




Wildlife conservation through traditional values: alarming numbers of crocodile attacks reported from Timor-Leste

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Abstract On the IUCN Red List the saltwater crocodile *Crocodylus porosus* is categorized globally as Least Concern, with national populations ranging from fully recovered to extinct. The saltwater crocodile population of the Southeast Asian island nation of Timor-Leste was severely depleted by colonial hunting but has recovered since independence in 2002. During 2007–2014 there was a 23-fold increase in reported crocodile attacks (104 documented attacks), concomitant with a 2% annual increase in the human population. Public tolerance to attacks and the reluctance to harm crocodiles are entwined with reverence of crocodiles as sacred beings by most but not all Timorese people. In 2022, 7–8 years after our previous assessment, we visited five sites on the south coast of Timor-Leste in Lautém, Viqueque, Manufahí and Cova Lima municipalities. High rates of crocodile attacks continue. We obtained 35 records of attacks for 2015–2022 (34% fatal). In the municipalities where crocodile attacks occurred (Lautém, Viqueque, Cova Lima), the sacred status of crocodiles prevented inhabitants from harming them in retribution. In Manufahí, where no attacks were reported, such traditional values never existed and crocodiles were hunted for subsistence and to improve safety. The design of a context-specific crocodile management programme that respects the reverence attributed to crocodiles by most people but reduces the risk of people being attacked by crocodiles is a conservation management challenge for the government of Timor-Leste. The developing tourism industry, which relies on coastal beaches and reefs, is jeopardized by the risk of crocodile attacks.

Keywords *Crocodylus porosus*, Global South, human–wildlife conflict, saltwater crocodile, Timor-Leste, traditional beliefs

The saltwater crocodile *Crocodylus porosus* is the largest living crocodilian; it can exceed 6 m in length and weigh over 1 t (Brackhane et al., 2018a). It eats a variety of fish, birds and mammals, including people when the opportunity presents. Attacks on people by saltwater crocodiles > 4 m long are usually fatal (Fukuda et al., 2015). *Crocodylus porosus* inhabits a wide range of saline and freshwater habitats (Brackhane et al., 2018a) and can undertake long-distance sea voyages (Spennemann, 2020). The IUCN Red List categorizes the global saltwater crocodile population as Least Concern (Webb et al., 2021) because abundant strongholds exist (e.g. Australia), but at a national level some populations (e.g. Thailand, Cambodia) are near extinction.

Timor-Leste gained independence in 2002 after 484 years of foreign rule by Portuguese and Indonesian colonial powers. It comprises 14,919 km² of largely mountainous land, borders West Timor (Indonesia) and is located c. 450 km north of Australia. Within Timor-Leste *C. porosus* occurs around the whole coastline, but the size, structure and dynamics of the wild population are poorly known (Brackhane et al., 2018a,b) because no standardized monitoring scheme is in place to inform conservation and management (Webb et al., 2021). In eastern Timor-Leste a possibly landlocked *C. porosus* population exists in Lake Ira Lalaro (Lautém district; Brackhane et al., 2018b).

In Timor-Leste the sacred status (*lulik*) of saltwater crocodiles goes back to the *Lafaek Diak* (Good Crocodile) creation myth of the country. Killing or even harming crocodiles is often taboo, even if they attack people (Brackhane et al., 2019). There is a reluctance to report attacks, particularly those that are non-fatal, as tradition dictates that victims are being punished for doing something wrong. These traditional values did not stop intense hunting and population depletion by colonial rulers but did underpin social acceptance of the post-independence recovery of wild populations (Brackhane et al., 2019).

Human–crocodile conflict has been increasing in Timor-Leste since independence. Sideleau et al. (2016)

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FIG. 1 The seven *sukus* in Timor-Leste that we visited in 2022: Suai Loro and Beco (Cova Lima district), Clacuc (Manufahi district), Uani Uma (Viqueque district) and Bauro, Muapitine and Mehara (the three *sukus* surrounding Lake Ira Lalaro in Lautem district).

compiled reports of 45 attacks during 2007–2014 (82% fatal), and Brackhane et al. (2018a) compiled reports of 130 attacks during 1996–2014, the majority (n = 104) during 2007–2014 (58% fatal). In September/October 2022, 7–8 years after our previous extensive assessment, we opportunistically collected information on both human–crocodile conflict and traditional values in Timor-Leste in seven *sukus* (villages) and associated waterbodies where human–crocodile conflict occurs. We visited the *sukus* Bauro, Mehara and Muapitine surrounding Lake Ira Lalaro (Lautem district), *suku* Uani Uma and lagoon Malai Wai (Viqueque district), *suku* Clacuc and lagoon Modomahut (Manufahi district) and *suku* Beco (Cova Lima district; Fig. 1). In *suku* Suai Loro (Cova Lima district) we could only obtain information on the cultural status of crocodiles. We aimed to add to the

available data on attacks and to determine whether the frequency of attacks during 2015–2022 had changed since our previous assessment. We also aimed to assess the degree to which cultural restraints against harming crocodiles were intact.

As described previously (Brackhane et al., 2018a, 2019), we asked the village headman (*Xefe Suku*), the traditional elder (*Lia Nain*) and other community members to provide information on attacks, including location, the name, age and activity of the victim and the severity of the incident (fatal vs non-fatal). We visited a victim of a recent crocodile attack in Beco and interviewed a fisherman in Uani Uma who had survived a crocodile attack in 2008, to cross-check the information provided (Brackhane et al., 2019). In Suai Loro we participated in a ceremony to honour local crocodiles.

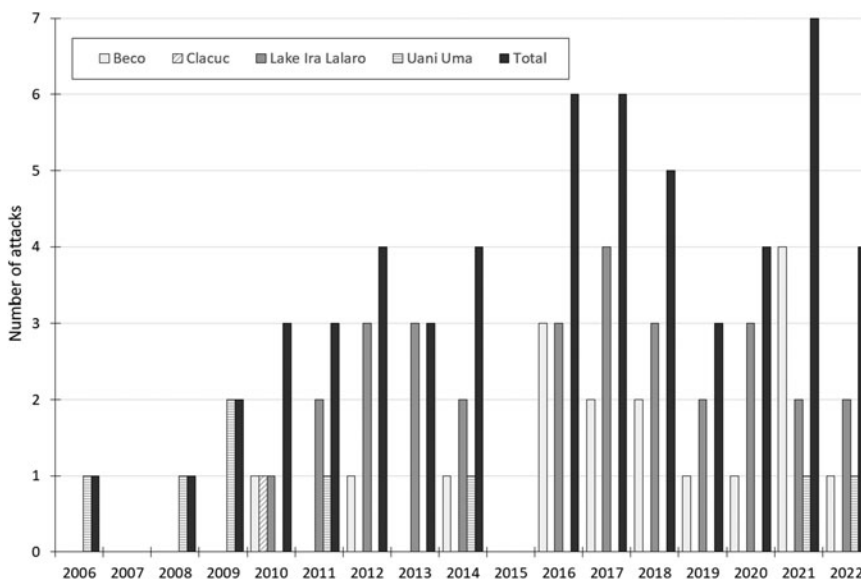


FIG. 2 Saltwater crocodile *Crocodylus porosus* attacks from 2006 to 2022 reported to us in the four sites visited during 2022 in Timor-Leste (n = 46; Fig. 1), complemented by attack reports from Brackhane et al. (2018a; combined n = 56). In Suai Loro we could only obtain information on the cultural status of crocodiles.



PLATE 1 (a) Saltwater crocodile *Crocodylus porosus* owners (*nain lafaek*) in front of a traditional crocodile house (*uma lafaek*) in Suai Loro (Fig. 1), (b) victim of a crocodile attack in Beco, (c) c. 4.5 m long crocodile in a lagoon in Suai Loro, and (d) local fisher working within c. 150 m of the crocodile shown in (c). Photos (a & b): S. Brackhane; photos (c & d): Y. Fukuda.

We obtained records of 46 crocodile attacks during 2006–2022 (35% fatal), 35 of which (34% fatal) occurred during 2015–2022 in Lake Ira Lalaro ($n = 19$), Uani Uma ($n = 2$) and Beco ($n = 14$; Fig. 2). None were reported from Clacuc during 2015–2022. The people attacked were mostly men ($n = 31$; 67%), and most attacks ($n = 37$; 80%) occurred whilst fishing or collecting mud crabs. Three people were attacked whilst working in rice paddies.

These new data indicate that crocodile attacks are still occurring at a high rate and that the number of reported attacks was considerably higher during 2015–2022 than during 2007–2014 in Beco (14 vs three crocodile attacks) and in Lake Ira Lalaro (19 vs 11 crocodile attacks). Crocodiles and/or risky human activities are either increasing in these areas or some historical attacks were not reported during previous assessments.

Cultural attitudes towards crocodiles were diverse amongst the four districts. In Bauro, Muapitine, Mehara, Uani Uma, Beco and Suai Loro crocodiles were regarded as sacred animals and hunting so-called grandfather crocodiles was generally taboo. In lagoon Malai Wai in Uani Uma a local fisherman was attacked and killed by a crocodile in 2020. The community was not prepared to kill or remove the crocodile unless it could be identified as a migratory so-called troublemaker crocodile from elsewhere (Brackhane et al., 2019). In Suai Loro traditional ceremonies conducted by traditional so-called crocodile owners (*nain lafaek*) in a dedicated crocodile house (*uma lafaek*) were an essential prerequisite for any activity involving local grandfather crocodiles, to prevent the crocodile becoming upset and

hurting or seeking revenge against the community (Plate 1a). In Beco a local fisherman had survived a crocodile attack 3 weeks before our visit, whilst collecting mud crabs (Plate 1b). He had serious injuries and was being treated exclusively by traditional means and medicines, rejecting assistance to travel to a hospital. In a lagoon in Suai Loro several large crocodiles were present (Plate 1c), but fishermen passed within metres of them without fear of attack (Plate 1d). In Manufahí district (e.g. in Clacuc at Modomahut lagoon) this sacred status had perhaps never existed amongst residents except for amongst some ethnicities relocated to Manufahí from other districts during the period of Indonesian occupation. Here crocodiles are hunted for subsistence, when available, and eggs are harvested for food.

The cultural significance of *C. porosus* has helped its population recover but at a high human cost in terms of attacks on people (Brackhane et al., 2018a, 2019). It is of concern that at Lake Ira Lalaro 19 attacks occurred during 2015–2022. Use of wetlands for subsistence, particularly fishing, is critical to the well-being of local people in Timor-Leste but is the activity that most attack victims were engaged in. The remoteness and access difficulties of these areas, exacerbated in the wet season, is a challenge to quantifying the distribution and size structure of the wild *C. porosus* population. Aerial, ground and boat surveys have a role to play in this, as does local knowledge (Brackhane et al., 2019). Implementing effective management in local contexts requires detailed knowledge about attack contexts, agreement from local stakeholders and resources for implementation. An education campaign, similar to the Crocwise programme in Australia, could be adapted to the local context to inform local people and tourists about the risks of crocodile attacks and the local cultural status of crocodiles. Tourism (diving, snorkelling) is an important new area of economic development in Timor-Leste, but crocodile attacks could potentially undermine investment in this industry.

Human–wildlife conflict is becoming more frequent, serious and widespread in many regions as wild spaces shrink and the human population increases (Sillero-Zubiri et al., 2023). In the case of saltwater crocodiles, the increasing and expanding populations in several parts of their range (e.g. Solomon Islands, Aswani & Matanzima, 2024; Malaysia) add to the potential for conflict (Webb et al., 2021). The situation in Timor-Leste is a case study of the challenges decision-makers face in implementing a context-specific management programme without incurring high costs to local people in regions where humans and crocodiles coexist (IUCN, 2023).

Author contributions Study design: SB, YF, GW; fieldwork: SB, YF, FMEX, VdA; data analysis: SB, YF, MG, JT; writing: SB, YF, DdAdD, RDRP, GW.

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Conflicts of interest None.

Ethical standards This research abided by the British Sociological Association and *Oryx* guidelines on ethical standards. All work was conducted with the necessary approvals from the government authorities of Timor-Leste. Survey teams included qualified and experienced individuals from both the Timorese government and local community, ensuring effective communication with local people was achieved during informal encounters. Participation in the interviews was voluntary and informed oral consent was received from all respondents. No animals were handled during this study.

Data availability The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available because they contain information that could compromise the privacy of the research participants.

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