habitat preferences, 9.78 km2 was the highly suitable habitat while 4.63 km2 was the least suitable. The influence on communal resources, fishery activities and irrigation practice at small-scale on riverbanks and increment of water level due to flooding of the Tekeze River Dam were among the primary causes of disturbances induced by human to *C. niloticus* distribution and its habitats. The perception of most respondents to the conservation of this specie was not encouraging although their presence in the river was important in keeping the ecological balance of the ecosystem. It is therefore suggested that the success of conservation programs and habitats management should focus on educating the local community to raise awareness and change their attitudes towards promoting conservation development initiatives of *C. niloticus* in the area.

## MOZAMBIQUE

**Anderson**, J.L., Pariela, F. **2005. Strategies to mitigate human-wildlife conflicts in Mozambique**. Wildlife Management Working Paper, Number 8, FAO, Rome. See Section 4.2 'Crocodiles' (pp.25-29)

**Dunham**, K. M., Ghiurghi, A., Cumbi, R., and Urbano, F. **2010. Human–wildlife conflict in Mozambique: a national perspective, with emphasis on wildlife attacks on humans**. Oryx 44, 185–193.
Summary: Human–wildlife conflicts are common across Africa. In Mozambique, official records show that wildlife killed 265 people during 27 months (July 2006 to September 2008). Crocodile *Crocodylus niloticus*, lion *Panthera leo*, elephant *Loxodonta africana* and hippopotamus *amphibius* caused most deaths but crocodiles were responsible for 66%. Good land-use planning, a long-term solution to many conflicts, is particularly relevant in Mozambique, where the crocodile and hippopotamus populations of protected areas are often in rivers that border these areas, and cause conflicts outside them, and where people commonly live within protected areas. Poverty may prompt fishermen to risk crocodile attack by entering rivers or lakes.

**Fergusson**, R., **2010. Wildlife survey phase 2 and management of human wildlife conflicts in Moçambique: survey of crocodile populations in Moçambique**. Final report for Ministério de Agricultura Direcção Nacional de Terras e Florestas.

**Le Bel,** S. Murwira, A., Mukamuri, B., Czudek, R., Taylor, R. and La Grange, M., **2011. Human wildlife conflicts in southern Africa: riding the whirl wind in Mozambique and in Zimbabwe**. Chapter in J. Lapez-Pujol (editor), The importance of biological interactions in the study of biodiversity. InTech, Available from: http://cdn.intechweb.org/pdfs/20148.pdf
**Summary:** The objective of this chapter is not to give a recipe of devices to solve all HWCs (e.g. problems of crop raiding elephants) or to give a roll map to NGO's in an attempt to reconcile hungry communities and free ranging mega-herbivores. As no blueprint or panacea exists, our philosophy is to explore options which will help rural communities to improve their capacity to live with problem animals. The principles developed though this chapter aim to increase human tolerance of wildlife species and to decrease negative interactions with them. To achieve this, we will be referring to recent works conducted in Mozambique and in Zimbabwe, both countries who decided with the assistance of FAO (Food and Agriculture Organization of the United Nations) and AFD (Agence Française de Développement) to develop a national strategy to manage HWC. The first section will point out key principles of HWC based on the example of Mozambique and specifically the case of Limpopo National Park. A focus on communities living in areas adjacent to national parks in Zimbabwe will help explain the depth of the HWC problem.

**Moore Gerety, R. 2018. Go Tell the Crocodiles: Chasing prosperity in Mozambique**. New York: The New Press.
**Summary**: See chapter 6 on cultural beliefs, attitudes, ranching, hunting and management at attack hotspot at Bawa and on Lake Cahora Bassa.

## NAMIBIA

**Aust**, P., Boyle, B., Fergusson, R., and Coulson, T. **2009. The impact of Nile crocodiles on rural livelihoods in northeastern Namibia**. South African Journal of Wildlife Research 39, 57– 69.
**Abstract**: Nile crocodiles (*Crocodylus niloticus*) are one of the few dangerous predators regularly found outside protected wildlife areas. This is particularly so in northeastern Namibia where an extensive network of rivers and wetlands coupled with successful conservation measures has allowed crocodile populations to flourish since uncontrolled exploitation ended over three decades ago. This area is predominantly communal land characterized by numerous subsistence communities dependent on river and wetland resources. In recent years, the combination of a growing human population and resurgent crocodile populations has resulted in considerable conflict between humans and crocodiles. The principle objective of this study was to quantify the impact of crocodiles on rural livelihoods. Results suggest that human–crocodile conflict in Namibia may have greater impacts than previously assumed, and may undermine conservation and development objectives.

**Aust**, P.W. **2009. The ecology, conservation and management of Nile crocodiles (*Crocodylus niloticus*) in a human dominated landscape**. PhD Thesis. Imperial College, London.
**Summary**: The aim of this thesis is to (a) quantify the extent of human crocodile conflict (HCC) and (b) establish the implications for conservation and development. The extent of HCC was assessed by (i) analysing losses incurred by local communities (ii) analysing the demographics of crocodiles in relation to human activities (iii) analysing the relationship between humans and crocodile prey species. A large part of this study took place in the Kavango and Caprivi regions of North Eastern Namibia.

**Boyle**, **B. 2007. Human Crocodile Conflict: A case study of North Eastern Namibia.**
M.Sc. Thesis, Imperial College London, London.

## SOUTH AFRICA

**Combrink**, A.S. **2014. Spatial and reproductive ecology and population status of the Nile crocodile (*Crocodylus niloticus*) in the Lake St Lucia estuarine system, South Africa**. PhD Thesis, University of KwaZulu-Natal, South Africa. See Chapter 8 (with Jon Warner, Ricky Taylor and Colleen Downs): **Homing behaviour and movements of a translocated Nile Crocodile (*Crocodylus niloticus*) in the Lake St Lucia estuarine system, South Africa**, pp.316-46. Available at:
https://researchspace.ukzn.ac.za/xmlui/handle/10413/12242

**Combrink**, A.S., Korrûbel, J.L., Kyle, R., Taylor, R. and Perran Ross. **2011. Evidence of a declining Nile crocodile (*Crocodylus niloticus*) population at Lake Sibaya, South Africa**. South African Journal of Wildlife Research 41(2): 145–157. Available on Researchgate
**Abstract**: Formerly widespread throughout the waterbodies of eastern South Africa, viable Nile crocodile (*Crocodylus niloticus*) populations are now restricted to three disjunct protected areas in KwaZulu-Natal (KZN), Mpumalanga and Limpopo. Growing evidence suggests that protected populations are declining, including the breeding *C. niloticus* population at Lake Sibaya in KZN. Aerial surveys were conducted at Lake Sibaya from 2003–2004 and 2007–2009, spotlight counts in 2003 and intensive nesting surveys in 2003 and 2004. The neighbouring community perceives crocodiles as a threat to their lives and livestock, and increasing human pressures on *C. niloticus* in the area will probably ensure that the population will not recover naturally. Unless crocodiles are perceived as a useful or somehow beneficial natural resource by the surrounding community, the species faces possible extirpation from Lake Sibaya in the future.

**Jacobs, J. 2022. An investigation into human-crocodile coexistence in the Limpopo, Luvuvuhu and Olifants Rivers within the Limpopo Province, S. Africa.** MSc Thesis, Tshwane University of Technology, South Africa.

**Pooley, A.C. 1982. Discoveries of a Crocodile Man**. Collins, Johannesburg, South Africa.
See chapters 5 (Muti, magic and foster father again) and 10 (Man killers and others).
A second edition is available as a printed book or pdf here.

**Pooley**, S., H. Botha, X. Combrink and G. Powell. **2019. Synthesising Nile crocodile attack data and historical context to inform mitigation efforts in South Africa and eSwatini (Swaziland)**. Oryx 54(5): 629 - 638.
**Abstract**: Conflicts with wildlife are a major challenge for conservation across Africa, and Nile crocodiles *Crocodylus niloticus* are allegedly responsible for more attacks on people than any other species; however, there is a lack of data regarding such attacks. We analysed reported attacks on people by Nile crocodiles in South Africa and eSwatini (Swaziland) during 1949-2016, identifying spatial and temporal patterns in attack incidence, as well as victim demographics. Through a literature review and archival searches we identified records of 214 attacks. Most attacks occurred in natural water bodies, with attacks in dams increasing since 2000. Most victims were attacked while swimming or bathing, others while fishing, doing domestic chores, and crossing waterways. There was a significant relationship between gender and activity when attacked. Children (<16 years old) accounted for 51% of all attacks, with a higher fatality rate compared to adults. Most victims were male (65%), with teenage boys being the largest individual category. We make recommendations for conservation policy and management to mitigate attacks by Nile crocodiles.

**Pooley, S.** and Combrink, X. **2018, Investigating local people's interactions with Nile crocodiles around South Africa's Ndumo Game Reserve: preliminary visit and workshops**. IUCN Crocodile Specialist Group Newsletter 37: 2, 23-26.

**Pooley, S. 2017, Don't get eaten by a crocodile** (poster; there are editions for South Africa, Swaziland and Botswana). Available on ResearchGate.

**Pooley**, S., **2015. Using predator attack data to save lives, human and crocodilian**. *Oryx: The International Journal of Conservation*, 49, 581-583. (See 'General' papers above)

**Pooley, S. 2015. Don't get eaten by a crocodile in South Africa or Swaziland**. London, UK. Available here.
**Summary**: Booklet illustrated with infographics of long-term attack data for the region. Includes educational material on crocodiles, case studies of attacks, and suggestions for avoiding attacks, what to do when an attack occurs, and an attack incident form.

**Powell, G.,** Versluys, T., Williams, J., Tiedt, S., Pooley, S. **2020. Using environmental niche modelling to investigate the importance of ambient temperature in human-crocodilian attack occurrence for two species of crocodilian**. Oryx 54(5): 639-647.
**Abstract**. Crocodilian attacks follow a seasonal pattern in many regions, but there has been limited analysis of the relationship between attack occurrence and fine-scale contemporaneous environmental conditions. We use methods from environmental niche modelling to explore the relationships between attacks on people and abiotic predictors at a daily temporal resolution for the Nile crocodile *Crocodylus niloticus* in South Africa and Eswatini (formerly Swaziland), and the American alligator *mississippiensis* in Florida, USA. Our results indicate that ambient daily temperature is the most important abiotic temporal predictor of attack occurrence for both species, with attack likelihood increasing markedly when mean daily temperatures exceed 18°C and peaking at 28°C. We discuss the potential of our findings to contribute to the management of crocodilians, with benefits for both human safety and conservation.

## SWAZILAND (ESWATINI)

**Pooley, S. 2015. Don't get eaten by a crocodile in South Africa or Swaziland**. London, UK. Available at: https://www.researchgate.net/publication/280731914_Don't_get_eaten_by_a_crocodile_in_South_Africa_or_Swaziland
**Summary**: Booklet illustrated with infographics of long-term attack data for the region. Includes educational material on crocodiles, case studies of attacks, and suggestions for avoiding attacks, what to do when an attack occurs, and an attack incident form.

**Pooley, S., 2014. Human crocodile conflict in South Africa and Swaziland, 1949–2014**. In Proceedings of the 23rd Working Meeting of the IUCN–SSC Crocodile Specialist Group, Lake Charles, USA, 25–30 May 2014, pages 236-245. IUCN, Gland, Switzerland.

**Sliwa**, A. 2010. **Das Swasiland-Projekt des Kölner Zoos – Schutz von Flusspferden und Nilkrokodilen**. Zeitschrift des Kölner Zoos, 4(53): 171-178. Available at: http://docplayer.org/27151976-Zeitschrift-des-koelner-zoos-nr-4-jahrgang.html

## TANZANIA

**Zakayo, F. 2014. Human-crocodile conflicts in areas adjacent to Lake Rukwa and Momba River, Momba District, Tanzania**. MSc thesis, Sokoine University of Agriculture. Morogoro, Tanzania. Available at: http://suaire.suanet.ac.tz:8080/xmlui/bitstream/handle/123456789/678/Frank%20%20Zakayo.pdf?sequence=1&isAllowed=y
**Summary**: Conflicts between human and crocodiles are increasing due to increase in human population. The conflicts have significant impacts on both human and crocodile populations. The study focused on assessment of human-crocodile conflicts in areas adjacent to Lake Rukwa and Momba River, Momba District, Mbeya Region Tanzania, for the period of 2003 to 2012. Cross-sectional research design and purposive sampling of villages were used in data collection. A total of 120 households were randomly sampled from four villages of Kamsamba, Senga, Muuyu and Samang'ombe. Data were collected using direct observation, structured interviews, focus group discussions and key informants interview. Simple descriptive statistics, cross tabulations and Chi-square test were used to analyze data.

## ZAMBIA

**Chomba**, C., Senzota, R., Chabwela, H., Mwitwa, J., Nyirenda, V., **2012. Patterns of human – wildlife conflicts in Zambia, causes, consequences and management responses**. *Journal of Ecology and the Natural Environment*, Vol. 4(12), pp.303-313. Available at: http://www.academicjournals.org/journal/JENE/article-full-text-pdf/9E4133C11472
Summary: A study was carried out to determine causes, consequences and management responses of human – wildlife conflicts in Zambia during the period 2002 to 2010. Data was collected by field staff in the four management regions of Zambia Wildlife Authority and analyzed to establish patterns and species responsible for human fatalities, livestock predation, crop damage and other damages to human property. During the period of 2002 to 2008, a total of 347 people were killed or 49 people killed annually by five species of wildlife: crocodile, elephant, hippo, lion and buffalo. Overall, crocodile was responsible for the greatest number of human fatalities and livestock predation combined.

**Esmail**, N. 2014**. Investigating conservation conflicts in Musalangu Game Management Area, Zambia**. MSc Thesis, Imperial College London. Available at: https://www.iccs.org.uk/wp-content/uploads/2015/01/Esmail_Nafeesa_ConSci_2014.final_.pdf
**Summary**: covers HWC for all species in the area, but includes some stats on crocodiles. Did interviews and collected data on incidents, and compared attitudes with attack frequencies. Writes: 'An exaggerated local

perception of these beliefs, values and fears can be further corroborated by the salience expressed for each animal. Lion, leopard, hyena, hippopotamus and crocodile had the greatest calculated salience difference between the greatest dislike and negative impact from conflict. This can be explained as visual and awareness biases indicating the potential risk from large-bodied, potentially dangerous and/or intimidating species as described by Dickman (2012) to be present.'

**Wallace** KM, Leslie A, Coulson T. **2011. Living with predators: a focus on the issues of human–crocodile conflict within the lower Zambezi valley**. Wildlife Research**, 38**:747–755.
Summary: The people of the Chiawa Game Management Area are heavily dependent on the Zambezi River for several resources from potable water and irrigating fields to a source of food (subsistence and small-scale commercial fishing). Aims: To assess the spatial and temporal scale of human-crocodile conflict (HCC) and identify associated factors, with a view to recommending mitigation measures.

**Wallace**, K.A., A.J. Leslie and T. Coulson, 2010. **Living with predators: a focus on the issues of human-crocodile conflict within the Lower Zambezi Valley**. In: Crocodiles. Proceedings of the 20th Working Meeting of the Crocodile Specialist Group, pp.50-64. IUCN, Gland, Switzerland.

**Wallace**, K.A., A.J. Leslie and T. Coulson, 2010. **Living with the Nile crocodile** (abstract). In: Crocodiles. Proceedings of the 20th Working Meeting of the Crocodile Specialist Group, IUCN, Gland, Switzerland, p.65. IUCN, Gland, Switzerland.

**ZIMBABWE**

**Chakanyuka, T., Utete, B. 2022. Adaptive co-management, co-existence or just wildlife conservation? Case study of the human and Nile crocodile (Crocodylus niloticus) conflicts in Ngezi Dam, Mashonaland West, Zimbabwe**. African Journal of Ecology. In press. **https://doi.org/10.1111/aje.12974**
**Summary**: This case study estimated the abundance and distribution of Nile crocodiles (Crocodylus niloticus) in the dam, identified potential human–crocodile conflict hotspots, assessed dam-side communities' perceptions and attitudes towards crocodiles, and examined the application of co-existence and adaptive co-management concepts in human–crocodile conflict resolution. The research integrated field surveys, focus group discussions and face-to-face interviews. Most respondents (76%) showed a negative attitude towards crocodiles, which they indicated destroy livelihoods through injury, death and livestock depredation. We propose a human–crocodile conflict contextual resolution framework (HCCCR), which prioritises interactive adaptive co-management.

**Chihona**, S. **2014. The impact of Nile crocodile (*Crocodylus niloticus*) on the communal livelihoods: A case study of areas surrounding Ruti Dam in Gutu and Buhera districts in Zimbabwe**. MSc thesis, University of South Africa (UNISA). Available at:
http://uir.unisa.ac.za/bitstream/handle/10500/18582/dissertation_Chihona_s.pdf?sequence=1
**Summary**: Ruti dam is located on the Nyazvidzi river, and is home to many Nile crocodiles (*Crocodylus niloticus*), which rely on fish and livestock for food. The community also relies on the dam and riverine for its resources. The investigation of crocodile impacts on humans and livestock, the trends and seasonality of attacks and identification of other predators resulted in formulation of research. The field interviews, using a structured questionnaire, field observation and focused group discussions were mainly used in data collection. Threats posed by crocodiles were identified as mainly human and livestock depredation, which has increased since the introduction of the crocodiles into the dam. The crocodile depredation varies between seasons, due to differences in water levels in the dam, and availability of alternative water sources.

**Le Bel**, S. Murwira, A., Mukamuri, B., Czudek, R., Taylor, R. and La Grange, M., **2011. Human wildlife conflicts in southern Africa: riding the whirl wind in Mozambique and in Zimbabwe.** Chapter in J. Lapez-Pujol (editor), The importance of biological interactions in the study of biodiversity. InTech, Available from:
http://cdn.intechweb.org/pdfs/20148.pdf

**Summary:** The objective of this chapter is not to give a recipe of devices to solve all HWCs (e.g. problems of crop raiding elephants) or to give a roll map to NGO's in an attempt to reconcile hungry communities and free ranging mega-herbivores. As no blueprint or panacea exists, our philosophy is to explore options which will help rural communities to improve their capacity to live with problem animals. The principles developed though this chapter aim to increase human tolerance of wildlife species and to decrease negative interactions with them. To achieve this, we will be referring to recent works conducted in Mozambique and in Zimbabwe, both countries who decided with the assistance of FAO (Food and Agriculture Organization of the United Nations) and AFD (Agence Française de Développement) to develop a national strategy to manage HWC. The first section will point out key principles of HWC based on the example of Mozambique and specifically the case of Limpopo National Park. A focus on communities living in areas adjacent to national parks in Zimbabwe will help explain the depth of the HWC problem.

**Marowa**, I., Matanzima, J. and Nhiwatiwa, T. **2021. Interactions between humans, crocodiles, and hippos at Lake Kariba, Zimbabwe**. Human-Wildlife Interactions 15(1) article 25 (available here).
**Summary**: this paper describes the nature of HWCs emerging between humans and the Nile crocodile (*Crocodylus niloticus*) and between humans and the African hippopotamus (*Hippopotamus amphibius*; hippo) on Lake Kariba, Zimbabwe. The authors used a mixed-methods approach including questionnaires, face-to-face interviews, focus group discussions, and participant observation. The research participants involved national parks officials, fishing camp residents, and HWC victims. This confirmed that crocodiles and hippos have negatively affected humans through deaths and injuries, instilling fear, and destruction of fishing equipment. In retaliation, humans have implemented lethal methods.

**Matanzima, ??????????????**

**McGregor, J. 2005. Crocodile crimes: people versus wildlife and the politics of postcolonial conservation on Lake Kariba, Zimbabwe**. *Geoforum*, 36:353-369.
**Abstract**: This article is about the politics of conservation in postcolonial Southern Africa. It focuses on the process and consequences of redefining the Nile crocodile as an endangered species and explores the linked local and international, commercial and conservationist interests that allowed the animal to re-establish itself in state-protected waterways in colonial and postcolonial contexts. It investigates the effects of the animal's successful re-accommodation by examining conflicts between crocodiles and the fishing communities sharing space on Lake Kariba, Zimbabwe. Understanding the attitudes and circumstances of the local communities who bear the physical and economic costs of living with dangerous animals is important—it threatens the future of conservation programmes and reveals the potential for significant abuses to accompany the conservation of wildlife in postcolonial contexts.

**Musiwa**, A.R. and Mhlanga, W. **2020**. Human-wildlife conflict in Mhokwe Ward, Mbire District, North-East Zimbabwe. African Journal of Ecology (https://doi.org/10.1111/aje.12774).
**Summary**: investigates the economic and social aspects of human-wildlife conflict (HWC) in Mhokwe, Mbire district, Zimbabwe. Data were collected through key informant interviews and a questionnaire survey. However, while *C. niloticus* are named, few incidents involving crocodile were found.

**Utete, B. 2021. A review of the conservation status of the Nile crocodile (*Crocodylus niloticus* Laurenti, 1768) in aquatic systems of Zimbabwe**. Global Ecology and Conservation (doi:https://doi.org/10.1016/j.gecco.2021.e01743). **Summary**: This review assessed the abundance, distribution and population trends of Nile crocodiles and effects of ranching, trophy hunting and human-crocodile conflicts (HCC) on its conservation status in water systems of Zimbabwe. Ranching and trophy hunting have contributed to the increases in crocodile populations. Human encroachment and wetland degradation have increased HCC in fringe communities proximate to protected areas consequently inducing negative perceptions and hurt-rage which threatens crocodile populations. The conservation status of crocodiles in

Zimbabwe should be ascribed as Vulnerable or Near Threatened rather than the current Least Concern or Low Risk status.

**Zisadza-Gandiwa, P., Gandiwa, E. and Muboko, N. 2016. Preliminary assessment of human-wildlife conflicts in Maramani Communal Area, Zimbabwe**. African Journal of Ecology (doi: 10.1111/aje.12282).
**Summary**: very little on crocs but includes relative percentages of perceptions of how much damage various species cause, including Nile crocodiles.

## MADAGASCAR

**Behra, O. 1996. Reports of crocodiles attacks on people in Madagascar 1990 to 1996**. Newsletter of the *Crocodile Specialist Group,* 15(3):3–4.

**Maheritafika**, H.M.R., Robsomanitrandrasana, E., Rabesihanaka, S., Rafenomanana, F., Ravaoarimalala, A., Andrianjaratina, L., Manolis, C. and Lippai, C. **2016. Preliminary assessment of human-crocodile conflict in Madagascar**. Newsletter of the Crocodile Specialist Group, 35(1) 19-21.
**Summary**: Like many range states for *Crocodylus niloticus*, human-crocodile conflict (HCC) is a significant management issue in Madagascar. Here, we present a preliminary assessment of crocodile attacks, to better understand the distribution and cause of attacks.

**Rakokotondrazafy, A.M.NA., 2009. Impacts du conflit entre homme et crocodile sur la population de crocodiles sauvages à Madagascar.** In Proceeding of 1st Workshop of the West African Countries on Crocodilian farming and conservation 13-15 November 2007, La Tapoa Regional Parc W, Niger, pp.65-70. IUCN, Gland, Switzerland.

Anglers ignoring safety advice, St Lucia Estuary, South Africa (photo by Tony Pooley)

## Americas and the Caribbean

Records are reasonably good for the U.S.A., where *Alligator mississippiensis* is distributed across the southern states from Texas to North Carolina. The majority of attacks are recorded in Florida, followed by Louisiana, Mississippi and Georgia. The American crocodile (*Crocodylus acutus*) occurs in southern Florida, is possibly increasing its range, and is quite capable of attacking humans.

## USA

**General resources**

**Florida Fish and Wildlife Service Commission**. Living with crocodiles and alligators. Includes a variety of resources, available here https://myfwc.com/conservation/you-conserve/wildlife/gators/

**Papers and theses**

**Dutton, H.J.,** Waller, J.E., Carbonneau, D.A., Hord, L.J., Stiegler, S.G., Woodward, A.R., Brunell, A.M., Carter, C.C., and Delaney, J.P. **2014. Florida's Alligator Management Program: An Update 2002-2014.** 2014. In Proceedings of the 23rd Working Group Meeting of the IUCN Crocodile Specialist Group, pp.60-71. IUCN, Gland, Switzerland.
**Abstract**: Florida's Alligator Management Program has developed around the premise that the economic value derived from consumptive use of Florida's alligator (*Alligator mississippiensis)* resource can provide economic incentives to conserve alligators and preserve their wetland habitat. The expansion of management programs and growth of an industry dependent on the alligator resource has provided a constituency group to serve as advocates for wetland conservation. The major objectives of the program are to implement sustained alligator harvest programs while optimizing the economic, aesthetic, and ecological values of alligators as a renewable natural resource. By emphasizing these values, not only are there incentives for conservation of the alligator, but also the wetland ecosystems they inhabit. The intent of this paper is to provide the current status of this unique and comprehensive management program relative to the last update provided to Crocodile Specialist Group members in 2002 (Dutton et al. 2002).

**Eversole, C.B., Henke, S.E., Ogdee, J.L., Wester, D.B., Cooper, A.. 2014. Nuisance American alligators: an investigation into trends and public opinion**. Human - Wildlife Interactions 8(1): 5-21.
**Abstract**: The population rebound of the American alligator (*Alligator mississippiensis*), with the rapid growth of populations throughout its range, has caused an influx of human–alligator conflicts. We quantified 5,838 nuisance alligator reports from 2000 to 2011 to develop more site-specific strategies of management and to determine where management should be focused to minimize the conflict. We also surveyed the general public's attitude toward and knowledge of alligators (n = 98) as a technique to better understand human dimensions of nuisance alligator management in **Texas**.

**Gross**, B.A., Patton, Z., Baecher, A.J. and Densmore III, L.D. **2018. Evaluation of nuisance alligator management in the south-eastern United States and examination of human-alligator conflicts (abstract).** In Proceedings of the 25th Working Group Meeting of the IUCN Crocodile Specialist Group, p.134.
**Abstract**: The American alligator (*Alligator mississippiensis*) is an iconic North American species, a keystone predator, and an important part of many state economies. As human development encroaches into more alligator habitat, conflict between *A. mississippiensis* and humans becomes inevitable and a necessary aspect of regulation for the state wildlife departments that fall within the alligator's range. Through communication with state natural resource departments dealing with alligators, extensive review of incidents documented by those departments and examination of recorded human-crocodylian interactions in the United States as a whole, this investigation seeks to better understand the current nature of human-crocodylian conflict and those programs that must deal with these conflicts. Investigation of these issues has indicated that improved nuisance alligator data collection upon immediate management of a nuisance individual, implementation of

more intentional communication of program effectiveness, and a push toward cooperation between the programs of multiple states may lead to the development of more effective *A. mississippiensis* management programs.

**Hayman, R.B**., Harvey, R.G., Mazzotti, F.J., Israel, G.D. and Woodward, A.R. **2014. Who complains about alligators? Cognitive and situational factors influence behavior toward wildlife**. Human Dimensions of Wildlife: An International Journal 19(6): 481-497.
**Summary**: Understanding perceptual and situational factors underlying nuisance complaints can help managers maintain carnivore populations while mitigating conflicts with people. Our study uses data from a mail survey (N= 467 complainants about nuisance alligators, and N= 669 random Florida residents) and a three-step binary logistic regression analysis to examine how general attitudes, specific beliefs, and situational factors influence the behavior of reporting nuisance alligators.

**Hayman, R.C., 2011. Opinions, attitudes, and risk perceptions about American alligators (*Alligator Mississippiensis*) in Florida**. MSc Thesis, University of Florida.

**Hayman, R.B.**, Mazzotti, F.J., Israel, J.D., Brennan, M.A., Harvey, R.G., Woodward, A.R. **2010**. **Attitudes, knowledge, and risk perceptions about alligators in Florida (abstract)**. In: Crocodiles. In Proceedings of the 20th Working Meeting of the Crocodile Specialist Group, p.47. IUCN, Gland, Switzerland.
**Abstract**: As American alligator (*Alligator mississippiensis*) populations in Florida have recovered from depressed levels in the 1960's, human-alligator conflicts have increased. Maintaining populations of potentially dangerous wildlife species at levels consistent with human desires can be a challenge. The Florida Fish and Wildlife Conservation Commission's Alligator Management Program (FWC) has previously conducted surveys of public opinions about alligators, and the purpose of this study was to gauge current public attitudes, knowledge, attitudes and risk perceptions about alligators. In the summer of 2009, we mailed questionnaires to 2,600 randomly selected Florida households and 1,000 households that had reported a complaint about a nuisance alligator to FWC within the previous year. We received 1,175 completed questionnaires. Forty-four percent (n=510) of respondents reported having requested that a nuisance alligator be removed, while 56% (n=644) reported never having made such a request. We found differences between nuisance complainants and noncomplainants in knowledge levels, attitudes, nuisance beliefs, and risk perceptions associated with alligators. Understanding the differences in these measures between groups can help FWC tailor management strategies for alligators in Florida.

**King, R. and R. Elsey, 2014. Louisiana's nuisance alligator program.** In Proceedings of the 23rd Working Group Meeting of the IUCN Crocodile Specialist Group, pp.163-181. IUCN, Gland, Switzerland.
**Abstract:** The Louisiana Department of Wildlife and Fisheries manages the American alligator (*Alligator mississippiensis*) as a commercial, renewable natural resource. The goal of the Department's alligator program is to manage and conserve Louisiana's alligators as part of the state's wetland ecosystem, providing benefits to this keystone species, thus aiding the fish and wildlife that depend upon alligators. The Department's sustained use program is one of the world's most successful conservation efforts. This success has increased the state-wide alligator population, but because of this success, the occurrence of human – alligator conflict has also increased state-wide. The Department commonly receives over 2,000 nuisance alligator complaints annually. Approximately 3,000 nuisance alligators are harvested in peak years, and an additional number of smaller sized nuisance alligators are relocated annually by state licensed nuisance alligator hunters. Habitat loss and human encroachment are increasing in Louisiana, and as the human population increases, so will the occurrence of human – alligator conflict. The nuisance alligator program continues to strive to minimize alligator and human conflicts throughout the state. The analysis of the 2012 – 2013 nuisance alligator data will be discussed. Number and location of complaints received by parish, month, and nuisance hunter will be reviewed. The number and size of alligators harvested or relocated and the time to complete the complaint assignment will be analyzed. Management implications developed from this analysis will also be discussed.

**Langley, R.L. 2005. Alligator attacks on humans in the United States**. Wilderness and Environmental Medicine 16(3): 119-124. *See next entry for update.*
**Summary:** This study provides information on alligator attacks reported in the United States as well as infections that are commonly associated with alligator bites. **Methods**. In order to collect information on the number of alligator bites, nuisance calls, and estimated alligator population of each state, calls were made to wildlife offices in all southern US states, and an online search for lay press articles was performed. Detailed information was available from Florida and is presented regarding the types of injuries and the activities of the victims at the time of the injuries. **Results**. From 1948 to August 1, 2004, 376 injuries and 15 deaths have been reported in the United States as a result of encounters with alligators. The number of nuisance calls as well as the alligator population is increasing. **Conclusions**. As the human population encroaches on the habitat of alligators, attacks and nuisance complaints increase. A uniform reporting system among states should be developed to obtain more complete information on alligator encounters.

**Langley, R.L., 2010. Adverse encounters with alligators in the United States: an update.** Wilderness & Environmental Medicine, 21, 156–163.
**Objective.** Severe injuries and fatalities can occur from an alligator attack. Encounters with alligators appear to be increasing in the United States. This review provides information from alligator attacks reported in the United States as well as infections that may occur after an alligator bite.

**Powell, G.,** Versluys, T., Williams, J., Tiedt, S., Pooley, S. **2020. Using environmental niche modelling to investigate the importance of ambient temperature in human-crocodilian attack occurrence for two species of crocodilian**. Oryx (in press).
**Abstract**. Crocodilian attacks follow a seasonal pattern in many regions, but there has been limited analysis of the relationship between attack occurrence and fine-scale contemporaneous environmental conditions. We use methods from environmental niche modelling to explore the relationships between attacks on people and abiotic predictors at a daily temporal resolution for the Nile crocodile *Crocodylus niloticus* in South Africa and Eswatini (formerly Swaziland), and the American alligator *mississippiensis* in Florida, USA.
Full description in South Africa section.

**Pratt, E.N. 2021. Analysis of Drivers of Spring Alligator Hunting in Texas and Policy Implications**. MSc thesis, Texas State University, San Marcos, Texas. Available here
**Summary**: we applied the principle-policy paradox (PPP) and potential for conflict index (PCI2) to a case study on American alligator (*Alligator mississippiensis*) hunters in non-core counties in Texas. 25 We surveyed 318 spring alligator hunters who had legally taken an alligator within the last five years and asked them to evaluate and indicate the level of acceptability of proposed management actions regarding the spring alligator hunting season. Results indicate that spring alligator hunters strongly oppose the removal of the spring hunting season and alternative management action show a lack of consensus among hunters. These results demonstrate that hunters exhibit a paradox between concern for alligator populations and sustainability, and policy acceptance to help achieve these conservation goals. Hunters obviously want healthy alligator populations so as to be able to continue hunting, but at the same time they may not be in favor of policies that curtail or limit hunting. We conclude that policy managers, specifically Texas Parks and Wildlife Department (TPWD) should seize this opportunity to work with hunter cognitions of alligators to introduce a policy that has positive impacts on both alligators and future alligator hunters.

**Smithem, J.L., Mazzotti, F.J., 2008. Risk perception and acceptance of the American Crocodile (*Crocodylus acutus*) in South Florida**. Florida Scientist, 71(1): 9–22.
**Summary**: This study used a self-administered questionnaire (n=249) to examine factors that affect risk perceptions and acceptance of the American crocodile (*C. acutus*) in south Florida. … Results indicate that residents and visitors who have the potential to encounter an American crocodile generally have low risk perceptions of, favourable attitudes toward, and high acceptance capacity for the species.

**Woodward, A.,** Leone, E.H., Dutton, H.J., Hord, L., and Waller, J.E. **2014. Human alligator conflict in Florida, USA**. In Proceedings of the 23rd Working Group Meeting of the IUCN Crocodile Specialist Group, pp.182-199. IUCN, Gland, Switzerland.
**Abstract:** We evaluated the trend of American alligator (*Alligator mississippiensis*) bites during 1971-2013 and examined patterns associated with bites on humans in Florida documented during 1948-2013. We excluded provoked bites and used 307 non-provoked and 55 unintentionally provoked bites for our analyses. Alligator bites in Florida appear to be feeding attempts, although in just over half of the incidents, the event consisted of a single bite followed by a release, suggesting that alligators were unsure about their prey in these cases. The risk of alligator bite can be contained by selectively removing problem alligators and continuing education of humans likely to interact with alligators. Increasing harvest pressure of alligators in human residential and high recreational use areas may be the only means of significantly reducing the risk of alligator bites.

**Woodward**, A.R., Leone, E.H., Dutton, H.J., Waller, J.E. and Hord, L. **2019. Characteristics of American alligator bites on people in Florida**. The Journal of Wildlife Management, 83(6)**:** 1437-1453.
**Abstract**: Human-American alligator (*Alligator mississippiensis*) conflict in Florida, USA, has increased since the early 1970s, along with the recovery of the American alligator population. To better understand factors contributing to the risk of people being bitten by free-ranging alligators in Florida, we evaluated the trend of alligator bites during 1971-2014 and examined characteristics associated with bites on people documented during 1948-2014. We classified 372 bites as either unprovoked or unintentionally provoked and used these in further analyses. We looked at major injuries, bites p.a., bites per Florida resident, changes in frequency of fatal attacks over 1971-2014, monthly frequency of bites (in relation to mean max and min temperatures, and testosterone concentrations in adult male alligators), locations of bites, and demographics of bite victims (residents or visitors, age and gender, location of attacks, size of alligators responsible for bites. The risk of alligator bites can be reduced by educating people likely to interact with alligators and by selectively removing problem alligators in human residential areas and water bodies used regularly by people for swimming, wading, and shoreline activities.


Perran Ross, Payne's Prairie, Florida

## Latin American & Caribbean

As is the case for Africa, we know there are attacks occurring in many more regions than we have published data for. For the Caribbean, we have little published data for Cuba, Puerto Rico, Jamaica and Trinidad, though we know that negative interactions occur there. Mexico is the regional standout country for amount of recorded attacks, and also publications and management interventions. Other Central American countries with data and increasing trends include Belize, Costa Rica and Panama, and Colombia in South America. Countries with concerning trends but little data include Honduras and Guyana.

**General papers**

**Pooley S, Siroski PA, Fernandez L, Sideleau B, Ponce-Campos P. 2021. Human–crocodilian interactions in Latin America and the Caribbean region**. Conservation Science and Practice. 2021;e351. https://doi.org/10.1111/ csp2.35
**Summary**: Because there is little information on specific situations across this vast and complex region, in 2018 we initiated a biannual questionnaire survey to establish a reporting network. This article summarizes the findings of surveys conducted in 2018 and 2020. We triangulated this feedback with croc attack data, and consultation with regional experts, to produce this very preliminary overview. We identify trends in negative human–crocodilian interactions at country level, the most reported causes of these, and identify the key species and regions of concern. We surveyed attitudes to management policies and responses to negative interactions including direct action and outreach activities. We acknowledge knowledge gaps, and motivate for improved regional cooperation with regard to policies and management (notably monitoring and evaluation) and data collection and sharing.

The IUCN CSG Steering Committee meetings include regional summaries (minuted), touching on HCC where relevant, for example:

**Siroski, P.**, Llobet, A. and Velasco, A. 2018. Crocodile Specialist Group Steering Committee Meeting: Latin America and the Caribbean, Universidad Nacional del Litoral, Santa Fe, Argentina, 6 May.

**Velasco, A. 2012. Latin America & Caribbean Regional Report.** Steering Committee Meeting, National Museum of the Philippines, Manila, 21 May 2012.
**Summary**: notes on HCC in region specifically Panama, and the table: Summaries of fatal and non-fatal attacks (2007-February 2012) with data from Brandon Sideleau, Armando Rubio and Juan Bolaños.

## The Caribbean

**CUBA**

There are some notes and historical information in:
**Alonso-Tabet, M**., Ramos, R., Rodriguez-Soberon, R., Thorbjarnarson, J. B., Belliure, J., & Berovides, V. **2014**. ***Los Crocodylia de Cuba***. Universidad de Alicante, San Vicente del Raspeig, Cuba. 340 pages.

**JAMAICA**

**Henriques, L. 2012. Jamaican crocodile conservation.** Newsletter of the Crocodile Specialist Group, 31(3), pp.6-7.

## Central America

There are records from across Central America from Mexico to Panama, with most attack recorded in Mexico, Costa Rica and Panama, but we lack publications on the situations in Guatemala, Honduras, El Salvador and Nicaragua. Most recorded attacks involve the American crocodile (*Crocodylus acutus*), with attacks also recorded for Morelet's crocodile (*C. moreletii*), though there are also records for the spectacled caiman (*Caiman crocodylus*).

**Regional**

**Ponce, P.**, Sideleau, B. and Ross, J.P. **2018. Human-crocodile conflicts with American and Morelet's Crocodiles** (**abstract**).). In Proceedings of the 25th Working Group Meeting of the IUCN Crocodile Specialist Group, p.208.
**Abstract**: Human-crocodile conflict (HCC) with American and Morelet's crocodile have been updated to 2014 with focus on Mexico. Here we analyze information of both species along their distribution up to September 2017, including the most common factors that influences HCC of both species. American crocodile accumulated 344 cases in 13 countries since late 1950s, being the fifth more conflictive species in the world, and the second in the American continent, after the American alligator, the fourth in the world. Three countries accumulate the highest percentage (87.5%) of *C. acutus* in the 13 countries, Mexico the highest (62.9%), Costa Rica (17.6%) and Panama (7.0%). Morelet's crocodile have 111 cases recorded in three countries since early 1970s and Mexico accumulate 76.6% of total cases.

**Sigler**, L., & Gallegos M., J. **2017**. **El conocimiento sobre el cocodrilo de Morelet *Crocodylus moreletii* (Duméril y Duméril 1851) en México, Belice y Guatemala**. México, D.F. 216pp.
**Summary**: the book includes a chapter on human-crocodile interactions including crocodile attacks and killing of Morelet's crocodiles throughout its range.

**BELIZE**

**Chenot-Rose, C. 2011. American crocodile population and habitat viability assessment and conservation in Ambergris Caye, Belize**. Newsletter of the Crocodile Specialist Group, 30(1), pp.16-17.

**Finger AG,** Rainwater TR, McMurry ST, Platt SG, Rosado N, Windsor M, Mazzotti FJ. **2002. Human-crocodile conflict in Belize: a summary.** *Crocodiles: Proceedings of the 16th Working Meeting of the IUCN-SSC Crocodile Specialist Group.* October 7–10, 2002; Gainesville, FL. Gland, Switzerland: IUCN; 2002:198–199.
**Summary**: Two species of crocodiles are indigenous to Belize, Morelet's crocodile (*Crocodylus moreletii*) and the American crocodile (*Crocodylus acutus*) (Groombridge, 1987). While anecdotal testimony suggests crocodile attacks on humans in Belize have historically involved American crocodiles, the majority of the documented cases appear to involve only Morelet's crocodiles. Includes a brief review of historical attacks. Following a fatal attack in a canal in Belize City in August 2001, media and concerned citizens stressed the need for a nationwide crocodile management strategy in Belize. As a result, the Belize government contacted the Florida Association of Volunteer Agencies for Caribbean Action who in turn contacted Dr Frank Mazzotti to make assessments and recommendations for the mitigation of human-crocodile conflict.

**Garel, A.,** Rainwater, T.R. and Platt, S.G. **2005. Triathlon champion attacked by crocodile in Belize.** Crocodile Specialist Group Newsletter 24(2): 8-10.

**Rice, B. 2017. Illegal Wildlife Hunting and Trade in Southern Belize: An Assessment of Impacts and Drivers.** Capstone Collection. 3057. (http://digitalcollections.sit.edu/capstones/3057).
**Abstract**: The use of wildlife as a resource is a common practice in all countries around the world, however, illegal activities are contributing to various environmental and social altercations amongst the involved communities and individuals, both directly and indirectly. To date, most of the focus is on the African continent and Southeast Asia, with less attention on other biodiverse locations, such as Central and South America. Information about illegal wildlife hunting and trade is increasing in Central and South America but the data is still lacking in both qualitative and quantitative analysis. In Belize, previous studies have examined the legal and social aspect of wildlife hunting and trade, but there remains a void of information regarding the activities. Herein, this study explored some of the causation and subsequent results of illegal hunting and trade in Southern Belize through semistructured interviews with conservation practitioners and hunters.

Eight participants mentioned crocodiles (*Crocodylus acutus* or *Crocodylus moreletii*) as the species that is hunted the most that does not have a hunting season; participants did not specify a species.

**Sideleau, B. 2014. Details of a fatal attack on a human by a Morelet's crocodile (*Crocodylus moreletii*) in Belize**. Crocodile Specialist Group Newsletter 33(2): 29-30.

**COSTA RICA**

**Carrillo, R.N., 2013. Interacción entre el ser humano y el cocodrilo americano (*Crocodylus acutus*) en la cuenca Del Río Tempisque, Guanacaste, Costa Rica**. MSc Thesis, Universidad Nacional, Costa Rica.

**Barrantes LD. 2010. Analysis of crocodile attacks in Costa Rica, 1990-2009**. Crocodile Specialist Group Newsletter 29(2): 14.

**Carrillo, R.N., Porras-Murillo, L.P. 2014. Human-Crocodile Interaction in the Great Tempisque Wetland, Costa Rica**. In Proceedings of the 23rd Working Group Meeting of the IUCN Crocodile Specialist Group, pp.325-331. IUCN, Gland, Switzerland.
**Abstract:** Great Tempisque Wetland, habitat of the American crocodile (*Crocodylus acutus*), has been subjected to human pressure, which has dramatically reduced the habitat available for this species. However, the population of *C. acutus* has increased over the last 15 years, and the probability of encounters between crocodiles and people also increases. We evaluated the interaction between human and crocodile from a qualitative approach of social research to determine human-crocodile interaction in the communities surrounding the area. The interaction between humans and crocodiles are leading to a conflict in 22 communities.

**Porras Murillo, L.P., Cambronero, E.M. 2020. Analysis of the Interactions between Humans and Crocodiles in Costa Rica**. South American Journal of Herpetology. 16(1): 26-33.
**Summary**: *Crocodylus acutus* and *Caiman crocodilus* are under habitat pressure due to human expansion. Coupled with the simultaneous growth of the crocodile population, this has increased crocodile-human interactions. This study systematized and evaluated the interactions between crocodiles and humans in Costa Rica. Historical information was collected: 99 records (1990-2017) were found from press reports and the Integrated System for Processing Environmental Complaints of the Ministry of Environment and Energy (SITADA). The Fire Department recorded 123 events in 2017. Most interactions occurred during the day, and in the Central Pacific, followed by the Caribbean and then the South Pacific. The country needs to create a national database of interactions and to encourage individuals to report their interactions. Further research should continue to analyze the data for trends with the goal of building recommendations to prevent an increase in negative interactions.

**Sandoval-Hernández, I.,** Duran-Apuy, A. and Quirós-Valerio, J. **2017. Activities that may influence the risk of crocodile (*Crocodylus acutus*: Reptilia: Crocodilidae) attack to humans in the Tempisque River area, Guanacaste, Costa Rica**. *UNICIENCIA* 31(1): 13-22.
**Abstract**: One of Costa Rica's largest populations of crocodiles is located at the Tempisque River. The species is threatened by habitat loss and poaching; but its populations have grown due to the protection given by law. The research was conducted in Guanacaste, Costa Rica. We made a characterization of popular knowledge, activities and perceptions of 374 residents. The most dangerous activities done are recreation, swimming and fishing. The risk of attack and the crocodiles' density in the river are not recognized. Also, a lack of knowledge about the natural history and ecology of the species is shown. The reasons for attacks are: the aggressiveness of the animals and their density. There are differences in the responses on the reasons of the attacks. Generally, the crocodile perception is unfavourable. (Summary from *CSG Newsletter* 36(1): 13.)

**Sandoval, I. and Bonilla, F. 2018. Costa Rican universities train rescue teams in crocodile management.** Crocodile Specialist Group Newsletter 37(4), p.12.

News item on training provided by university researchers for authorities attending 'emergencies' generated by *Crocodilus acutus* in Costa Rica.

## MEXICO

**Protocol**

**Villegas, A**., Esquivel, A.A., Escobedo-Galván, A.H., et al. **2018. Protocolo de Atencion a Contingencias Humano-Crocodilianos**. Secretaría de medio Ambiente y Recursos Naturales / Comisión Nacional de Áreas Naturales Protegidas, Mexico. 44 pages. Available via ResearchGate.

**Papers**

**Aguilar-Olguín, S., Rivera-Rodríguez, M.C., Hernández-Hurtado, H., Ramírez-Martínez, M.M. 2021. Local** k**nowledge on *Crocodylus acutus* (Reptilia: Crocodylidae) in coastal zone of Colima, Mexico** [Conocimiento local sobre Crocodylus acutus (Reptilia: crocodylidae) en la zona costera de Colima, México]. Caldasia 43(1): 117-125

**Summary**: local knowledge about crocodiles was studied on Colima's coastal zone utilizing semi-structured interviews. These interviews were divided into five sections: biological knowledge, human-crocodile interaction, crocodile attacks, exploitation, and general perception. Thirty interviews were done. Participants included those involved in fishing, tourism, trading, mechanical workshop workers, fish farming, ranchers and elementary school teachers. Less than 50 % have a biological knowledge of crocodiles. Interest in utilizing the species as a tourist draw was shown, which could promote crocodile conservation in the area. We propose capacitation and awareness to groups that work or live around the lagoons to establishing integrational conservation plans and management processes.

**Delgado, A.R.,** Andrade, A., Torres, E., Solis, L., Reyes, C., Tello, L.A., **2014. Current records of the Human-Crocodile Conflict in Mexico (abstract)**. In Proceedings of the 23rd Working Group Meeting of the IUCN Crocodile Specialist Group, p.396.

**Abstract**: In Mexico there are three species of crocodilians but only *Caiman crocodilus* is the one free of unfortunate records. From 2010 to date, 46 reports have been obtained from health institutions, press and regional authorities. *Crocodylus acutus* is the species mostly involved with 34 interactions (74%) including two fatalities, while Morelett's crocodile had 12 interactions (26%). Data is provided for the following states (from highest to lowest incidence): Jalisco; Michoacan; Quintana Roo; Tamaulipas; Oaxaca; Nayarit; Guerrero; Chiapas; Colima; San Luis Potosí; and Tabasco, Veracruz and Campeche. There is now the National Attention Protocol for Conflicts with crocodiles in Mexico coordinated by the General Direction of Wildlife from SEMARNAT since 2013. This protocol involves federal, state and municipal authorities, researchers, and Mexican crocodile handler. In Jalisco, crocodile's dental impressions are made in cardboard to estimate the total length of the animal involved and to compare with the people wounded.

**Cupul-Magaña** FG, Rubio-Delgado A, Reyes-Núñez C, Torres-Campos E, Solís-Pecero LA. **2010**. **Ataques de cocodrilo de río *Crocodylus acutus*) en Puerto Vallarta, Jalisco, México: presentación de cinco casos (American crocodile (*Crocodylus acutus*) attacks in Puerto Vallarta, Jalisco, México: Presentation of five cases).** Cuadernos de Medicina Forense, 16(3): 153-160. Available at: http://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S1135-76062010000200003

**Abstract:** Five cases of non-fatal crocodile attacks on people in the region of Puerto Vallarta, Jalisco, Mexico (2007-2010) are presented. In four cases the victim suffered amputation of upper or lower extremity, but only in one case the victim resulted in bitten on the arm. With the documentation of these five cases, the number of attacks by American crocodile (*Crocodylus acutus*) in the coast of the Mexican state of Jalisco for the past 52 years is between 30 and 31. The results show an increase in crocodile attacks. We describe the cases and suggest possible explanations for the crocodile's attacks.

**García-Grajales, J., Delgado, A.R., González, C.C., Buenrostro-Silva, A. 2021. New records of human-crocodile interactions in Mexico from 2018 through the first half of 2021**. [Nuevos registros de interacciones humano-cocodrilo en México desde 2018 hasta el primer semestre de 2021].
Revista Latinoamericana de Herpetologia 4(2): 153-160. [Article in English]
**Summary**: Provides 51 new records of human-crocodile (HC) interactions in Mexico from 2018 through the first half of 2021. The states of Tamaulipas and Quintana Roo on the Gulf of Mexico represented 40% of the cases, while Oaxaca and Nayarit on the Mexican Pacific coast represented 22% of the cases. There were more male victims than females. Seven cases were fatal, and 44 non-fatal.

**García-Grajales J**, Buenrostro-Silva A. **2019. Assessment of human–crocodile conflict in Mexico: patterns, trends and hotspots areas**. *Marine and Freshwater Research,* 70(5), 708-720.
https://doi.org/10.1071/MF18150 available via Researchgate.
**Abstract**: A compilation of the publicly available data on incidents of crocodile attacks on the Gulf of Mexico and Mexican Pacific coast from January 2000 to the first days of January 2018. Of the recorded unprovoked crocodile attacks (n = 149) on humans in Mexico, 102 cases correspond to the Mexican Pacific coast and 47 to the Gulf of Mexico. The age of victims ranged from 19 to 40 years old. Three municipalities of high risk (hotspots areas) were Puerto Vallarta, Lázaro Cárdenas and Pinotepa Nacional in the Mexican Pacific coast, whereas, in the Gulf of Mexico, only Bénito Juárez was of high risk. To mitigate this conflict, it is necessary that local authorities in the high risk municipalities establish public-safety programs with the goal of raising awareness of the risk of crocodile attacks on the basis of information status and distribution of the crocodile population, linked to the extent of HC conflicts, as a first step for better management and risk mitigation.

**García Grajales, J. and Buenrostro Silva, A. 2018. Crocodile attacks in Oaxaca, Mexico: An update of its incidences and consequences for management and conservation**. Acta Universitaria 28 (Online First): 1-8.
**Summary**: This study updated analyses of the incidence of crocodile attacks on humans in Oaxaca and looked for patterns or trends that could have relevance to future conflict mitigation. Attack records were compiled from 2004 to 2017. The highest proportion of attacks and deaths occurred on the northwest coast in two periods of the year related to the nesting and rainy seasons. No seasonal differences existed in the number of crocodile attacks, or the mean number of attacks between years. Most attacks were related with fishing activity; male victims were much more common than female, and a higher proportion of fatal cases of victims were children (< 10 years). Essential baseline surveys, and public education about crocodile awareness and risks, were recommended.

**García-Grajales, J.**, **Buenrostro-Silva, B. 2015. Nota Científica: Apreciación local acerca del cocodrilo americano (*Crocodylus acutus*) en comunidades rurales del Parque Nacional Lagunas de Chacahua, (Oaxaca, México)**. Etnobiología, 31(1): 73-80. Article in Spanish.
**Abstract**: Directed interviews were conducted with the aim of learning about the appreciation of the American crocodile for the inhabitants of the communities surrounding the Lagunas de Chacagua National Park (Oaxaca). From January to June in 2012, 54 surveys were applied to three rural communities settled around the National Park. A quarter of respondents thought that there are only two species of crocodiles, another quarter that there is only one species, another quarter answered that they did not know about the existence of different types of crocodiles, with only 16.7% answering that there were three species in Mexico. Regarding the perception of their dangerousness, 56% consider that they are harmless, 39% stated that they are dangerous, 4% do not know the degree of danger and 2% consider that they can be both depending on the situation. Most respondents knew about the possibility of breeding crocodiles in captivity. Finally, most respondents did not recognize myths or legends regarding crocodiles.

**García-Grajales, J.**, Buenrostro-Silva, A., and Mata-Silva, V., **2014. New human-crocodile conflict incidents in Oaxaca, Mexico**. Crocodile Specialist Group Newsletter 33(2): 28-29.

**García-Grajales, J.**, Buenrostro-Silva, A. **2013. New record of a non-fatal attack by an American crocodile and geographic analysis of historical attacks in Oaxaca**. Crocodile Specialist Group Newsletter 32(4): 16-18.

**García-Grajales, J**, Buenrostro-Silva A, Brandon-Pliego, JD. **2008. Negative fatal interaction with American crocodile in Oaxaca, Mexico.** Crocodile Specialist Group Newsletter 27(3): 4-5.

**González-Desales, G.A.**, Sigler, L., García-Grajales, J., Charruau, P., Zarco-Gonzalez, M.M., Balbuena-Serrano, Á., Monroy-Vilchis, O. **2021. Factors influencing the occurrence of negative interactions between people and crocodilians in Mexico**. Oryx 55(5): 791-799.
**Summary**: This paper compiles information on negative interactions between people and the spectacled caiman *Caiman crocodilus* and American crocodile *Crocodylus acutus* from the Worldwide Crocodilian Attack Database for 1993-2018. It also investigates interactions through interviews with people in La Encrucijada Biosphere Reserve. It explored the relationship between the occurrence of negative interactions between people and *C. acutus* and the species' nesting season and abundance, and presence records. The frequency of negative interactions increases when anthropogenic activities occur close to nesting sites (< 30 km) and during the nesting season (February-September). In La Encrucijada, local inhabitants killed 30 crocodiles measuring > 2.5 m long in 2011-2012 following negative interactions with crocodiles. The frequency of negative human-crocodilian interactions was not correlated with abundance of crocodilians but was correlated with the number of presence records of crocodiles. Strategies to minimize negative interactions include warnings at nesting sites, increased monitoring of anthropogenic activities during crocodile nesting season, and management of nests to prevent destruction by people.

**Huerta-Ortega, SM**, Ponce-Campos P. **2002. Interaccio´n hombre-cocodrilo en la costa de Jalisco, Mexico.** In *Crocodiles: Proceedings of the 16th Working Meeting of the IUCN SSC Crocodile Specialist Group.* October 7–10, 2002; Gainesville, FL. Gland, Switzerland: IUCN; 2002:200–203.
**Abstract**: The coast of Jalisco has 52 water bodies and 35 have crocodile populations. The principal problem of the conservation of the species in this State is because the accidents happened with crocodiles. That is why it is important to study the problem to determine solutions for the extinction of these animals. To carry out this project we visited most of the water bodies where we made interviews to the local people trying to find people who had been attacked by a crocodile. We are registered 16 accidents since 1958, most of them with local people, adult crocodiles and related with fishing activities. Some of these accidents occurred during reproductive season. We found since 1993, the accidents are increasing because the raise the human activity near the estuaries as well as the growth of crocodile population. Therefore, it is necessary to begin environmental education with focus in the crocodile and the importance of its habitat in addition to inform them about the risks and how to avoid them.

**Peña-Mondragón**, J.L., Garcia, A., Rivera, J.H.V., Castillo, A. **2013**. **Interacciones y percepciones sociales con cocodrilo de río (*Crocodylus acutus*) en la costa sur de Jalisco, México** [Social interactions with perceptions crocodile (*Crocodylus acutus*) on the coast south of Jalisco, Mexico]. Rev. Biodivers. Neotrop. 3 (1): 37-41. Article is in Spanish.
**Abstract**: It was documented the perception towards river crocodiles (*Crocodylus acutus*, Cuvier 1807) of two rural communities in the southwest Jalisco coast. Through semi-structured interviews, it was found that the perception towards the species is negative; 85% of interviewees considered it a dangerous animal because it attacks people and cattle. Results show that inhabitants perceive that due to protection activities, the crocodiles' population size has increased. Attitudes of rejection lead to propose the elimination of crocodiles or that the owners of the Chamela-Cuixmala Biosphere Reserve look after them or lock them in. Some people mentioned the use of the animals as an alternative (55%). This study may contribute to the formulation of a strategy that promotes the conservation of the species through motivating changes in the perceptions, attitudes and valuation of the people that share the habitat with crocodiles. Environmental education actions are proposed that support these changes, at the same time that useful information is

disseminated for the protection of people from possible attacks, as well as to evaluate possible economic uses of the species.

**Ovando-Hidalgo N,** Pérez-Sánchez E, Rodríguez-Quevedo F, Zequeira-Larios C, Macías-Valadez Treviño ME. **2008. Assessment of human-crocodile interaction in the state of Tabasco, Mexico**. Crocodile Specialist Group Newsletter 27(4): 10-11.

**Ponce-Campos, P., 2014. Human-crocodile conflict with *Crocodylus acutus* in Mexico, with comments on *Crocodylus moreletii* and *Caiman crocodiles***. In Proceedings of the 23rd Working Group Meeting of the IUCN Crocodile Specialist Group, pp.246-25.
**Abstract:** Human-Crocodile Conflict (HCC) involving *Crocodylus acutus* is reported from 11 countries. Information is presented up to 2010 in order to determine the most common causes. HCC related to *C. acutus*, shows trends and percentages by age and sex of persons involved, and the most common causes of conflicts. Finally, hot spots, the most "dangerous" places for people, are presented. México has the greatest number of HCC reports, primarily along the Pacific coast where there is the greatest concentration of *C. acutus*. Costa Rica has the greatest number of deaths recorded, which may be related to the large size of *C. acutus*. Regression analysis shows increasing incidence over years ($P<0.05$), with a similar trend at a state (Jalisco), country (México), and species distribution level. The increase is suggested by the recovery of the species, habitat reduction and habitat use by humans. The highest proportion of incidents was associated with rustic and local fisheries, at least in México. Deaths by *C. acutus* are recorded from 10 countries. In México deaths are recorded from all of the coastal states where species is distributed, except Nayarit, where one possible death case is under investigation. Deaths related with *C. moreletii* in México are recorded from the gulf coast in Tamaulipas, Veracruz, and Quintana Roo. Deaths related to *Caiman crocodilus* have not been reported.

**Ponce, P.,** Ross, J.P., Carballar, J. Montes, O. and Muñiz, M. 2018. **Human-crocodile conflicts in Mexico: an update** (**abstract**). In Proceedings of the 25th Working Group Meeting of the IUCN Crocodile Specialist Group, p.133.
**Abstract**: Human-crocodile conflict (HCC) in Mexico was reported in 2014, including a brief history of the study of HCC and the first estimates of HCC. There were 153 cases reported up to early 2014, involving all three species found in the country (*C. acutus*, *C. moreletii* and *Caiman crocodilus chiapasius*) and data on undetermined species. We update the information for Mexico, reporting a total of 317 cases up to Sept 25, 2017. We report 212 cases involving *C. acutus* (66.8 %), *C. moreletii* 87 (27%), undetermined species 15 (4.7 %) cases and *Caiman crocodilus chiapasius* only three cases (0.95 %). We analyze the increasing numbers of cases reported at both national and state by state levels. We propose some factors involved with the HCC, related to American crocodile including the increasing numbers and the size of the crocodiles, and the intensity of human activities in the crocodile habitat like fisheries, tourism, habitat fragmentation, and destruction by the tourist sector.

**Ponce**, P., Ross, J.P., Vazquez, J.R.C., Charrau, P. **2018. Human-crocodile conflicts in Mexico with American and Morelet's crocodiles: when and why?** (**abstract**). In Proceedings of the 25th Working Group Meeting of the IUCN Crocodile Specialist Group, p.137.
**Abstract**: Human-crocodile conflicts (HCC) impact conservation of crocodylians because people fear and sometimes kill dangerous crocodiles. We report when and why HCC happens, with *Crocodylus acutus* (189 events) and, *C. moreletii* (84 events) in Mexico. We found that HCC is distributed unevenly through the year. Data for two species shows that 71.9 % of events occur from April to September (53% *C. acutus* and 18.9% *C. moreletii*) and 22.1% in cooler months and dry season. Both species have more HCC reported during the rainy season, coinciding in part with reproductive events. We analyzed the data by latitude, which affects the timing of reproduction in both species. *C. acutus* shows peaks during nesting; in June when hatchings are present, and in September during hatchling care. This pattern is more evident at higher latitudes >18No, not at latitude lower than 16No. We found the lowest values during *C. acutus* mating season. This might be

explained by stress and sex hormones, and body temperature. Our data suggest that *Crocodylus acutus* attacks are associated with territory defence (nesting and incubation), and parental care (hatching and hatchling care). HCC in *Crocodylus moreletii*, is not so clearly defined by reproductive events. This species attacks during mating to incubation, but less during hatching and the hatchling care period. HCC during reproductive events between species are not correlated statistically. Surprisingly, the incidence of fatal attacks is not correlated with the number of attacks. Human deaths in *C. acutus* are higher in September during the period of hatchling care. Deaths caused by *C. moreletii* occur during mating, nesting, are low when hatchlings are present and again higher during cooler and dryer months. We conclude that HCC varies due both to species behavior and to the different timing of life history events due to latitude and season and that overall analyses of HCC should take these factors into account.

**Sarmiento** M, E., Sigler, L. and Sarmiento M, Y. **2018. Human-Crocodile Interaction and the Problem of Illegal Use of Crocodile Populations in Biosphere Reserve "La Encrucijada", Chiapas, Mexico**. In Proceedings of the 25th Working Group Meeting of the IUCN Crocodile Specialist Group, p.50.

**Sideleau, B. 2015. Recent reports of fatal attacks on humans by crocodiles in Mexico**. Crocodile Specialist Group Newsletter 34(2): 21-22.

**PANAMA**

**Mendieta, C, Duarte, A. 2009. Ataque por animales acuáticos (tiburón y cocodrilo). A propósito de dos casos fatales en la provincia de Bocas del Toro (Panamá**) (Attack for aquatic animals (shark and alligator). Report of two fatal cases in the Bocas del Toro province (Panama)). Cuadernos de Medicina Forense**,** 15(58):309-15. Available at: http://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S1135-76062009000400006

**Abstract**: Attacks for aquatic animals, especially those due to shark and alligator, are very unusual. Shark attacks have been reported in countries such as Australia, South Africa, Brazil, Bahamas, Mexico and Puerto Rico, some with fatal consequences in the last five years. In Panama, reported cases from shark attack are scarce, being the last one in the city of San Carlos, while the last fatal case was reported in the year 1964. Alligator attacks, as in the previous case, are very scarce. Worldwide, the major part of the described cases are from Australia, Angola, India, Brazil and Florida. In Panama, the last fatal case occurred in the Miraflores lake in May 2007; however, the corpse was never found. In this paper, we described two cases of animal predation, from shark and alligator, occurred in the Bocas del Toro province (Panama) with the aim to recognize the pattern of bite injuries and the vulnerable anatomical affected areas.

## South America

This region has the world's greatest diversity of crocodilians, but reported attacks are limited to mostly two species: the American crocodile (*C. acutus*) and black caiman (*Melanosuchus niger*), though *Caiman crocodilus fuscus* are discussed. We have little published data, with publications recorded from only three countries despite CrocBITE records of attacks in Argentina, Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru and Paraguay. Conflicts occur over species which seldom attack humans, too, including many of the smaller caiman species.

**Regional**

**Marioni, B., Barão-Nóbrega, J.A.L., Botero-Arias, R., (...), Magnusson, W.E., Villamarín, F. 2021. Science and conservation of Amazonian crocodilians: a historical review**. Aquatic Conservation: Marine and Freshwater Ecosystems 31(5): 1056-1067.

**Summary**: Crocodilians have co-existed with humans throughout the Amazon basin for thousands of years, often having a strong cultural and economic influence on people's lives. Shifts in the socio-economic and

political reality of the Amazon basin during the last century have led crocodilian populations to face large variations in their numbers according to different levels of exploitation and strategies for their conservation. This article reviews the scientific knowledge obtained (1945-2019) on the biology, conservation and management for the four Amazonian crocodilian (caiman) species (*Caiman crocodilus*, *Melanosuchus niger*, *Paleosuchus palpebrosus* and *Paleosuchus trigonatus*). The paper argues that it is necessary to develop new ways to maintain healthy caiman populations through innovative management programmes. Sustainable harvesting of wildlife can promote conservation targets, especially initiatives based on community co-management. Some general guidelines for future management schemes are proposed.

**BRAZIL**

**Cook**, P., Hawes, J.E., Campos-Silva, J.V., Peres, C.A. **2022. Human-wildlife conflicts with crocodilians, cetaceans and otters in the tropics and subtropics**. PeerJ 9,e12688 **Available here: https://peerj.com/articles/12688/**
**Summary**: A review of current literature on conflicts with tropical and subtropical crocodilians, cetaceans and otters in freshwater and brackish habitats. Case study: conflicts with four freshwater predators in the Western Amazon: black caiman (*Melanosuchus niger*), giant otter (*Pteronura brasiliensis*), boto (*Inia geoffrensis*) and tucuxi (*Sotalia fluviatilis*). Of the species reviewed in this study, 37.5% had conflicts frequently documented in the literature, with the saltwater crocodile (*Crocodylus porosus*) the most studied species. Conflict severity had a positive relationship with species body mass, and a negative relationship with IUCN Red List status. In the Amazonian case study, we found that the black caiman was ranked as the greatest 'problem' followed by the boto, giant otter and tucuxi. Local fishers responded very differently depending on which of the four species were found entangled in nets. We make recommendations for future research.

**Freitas Filho, R.F., Piña, C. and Moulton, T.P. 2009. 'Our hidden enemy' and the irrational fear of crocodilians**. Crocodile Specialist Group Newsletter 31(2): 8-9.
**Summary**: Problems associated with encounters between humans and crocodilians are well known from the popular media to the scientific literature. Human populations in many countries report incidents with crocodilians. In the southern suburbs of Rio de Janeiro, the coastal lagoons of Marapendi and Tachas and their tributaries are home to the Broad-snouted caiman (*Caiman latirostris*). According to local residents this population appears to have increased in recent years. And concomitant with this and the increase in human population, the incidence of complaints and fear of incidents have risen markedly

**Haddad, V. Jr, Fonseca, WC, 2011. A Fatal Attack on a Child by a Black Caiman (*Melanosuchus niger*)**. Wilderness & Environmental Medicine, 22, 62–64.
**Summary**: We describe a fatal attack by a black caiman (*Melanosuchus niger*) on an 11-year-old child with comments on the reptile's aggression mechanisms and the conditions under which this kind of incident takes place in the Amazon region. [Attack occurred near the confluence of the Mamoré and Novo Pacaás Rivers, in Guajará-Mirim, a town in Rondônia State, Brazilian Amazon]

**Mascarenhas-Junior, P.,** Maffei, F., Muniz, F., Freitas-Filho, R.F., Gonçalves Portelinha, T.C., Campos, Z. and Bassetti, L.A.B. **2021. Conflicts between humans and crocodilians in urban areas across Brazil: A new approach to support management and conservation**. Ethnobiology and Conservation 10 (doi:10.15451/ec2021-12-10.37- 1-19)
**Abstract**: Crocodilian-human conflicts, caused especially by urban expansion and habitat destruction, have been considered one of the main threats to the conservation of these species worldwide. In Brazil, such conflicts have been documented with crocodilian species all over the country. This study identified 400 conflict events between humans and caimans within Brazilian cities between 2016 and 2021. Caiman latirostris (57.4%) was the most common species found in large urban centers in the northeastern and southeastern 36 regions. Most of the encounters (N= 250) were registered in the rainy season and the

rescues were mainly carried out by the environmental military police and fire brigades. The management protocols in the presence of crocodilians in urban areas have been outlined, to be carried out by the Municipal Environmental Secretariats to minimize animal stress and the risk of accidents in urban areas. The increasingly common interaction between humans and caimans in urban environments is an important alert to envisage best conducts for the coexistence between humans and crocodilians and shows the need to invest in public policies to mitigate the effects of cities on wildlife.

**COLOMBIA**

**Balaguera-Reina, S.A., Nidia Farfàn-Ardila. 2018. Are We Ready for Successful Apex Predator Conservation in Colombia? Human-Crocodilian Interactions as a Study Case.** Herpetological Review, 49(1): 5–12.
**Summary** (from the paper): studies regarding how the general public interacts both positively (i.e., pro-conservation, pro-sustainable use, pro-keeping them in the ecosystem) and negatively (i.e., against share space and resources, attacks on humans or domestic animals, crocodilians killed by humans) with crocodilians in Colombia are lacking. There is also a paucity of understanding about how the media relates to these species and how available information (via TV, websites, or newspapers) impacts human-crocodilian interactions (people's attitudes and behaviors towards crocodilians). Herein, we conducted a comprehensive review of scientific and non-scientific reports of interactions between humans and crocodilians in Colombia from 1984 to 2017. The time span was defined based on the oldest document found referring to human-crocodilians interactions. Our main objectives were to define and quantify, both spatially and temporally, interactions reported between humans and crocodilians in Colombia and discuss their implications in crocodilian conservation and the search for coexistence.

**Balaguera-Reina, S.A. 2012. Relaciones etno-zoológicas, hábitat y estructura poblacional de *Caiman crocodilus fuscus* en las Ciénagas Zapatosa y Costilla, Departamento del Cesar, Colombia** (Ethno-zoological relationships, habitat and population structure of *Caiman crocodilus fuscus* at Zapatosa and Costilla swamps, Cesar Department, Colombia). Herpetotropicos, 8 (1-2): 5-12. Available at: https://www.researchgate.net/publication/259873425_Relaciones_etno-zoologicas_habitat_y_estructura_poblacional_de_Caiman_crocodilus_fuscus_en_la_cienagas_de_Zapatosa_y_Costilla_Departamento_del_Cesar_Colombia
**Abstract:** A socio-cultural and ecological evaluation was undertaken in these swamps for the ex-situ restocking of *C. crocodiles fuscus*. Includes results from 59 interviews about level of knowledge of species' ecology, and conflicts between human community and caimans.

**Balaguera-Reina, S.A. 2012. Attacks and human-crocodile conflict in local communities in Colombia.** Crocodile Specialist Group Newsletter 31(2): 12-14.

**Balaguera-Reina, S.A. 2012. Ecology, population status and human interactions of *Crocodylus acutus* at Zapatosa and Costilla swamps, Cesar department, Colombia**. Newsletter of the Crocodile Specialist Group, 31(3), pp.7-9.

**Balaguera-Reina, S.A., González-Maya, J.F. 2010. Percepciones, conocimiento y relaciones entre los Crocodylia y poblaciones humanas en la Vía Parque Isla de Salamanca y su zona de amortiguamiento, Caribe Colombiano**. Revista Latinoamericana de Conservación, 1(1): 53-63. Available at: http://lajoc.procat-conservation.org/ojs/index.php/procat/article/view/46
**Abstract:** The understanding of the interactions between wildlife and human communities is important due to its potential impact on the conservation and human perceptions of key species. During August 2006, semi-structured interviews were carried out in order to evaluate the perceptions, knowledge, and relationships between crocodilians (*Caiman crocodilus fuscus* and *Crocodylus acutus*) and human communities in the Vía Parque Isla de Salamanca (VIPIS National Park) and its buffer zone located in the Magdalena department, Caribbean region of Colombia. A total of 67 interviews were conducted, demonstrating a broad knowledge about morphology, ecology and distribution within the community. Greater knowledge about the species

was found in older people (>40 years old) than younger people (< 30 years old) who also held more negative opinions of crocodilians. According to the data provided by inhabitants and fisherman it can be concluded that these species continue to be harvested, both directly (hunting) and indirectly (by-catch). In addition, conflict was reported, resulting from the competition for resources (fish and domestic fauna) and space. Most interviewees discussed the importance of these species from an economic perspective, while few recognized their ecological role.

**Morales-Betancourt**, M.A., Lasso, C.A., Paez, V.B., Bock, B.C. 2015. *Libro Rojo de Reptiles de Colombia*. 2015. Instituto de Investigacion de Recursos Biologicos Alexander von Humboldt, Universidad de Antioquia. Bogota, D.C., Colombia. 197 pages.
**Summary**: the section on crocodilians includes notes on human use and human-crocodile interactions in Colombia, for *Crocodilus acutus*, *C. intermedius* and *Melanosuchus niger.*

**PERU**

**Vásquez**, R.P., Vásquez, R., Matayoshi, P.A., Regal, F.G., Freitas, D.C., Garnica, C.P., & Tovar, L.A.N. **2017. Estudio poblacional de las especies de crocodílidos en el Perú**. Fundacion para el Desarrollo Agrario: 97 pages. **Summary**: includes some details of habits and use, and conflicts involving *C. acutus* in particular.

**VENEZUELA**

**Barros**, T.R. Rivas, G., Lander, A., Perozo, H. and Torres, L. **2011. Translocation of American crocodiles to northern Lake Maracaibo basin, Venezuela: minimizing conflict between people and crocodiles**. Newsletter of the Crocodile Specialist Group, 30(4): 9-10.

**Espinoso-Blanco, A**. & Vargas-Clavijo, M. **2014**. Los Crocodylia en el Patrimonio Zoocultural Venezolano: Implicaciones para el manejo y conservación de las especies. *Bol. Acad. C. Fis., Mat. Y Nat*., **74**(2), 15-27. Summary: the authors analyze socio-cultural relations of Venezuelans with the Crocodylia. They record expressions referring to these animals which have played a significant role in folklore. They are associated with power, strength, ferocity and respect. They identify a need to identify, understand and integrate these ethnozoological expressions into environmental policy and management of these species.

**Otto, B.E.** and Hoogesteijn, R. **2017. La caza comercial del Caimán del Orinoco, *Crocodylus Intermedius*, en Venezuela, 1894-1897, 1929-1963, considerando metodologías y relatos de la época** [The commercial hunting of the Orinoco Crocodile *Crocodylus Intermedius*, in Venezuela, 1894-1897, 1929-1963, considering methodologies and reports of the era.] Bol. Acad. C. Fís., Mat. y Nat. Vol. LXXVII Nos. 2-3 Abril-Septiembre: 16-28.
**Abstract**: The Orinoco crocodile (*Crocodylus intermedius*) was hunted intensively and commercially in Venezuela and Colombia in the early and mid-twentieth century, driving it almost to its extinction. It was abundant in the Llanos' rivers, but after the indiscriminate exploitation only small populations persist nowadays, being catalogued "in critical danger". The old experiences and hunting methods are reported according to bibliographical references and interviews of the former caiman hunters, known as "*caimaneros*", their abundance and dangerousness are also reported in these times. Importance is given to the rescue and dissemination of the ancient writings, stories, narratives and interviews of past epochs, which also constitute a little-known material of great interest and importance of this emblematic species of the Venezuelan Llanos.

## Australia and Oceania

Data is very good for Australia, and there has been much research interest in Timor Leste (with possible links to Australian croc emigrations). A significant gap is Irian Jaya and Papua New Guinea.

### AUSTRALIA

Most attacks involve the saltwater crocodile (*Crocodylus porosus*), though freshwater crocodiles (*Crocodylus johnstoni*) have been known to bite humans. The NT and QL governments keep good records and have in the past developed comprehensive management plans.

**General**

There are now dated, but potentially useful, overviews of crocodile management including human-crocodile conflict, in Western Australia, Northern Territory and Queensland, in **Crocodiles: Proceedings of the 17th Working Meeting of the IUCN Crocodile Specialist Group**.

Further, **Webb and Manolis' (1998)** book **Australian Crocodiles** (Reed New Holland, Sydney, Australia) provides useful background on the history of human-crocodile interactions including attacks in Australia.

For a study of relocation as a strategy for *C. porosus*, see: B. Walsh & P.J. Whitehead (1993). Problem crocodiles, *Crocodylus porosus*, at Nhulunbuy, Northern Territory: an assessment of relocation as a management strategy. In *Wildlife Research*. 20 (1): 127-135.

**Online resources**

**Northern Territory Government**, be Crocwise resources available at:
https://nt.gov.au/emergency/community-safety/crocodile-safety-be-crocwise

**Queensland Department of Environment and Science** crocodile safety videos, available at:
https://www.youtube.com/user/QldEHP/search?query=crocodiles

**Management Plans**

Anon, 2017. **Queensland Crocodile Management Plan**. Conservation and Biodiversity Policy Unit, Department of Environment and Heritage Protection, State of Queensland. Available at:
https://environment.des.qld.gov.au/__data/assets/pdf_file/0024/87711/wl-mp-croc-manage-plan.pdf

Anon. 2018. **Nature Conservation (Estuarine Crocodile) Conservation Plan 2018**. Conservation and Biodiversity Policy Unit, Department of Environment and Heritage Protection, State of Queensland. Available at: https://www.legislation.qld.gov.au/view/pdf/inforce/2018-09-21/sl-2018-0147

**Saalfeld**, K., Fukuda, Y., Duldig, T. and Fisher, A. **2016. Management Program for the Saltwater Crocodile (*Crocodylus porosus*) in the Northern Territory of Australia, 2016-2020**. Northern Territory Department of Environment and Natural Resources, Darwin. Available at:
https://nt.gov.au/__data/assets/pdf_file/0007/443581/crocodile-management-program.pdf

**Papers, Chapters and Articles**

**Brien, M., Taplin, L., Talmage, R., (...), Freeman, P., Joyce, M. 2021. The Suitability of Digital Video Surveillance and Multi-beam Sonar to Monitor Saltwater Crocodiles**. Acoustics Australia: 49(1): 43-52. **Summary**: This paper tested the reliability of digital video surveillance systems (DV) placed above water and multi-beam sonar (sonar) placed under water to detect and monitor saltwater crocodiles in a seminatural freshwater environment. A total of 29 crocodiles were detected within the study area using DV, and 28 with

sonar. Sonar recorded both entry and exit for all, while DV recorded both entry and exit for 15 crocodiles. The length of time that crocodiles were detected was longer on average for sonar. This reflected the time spent above (detected by sonar and DV) or below water (not detected by DV), as only sonar was able to detect crocodiles underwater. The use of sonar may provide a valuable management tool for detecting and monitoring saltwater crocodiles in areas frequented by people where there is a high chance of a negative interaction.

**Brien, M.L.,** Gienger, C.M., Browne, C.A., Read, M.A., Joyce, M.J. and Sullivan, S. **2017**. **Patterns of human-crocodile conflict in Queensland**: a review of historical estuarine crocodile (*Crocodylus porosus*) management. *Wildlife Research* 44(4): 281-290.
**Abstract**: The present study aimed to determine historical, temporal and spatial patterns of human-crocodile conflict in Queensland. The study used Queensland Government records of estuarine crocodile attacks (1971-2015), sightings by the general public (2003-2015), and removals and relocations for management purposes (1985-2015) to develop General Linear Models describing historical, temporal and spatial patterns. The highest number of attacks, sightings, removals and relocations occurred along the populated east coast between Townsville and the Daintree during wet season months (November-February). There have been 35 crocodile attacks in Queensland since 1971, mostly involving local people or regular visitors, specifically adult males. There has been an increase in the rate of crocodile attacks over time. The number of crocodile sightings has been increasing annually, while the number of crocodiles removed or relocated for management purposes (n= 608) has fluctuating widely each year. The level of human– crocodile conflict in Queensland is increasing, and this is likely to be a consequence of increasing human and crocodile populations. While conflict is highest during the wet season, estuarine crocodiles pose a threat to public safety year-round. With the increase in conflict, the ongoing management of estuarine crocodiles, through targeted removals in and around areas of higher human habitation and through education, is essential for ensuring public safety into the future.

**Brien, M. 2008. Queensland crocodile research and management program under fire.** Crocodile Specialist Group Newsletter 27(4): 14-15.

**Britton**, A. R. C., and Campbell, A. **2014. Open season on crocodiles is not the solution to attacks on people**. The Conversation. 21 August 2014. https://theconversation.com/open-season-on-crocodiles-is-not-the-solution-to-attacks-on-people-30722

**Campbell, H.A.,** Dwyer, R.G., Wilson, H., Irwin, T.R., Franklin, C.E., **2015. Predicting the probability of large carnivore occurrence: a strategy to promote crocodile and human coexistence.** *Animal Conservation*, 18(4), pp.387–395.
**Summary**: Informing when and where humans and large carnivores occupy the same space may reduce attack frequency and promote coexistence. Here, we demonstrate a methodology to better understand the spatiotemporal relationship between a population of large carnivores and humans. The carnivore of study was the estuarine crocodile *Crocodylus porosus*, a large semi-aquatic predator responsible for 705 recorded human attacks over the last 20 years. 84 individuals >2.5 m in length were implanted with an acoustic transmitter which emitted a coded pulse detected when in proximity to underwater hydrophones deployed throughout the river. Over 3 years, 24 of the tagged crocodiles were detected 269 times moving through a shallow-water area where humans frequently entered the water. The tagged crocodile presence was extrapolated to the population level, the results suggesting that between September and December, the probability of crocodile presence within the human entry zone was higher during darkness than during daylight. Human visitors confined their activity to shallow water during daylight hours, but no consideration was given to the significant rise in crocodile presence with season and tide. The observed patterns in crocodile and human behaviour exhibited parallels with historical incidences of crocodile attack.

**Caldicott, D.G.E.,** Croser, D, Manolis, C., Webb, G., Britton, A. **2005. Crocodile Attack in Australia: an analysis of its incidence and review of the pathology and management of crocodilian attacks in general**. *Wilderness and Environmental Medicine,* **16:**143-159.
**Abstract**: As both human and crocodilian populations expand, they increasingly encroach on each other's territories, bringing morbidity and mortality to both populations. This article reviews the medical and herpetological literature pertaining to injuries caused by crocodilians, and the patterns of saltwater crocodile attacks in Australia from 1971 to 2004 are analyzed. We examine the features of crocodilians that contribute to explaining their evolutionary success, as well as the potential hazard they pose to humans. Only by understanding their capabilities is it possible to mitigate the potential threat.

**Fijn, N., 2013. Living with Crocodiles: Engagement with a Powerful Reptilian Being**, *Animal Studies Journal*, 2(2), pp.1-27.
**Abstract:** As an animal, crocodiles loom large in the human imagination. Eco-philosopher Val Plumwood came to the realisation that for the crocodile she was food, merely a piece of meat. The intention of this paper is to instigate thought on how views can differ from the portrayal of the crocodile as a primitive monster. In northeast Arnhem Land, for individual Yolngu, whose clan totem includes the saltwater crocodile, or Bäru, this being is an integral part of social existence. I examine how Yolngu negotiate with the saltwater crocodile as a very real threat to human life; but also have a deep respect for the crocodile through a mutual essence and connection to country.

**Fukuda, Y.,** Manolis, C. & Appel, K. **2014. Management of human–crocodile conflict in the Northern Territory, Australia: review of crocodile attacks and removal of problem crocodiles**. *The Journal of Wildlife Management*, 78, 1239–1249.
**Summary**: We reviewed the historical records of attacks by saltwater crocodiles (*Crocodylus porosus*) and the removal of problem saltwater crocodiles in the Northern Territory of Australia. Despite the increasing rate of attacks over time, the Northern Territory's management program, and in particular the removal of problem crocodiles from urban areas, is considered to have reduced potential HCC. Public education about crocodile awareness and risks must be maintained.

**Fukuda, Y**., Manolis, C., Saalfeld, K., Zuur, A., **2015. Dead or alive? Factors affecting the survival of victims during attacks by Saltwater Crocodiles (*Crocodylus porosus*) in Australia**. PLoS ONE 10(5): e0126778.
**Summary**: We identified the factors that most effectively decide whether a victim is injured or killed in a crocodile attack by fitting generalized linear models to a 42-year dataset of 87 attacks (27 fatal and 60 non-fatal) by saltwater crocodiles (*Crocodylus porosus*) in Australia. The models showed that the most influential factors were the difference in body mass between crocodile and victim, and the position of victim in relation to the water at the time of an attack. The results suggest that culling programs targeting larger crocodiles may not be an effective management option to improve safety for children.

**Fukuda**, Y., Webb, G., Manolis, C. et al. **2019. Translocation, genetic structure and homing ability confirm geographic barriers disrupt saltwater crocodile movement and dispersal**. PLOS ONE, 14(8), e0205862
**Summary**: Translocated saltwater crocodiles (*Crocodylus porosus*) in the Northern Territory of Australia often return to their original capture sites, complicating management interventions aimed at reducing human-crocodile conflict. We used ARGOS satellite tracking devices on eight large males (5 translocated, 3 released at capture sites). Translocated crocodiles were more mobile than the controls, and moved at sea in the direction of original capture sites. However, a geographic structure, Cobourg Peninsula, prevented homing being achieved in all five cases. Genetic analysis demonstrated significant genetic structure across the coast and confirmed that Cobourg Peninsula contributes to genetic differentiation among populations along the NT coast.

**Hines, K.N., Skroblin, A., 2010. Australian freshwater crocodile (*Crocodylus johnstoni*) attacks on humans**. Herpetological Review, 41(4): 430-433.

**Summary**: In September 2008, two *C. johnstoni* attacked one of the authors (KNH) in the Throssell River of the Kimberley Region of W Australia in the presence of the second author (AS). This experience provides evidence contrary to the prevailing opinion that this species is harmless to humans. We have found additional accounts of *C. johnstoni* attacks on humans in northern Australia, but the difficulty we had in acquiring this information suggests that the widespread belief that *C. johnstoni* is harmless may in part be perpetuated through a lack of reporting, reluctance to lend credence to such accounts, and consequently a lack of media intention. These factors impeded a full understanding of this species' behaviour and jeopardize public safety.
Available at: http://www.kirstennaturetravel.com/wp-content/uploads/2013/03/Hines-Skroblin-2010.pdf

**Kofron, C.P., 2004**. **The Trial Intensive Management Area for Crocodiles: A Crocodile Removal Zone in Queensland, Australia**. Coastal Management, 32:3, 319-330.
**Summary:** From 1990 to 2001, there have been nine substantiated crocodile attacks on people in Queensland, resulting in one death and eight serious injuries. Human safety from crocodile attack is an issue of great public and political concern in Queensland. From May 1998 to June 2001, the Queensland Parks and Wildlife Service operated a trial crocodile removal program (the Trial Intensive Management Area for Crocodiles, or TIMAC) in the Cairns area, with a removal zone that extended 70 km along the coast. TIMAC was expanded to provide a problem crocodile response service throughout north Queensland. There were no crocodile attacks in the removal zone during the three-year trial program. At the request of local governments, the program became permanent in July 2001.

**Manolis, S.C. & Webb, G., 2013. Assessment of saltwater crocodile (*Crocodylus porosus*) attacks in Australia (1971–2013): implications for management**. In Proceedings of the 22nd Working Meeting of the IUCN–SSC Crocodile Specialist Group, 21–23 May 2013, pp. 97–104. IUCN, Gland, Switzerland.
**Abstract**: When Saltwater Crocodiles (*Crocodylus porosus*) were protected in Australia (1969-1974) after some 25 years of unregulated hunting, the population had been reduced to less than 5% of its former abundance and comprised mainly young (small) crocodiles. In the Northern Territory (NT), which holds the majority of the Australian population of Saltwater crocodiles, the population is considered to have recovered to pristine levels of abundance, but the average size of crocodile continues to increase. The frequency of crocodile attacks (102 since 1971) is increasing over time. Here, we analyse crocodile attack data and assess future management of Saltwater crocodiles in the NT within the context of reducing human-crocodile conflict, without jeopardizing conservation goals.

**Manolis, S.C. & Webb, G., 2014. Human-Crocodile Conflict in the Australia and Oceania Region**. In Proceedings of the 23rd Working Group Meeting of the IUCN Crocodile Specialist Group, pp.200-208. IUCN, Gland, Switzerland.
**Abstract:** The incidence of human-crocodile Conflict involving Saltwater crocodiles in the Australia-Oceania region is increasing, and it is becoming a key political issue in Timor Leste and the Solomon Islands, where the species is listed on CITES Appendix I, and where management programs have yet to be developed. Management programs need to reflect the cultural and social characteristics of these small island nations, as one model does not fit all.

**Manolis, C. 2011. Two crocodile attacks on boat occupants in Northern Australia**. Newsletter of the Crocodile Specialist Group, 30(2): 9.

**Nichols, T., and Letnic, M. 2008. Problem crocodiles: reducing the risk of attacks by *Crocodylus porosus* in Darwin Harbour, Northern Territory, Australia**. Pages 503–511 in J.C. Mitchell, R.E. Jung Brown and B. Bartholomew (editors), *Urban Herpetology. Herpetological Conservation*, Vol. 3 (Society for the Study of Amphibians and Reptiles: Salt Lake City, UT.).
**Abstract**: Since the Northern Territory population of *C. porosus* was declared a protected species in 1971, their populations have risen markedly, increasing the potential for conflict between people and crocodiles,

particularly near the major population centre of Darwin. To reduce the likelihood of crocodile attacks, the Parks and Wildlife Service of the Northern Territory operates a program to remove crocodiles from Darwin Harbour. Between 1999 and 2004, 926 *C. porosus* were captured, mostly in permanently set traps. Includes data on capture rates and seasonality. Suggests that future crocodile removal efforts will need to be increased to reduce the risk of crocodile attacks on humans in the Darwin area. Available here.

**Plumwood, V. 2012. The Eye of the Crocodile**. ANU E Press. See 'First Section'.
**Summary**: This account of and commentary on her experience of being attacked by a crocodile in Kakadu National Park was first published as 'Being Prey' in 1996 in *Terra Nova*, 1(3) 32-44.

**Rose, A., Fukuda, Y., Campbell, H.A. 2020. Using environmental DNA to detect estuarine crocodiles, a cryptic-ambush predator of humans**. Human-Wildlife Interactions 14(1): 64-72.
**Summary**: Many animals that pose a threat to humans are highly cryptic, and detecting their presence before the interaction occurs can be challenging. We describe a method whereby the presence of the estuarine crocodile (*Crocodylus porosus*), a cryptic and potentially dangerous predator of humans, was detected using traces of DNA shed into the water, known as environmental DNA (eDNA). In northern Australia, we sampled water from aquariums where crocodiles were present or absent, and we were able to discriminate the presence of estuarine crocodile from the freshwater crocodile (*C. johnstoni*), a closely related sympatric species that does not pose a threat to humans. Further, we could detect the presence of estuarine crocodiles within an hour of its entry and up to 72 hours after the crocodiles were removed from aquariums. Therefore, eDNA could be a valuable tool for reducing human-wildlife conflict through early detection of the species.

**Pooley, S. 2014. Invasion of the Crocodiles**. Book chapter in Iain McCalman, Jodi Frawley (eds.) Rethinking Invasion Ecologies from the Environmental Humanities (Routledge Environmental Humanities).
**Summary**: The film *Invasion of the Crocodiles*, 2007, first shown on BBC Natural World in 2007, took its title from the assertion that 'Australia's deadly saltwater crocs are making a dramatic comeback [and] are spreading in alarming numbers'. Publicity for the film stated that 'hundreds of cattle are being killed, and most worrying of all, attacks on people are increasing every year, often in places where crocs were previously unknown' (BBC, 2007). These brief statements bring up a series of issues central to the idea of ecological invasions, including the distinction between desirable and undesirable animals, and the spatial and temporal dimensions of the concept of invasions. However, in this case the desirable animals are introduced, and the undesirable ones are 'native'. This chapter first discusses some key definitions used by invasion ecologists. Temporal and spatial dimensions are central, as is the notion of harm. The discussion of the temporal dimension includes brief histories of crocodilians, and crocodilians and humans, in Australia. The discussion of spatial dimensions also touches on the notion of place, and Australian ideas about nativeness. The discussion of harm focuses on crocodiles as predators, and human–crocodile conflict.

**Tiemensma, M. 2019. Environmental deaths in the Northern Territory of Australia, 2003-2018**. Wilderness Environ. Med. Apr (doi: 10.1016/j.wem.2019.03.002).
Includes stats on fatal crocodile attacks. In the environmental death category, crocodiles accounted for 10% of attacks. There is a table on p.181 giving a breakdown of deaths by gender / characteristics (age range, residential/visitor status, alcohol and drug use, underlying medical condition). The brief section on crocodile attacks is on pp.182-3.

**Webb, G., 2012. Crocodile culls won't solve crocodile attacks**. The Conversation, 9 December. Available at: http://theconversation.com/crocodile-culls-wont-solve-crocodile-attacks-11203

## PALAU

**Manolis, S.C. & Webb, G., 2014. Human-Crocodile Conflict in the Australia and Oceania Region**. In Proceedings of the 23rd Working Group Meeting of the IUCN Crocodile Specialist Group, pp.200-208. IUCN, Gland, Switzerland.

**Matthews, E. 2005. Local knowledge about crocodiles in Palau.** Newsletter of the Crocodile Specialist Group, 24(2): 12-14.

## PAPUA NEW GUINEA

**Anon. 2006. Papua New Guinea Report.** Crocodile Specialist Group Newsletter 25(1): 6.
**Summary:** Regarding rejection of plan for safari hunting, and 'crocodile attacks on the increase'.

**Solmu, G., 2009. Increasing numbers of crocodile attacks with increasing crocodile population**. Crocodile Specialist Group Newsletter 28(3): 12.

**Solmu**, G., Sine, R., Kula, V., Nundima, J. and Langelet, E. **2018. Status update on the *C. porosus* and *C. novaeguineae* populations in Papua New Guinea, 1981-2018**. In Proceedings of the 25th Working Group Meeting of the IUCN Crocodile Specialist Group, pp.209-218.
**Summary**: includes notes relating to HCC as follows (p.210): A record of interviews was also conducted with villages and the Sepik Wetlands Management Team (SWMI) on human crocodile conflict. There were reports and eyewitness accounts of four (4) incidences that occurred over a period of one month during December 2017. The first two (2) attacks occurred on the 15 December, the third was on 28 December and the final victim was reported also in December with no date. All four attacked victims were local women. They were hospitalized with major injuries to their arms and legs with two of this needing assistance of wheelchairs. These attacks are not concentrated in one specific location but are separated by large distances and different villages. Three of the attacks are near Ambunti whilst the other is from Kubkain village. These attacks are presumed to be occurring with the onset of wet seasons and peak *C. porosus* mating season and women are vulnerably fishing in the open lake systems that have in the past having large habitats cover. Further notes on p.217: This crocodile-human conflict (Aust et al. 2009) is assumed to be exacerbated by the increasing degradation of prime herbaceous habitats for nesting and additionally the day-to-day survival for humans e.g. fishing for food. It has been suggested that crocodile densities exhibit a negative correlation with human densities and development patterns (Aust et al. 2009), hence increased human concentration and developments near lagoon systems will likely result in higher risks of crocodiles attacks and *C. porosus*, regardless of size, is classed as a problem animal.

## SOLOMON ISLANDS

**Manolis, S.C. & Webb, G., 2014. Human-Crocodile Conflict in the Australia and Oceania Region**. In Proceedings of the 23rd Working Group Meeting of the IUCN Crocodile Specialist Group, pp.200-208. IUCN, Gland, Switzerland.

**Van der Ploeg, J,** Ratu F, Viravira J, Brien M, Wood C, Zama M, Gomese C and Hurutarau J. **2019**. **Human-crocodile conflict in Solomon Islands**. Penang, Malaysia: WorldFish. Program Report: 2019-02.
**Summary**: This report is based on interviews with 822 people in 234 villages in seven provinces in Solomon Islands. A total of 225 crocodile attacks on people were recorded, with an average of five people per year being killed by saltwater crocodiles in Solomon Islands. The saltwater crocodile population has recovered rapidly since protection in 1993, with between 1400 and 2300 non-hatchling saltwater crocodiles in the

country. With more and larger saltwater crocodiles present, the number of attacks on people has increased and will most likely continue to do so. Communities are taking preventive measures and cultural restrictions on killing and eating crocodiles remain pervasive throughout the country. This excellent report includes recommendations to help humans and crocodiles to coexist in the Solomon Islands.

**TIMOR LESTE**

**Anon. 2016. Timor Leste's Crocodile Risk Assessment 2016**: ensuring public safety by mapping crocodile observations! http://common-environment.org/en

**Brackhane, S. 2016. Human-crocodile conflict in Timor-Leste - Assessment and recommendations for management**. MSc thesis, Albert Ludwig's University, Freiburg, Germany.

**Brackhane, et al. 2018. When conservation becomes dangerous: human-crocodile conflict in Timor-Leste.** The Journal of Wildlife Management; DOI: 10.1002/jwmg.21497

**Brackhane**, S., G. Webb, F. M. E. Xavier, J. Trindade, M. Gusmao, and P. Pechacek. 2019. **Crocodile management in Timor-Leste: drawing upon traditional ecological knowledge and cultural beliefs**. Human Dimensions of Wildlife **24**:314-331.

**Kaiser**, H., Carvalho, V.L. , Freed, P. and O'Shea, M., **2009. Status report on *Crocodylus porosus* and human-crocodile interactions in Timor Leste.** Crocodile Specialist Group Newsletter 28(3): 12-14.

**Manolis, S.C. & Webb, G., 2014. Human-Crocodile Conflict in the Australia and Oceania Region**. In Proceedings of the 23rd Working Group Meeting of the IUCN Crocodile Specialist Group, pp.200-208. IUCN, Gland, Switzerland.

**Sideleau, B.**, Edyvane, K. and Britton, A**., 2016. An analysis of recent saltwater crocodile (*Crocodylus porosus*) attacks in Timor-Leste and consequences for management and conservation**. Marine and Freshwater Research 68(5): 801-809 https://doi.org/10.1071/MF15354
**Abstract**: Saltwater crocodiles (*Crocodylus porosus*) are potentially dangerous to humans, yet they have major cultural value to many people in Timor-Leste. Recent increases in attack risk are influencing traditional attitudes, threatening culls of remaining wild crocodile populations. Attack records were compiled for April 2007 to April 2014, using the CrocBITE online database. Recorded attacks (n = 45) showed a high fatality rate, the majority being recorded since 2010. The highest proportion of attacks occurred in southern coastal wetlands suited to crocodiles, areas representing major sources of food, livelihoods and ecosystem services (i.e. fisheries, timber, coastal protection) for locals. Subsistence fishing posed the highest attack risk, particularly from September to February when food security is low. Attacks matched gender roles (male fishermen) and demographic patterns (mostly teenagers, the fastest growth group). Predicted increases in food insecurity, fishing activities, coastal impacts and rising human and crocodile populations pose worrying implications for human–crocodile conflict. We recommend essential baseline surveys enabling meaningful management decisions. Tailored management and educational awareness based on proven existing models could mitigate attack risk while remaining compatible with traditional Timorese attitudes towards crocodiles.

**Brackhane, S.,** Webb, G., Xavier, F.M.E., Trindade, J., Gusmao, M. and Pechacek, P. **2019. Crocodile management in Timor-Leste: Drawing upon traditional ecological knowledge and cultural beliefs**. Human Dimensions of Wildlife (https://doi.org/10.1080/10871209. 2019.1614240).
**Abstract**: Cultural beliefs based on Timor-Leste´s creation myth "Lafaek Diak - The Good Crocodile" are anchored in the East Timorese traditional belief system *lulik* and involve worship of the widely distributed, but dangerous, saltwater crocodile (*Crocodylus porosus*). The wild saltwater crocodile population and rate of fatal attacks on people are both increasing due to conservation action. More innovative management is

needed to reduce the frequency of attacks, but reverence for crocodiles constrains the management options available. Semi-structured interviews were conducted with Timorese stakeholders to understand the cultural beliefs and traditional ecological knowledge underlying human-crocodile interactions, and conflict (HCC) in Timor-Leste. Cost-effective management could integrate stakeholder groups, especially traditional elders and local knowledge holders.

## East and Southeast Asia

Most of the published literature focuses on Malaysian Borneo, and the Philippines. Gaps include Bangladesh.

### MYANMAR

Than, K.Z., Zaw, Z., Hughes, A.C. **2022. Integrating local perspectives into conservation could facilitate human-crocodile coexistence in the Ayeyarwady Delta, Myanmar**. Oryx 56(1): 82-90.
**Summary**: The saltwater crocodile *Crocodylus porosus*, although categorized as Least Concern on the IUCN Red List, are restricted to a single protected area, Meinmahlakyun Wildlife Sanctuary, in Myanmar. This paper investigated local knowledge about the environment, crocodiles, habitats and threats, awareness of human-crocodile conflict, and perceptions of the benefits and impacts of saltwater crocodile conservation through questionnaires in 244 households in 17 villages. People were found to be knowledgeable about the local environment, saltwater crocodiles, and their habitats. People relying on natural resources from Meinmahlakyun had negative attitudes towards crocodile conservation. Law enforcement through restricting resource access builds resentment towards the conservation of the species. Local people suggested that understanding risks posed by crocodiles was the best approach to facilitate human-crocodile coexistence in the Ayeyarwady delta region.

### PHILIPPINES

**Corvera**, M.D., Manalo, R.I. and Aquino, M.T.R. **2017. People and crocodiles sharing one environment: An analysis of local human-crocodile conflict management strategies in the Philippines**. Journal of Animal Science and Research 1(1) DOI: http://dx.doi.org/10.16966/2576-6457.105
**Summary**: This study determined the leading cause of conflicts, local practices, and management strategies that encourage human-crocodile coexistence in the Philippines. Reported conflicts from 2000-2015 were found via literature reviews and verified through correspondence, face-to-face key informant interviews and focus group discussions. Community visits documented the local practices and management strategies addressing such conflicts. Human pressure in known crocodile habitats triggered the 26 HCC cases that mostly occurred in the southern Philippines. Competition for space is inevitable, and yet not all encounters end in conflicts. In some sites, mutual coexistence with crocodiles was possible through building literal or metaphorical bridges: making use of cultural veneration and indigenous knowledge of crocodile behavior. The removal of potential problem animals, display of warning signs, advocacy campaigns, and provision of alternative livelihoods have been the common responses of the government. The success or failure of these efforts can be inferred from the level of local knowledge and social acceptance of local communities as well as the number of crocodile conflicts in the locality.

Cureg, M.C., Bagunu, A.M., Van Weerd, M., Balbas, M.G., Soler, D., Van der Ploeg, J. **2016. A longitudinal evaluation of the Communication, Education and Public Awareness (CEPA) campaign for the Philippine crocodile *Crocodylus mindorensis* in northern Luzon, Philippines**. International Zoo Yearbook 50: 1-16.
**Abstract**: The Philippine crocodile *Crocodylus mindorensis* is Critically Endangered and its range is restricted to a few localities in human-dominated landscapes. Therefore, the survival of this species in the wild depends strongly on the support of local people. Communication and education are prerequisites for successful in situ conservation. Over a 12 year period, the Mabuwaya Foundation distributed posters, calendars and comic books, organized theatre shows, gave school lectures, facilitated community meetings and established a crocodile rearing station/visitor centre to mobilize local support for the conservation of the Philippine crocodile in the northern Sierra Madre in Luzon. This paper documents changes in people's

awareness of and attitudes towards the conservation of the Philippine crocodile, and changes in people's behaviour in ten barangays (villages) in the municipality of San Mariano. Most people living in crocodile habitat now know that the Philippine crocodile is protected by law and support the conservation of the species in the wild. Hunting, the destruction of nests and the use of destructive fishing methods have all significantly declined in these areas. As a result of the integrated conservation programme, the Philippine crocodile population is slowly recovering.

**Gonzales, Jr.,** R.I. Manalo, V. L. B. Alibo, V. P. Mercado, W. T. Belo & D. C. Barlis. **2013. Manobo-Crocodile co-existence in Agusan Marsh, Philippines: a cultural legacy of mutual benefit**. In Proceedings of the 22nd Working Group Meeting of the IUCN-SSC Crocodile Specialist Group, pp.83-89. IUCN: Gland, Switzerland.
**Abstract**: There is mutual, yet fragile co-existence between the Manobos and the crocodiles in Agusan Marsh. Regarded as river people, the Manobo tribes of Agusan Marsh possess powers based on their cultural beliefs and values that essentially contribute in protecting their inherited lands and waterways. Their indigenous knowledge systems and practices (IKSPs) reveal that their understanding of the wetland ecosystem they belong to is holistic; that their lives' sustenance is a function of their interrelationships and interdependence with the rest of the other components in the marsh. More specifically, their IKSPs unravel their mutual co-existence with even the apex predator in the area, the crocodiles. The longevity of their co-existence that dates back since 14th century displays a relationship that is mutually beneficial to one another. It has only been in the recent years when this relationship has been threatened. Alongside the weakening protection and conservation initiatives towards the crocodiles in the marsh is the slowly eroding Agusanon Manobo culture. Reconsidering these IKSPs that are in danger of adulteration, its documentation is but imperative. Anchored to this premise, this paper presents an account of Manobo-crocodilian relations in the marsh by way of their mythical beliefs, religious rituals, cultural practices and anecdotal accounts. Focus Group Discussions and Key Informant Interviews with the chieftains of the different provinces and municipalities within and surrounding the marsh was conducted. The results from these meetings and discussions were then verified to existing literatures as well as to local historians.

**Koopmans, F.,** Van Weerd, M., Rodriguez, D. and Van der Ploeg, J. **2012. Philippine crocodile attacks on livestock: implications for conservation**. Proceedings of the 21st Working Meeting of the Crocodile Specialist Group in Manila, Philippines, 22-25 May 2012. IUCN, Gland, pp.221-27.
**Abstract**: Human-crocodile conflicts pose a serious threat to the conservation of crocodiles in the wild. This study examines conflicts between people and the critically endangered Philippine Crocodile (*Crocodylus mindorensis*). Interviews were conducted in 2010 to quantify the damage inflicted by Philippine crocodiles in the municipalities of San Mariano and Divilacan on the island of Luzon, Philippines. A total of 112 conflicts were recorded, mostly predation on livestock. These conflicts erode local support for the conservation of the species in the wild. Improving livestock husbandry, for example the construction of pig and chicken pens, offers the best prospects to prevent crocodile predation on livestock in the future.

**Rodriguez, D.,** Van Weerd, M., Van der Ploeg, J., Van de Ven, W., Telan, S., Balbas, M. and Guerrero, J., **2012. People's attitudes towards the reintroduction of the Philippine Crocodile in Dicatian Lake**. Proceedings of the 21st Working Group Meeting of the IUCN Crocodile Specialist Group, pp.105-110. IUCN, Gland, Switzerland.
**Abstract**: In July 2009, 50 captive-bred Philippine Crocodiles were reintroduced in Dicatian Lake in the Northern Sierra Madre Natural Park on Luzon. Twenty-two months after this pilot reintroduction we conducted a survey in barangay Dicatian to assess people's perceptions on and attitudes towards the reintroduction of the species. There have been several incidents of crocodiles attacking livestock. However, a large majority of the people in the village of 77% still supports the reintroduction of the species in the lake.

**Van der Ploeg, 2012. Philippine crocodile attacks on humans in the Northern Sierra Madre**. Newsletter of the Crocodile Specialist Group, 31(2): 20-23.

**Van der Ploeg**, J., Araño, R.R. and Van Weerd, M., **2011a. What local people think about crocodiles: challenging environmental policy narratives in the Philippines**. Journal of Environment & Development 20(3): 303-328. Available on Researchgate.
**Abstract**: This article challenges several assumptions that have shaped environmental policy in the Philippines. Policy makers assume that people are antagonistic toward conserving crocodiles in the wild and think that the enforcement of environmental legislation in a context of widespread rural poverty is illegitimate and ineffective. They argue that these negative public attitudes can only be transformed by generating revenues for rural communities, for example, through crocodile ranching or ecotourism. Despite the evident failure to conserve crocodiles in the wild, this thinking continues to underpin policy and practice in the Philippines. A community-based conservation project in the northern Sierra Madre on Luzon puts this utilitarian logic in perspective. The project succeeded in transforming hostile attitudes toward crocodiles and mobilized broad societal support for the protection of the Philippine crocodile and its freshwater habitat. Cultural values, such as pride in the occurrence of this rare and iconic species, form an important incentive for people to support the preservation of the species in the wild. These experiences highlight the importance of moving beyond ideological positions in discussions on biodiversity conservation, and enable the design of integrative and innovative solutions to conserve wildlife in human-dominated landscapes.

**Van der Ploeg, J., van Weerd, M. and Persoon, G.A. 2011b. A cultural history of crocodiles in the Philippines; towards a new peace pact?** *Environment and History* 17(2): 229- 264.
**Abstract**: Crocodiles have an image problem in the Philippines. In mainstream Filipino society crocodiles are considered dangerous maneaters, and compared with corrupt government officials or selfish basketball players. It is often argued that these negative public attitudes towards crocodiles make in-situ crocodile conservation impossible in the Philippines. Only by securing economic benefits for rural communities through sustainable use can crocodiles be conserved. In this paper we contest this narrow utilitarian view. In fact, indigenous peoples in the northern Sierra Madre have a history of co-existence with crocodiles. In the pre-Hispanic Philippines people feared and revered crocodiles: specific rules regulated the relationship between crocodiles and people. Traditional beliefs and practices enable people to share the landscape with a potentially dangerous carnivore. This forces us to rethink conventional conservation strategies that focus narrowly on economic values.

**Van der Ploeg,** J., Balbas, M.G. and van Weerd, M., **2009. Do crocodiles have rabies? Initiating a dialogue on in-situ Philippine crocodile conservatio**n. Crocodile Specialist Group Newsletter 28(3): 7-10.

## Malaysia

Most attacks in this region are attributed to saltwater crocodiles (*Crocodylus porosus*) though there are records of attacks by Tomistoma (*Tomistoma schlegelii*). Most of the literature focuses on Sarawak.

Rummy, P., Rummy, J. **2022. Boon or Bane? The Significance of Scientific Knowledge and Education Consciousness for Crocodylian Conservation in Malaysia**. ASM Science Journal 17 ISSN:1823-6782
**Summary**: A scientific apprehension of the nature of crocodiles, combined with the awareness through education could enhance conservation efforts in Malaysia. There is a necessity to safeguard estuarine crocodiles (*Crocodylus porosus*) and the Malayan gharials (*Tomistoma schelegii*) in the local ecosystem and we propose sustainable protection standards for them. We reviewed selected scientific studies related to crocodylians, and resources on local environmental education and wildlife conservation efforts. Exposure to scientific knowledge on crocodylians is exceptionally rare in Malaysia compared to other wildlife. Erosion of knowledge will have adverse impacts on conserving them. We highlight the need to redress existing biodiversity policies and foreground formal biodiversity curriculum and literacy in Malaysian schools.

**SAHAB, SARAWAK AND BRUNEI**

**Dacey, T. 2010. International Workshop on Human-Crocodile Conflict: crocodile conservation through sustainable use.** Kota Kinabalu, Malaysia, 23-25 June 2010. Crocodile Specialist Group Newsletter 29(2): 6-7.

**Gani, M.I.Z.A., Hassan, R., Tisen, O.B., Ahmad, R. 2022. Human-Crocodile Conflicts in Sarawak, Malaysian Borneo: An analysis of crocodile attacks from 2000 until 2020**. International Journal of Biology and Biomedical Engineering 16: 186-195.
**Summary**: Crocodiles have caused a relatively high number of fatal attacks on local people in Sarawak. However, they have cultural value and are respected by the riverine communities in the state. This study investigated the patterns of human-crocodile conflict in Sarawak. Information on crocodile attacks were collected from multiple sources for a 21-year period (2000-2020). The attack record (n=164) showed a balance between fatal and non-fatal cases. Most common victims in Sarawak were male and adults (31 to 40 years). 59% of attacks occurred during daylight, with the peak time between 18:00 to 23:59 hours. Crocodile attacks occur slightly more during the wet season (October to March). Fishing and bathing in the rivers possess the highest risk of crocodile attack. The findings imply that crocodiles' attack pattern in Sarawak is associated with the people's activities pattern.

**Jet**, O.J., Palaniappan, P.M. and Hussein, M.A.S., **2012. Status of saltwater crocodile population in the Kawang River, Sabah**. Crocodile Specialist Group Newsletter 31(2): 17-18.
**Summary**: Kawang River is one of the remaining habitats for *Crocodylus porosus* on the west coast of Sabah, Malaysia. In this study, we aimed to quantify the current abundance of the species and identify potential human-crocodile conflict (HCC) issues in the Kawang River area.

**Hassan, R.** and Abdul Gadin, M.I.Z., **2013**. **Crocodiles in Western of Sarawak, Malaysia**. In Proceedings of the 22nd Working Group Meeting of the IUCN-SSC Crocodile Specialist Group, pp.90-95. IUCN: Gland, Switzerland.
**Abstract**: Saltwater crocodile *Crocodylus porosus* is the most common crocodile species found in Sarawak. Humans and crocodiles have been living in harmony for centuries, peacefully sharing the same landscape. However, in the past three decades, reports on human-crocodile conflicts are on the rise, bringing the assumption that the crocodile populations are bigger in size now and expanding to all rivers. This study is designed to assess the relative density of crocodile in three different rivers located in the western part of Sarawak namely Batang Samarahan, Sibu Laut River and Bako River, using the standard census survey

method. For the year 2011, relative densities of crocodile were 0.53 non-hatchling/km, 1.04 non-hatchling/km, 1.8 non-hatchling/km for Batang Samarahan, Sibu Laut River and Bako River, respectively. There is no previous record on crocodile density for Batang Samarahan. For Sibu Laut River, there is a 40% decrease in density compared to year 2003 survey data. Previous survey data for Bako River are available for year 2003 and 2008. Bako River has experienced fluctuation of crocodile density, as systematic culling had been carried out as a response to fatal crocodile attack which happened in year 2006. Findings reported in this study are limited to small number of surveys conducted within the year 2011, therefore more studies should be carried out in future to get a more comprehensive picture of crocodile populations in these rivers. This paper also examined the socio-economy profile of local people living along the three rivers and reports on their perspectives towards human-crocodile conflicts.

**Lading, E. 2013**. **Crocodile attacks in Sarawak (abstract).** In Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group, p.96. IUCN: Gland, Switzerland.
**Abstract**: In Sarawak human and crocodiles have shared the same environment for many millenniums, and for most parts have coexisted peacefully. Relatively, few humans fell victim to the predators in the past but of lately the number of crocodile attacks have increased dramatically. Statistic has shown that a total of 118 attacks have taken place since 1941 until end of March 2013 where 64 of it were fatal while another 54 cases were reported to have caused various degrees of injuries ranging from just minor scratches to a level that have caused the victims to be bed-ridden for life. The above figure has given an average of 1.66 attacks occurring per year with a rate of 0.90 victims were killed annually by the predators. Two more attacks were just occurred in early April 2013 where a body of one of the victims is yet to be found to this date. The increase in crocodile attacks of lately, was due to drastic increase in the population of estuarine crocodiles throughout Sarawak. Rivers that have never been inhabited by crocodiles in the past 30 years have now been infested by the maneaters even up to its upper reaches not affected by daily tidal cycles. The enforcement of the Wild Life Protection Ordinance, 1998 is thought to be one of major factors contributing to the increase of the species. The clearings of vegetations along riverbanks are another factor as it promotes growth of grassy vegetations favourable for the crocodile nesting sites. Apart from various awareness programs on the species among local communities culling of dangerous individual crocodiles are part of the ongoing management program for the species in Sarawak, and some public places such as beaches have been declared as Crocodile-Free Zones.

**Lading, E. 2004. Crocodile conservation in Sarawak**. In Proceedings of the 17th Working Meeting of the IUCN-SSC Crocodile Specialist Group, pp.174-179. IUCN: Gland, Switzerland.
**Summary**: includes data on distribution and conservation status of crocodiles in Sarawak, human-crocodile conflict (with attack data 1980-2004), perceptions of crocodile conservation and management suggestions.

**Lading, E. 2018**. **Management of Estuarine Crocodile (*Crocodylus porosus*) in Sarawak, Malaysia.** In Proceedings of the 25th Working Meeting of the IUCN-SSC Crocodile Specialist Group, pp.118-23.
Sarawak, one of the Malaysian States in the island of Borneo, is transected with numerous river systems and network. Due to its rugged topography in most areas rivers have become the main mode of transportation to local communities and providing foods and water to them. At the same time rivers and estuaries in Sarawak provide natural habitats for the increasing population of estuarine crocodiles. Unfortunately, overlapping use of rivers by crocodiles and local people often ends up in Human-crocodiles conflict (HCC). Despite the conflict that seemed to be on the rise of lately estuarine crocodile is legally protected under the State's Wild Life Protection Ordinance, 1998, and was listed under CITES Appendix I which was recently been downgraded to Appendix II. Estuarine crocodile is an important biological resource that could generate revenue to the State of Sarawak while at the same time plays an important role in the ecosystem. Thus, several management programs are now being implemented to ensure sustainable utilization of the species while at the same time aiming to reduce HCC. Some of the programs being put up for the species in Sarawak are; 1. Monitoring of crocodile harvest activities along certain rivers. 2. Resurveys and reassessment of crocodile population and distribution along certain rivers. 3. Conducting awareness program on crocodile

among communities dwelling along crocodile-infested rivers. 4. Establishing Crocodile Removal Zones (CRZ) in a number of public places. 5. Culling and removing nuisance crocodiles. 6. Establishing a crocodile sanctuary which serves both as a rescue centre for nuisance crocodiles as well as to provide tourist attraction and research on crocodile. 7. Enhancing research activities on crocodile for better management of the species. 8. Introducing crocodile-based tourism activities along a number of rivers in certain areas. 9. Installing crocodile warning sign boards at places of high crocodile densities to remind general public on potential danger posed by the predator when using rivers. It is hoped that the implementation of the above programs would help general public, particularly local communities, to understand the crocodile better of it roles in the ecosystem and its potential to contribute to the economy of the State and its people, and not just seen as pests that must be eradicated.

**Tisen, O.B.,** Gombek, F., Ahmad, R., Gombek, F., and Kri, C. **2013. Human-Crocodile issues: Sarawak Report**. In Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group, p.115. IUCN: Gland, Switzerland.
**Abstract**: Sarawak, the Malaysian state of Borneo, has 22 river basins. These river systems provide local communities with mode of transportation, water and food resources as well as being bastions to huge diversity of flora and fauna including estuarine crocodiles (*Crocodylus porosus*). For most of the time crocodiles and humans co-exist peacefully but there had been instances of serious consequences when crocodiles and humans crossed paths. Sarawak records the highest crocodile attacks in the world with an average of 10 per year. These had resulted in repeated and emotional public and political outcries for the management authority in Sarawak to take swift actions. The Sarawak State Cabinet in an effort to pacify the populace had directed the crocodile management authority to carry out state-wide culling of the crocodiles. This paper presents the human-crocodile issues and highlights efforts to formulate the Strategic Crocodiles Conservation Plan for Sarawak.

**Tisen, O.B.,** Bin Ahmad, R., Gombek, F., Lading, E., **2014. A Roadmap for Crocodile Conservation in Sarawak**. In Proceedings of the 23rd Working Meeting of the IUCN–SSC Crocodile Specialist Group, Lake Charles, USA, 25–30 May 2014, pages 227-235. IUCN, Gland, Switzerland.
**Abstract**: In Sarawak, the mention of crocodiles spews an air of love and hate – more of hate at present. Despite the current irritability with crocodiles which by a large population are regarded as vermin, the culture of the various tribes in Sarawak has always heralded crocodiles as a protector with divine strength and power. Sarawak's football team has a crocodile as its mascot, instilling its team with an aura of invincibility. Protection by the law for over twenty years had allowed the once near-threatened population to recover, so successful was the recovery that Sarawak is now faced with an increase in Human-Crocodile conflicts. Incessant public outcries propelled the State Cabinet to issue a directive to conduct state-wide crocodile culling exercise. The management authority, however, has convinced the cabinet to review this directive holistically and scientifically, resulting in the approval of the Strategic Crocodile Management in Sarawak to ensure win-win coexistence between human and crocodile. This paper reports on the up-to-date development and implementation of a roadmap towards a comprehensive crocodile conservation and management in Sarawak.

## VIETNAM

There are only historic records of a few attacks in Vietnam, into the late 20th century. These are discussed in: **Sideleau, B.M. 2021. A review of the historic distribution of the saltwater crocodile (*Crocodylus porosus*) in Vietnam**. Crocodile Specialist Group Newsletter 40(4): 13-15.

## Indonesia

The majority of attacks across the region are attributed to the saltwater crocodile (*Crocodylus porosus*), with some attacks recorded for the Tomistoma or false gharial (*Tomistoma schlegelii*) and a handful for the Siamese crocodile (*C. siamensis*). Not all conflicts are focused on attacks. Research attention has been focused on East Nusa Tenggara, Sumatra and Indonesian Borneo.

**Operational Procedure for HCC**

**Anon**. 2017. Standar Operasional Prosedur: Penanganan Konflik antara Manusia dengan Satwa Liar Buaya di Provinsi Nusa Tenggara Timur [**Standard Operating Procedure: Handling conflicts between humans and wild crocodiles in East Nusa Tenggara Province**]. Balai Besar Konservasi Sumber Daya Alam Dan Ekosistem, Kementerian Lingkungan Hidup Dan Kehutanan (Ministry of Environment and Forestry), Kupang.

### Papers

**Ardiantiono, S**., Atmadja, R.K., Wardhani, A. **2015. An analysis of saltwater crocodile (*Crocodylus porosus*) attack in Indonesia using citizen science CrocBITE Database exploration.** *Analisis Serangan Buaya Muara (*Crocodylus porosus*) di Indonesia melalui Eksplorasi Database CrocBITE Berbasiskan Citizen Science*. This article is written in Indonesian, not in English.
**Abstract** Saltwater crocodile (*Crocodylus porosus*) is a species with the highest cases of attack toward human in Indonesia. Understanding the crocodile attack is essential to plan the conservation and conflict mitigation. CrocBITE as one form of citizen science has been successful in involving society to collect the information of crocodile attack around the world including Indonesia which possesses the highest number of attacks about 420 since 1845. This research aims to analyze the distribution pattern of crocodile attack and design the attack mitigation plan by exploring database in CrocBITE website. Quantum GIS v2.2.0. Valmiera was used to map the factual attack location, spatstat in R i386 3.1.0 were run to know the conflict density and distribution pattern statistically. The results showed that the number of attacks was higher in the western part of Indonesia (Sumatra and Java), however in recent period (2000--2014) the conflicts were moved from northern Sumatra to the southern part and rare conflict detected in Java island. Significant increase of attack happened in 2000-2014 period during which the number of conflicts was doubled compared to 1845-1980. Based on this the research, it is recommended to build a barrier and propose crocodile protection zone for crocodile attack mitigation in Indonesia.
Available at:
https://www.researchgate.net/publication/312146767_Analisis_Serangan_Buaya_Muara_Crocodylus_porosus_di_Indonesia_melalui_Eksplorasi_Database_CrocBITE_Berbasiskan_Citizen_Science_An_Analysis_of_Saltwater_Crocodile_Crocodylus_porosus_Attack_in_Indonesia

**Sideleau, B., Sitorus, T., Suryana, D., Britton, A. 2021. Saltwater crocodile (*Crocodylus porosus*) attacks in East Nusa Tenggara, Indonesia**. Marine and Freshwater Research 72(7): 978-986.
**Summary**: the authors compiled public crocodile attack records (Saltwater crocodiles *Crocodylus porosus*) for East Nusa Tenggara (ENT) on humans from 2009 to 2018. They used an online database of incidents (CrocBITE), then worked closely with government representatives to visit human-crocodile conflict (HCC) hot spots, where some unreported attack records were collected. Local attitudes towards crocodiles were assessed. Of the 100 attacks compiled, 60% were fatal. Most victims were male and most attacks occurred during fishing. West Timor had the highest proportion of attacks. Cultural attitudes towards crocodiles were found to be generally positive throughout ENT, although recent media stories have introduced some negative beliefs and fears. The authors recommend resources and training are used to improve local crocodile knowledge, including habitat surveys in proximity to conflict areas, with community-based education in high risk areas.

**Sideleau**, B.M. **2016. Notes on the Current Status of the Saltwater Crocodile, *Crocodylus porosus*, within East Nusa Tenggara Province, Indonesia**. Pp.149-52 in Proceedings of the 24th Working Meeting of the IUCN-SSC Crocodile Specialist Group in Skukuza, South Africa. IUCN: Gland, Switzerland.

**Sideleau,** B.M. **2015. Details of a fatal saltwater crocodile attack in West Manggarai Regency, Flores, East Nusa Tenggara Province, Indonesia with notes on current and historical distribution**. Crocodile Specialist Group Newsletter, 34(3):

**Sideleau, B.M.** and **Britton, A.R.C., 2014. An Analysis of Recent Crocodile Attacks in the Republic of Indonesia - a Case Study on the Utility of the CrocBITE Database**. In Proceedings of the 23rd Working Meeting of the IUCN–SSC Crocodile Specialist Group, Lake Charles, USA, 25–30 May 2014, pp.332-335. IUCN, Gland, Switzerland.

**BORNEO**

**Rachmawan, D. and Brend, S., 2009. Human-*Tomistoma* interactions in Central Kalimantan, Indonesian Borneo**. Crocodile Specialist Group Newsletter 28(1): 9-11.

**Ramdani, Kusrini, M.D. and Prasetyo, L.D. 2021. Mapping the distribution of Saltwater Crocodile (*Crocodylus porosus*) and risks of Human-Crocoddile Conflicts in settlements around Kutai National Park, East Kalimantan**. Media Konservasi 26(1): 52-62.mdani
**Abstract**: Human-Crocodile Conflicts (HCC) are problems affecting crocodile conservation. Scientific publications on crocodile attack cases in Indonesia are few with low validation which hinder optimal conflict mitigation efforts. The estuarine river of Kutai National Park is a natural habitat for saltwater crocodiles and mostly nearby dense settlements. This study aims to map the distribution of saltwater crocodiles and potential conflicts in the Kutai National Park area. To predict the distribution of saltwater crocodiles, we used Maximum Entropy MAXENT with its environmental predictors, ie slope, altitude, distance from shore, distance from river, temperature, and habitat types (mangrove forest, freshwater swamp, and shrubs). MAXENT prediction showed that elevation was the most influential variable with AUC (Average Under Curve) value of 0.952. Settlements with activities occurring within one kilometer from the river and those adjacent to coastal areas proved to be the highest in human conflicts with crocodiles.

**Sideleau, B. 2018. A preliminary analysis of recent crocodile attacks in Borneo**. (**Abstract**) Proceedings of the 23rd Working Meeting of the IUCN-SSC Crocodile Specialist Group at Skukuza, Mpumalanga, S. Africa. IUCN, Gland.
**Abstract**: Borneo is the largest island within the Greater Sunda Islands archipelago, which it shares with the of Sumatra, Java, and Sulawesi. Borneo itself is split amongst three nations-Indonesia (the provinces of West, Central, South, East and North Kalimantan), Malaysia (the states of Sabah and Sarawak), and the sovereign state of Brunei. Three species of crocodilian are known to inhabit Borneo-the Saltwater crocodile (*Crocodylus porosus*), the Siamese crocodile (*C. siamensis*) and the Tomistoma (*Tomistoma schlegelii*). Borneo is fairly infamous for its man-eating Saltwater crocodiles (the legendary man-eater known as "Bujang Senang" is claimed to have killed 13 people in Sarawak before he was eventually caught and killed in 1992), but prior to data collection by CrocBITE (the worldwide crocodilian attack database) detailed information on crocodile attacks in Borneo (with the exception of Sarawak) was mostly limited to the local news media. For the period of 2007-2016 we recorded 221 crocodile attacks in Borneo, resulting in 129 deaths, with Sarawak (Malaysia) and East Kalimantan (Indonesia) having the highest numbers of reported attacks. While the Saltwater crocodile was responsible for the vast majority of attacks, a small number of attacks and deaths were attributed to the Tomistoma, and at least one non-fatal attack was attributed to the Siamese crocodile.

## GREATER SUNDA REGION

**Shaney, K.J**., Hamidy, A., Walsh, M., Arida, E., Arimbi, A. and Smith, E.N. **2017. Impacts of anthropogenic pressures on the contemporary biogeography of threatened crocodilians in Indonesia**. Oryx (https://doi.org/10.1017/S0030605317000977).

**Abstract**: The Greater Sunda region of South-east Asia supports a rich diversity of economically and ecologically important species. However, human pressures are reshaping contemporary biogeography across the region. Megafaunal distributional patterns have been particularly affected because of deforestation, poaching and human–wildlife conflict. Crocodilians are at the centre of these conflicts in Indonesia and yet remain poorly studied across much of the archipelago. We conducted population surveys of saltwater crocodiles *Crocodylus porosus* and false gharials *Tomistoma schlegelii* in Sumatra, and examined whether crocodile abundance and distribution are correlated with variations in human disturbance, fishing pressure, and habitat type. We then used these data to model remaining suitable habitat for *T. schlegelii* across South-east Asia. We propose several key conservation priorities: (1) eliminate the use of fish traps in remaining patches of *T. schlegelii* habitat, (2) prioritize crocodile population surveys in remaining suitable habitat, particularly in remote areas, (3) consider *T. schlegelii* to be potentially Endangered locally in Sumatra, and (4) expand existing reserves around the Lower Kampar River and Berbak National Park/Sembilang National Park areas of Sumatra.

**Singh, M.,** Kaptchuk, T.J. and Henrich, J. **2019. Small gods, rituals, and cooperation: The Mentawai crocodile spirit Sikaoinan.** (doi: 10.31235/osf.io/npkdy) Available at: https://osf.io/preprints/socarxiv/npkdy/

**Abstract**: Researchers focus on the powerful deities of large-scale societies, yet little work has examined punitive deities in small-scale societies. Here, in a detailed study of Mentawai's crocodile spirit Sikaoinan (Siberut Island, Indonesia), we start to fill this gap by addressing three key questions: (1) Are smaller gods believed to enforce cooperation, especially compared to bigger gods in larger-scale societies? (2) Do beliefs in these deities encourage people to incur costs? and (3) Does ritual produce beliefs in these deities? Drawing on systematic interview responses, behavioural data from healing ceremonies, and long-term ethnographic research, we show that Sikaoinan is believed to punish people who do not share meat with fellow clan members. Beliefs that Sikaoinan has attacked them motivate patients and their families to host costly healing ceremonies in which shamans remove the spirit from the patient's house. The public nature of these ceremonies, involving prestigious individuals speaking to Sikaoinan and apologizing to it for the patient's stinginess, reinforce onlookers' beliefs about Sikaoinan. Throughout Siberut, the most widely shared beliefs about Sikaoinan are represented in the ritual while beliefs not represented vary considerably, indicating that ritual may be a potent cultural transmission mechanism. These results suggest that moralizing supernatural punishers may be commonplace and that the important trend in the cultural evolution of religion has been the expansion of deities' scope, powers, and monitoring abilities.

## South Asia and Iran

Most work has been published for India (though see below for gaps) and Sri Lanka. There is interesting literature on Iran, but very little indeed for Nepal and in particular Pakistan. There is interesting work on human-mugger conflict and coexistence in this region.

**REGIONAL OVERVIEWS**

**Stevenson**, C., de Silva, A., Vyas, R., Nair, T., Mobaraki, A., Chaudhry, A.A. **2014. Human-Crocodile Conflict in South Asia and Iran**. In Proceedings of the 23rd Working Meeting of the IUCN–SSC Crocodile Specialist Group, Lake Charles, USA, 25–30 May 2014, pp.209-226. IUCN, Gland, Switzerland.

**Mobaraki**, A., McCaskill, L., Schepp, U., Abtin, E., Masroor, R., Pandhi, D., Desai, B., Muckerjee, S., Rasheed, T., Abdul Razzaque, S., de Silva, A., Stevenson, C., Rauhaus, A., Le, M.D., Rödder, D. and Ziegler, T. **2021. Conservation status of the mugger (*Crocodylus palustris*): establishing a task force for a poster species of climate change**. Crocodile Specialist Group Newsletter 40(3), 12-20.
**Summary**: Overview of the conservation status, including challenges of HCC and anthropogenic threats to mugger, in Iran, Pakistan, India and Sri Lanka. Includes some attack data for India and Pakistan.

**INDIA**

Inland, most attacks are attributed to the mugger crocodile (*Crocodylus palustris*), with attacks attributed to the saltwater crocodile (*C. porosus*) on the east coast and Andaman Islands (a recent white paper by Oommen et al. on the Andamans situation remains unpublished). There is a great amount published for India, but spatially rather patchy: most on Andamans, Sundarbans, Gujarat and Bhitarkanika Wildlife Sanctuary, and real gaps in both the northern and southern states.

**Chandi**, M. **2012**. **Representing human crocodile conflict: moving towards coexistence** (abstract). The 2nd Asian Regional Conference of Society for Conservation Biology, Book of Abstracts.
**Abstract**: Saltwater crocodiles (*C. porosus*) in the Andaman Islands in recent years have seemingly become a contentious species of wildlife to live with. From the earliest records of exploration in the islands, saltwater crocodiles have been recorded across the archipelago alongside human habitations, from hunter-gatherer indigenous communities to more recent settlers who are agriculturists, fishermen, and business entrepreneurs. Attacks on humans by saltwater crocodiles resulting in injuries and deaths are an issue that islanders currently have to grapple with. While understanding the population dynamics of these wild crocodile populations is important, equally important is the need to address the representation of this 'conflict' as well as the need for mitigating potential calamities due to crocodile attacks in future. In contrast are the ways that indigenous communities use and perceive these animals they live in proximity with. I attempt to illustrate the need to re-think mechanisms by which mitigation efforts may benefit both wild saltwater crocodiles as well as those human communities sharing their habitat.

**Chowdhury**, A.N., Mondal, R., Biswas, M.K. and Brahma, A. 2013. Post Traumatic Eco-Stress Disorder (PTESD): A qualitative study from the Sundarban Delta, India. In: Woolfolk, R. and Allen, L. (eds) Mental Disorders: Theoretical and Empirical Perspectives: 309-347. IntechOpen.
Summary: study of what they call Post Traumatic Eco-Stress Disorder in India's Sundarban Delta, including attacks by tigers, sharks and crocodiles.

**Das**, C.S., Jana, R. **2018. Human–crocodile conflict in the Indian Sundarban: an analysis of spatio-temporal incidences in relation to people's livelihood**. *Oryx*, 52(4): 661-668.
DOI: https://doi.org/10.1017/S0030605316001502

**Summary**: We studied conflicts between people and estuarine crocodiles *Crocodylus porosus* across socio-economic dimensions, using a spatio-temporal database. We collected data on 127 crocodile attacks that occurred during 2000–2013, through questionnaires including open- and close-ended questions, administered in 30 villages of five blocks of the Indian Sundarban. Most of the attacks (42%) occurred during winter (December-February), followed by the early monsoon (May-July; 27%). Almost 80% of victims were prawn seed collectors and were 11-50 years old, and 61.16% of victims died as a result of the attacks. Female victims accounted for a higher percentage of deaths (55.12%) than male victims (44.88%). Crocodile attacks were more common in the daytime than at night, with 76.35% of the killings occurring during 08.00-17.00. Existing management practices are insufficient : a comprehensive management plan for reducing dependency on forest resources is needed to minimize human–crocodile conflict.

**Gopi**, G.V., Pandav, B. **2009. Humans sharing space with *Crocodylus porosus* in Bhitarkanika Wildlife Sanctuary: conflicts and opinions**. Current Science, 09(4): 459-460.
**Summary**: historical overview of saltwater croc populations since protection in the sanctuary since 1976, of the resulting interactions with humans including data on attacks, and suggestions for mitigation.

**Gurjwar**, R.K. and Rao, R.J. **2018. An assessment of Human-Crocodile Conflict: Aquatic biodiversity conservation assessment in National Chambal Sanctuary, Madhya Pradesh, India**. Mauritius: LAP LAMBERT Academic Publishing.

**Jayson, E. A**., et al. **2006. Review of the reintroduction programme of the Mugger crocodile *Crocodylus palustris* in Neyyar reservoir, India.** Herpetol. J. 16(1): 69-76.
**Abstract**: Human-crocodile conflicts created by Mugger crocodiles *Crocodylus palustris* were studied 18 years after a reintroduction to the Neyyar Wildlife Sanctuary, Kerala, India. Twenty-nine Mugger crocodiles were reintroduced into the reservoir in the year 1983 and crocodile attacks on livestock were reported from 1985. During the initial period of the study 21 to 25 Mugger crocodiles were estimated but only 10 to 16 crocodiles were recorded towards the end of the period as nine were removed from the reservoir to reduce the conflict. Fishes provided sufficient prey, but food in the form of large mammals was inadequate. Twenty-nine crocodile attacks on humans were reported prior to the study and six occurred later, including two fatalities. The attacks occurred over 26 km of shoreline and followed previous patterns of attack behaviour in crocodiles. Larger crocodiles were more often involved with attacks than small crocodiles. As local people utilised the reservoir for various purposes, they did not support the conservation of crocodiles in the present circumstances. The case study indicated the failure of the reintroduction programme.

**Khan, W., Hore, U., Mukherjee, S. and Mallapur, G. 2020. Human-crocodile conflict and attitude of local communities toward crocodile conservation in Bhitarkanika Wildlife Sanctuary, Odisha, India**. Marine Policy, in press. https://doi.org/10.1016/j.marpol.2020.104135
**Summary**: This study reports on crocodile attacks within the 672 km$^2$ Bhitarkanika Wildlife Sanctuary (BWS), Odisha, India. Forest Department contain records of 51 attacks on people and 57 on cattle over 21 years (1996–2016). Human attacks were highest in the monsoon season and summer and lowest in the post-monsoon and winter. The activities of people attacked were (highest to lowest incidence): domestic chores and crossing rivers, defecating, Bathing, fishing, paddy cultivation and grazing cattle. Attacks on males (70%) were more common. The most common age of victims was 40–50 yr and 20–30 yr. Semi-structured interviews with the main household earning member in villages on the periphery of BWS (n = 57), revealed no notable influence of age, gender, and education on the perception and attitude of the local community. People affected negatively by attacks tended to be negative toward saltwater crocodiles conservation.

**Kumar**, S.S., Sivaperuman, C. and Yadav, B.P., **2012. Management of problem saltwater crocodiles (*Crocodilus porosus Schneider*) - A case study in the Andaman and Nicobar Islands, India.** Herpetological Bulletin, 120: 9-15.

**Abstract**: Crocodile attacks on human beings and livestock have been reported since the early 1970s in the Andaman and Nicobar Islands. Recently, a crocodile killed a woman snorkelling at the famous Radha Nagar Beach, Havelock forest division. Immediately, the Department of Environment and Forests of the Andaman and Nicobar Administration urged locals to be vigilant of the presence of crocodiles around Radha Nagar Beach, and a warning sign board was placed on the beach. The Forest Department decided to capture the problematic crocodile, and gathered a team to do so. The captured crocodile was transported and released into the mini zoo at Port Blair, and peace was restored at Radha Nagar Beach. In such a situation, removal of the problem crocodile might provide a temporary fix, but another male will eventually dominate the creek, and may again be a threat to tourism. Possible reasons for crocodile attack on humans include defending individual territories, attractive food-sources such as livestock and other domestic animals, and dumping of high protein waste food materials on banks or beach areas. The indigenous technology developed for capturing the crocodile is discussed in this paper.

**Mishra, A., 2007. Crocodile fears. Bhitarakanika too small for reptiles and people**. Down to Earth 15(23): 46-48. Summarised in Crocodile Specialist Group Newsletter 26(2), 10.

**Mukherjee**, S. **2022. Survey of human-crocodile conflict in non-protected areas of Kendrapara District, Odisha, India**. Crocodile Specialist Group Newsletter 41(1): 7-10.
**Summary**: A rapid survey of human-crocodile conflict outside protected areas of Kendrapara District, Odisha, was carried out on 7-9 October 2013. The aim was to carry out the survey in locations of human-crocodile interactions and further explore mitigation measures with long-term impact that may be best suited to these specific areas. Concludes that there is an urgent need for sensitization initiatives, erection of CEEs, and creation of wells and provision of water storage tanks to make water collection and use safer where people live alongside large saltwater crocodiles.

**Nala, R.R. 2017**. **Man-Crocodile Conflict, Rescue, Rehabilitation and Management Aspects of Crocodiles & Marsh Crocodile Estimation in Gir Protected Area and Greater Gir**. DCF, Wildlife Division: Sasan Gir, Junagadh, Gujarat, India. 47pp.

**Nayak, Lakshman**, Satyabrata Das Sharma, Mitali Priyadarsini Pati**. 2018. Conservation and management of Saltwater Crocodile (*Crocodylus porosus*) in Bhitarkanika Wildlife Sanctuary, Odisha, India**. Chapter 12 (pp 308-321) in Islam and Jorgensen (eds) 2018. Environmental Management of Marine Ecosystems. CRC Press.
**Summary**: Chapter includes sections on attacks on humans by wild crocodiles, and on domestic livestock, with stats from 1996/7-2009/10.

**Patel**, D., Vasava, A., Patel, K., Mistry, V., Patel, M. and Vyas, R. **2014. Attitudes, perceptions and knowledge of the local people regarding crocodiles and their conservation in Charotar Region, Gujarat, India**. In Proceedings of the 23rd Working Group Meeting of the IUCN Crocodile Specialist Group, pp.336-347. IUCN, Gland, Switzerland.

**Patro, S. and Padhi, S.K. 2019. Saltwater crocodile and human conflict around Bhitarkanika National Park, India: A raising concern for determining conservation limits**. Ocean & Ocean Management (https://doi.org/10.1016/j.ocecoaman.2019.104923).
**Abstract**: Recently, there has been an increase in saltwater crocodile-human interaction around Bhitarkanika National Park and the article reviews recent attacks on humans in the region. Information regarding the attacks was extracted from national newspapers and CrocBITE. Over the past 15 years, 57 persons got attacked by saltwater crocodile (*Crocodylus porosus* Schneider, 1801) in and around Bhitarkanika National Park. The trend of incidents shows that the attack on humans is increasing every year, which might be due to the increase in the density of *C. porosus* in a limited area of natural habitat. July to October was considered as the critical season when maximum attacks occur as this is the nesting and probable hatching season of *C. porosus* during which the species remain highly aggressive. In the last 42 years, since the crocodile breeding and management project implemented in India, the conservation of the species has resulted in a significant

increase of their number in Bhitarkanika National Park. Existing reports suggest that the present density of *C. porosus* in Bhitarkanika National Park has surpassed the value (5 to 6 crocodiles per km length of water) which was proposed while initiating the conservation programme. The present scenario requires the development and implementation of an updated management plan for the coexistence of humans and saltwater crocodiles. The conservation and management strategy of saltwater crocodiles shall include determination of carrying capacity of the sanctuary, minimizing exploitation of natural resources, relocation of crocodiles to other feasible sites, creating awareness among local people, development of alternative livelihood for the locals and construction of more bath huts along the water bodies.

**Rao**, R.J., Gurjwar, R.K. **2013. Crocodile human conflict in National Chambal Sanctuary, India.** In Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group, pp.105-109. IUCN: Gland, Switzerland.

**Sivaperuman**, C., Kumar, S.S. **2013. Human-crocodile conflicts in Andaman and Nicobar Islands - a case study** (abstract). In Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group, p. 114. IUCN, Gland, Switzerland.

**Stevenson**, C. 2012. **Human-crocodile conflict symposium**. Newsletter of the Crocodile Specialist Group, 31(3): 12-13.

**Upadhyay**, J.N., Sahu R.K. **2013. Study on *Crocodylus palustris*: co-existence of men, animal and population survey at Kheda Anand district in Gujarat, India**. I*n* Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group, pp.116-122. IUCN: Gland, Switzerland.

**Vasava**, A., Patel, D., Vyas, R., Mistry, V. and Patel, M. **2015**. **Crocs of Charotar. Status, Distribution and Conservation of Mugger Crocodiles in Charotar, Gujarat, India**. Voluntary Nature Conservancy: Vallabh Vidyanagar, India. **Summarised in** Newsletter of the Crocodile Specialist Group, 34(3): 19-20.
**Summary**: Conserving Muggers in these human dominated landscapes require a firm understanding of people's relationship with this species. This Mugger population is under severe anthropogenic pressures and the conflict in the form of Muggers being found in human habitation and creating panic amongst the local residents is increasing with time. Considering that these wetlands still provide suitable habitat for Muggers, there was an urgent need for a systematic assessment of populations and the drivers affecting the populations. A study was carried out from June 2013 to January 2015 to find out the recent status of Muggers in the Charotar region. The objectives of the project were (1) to understand the status and distribution of Muggers; (2) to identify the priority conservation areas; (3) to understand people's perception and attitude towards Muggers; and (4) to understand Mugger-human interaction.

**Vyas, R. 2018. Muggers of Vadodara.** Voluntary Nature Conservancy. In this 42-page illustrated booklet Dr Raju Dyas describes the fascinating world of the urban crocodiles of Vadodara, drawing on his 30 years of observing them in their natural habitats. The book includes brief overviews of mugger biology and behaviour, puts muggers in national and regional context in India, and provides detail on muggers in Vadodara, and the Vishwamitiri River. As the author notes, there has been an increase in mugger attacks in the river valley, affecting public perceptions of these crocodiles. There is a lot of good work going on including efforts by NGOs and the State Forest Department to respond promptly to incidents, and do outreach work to encourage tolerance of muggers. As Dr Vyas concludes, 'such large carnivorous reptiles surviving within our own city are not only a matter of pride but also our responsibility' (p.23). He includes advice on avoiding attacks, and on what to try if you are attacked.

**Vyas, R.** and Stevenson, C. **2017. Review and analysis of human and Mugger crocodile conflict in Gujarat, India from 1960 to 2013**. *Journal of Threatened Taxa* 9(12): 11016-11024.

**Abstract**: Human-Crocodile Conflict (HCC) occurs to varying degrees around the world, and with a number of crocodilian species (CrocBITE 2013). The Mugger or Marsh Crocodile *Crocodylus palustris* found in Gujarat State is the crocodilian species responsible for conflict with local people. This paper is a compilation of HCC occurring in various parts of Gujarat from 1960 to 2013. A total of 64 crocodile attacks were recorded: 44 (24 fatal and 20 non-fatal) on males, and 20 (9 fatal and 11 non-fatal) on females. By region 52 HCC were recorded in central Gujarat; five in Saurashtra, four in the northern region and three in Kutch; no crocodile attacks were recorded in southern Gujarat. Of the two major river systems in central Gujarat, 41 attacks occurred within the Vishwamitri-Dhadhar River System and 11 in the Narmada system. Most crocodile attacks happened between the months of April and September, peaking in May with 14 attacks. These months are the peak breeding season for the species in Gujarat. The most obvious contributors to HCC are lack of basic facilities in rural areas, poverty, illiteracy and the presence of adult animals close to human settlements and activities. Other contributing factors are lack of preventive measures by the forest department, absence of protocols for Mugger crocodile rescue, and haphazard release of problematic animals.

**Vyas, R., 2012. Current status of Marsh Crocodiles *Crocodylus palustris* (Reptilia: Crocodylidae) in Vishwamitri River, Vadodara City, Gujarat, India**. *Journal of Threatened Taxa* 4(14): 3333–3341.

**Vyas, R., 2012. Crocodile conflict in Gujarat State, India** (abstract). The 2nd Asian Regional Conference of Society for Conservation Biology, Book of Abstracts.
**Abstract**: In Gujarat, we record conflicts between animals and humans in two main categories: mammals (lions, leopards, and langur monkeys), and reptiles (snakes and crocodiles). Human-crocodile conflict is increasing, a trend over the last two decades that we need to address as a serious issue. The mugger, or Marsh crocodile (*Crocodylus palustris*), is the species responsible for human-crocodile conflict in Gujarat. We have studied the population since 2008, and have noted 122 crocodiles rescued from near human settlements, 16 attacks on people by muggers, and 10 crocodiles killed in retaliation by local people. We also report on crocodile numbers increasing in areas across the state where they were previously unknown, and a growing use, by people, of water bodies that are shared with crocodiles. There is a vital need to develop a crocodile management program for Gujarat to protect both people and crocodiles from escalating conflict. In situations of wildlife and human conflicts, poor management means the wildlife will lose out.

**Vyas, R., 2010. Mugger (*Crocodylus palustris*) population in and around Vadodara city, Gujarat State India**. *Russian Journal of Herpetology*, 17(1): 43-50.
**Summary**: Monitoring of over a two-decade period (1987–2007) of mugger (*Crocodylus palustris*) population of River Vishwamitri (Gujarat State, India) indicates the present status of the species in and around Vadodara City to be the most noticeable and unique. The population found in Vishwamitri-Dhadhar River System represents a unique case study of relationship between a crocodilian species and humans. The present study provides recommendations and an action plan for the long-term mugger conservation in the area.

**Vyas, R., 2010. The Muggers (*Crocodylus Palustris*) of Vishwamitri River: past and present. Herpetology & Environmental Research Project (HERP), Vadodara, Gujarat, India**.
Summary: This report is the result of a compilation, which is gathered from various sources along with the mugger population of Vishwamitri River, monitoring of over twenty-two years (January 1987 to December 2009).

**Vyas**, R. and Basu, D. **2008. Controversial Dam site now mugger conflict site**. Crocodile Specialist Group Newsletter 27(2): 28-30.

**Vyas**, R. **2005. Recent notable incidences of conflict between mugger and humans in Gujarat State**. Crocodile Specialist Group Newsletter, 24(2): 7-8.

**Whitaker**, N. and Srinivasan, M. **2020**. **Human crocodile conflict on the Cauvery River delta region, Tamil Nadu, south India**. International Journal of Fisheries and Aquatic Studies 8(5).
**Abstract**: Conflict between humans and crocodiles on the Cauvery River delta region is discussed. Four instances of situations were recorded, namely attacks on people (fatal and non-fatal), the capture of crocodiles from nearby inhabited areas, translocation of crocodiles to other areas of the river, and crocodiles entering human habitation. Distances between translocation sites and non-fatal attacks averaged 10.12 km, whilst distance between fatal attacks averaged 58.73 km.

**Whitaker**, N., **2006-2008. A compilation of reports on human-crocodile conflict in India**. Madras Crocodile Bank Trust and the UNDP/GEF SGP, 119pp.
**Summary**: This report includes surveys of human/crocodile conflict incidence in Chattisgarh, Rajasthan, Gujarat, Madhya Pradesh, Maharashtra, and Hut Bay on Little Andaman Island.

**Whitaker, N.**, and Nair, T. **2008. Survey of human//crocodile conflict in the Union Territory of the Andaman Islands, Hut Bay, Little Andaman, January 2008**. Report Submitted to UNDP, MCBT/CFH & ANFD. MCBT/UNDP/HCC-4. Available at: https://www.iucncsg.org/365_docs/attachments/protarea/Whit-f1a1ce2f.pdf

## IRAN

**Abtin, Elham and Asghar Mobaraki, 2017. *Gandou: Marsh Crocodile in Iran*.** Department of the Environment, Iran.
**Summary**: 'Muggers (*C. palustris*) occupy a range of natural and artificial waterbodies, especially artificial ponds inside villages, named "Hootak". Muggers also move between habitats, often crossing roads, and resulting at times in mortality by car strikes. Crocodiles use any available resources as food, including amphibians, birds, dogs and villager's livestock, but they mainly depend on fish. Despite this human-crocodile conflict, the local people respect crocodiles and never harm or hunt them. There have been few fatal attacks by Muggers on humans in Iran. Gandou: Marsh Crocodile in Iran" (144 pages) is based on the long and extensive fieldwork of the authors (Elham Abtin and Asghar Mobaraki) over more than 20 years.' (From *CSG Newsletter* 36(1): 4).
The book is available ($US15 plus postage) from the authors Elham Abtin (ala_saly@yahoo.co.uk) and Asghar Mobaraki (amobaraki@yahoo.com), Department of the Environment, Iran.

## NEPAL

**Bhattarai, D., Lamichhane, S., Pandeya, P., Gautam, J., Bhattarai, S. 2021. Living with mugger crocodiles (*Crocodylus palustris*): a case study from Kamal Daha, Koshi Tappu wildlife reserve, Nepal**. Crocodile Specialist Group Newsletter. 40(2): 8-10.
**Summary**: The presence of Muggers in human settlements, especially in farmers' fishponds, sometimes leads to a conflict with local people. In Kamal Daha, a small village situated in a buffer zone area of Koshi Tappu Wildlife Reserve (KTWR), in eastern Nepal, the researchers documented an unusual scenario in a pond named "Kamal Daha". Here, mugger were remarkably tolerant of human proximity, and there was community acceptance and tolerance to Muggers in Kamal Daha.

## SRI LANKA

Inland, most attacks are attributed to the mugger crocodile (*Crocodylus palustris*), with attacks attributed to the saltwater crocodile (*C. porosus*) on the coast.

**Amarasinghe**, T.A.A., Madawala, M.B., Karunarathna, D.M.S.S., Manolis, S.C., de Silva, A. and Sommerlad, R. 2015. **Human-crocodile conflict and conservation implications of saltwater crocodiles *Crocodylus porosus***

**(Reptilia: Crocodylia: Crocodylidae) in Sri Lanka**. Journal of Threatened Taxa 7(5): 7111-7130. Available at: file:///C:/Temp2/Downloads/61_thasun_amarasinghe_human-crocodile_conflict.pdf
**Summary**: presents findings of a 5-year survey on human-crocodile conflict on Sri Lanka and relate the results to improving management practices. Survey *C. porosus* populations, propose crocodile vigilance zones, specify threats to *C. porosus*, and record attacks on humans, pets and livestock.

**De Silva**, A., de Silva, P., Dawundasekara, D.M.N., **2013. Crocodile attacks in Sri Lanka**. In Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group, pp.227-233. IUCN: Gland, Switzerland.

**De Silva, A. 2011. Prevention of crocodile attacks in Sri Lanka: some traditional methods**. Crocodile Specialist Group Newsletter. 30(1): 28-31.

**De Silva, A., 2008. The Status of the Saltwater Crocodile (*Crocodylus porosus*) inhabiting the Nilwala River, Matara District and its Impact on the community**. IUCN/WWF/American Red Cross Partnership. 34 pages (include first report of HCC in Nilwala River)

**De Silva, A., 2010. Crocodiles of Sri Lanka: Preliminary Assessment of their Status and the Human Crocodile Conflict Situation**. (Report submitted after fulfilment of the project to Mohamed Bin Zeyed Species Conservation Fund) Author, AMP Print Shop. Gampola. 49pp.

**De Silva, A., 2008. Preliminary survey of saltwater crocodiles (*C. porosus*) in the Nilwala River, Sri Lanka**. Crocodile Specialist Group Newsletter 27 (3): 10-13.

**De Silva, A., 2013. The Crocodiles of Sri Lanka** (Including Archaeology, History, Folklore, Traditional Medicine, Human-Crocodile Conflict and a Bibliography of the Literature on Crocodiles of Sri Lanka). Published by the Author. Printed at AMP Print Shop, Gampola, 254 pp + 72 plates. ISBN: 978-955-52061-1-2.

**Gabadage, D.E. and Botejue, W.M.S., 2013. A Preliminary study on human crocodile relationship in Urubokka Oya, southern province of Sri Lanka** (abstract). In Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group, p.238. IUCN: Gland, Switzerland.
**Abstract**: A preliminary study was conducted to assess the impact of humans on crocodiles and vice versa along the Urubokka Oya / Maha Oya (oya = river) in Humbantota District, Sothern Province of Sri Lanka. This river provides good habitats with both rocky and muddy riverbanks and muddy shallow water. The river mainly flows through paddy cultivated lands and villages. Approximately 250 person hours were spent in the field over a period of six months from October 2012 to March 2013 to assess the relationship between humans and crocodiles. General area surveys and questionnaire were used as tools of data collection. No crocodiles were captured during the study. In average ~3 individuals of Mugger Crocodile (Crocodylus palustris) were recorded in a given field day, with total body length (TBL) ranging from ~0.3m to ~3m. No written record was found of humans been killed by crocodiles of this river or vice versa. One verbal record was found about a crocodile which have killed two humans in 2001 and the animal was captured by the officials of Department of Wild Life Conservation. During the last twelve years 9 crocodile attacks were recorded with 2 deaths, 3 major injuries and 4 minor injuries. However, 12 crocodile (TBL: ~0.3m to ~5m) deaths were recorded with 4 been killed by shooting, 5 been killed by beating and 3 juveniles found in an adjoining agricultural well killed by some chemical probably a pesticide. Altogether 8 crocodiles (TBL: ~0.6m to ~4.5m) have been captured and 3 have been handed over to Department of Wild Life Conservation. Out of the other five, 2 (TBL: ~1m) have been released to Kalametiya Bird Sanctuary and there is no record about what happen to the other 3 captured crocodiles. According to this survey it is prominent that there is a developing human crocodile conflict along Urubokka Oya and it will increase as the human population grows. Therefore, there is a need of a much in-depth study in order to have better management plans. Key Words: human crocodile conflict, Urubokka Oya, conservation, Sri Lanka.

**Pagoda, L.R. 2017. Crocodile human encounter patterns in Sri Lank**a. Prehosp. Disaster Med. 32 (Suppl. 1): s117 (doi:10.1017/ S1049023X17003338).
Abstract: Aim of this study is to identify what species of crocodile's attacks humans, their pattern when they attacked, where they attacked, what parts of the human body they prefer to grab most, why do they attack humans, and how crocodile human encounters are minimized so both species can live peacefully. The reported cases of crocodile attacks in Sri Lanka from 2010 to 2015 were reviewed. During the 5-year period 150 attacks were reported and 51 were fatal. The aim was to identify the attacks by two different species of crocodiles that live in Sri Lanka. We studied timeframe, location, causes, and how they attacked humans. Our research shows that fatal attacks are done by both species. The Saltwater crocodile attacked and killed 27 people, and Muggers killed 49 humans, not much difference. The usual attack sites for both groups are either in shallow water or close proximity to croc-infested water. This amounts to nearly 60% of attacks (90 incidents), of which 116 (77%) victims were males. They were attacked during bathing, washing clothes, swimming, collecting grass in marshy lands and playing in the water. Females were attacked while bathing, washing clothes and utensils. There were three rare cases where people were ambushed by Saltwater crocodiles in a marshy area when they regularly collect firewood. Ninety-five percent of the victims were dragged to the water by both groups of crocodiles. In most of the incidents limbs were attacked; there were reports of attacking to the head and torso by both groups of crocodiles. Most of the victims (>92%) were aware that the water sources are infested with crocodiles, but did not care enough to think of the impending danger. We found that some people were attacked non-fatal, by Saltwater crocodiles when they approached a crocodile nest, the attacks launched to defend the nest. An interesting observation that emerged from the accounts on crocodile attack victims and witnesses, was that it appeared that the animals had observed people engaged in water-based activity, like bathing and washing clothes, over a period of time before the attack. This would imply that at least some attacks, were not the result of a casual encounter with potential prey, but the culmination of a hunt at a spot where prey was known to gather. It has been observed that reptiles were poisoned after attacking humans, in some parts of the island. Reducing the crocodile land due to encroachment by humans, sand mining and destruction of mangroves, made reptiles attack humans as well as loitering in the land areas searching for food. In this review, we examined the features of crocodilians that contribute to explaining their evolutionary success, as well as the potential hazard they pose to humans. Only by understanding reptiles' capabilities and respecting its right to live, it is possible to mitigate the potential threat to life and limb of humans.

**Samarasinghe**, D.J.S., **2014. The Human-Crocodile Conflict in Nilwala River, Matara (Phase 1)**. YZA (Young Zoologists' Association) Publications, 118pp.

**Samarasinghe**, D.J.S., **2013. Human-Crocodile conflict in Nilwala River: a social science perspective** (abstract). In Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group, p.251. IUCN, Gland, Switzerland.
**Abstract**: Interactions between humans and crocodiles in the Nilwala River were present for centuries. However, during the past decade a total of 15 fatalities were recorded and eight crocodiles were killed in response to the four human attacks, as food and for protection last year. Therefore, this interaction has gradually progressed into a conflict. The main objective of the study was: Understand the root cause of the human-crocodile conflict and find out the barriers to overcome the problem and propose recommendations to conserve crocodiles and enhance human wellbeing in Matara. A structured questionnaire of 32 questions was developed to assess the knowledge, attitude and practices of people, additionally potential solutions developed were also included in the questionnaire. Awareness programs to schools and local government officials were also conducted. A total of 66 individuals were interviewed in six Divisional Secretariats. Majority of the respondents did not have proper knowledge about crocodiles as reported in previous studies. Sand mining was found to be a major cause of the issue changing the river physically, geologically and chemically (18 %, n=66 as per respondents). 26 % believes that a sudden population rise as the main reason for recent attacks. 68.1 % (n=66) use the river throughout the day for all purposes (42 % (n=81 responses)). 36 % believe that croc watching tours will not benefit community. 26.2 % (n=126 responses)

believed more crocodile exclusion enclosures must be built and19% (n=126 responses) proposed alternate water source as solutions. Majority (86%, n=66) believe that public showers are useful and (61 %, n=66) are willing to adopt a new lifestyle without the use of the river if an alternate water source is given. A list of short term and long-term rational solutions were formulated based on this study. Each numbered according to its priority. Both long term and short-term solutions must be implemented imminently

**Samaraweera**, A.M., Abesinghe, A.M.N.L., Cyril, H.W., de Silva, A., **2013. Preliminary study on attitudes, knowledge and practices (KAP) of villagers towards conservation of crocodiles (*Crocodylus palustris*) in Ethimale Tank of Uva Province. In Proceedin**gs of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group, pp.255-256. IUCN, Gland, Switzerland.
**Abstract**: A survey was formulated to study peoples' attitudes, knowledge, practices and risk perceptions towards survival of crocodiles (*Crocodylus palustris*) in the Ethimale tank at Moneragala district. A pre-tested structured questionnaire was used to collect data from 47 residents including fisherman and villagers, those who utilize the reservoir daily. The questionnaire included information on the crocodiles, their habitat and behaviour, importance and current practices of villages which affects survival of crocodiles. Knowledge and attitude were measured using knowledge and attitude indices. Data analysis was carried out by Microsoft Excel. As observed by the villagers, the number of crocodiles drastically reduced after 1983, with the damage occurred to the tank bund. Villagers practiced mass killing of the crocodiles and some were migrated to surrounding tanks in Ethimale. Intentional killing of yearlings and trapped crocodiles in fish nets and destruction of eggs to control their population, use of floating nets for fishing that attract crocodiles and illegal consumption of crocodile eggs and flesh were identified as the major threats for the survival of the crocodiles at present. Major problem for the villagers is the economic damage caused by crocodiles, by feeding on the fish catch and damaging the fishing nets. There are no incidences on direct crocodile attacks to human. Moreover, it was noted that the villagers possess moderate awareness on crocodiles including their behavior, measures to escape once a crocodile had attacked, and their importance as a part of the ecosystem. Around 40% provided positive responds on crocodile based eco-tourism, if enough protective measures are followed. Though, the need for conservation of the crocodiles is identified by the villagers (71%), their precedence for living does not allow practicing conservation measures. Hence, it can be concluded that crocodiles are under threat in the area and conservation initiatives need to be taken immediately to prevent them from extinction.

**Sivaruban**, A., and de Silva, A., **2013. Preliminary observations of the status of crocodiles and peoples' attitudes towards crocodiles in the northern province of Sri Lanka** (abstract). In Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group, p.257. IUCN, Gland, Switzerland.
**Abstract**: Most of the northern parts of Sri Lanka are poorly investigated for crocodiles during the past half a century due to over 30 years of civil conflict in the north of the country. However, there are reports of the presence of the mugger dating back to 1852. As such, a study was designed to investigate the status of crocodiles inhabiting the Northern Province which is a part of the ongoing crocodile survey of Sri Lanka. The Northern Province consists of 5 administrative districts namely Jaffna, Kilinotchchi, Mullativu, Vavuniya and Mannar. Each district was visited several times and preliminary investigations were carried out from May 2010 to January 2013. These investigations were carried out first to check for crocodiles and then to assess the knowledge and attitude of people regarding crocodilians by administered a structured questionnaire. The presence of crocodiles was checked by investigating the scats, footprints, drag marks during the day and night counts using 'eye shine' technique. Approximately ten tanks and part of the Jaffna estuary were investigated in Jaffna of which evidences such as foot marks, osteoderms and scats were collected. During the survey period we did not come across any crocodile bite victims in Jaffna district. However, in Vauniya several crocodile bite victims were interviewed, and mugger burrows were also observed in two tanks. In Mannar, muggers including both live and killed specimens were observed. Examinations of exhumed adults from Mannar island indicated people do not eat crocodile flesh in Mannar island, whereas around Giants tank many crocodiles have been killed for flesh. In Jaffna out of 71 people interviewed, 86% had no idea of the importance of crocodiles, 21% aware of crocodiles and said crocodile killing were done because of

attacks and 14% said they would not support conservation initiatives towards crocodiles. Our preliminary investigations suggest that there is an appreciable mugger population in many unexplored areas of the Northern Province. However, because of the resettlement activity in this part habitat reduction and crocodile kills are noticed. Thus, it is felt that the people must be informed about the important ecological roles played by crocodiles as well as to install crocodile exclusion enclosures for the people to carry out their routine activities.

**Somaweera, R., and de Silva, A., 2013. Using traditional knowledge to minimize human-crocodile conflict in Sri Lanka** (abstract). In Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group, p.257. IUCN, Gland, Switzerland.
**Abstract**: With the exponential increase of human populations due to large--scale agricultural and human settlement projects over the past half century, the number of humans and livestock using natural water bodies in the dry zone of Sri Lanka has increased significantly. Water bodies in these areas are also inhabited by mugger crocodiles (*Crocodylus palustris*) - the top predators of the ecosystem. This sharing of an essential, but a limited resource has resulted in an increase of 'Human-Crocodile Conflict' (HCC). Traditionally (and till present day), Crocodile Excluding Enclosures (CEEs) have been used by people in the southern wet zone of the island where humans frequently use waters inhabited by saltwater crocodiles (*C. porosus*). Surprisingly, CEEs are not in use in most parts of the dry zone where large populations of muggers exists and pose a serious medical concern through attacks (minor to grievous, including deaths) annually. This study: 1) identified three regions covering over 10 villages with a considerable HCC and, with the help of the communities, introduced and installed CEEs; 2) undertook two 'Knowledge Attitude and Practice' surveys, one pre construction and the other six months post-construction (100 participants each) to measure the success and understand limitations; and 3) conducted concurrent awareness programmes. Building physical barriers and concurrent development of a positive attitude towards crocodiles through awareness programmes were found to be effective actions in reducing the HCC in Sri Lanka. There is a significant increase in the frequency and duration of use of water resources by villages and also a positive attitude change towards crocodiles. No crocodile attacks on humans or killing of crocodiles by humans were reported from the areas since the CEEs were installed, where at least seven crocodile deaths have been reported the year before.

**Thilakarathna, A. and Godage, W.M.C.P. 2021. From conflict to coexistence: A critical look at issues related to human-wildlife interactions in Sri Lanka**. Asian Journal of Law and Governance 3(1): 47-59.
**Summary**: argues that conflicts over wildlife in Sri Lanka are more diverse than one might think as the conflict has now become human-wildlife-human conflict, where there is a conflict between who are trying to save the wildlife from the humans and the others who are trying to save their lives and crops from the wildlife. The crocodile material is based on Amarasinghe et al. (2015) and Uluwaduge (2018).

**Uluwaduge, P.**, Edirisooriy Menike, K.V.D., Senevirathna, E.M.T.K. and Pathirana, G.C.L. **2018. Mitigating the human-crocodile conflict in Sri Lanka: A study based on the Nilwala River area in Matara District**. Procedia Engineering 212: 994-1001.
**Abstract**: Human and crocodile have been coexisting for many years in Sri Lanka, particularly close to the Nilwala River area in Matara District, but fatalities were rarely reported. However, during the last decade the threats from crocodiles to humans have enhanced in the Nilwala River area, mainly during the years of 2005, 2008, 2009, 2012, 2013, 2014 and 2015. Some 26 attacks, killing 18 humans by saltwater crocodiles were recorded since 2000 in this area. In retaliation to these attacks, people in this area killed several crocodiles, and recorded the saltwater crocodile under the threatened category in Sri Lanka. Therefore, it is a worth to form a dialogue to mitigate human-crocodile conflict in the Nilwala River area in Sri Lanka. Primary data was collected from semi-structured interviews. Sample size was consisted of 45 respondents. Secondary data was collected through published books, research reports, symposia proceedings, journal articles and websites, etc. Collected data from different sources, as mentioned above was analyzed using qualitative and quantitative methods, and it was presented using maps, texts, tables and figures. The study found that sand

mining, population rise, using the river for daily needs such as drinking, bathing, washing clothes and fishing, unauthorized buildings in the river bank, scrub jungles, slow flowing of river are the major causes of the human-crocodile conflict in Nilwala River area. The study further found that Piladuwa, Fort and Thihagoda are the most vulnerable areas for human-crocodile conflict. “Kimbulkotuwa” or Crocodile Excluding Enclosure (CEEs) is a main method used to mitigate the human-crocodile conflict in this area.

**Vijaya-Anand**, V., Senadheera, S., and Rupatunge, T., **2013. A view on saltwater crocodile (*Crocodylus porosus*) captured from anthropogenic habitats in Western Province, Sri Lanka**. Proceedings of the 22nd Working Meeting of the IUCN-SSC Crocodile Specialist Group, pp.258-260. IUCN: Gland, Switzerland.
**Abstract**: Over the past few years there has been a dramatic increase in the media attention to humans and domestic animals that have been attacked by Saltwater crocodiles. Receiving less attention, many Saltwater crocodiles have also been killed by humans. In-between there are many instances that crocodiles were captured from the residential areas and relocated to suitable habitats with the involvement of the Dept. of Wildlife Conservation (DWC) and other conservationists. Among the 16 specimens captured by the DWC during the past 2 years, 14 were males. There have been several reports of this occurring elsewhere, and the animals have died before rescue was possible. The other crocodiles that were captured were released back to the National Parks such as Yala and Bundala and to sanctuaries such as Muthurajawela.

**Medical References relating to crocodile attacks on humans**


Abrahamian, F. M. and E. J. C. Goldstein (2011). Microbiology of animal bite wound infections. Clin. Microbiol. Rev. 24(2): 231-246.

Anderson, J.R. (1999) Characterisation of the oral and cloacal flora of wild and farmed crocodiles (*Crocodylus porosus* and *C. johnstoni*) in northern Australia. James Cook University of North Queensland.

Bonito, C., et al. (2013). Clinical image: crocodile bite. Journal of Pakistan Medical Students (JPMS) 3(3): 118-119.

Burgess, G. H., et al. (1997). Sharks, alligators, barracudas, and other biting animals in Florida waters. J. Fla. Med. Assoc. 84(7): 428-432.

Butterfield, W. C. (1976). Voluntary work in Nicaragua or the fine art of treating alligator bites. Connecticut Medicine 40(10): 703-704.

Caldicott, D.G.E., et al. (2005). Crocodile attack in Australia: An analysis of its incidence and review of the pathology and management of crocodilian attacks in general. Wild. Environ. Med. 16(3): 143-159.

Charruau P, Pérez-Flores J, Pérez-Juárez JG et al (2012). Oral and cloacal microflora of wild crocodiles *Crocodylus acutus* and *C. moreletii* in the Mexican Caribbean. Diseases of Aquatic Organisms 98:27–39.

Chattopadhyay, S., et al. (2013). Fatal crocodile attack. J. Forensic Legal Med. 20(8): 1139-1141.

Chiu, C. H., et al. (2009). Continuous infraclavicular block for forearm amputation after being bitten by a saltwater crocodile (*Crocodylus porosus*): A case report. Kaohsiung J. Med. Sci. 25(8): 455-458.

Constance, B.B. and Read, M.A. 2016. Chapter 33. Alligator and crocodile attacks. Pp. 686-692 in Auerbach's Wilderness Medicine, ed. by P.S. Auerbach, T.A. Cushing and N.S. Harris. Elsevier Health Sciences.

Da Silva, G. C., et al. (2010). Injuries and envenoming by aquatic animals in fishermen of Coxim and Corumba municipalities, State of Mato Grosso do Sul, Brazil: identification of the causative agents, clinical aspects, and first aid measures. Revista da Sociedade Brasileira de Medicina Tropical. 43(5): 486-490.

Doering, E. J., et al. (1971). Alligator bite (letter). J. Am. Med. Assoc. 218(2): 255-256.

Flandry, F., et al. (1989). Initial antibiotic therapy for alligator bites: Characterization of the oral flora of *Alligator mississippiensis*. Southern Medical Journal 82(2): 262-266.

Forrester, J. A., et al. (2012). Fatalities from venomous and nonvenomous animals in the United States (1999-2007). Wild. Environ. Med. 23(2): 146-152.

Goldstein, E.J.C. and Abrahamian, F.M. (2015). Animal bites and zoonoses: from A to Z: alligators to zebras. Pp. 659-679 in Zoonoses - Infections Affecting Humans and Animals, ed. by A. Sing. Springer-Science + Business Media: Dordrecht.

Gruen, R. L. (2009). Crocodile attacks in Australia: Challenges for injury prevention and trauma care. World J. Surg. 33(8): 1554-1561.

Haddad, V. and W. C. Fonseca (2011). A Fatal Attack on a Child by a Black Caiman (*Melanosuchus niger*). Wild. Environ. Med. 22(1): 62-64.

Harding, B. E. and B. C. Wolf (2006). Alligator attacks in southwest Florida. J. Forensic Sci. 51(3): 674-677.

Hertner, G. (2006). Caiman bite. Wild. Environ. Med. 17(4): 267-270.

Hines, T.C., Keenlyne, K.D. (1977). Two incidents of alligator attacks on humans in Florida. *Copeia* 4: 735-738.

Howard, R.J. and George H. Burgess. (1993). Surgical hazards posed by marine and freshwater animals in Florida. The American Journal of Surgery, 166 (November): 563-567.

Idani, M., Zegbeh N'guessan, E.K., Millogo, M., (...), Crezoit, G.E., Konsem, T. 2022. Cranio-cervico-facial injuries due to crocodile bite: A rare observation in Yalgado Ouedraogo University Hospital (Burkina Faso). Journal of Oral Medicine and Oral Surgery 28(1)12

Katlowitz, N. M., et al. (1995). Reestablishment of male sexual function and appearance 23 years after alligator induced traumatic orchiectomy and penile lacerations. J. Urol. 153(6): 1929-1930.

Langley, R. L. (2005). Alligator attacks on humans in the United States. Wild. Environ. Med. 16(3): 119-124.

Langley, R. L. (2005). Animal-related fatalities in the United States—an update. Wild. Environ. Med. 16: 67-74.

Langley, R. L. (2010). Adverse encounters with alligators in the United States: An update. Wild. Environ. Med. 21(2): 156-163.

Mazingi, D., Mbanje, C., Muguti, G.I. and Chitiyo, S.T. 2019. A case report of a bite from the Nile Crocodile (*Crocodylus niloticus*) managed with regional anaesthesia. Wilderness & Environmental Medicine (https://doi.org/10.1016/j.wem.2019.06.013).

Mekisic, A. P. and J. R. Wardill (1992). Crocodile attacks in the Northern Territory of Australia. Med. J. Aust. 157(11-12): 751-754.

Njiokou, F., et al. (2006). Wild fauna as a probable animal reservoir for *Trypanosoma brucei gambiense* in Cameroon. Infect. Gen. Evol. 6(2): 147-153.

Noonburg, G. E. (2005). Management of extremity trauma and related infections occurring in the aquatic environment. J. Am. Acad. Orthopaed. Surg. 13(4): 243-253.

Pérez, V.A., Solano, B.P., Hernández, Y.S., Vindas C.M., Rodriguez, F.M., Hernández, I.S. 2018. Identification of Microbial Flora in the American Crocodile Oral Cavity (*Crocodylus acutus*), Cañas, Guanacaste, Costa Rica (abstract). In Proceedings of the 25th Working Group Meeting of the IUCN Crocodile Specialist Group, p.178.

Rao, G.K.B.S.C., Waziri, S., Nielsen, A.E.V., Schwartz, F., Mortensen, J.F. 2022. Crocodile Bites. *Ugeskrift for laeger* 184(6). ISSN:0041-5782E-ISSN:1603-6824 [ARTICLE IN DANISH] Case report of treatment of a middle-aged man.

Raynor, A. C., et al. (1983). Alligator bites and related infections. J. Fla. Med. Assoc. 70(2): 107-110.

Rosenthal SG, Bernhardt HE, Phillips JA III. (1974). *Aeromonas hydrophila* wound infection. *Plast Reconstr Surg.*53: 77.

Sartain, S. E. and R. W. Steele (2009). An Alligator Bite. Clinical Pediatrics 48(5): 564-567.

Schmidt, E., Kulendran, K., Green, D., Chong, H.I. 2021. Penetrating skull injuries from a crocodile bite: general surgery in Far North Queensland. ANZ Journal of Surgery 91(9): 1943-1945.

Schneider, C.S., Pokines, J.T., L'Abbé, E.N. and Pobiner, B. 2021. Reptile taphonomy. In Manual of Forensic Taphonomy, ed. by J.T. Pokines, E.N. L'Abbé and S.A. Symes. CRC Press.

Subramaniam, K., Wong Yi-Li, G., Krishnan, V., Yi, I.C.S., Amran, M.A.B.M. 2021. Crocodile Attack Injuries: A Failed Attempt to Conceal Homicide. Academic Forensic Pathology 11(3): 174-179. Includes data on Sarawak. Case study of victim being scavenged by crocodiles after his murder.

Scott, R. and H. Scott (1994). Crocodile bites and traditional beliefs in Korogwe District, Tanzania. British Medical Journal 309(6970): 1691-1692.

Shepherd, S. M. and W. H. Shoff (2014). An urban Northeastern United States alligator bite. American Journal of Emergency Medicine 32(5): 1-3.

Sinton, T.J. and R.W. Byard. (2016). Pathological features of fatal crocodile attacks in Northern Australia, 2005-2014. Journal of Forensic Sciences (August). doi: 10.1111/1556-4029.13171

Smith, S., Bagshaw, R.J. and Hanson, J. (2017). The microbiology of crocodile attacks in Far North Queensland: implications for empirical antimicrobial therapy. Med. J. Aust. 206(7): 307-308.

Tarlé, R.G., Haddad, V.. 2022. Broad-Snouted Caiman (Caiman latirostris) bite. Revista da Sociedade Brasileira de Medicina Tropical 55,e0655-2021

Tuakli, J. and L. Wosornu (1979). Animal bites and injuries--indications for metronidazole. Med. J. Zambia 13(3): 54-57.

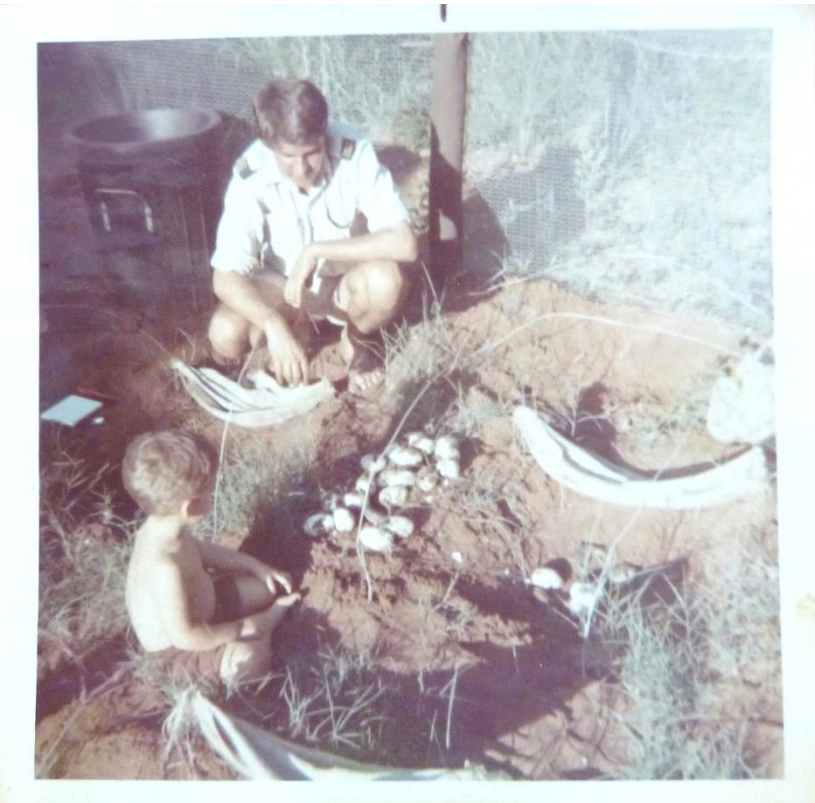
Vanwersch, K. (1998). Crocodile bite injury in southern Malawi. Tropical Doctor 28(4): 221-222.

Venter, M., Kelly, A., Boffard, K., Pretorius, R. and Younus, A. 2020. African Nile crocodile bite of the forearm: A case report. East African Orthopaedic Journal 14(2): 102-107.

Wamisho, B. L., et al. (2009). Crocodile bites in Malawi: microbiology and surgical management. Malawi Med. J. 21(1): 29-31.

Warwick, C. and C. Steedman (2012). Injuries, envenomations and stings from exotic pets. J. R. Soc. Med. 105(7): 296-299.

Wolf, B. C. and B. E. Harding (2014). Fatalities due to indigenous and exotic species in Florida. J. Forensic Sci. 59(1): 155-160.



**In memory of my father, Tony (A.C.) Pooley**