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Crocodile management in Timor-Leste: Drawing upon traditional ecological knowledge and cultural beliefs

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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. We used semi-structured interviews with Timorese stakeholders (25 local authorities, 10 national experts, 15 citizens) to understand the cultural beliefs and traditional ecological knowledge underlying human-crocodile interactions, and conflict (HCC) in Timor-Leste. Interviewees knew this species was a risk (respect, fear) and its population was expanding, and had culturally determined beliefs (ceremonies, rituals) that included differentiating between local "ancestor" crocodiles and invasive "troublemakers." Cost-effective management could integrate stakeholder groups, especially traditional elders and local knowledge holders.

KEYWORDS

Cultural beliefs; traditional ecological knowledge; *saltwater crocodile (Crocodylus porosus)*; human-crocodile conflict; Timor-Leste; rural communities

Introduction

"The Crocodile Is Our Ancestor. We are the Descendants of the Crocodile."
-Local fisherman of Timor-Leste

Wildlife conservation is about taking actions to preserve and maintain species and habitats that humans value for intrinsic and utility reasons (Decker, Riley, & Siemer, 2012; Webb, 2014). With some predator populations recovering (e.g., crocodiles), conservation values and motives can change as the probability of people experiencing negative interactions increases (Dickman & Hazzah, 2016). Conserving highly depleted wild populations of predators that seldom cause problems for people is rarely controversial (Webb, 2014). Yet, managing abundant and recovering populations of animal species, such as saltwater

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crocodiles *(Crocodylus porosus*) that prey on both people and livestock, creates public and political divides between stakeholder groups with different values and beliefs (Marshall, White, & Fischer, 2007; Teel, Manfredo, & Stinchfield, 2007). Rural populations, who bear the brunt of most human-wildlife conflict (Barua, Bhagwat, & Jadhav, 2013; Inskip & Zimmerman, 2009; Woodroffe, Thirgood, & Rabinowitz, 2005), especially with crocodiles (Das & Jana, 2018; Dunham, Ghiurghi, Cumbi, & Urbano, 2010; Pooley, 2015), may hold predators in high esteem, but must make compromises when human lives and livelihoods are adversely affected.

Cultural and religious beliefs, including animism, shape some relationships between indigenous stakeholders and wildlife (Harvey, 2017; Schneider, 2018). Cultural beliefs can create incentives for wildlife conservation, but also dictate the types of management actions that will be acceptable for local stakeholders (Bhatia, Redpath, Suryawanshi, & Mishra, 2016; Byers, 1999; Infield, Entwistle, Anthem, Mugisha, & Phillips, 2018). Hence, cultural beliefs of local stakeholders need to be considered carefully when formulating conservation and management programs (Dickman, 2010; Ruiz-Mallén & Corbera, 2013; Treves, Wallace, & White, 2009).

The conservation of saltwater crocodiles in Timor-Leste provides an insightful case history of how cultural beliefs affect human-crocodile interactions and crocodile management. According to the Timorese creation myth "Lafaek Diak – The Story of the Good Crocodile," a giant crocodile formed the island of Timor (Figure 1(a)), which for many people bestows cultural reverence on the "ancestor crocodile" (Kaiser, Carvalho, Freed, & O'Shea, 2009; Käslin, 2015; Sideleau, Edyvane, & Britton, 2016). Crocodiles are commonly referred to as "Avo Lafaek – Grandfather Crocodile" and are part of the Timorese belief system *lulik*, which can be found among all ethnolinguistic groups of Timor-Leste (McWilliam, Palmer, & Shepherd, 2014; Trindade, 2011). *Lulik* can be translated as *'forbidden,' 'holy,'* or *'sacred'* and "refers to the spiritual cosmos that contains the divine creator, the spirits of the ancestors, and the spiritual root of life, including sacred rules and regulations that dictate relationships between people and people and nature" (Trindade, 2011, p. 1).

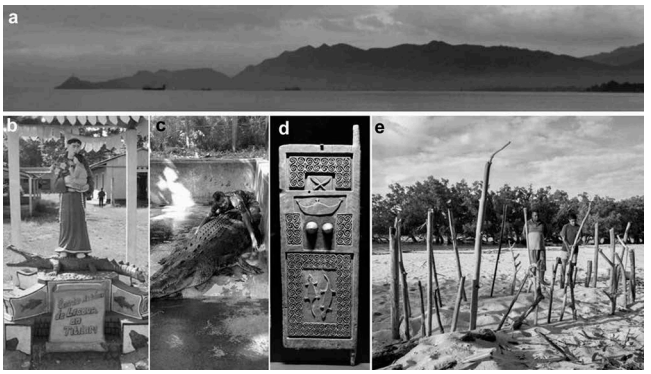

Figure 1. Local landscapes reinforce Timorese beliefs that the island of Timor was created by a giant crocodile (a). Ancestor beliefs outlasted Catholic missionary work (b). Crocodiles are mascots for military forces (c) and feature various traditional crafts (d). After a problem crocodile is killed, it is buried within a traditional ceremony (e). (Photo credits: Sebastian Brackhane (a, b), Eder Almeida (c), Daderot/CC0 1.0 (d), and Anders Kristensson (e)).

The *lulik* belief system widely complies with the theoretical concept of *dualistic cosmology* (Trindade, 2008), as described by Lévi-Strauss (1963) and van Wouden (1968). The *lulik* cosmos consists of physical and spiritual components that complement each other, maintaining balance within Timorese society and the natural environment (Trindade, 2015). The spiritual world constitutes the inner realm of the *lulik* cosmos, whereas the physical components constitute the outer realm. The outer realm is open to new values that sometimes are of foreign origin. For example, large parts of the Timorese society integrated Catholicism into their *lulik* cosmos during the centuries of Portuguese colonialism (McWilliam et al., 2014). Catholicism was adopted as a new value within the physical component, but did not eliminate the old values of the spiritual component (Bovensiepen & Delgado Rosa, 2016). Hence, the creation myth around "Grandfather Crocodile" could persist during missionary times (Figure 1(b)).

Today, saltwater crocodiles are the national iconic animal of Timor-Leste. This species is the mascot for the military and police forces (Figure 1(c)), and saltwater crocodiles are prestigious pets in the homes of local residents (Kaiser et al., 2009). Considering this high regard for saltwater crocodiles, most western-based concepts of wildlife management are not directly transferable to Timor-Leste. More innovative culturally and cosmologically informed management approaches may be needed to mitigate the accelerating rate of saltwater crocodile attacks on people (Browne-Nuñez & Jonker, 2008).

The status of the saltwater crocodile population in Timor-Leste prior to independence from Indonesia in 2002 is largely unknown. Under protective legislation introduced by the Timorese government after independence, the abundance of saltwater crocodiles has increased (Brackhane, 2015). Brackhane, Webb, Xavier, Gusmao, and Pechacek (2018a) quantified a 23-fold increase in saltwater crocodile attacks on people in Timor-Leste since 2007. Deaths due to saltwater crocodiles now constitute 14% of the annual road fatalities and are 10 times higher than deaths from malaria and 2.5 times higher than deaths from dengue fever (Brackhane et al., 2018a).

Given widespread adherence to crocodile ancestor worship in Timor-Leste, rationalizing the increasing human-crocodile conflict (HCC) creates some unique wildlife management challenges. The past and current president of Timor-Leste (2012–17; 2018-now; Taur Matan Ruak), when seeking technical guidance, described his dilemma: "Our grandfather is now eating his grandchildren" (Webb, 2014, personal communication).

Timor-Leste established a national Crocodile Task Force in 2012 to mitigate the accelerating HCC, but lacks the resources needed to design and implement an effective management program (Brackhane, Xavier, Gusmao, & Fukuda, 2018b). Yet, with attacks in designated tourist areas, such as Com and Tutuala, and with increased crocodile sightings in the capital Dilí (Sideleau et al., 2016), pressure for the Crocodile Task Force to take more action is mounting.

How management of this HCC can be achieved in a way that is not disrespectful to the ancestor crocodile is a serious challenge. The planned removal of problem crocodiles to a recently established enclosure in Hera, for example, provoked conflict with traditional elders from affected rural communities who strongly opposed the plan and feared negative consequences from "mother nature" should "grandfather crocodiles" be removed (Henschke & Wirawan, 2016; Quintão, 2016).

Considering this strong cultural context in Timor-Leste, we expected that local stakeholders would perceive human-crocodile interactions and crocodile management strategies based largely on their cultural belief system and traditional ecological knowledge

(TEK). For our study, we used the definition of TEK by Usher (2000) who suggested that "TEK refers specifically to all types of knowledge about the environment derived from the experience and traditions of a particular group of people" (p. 185). Here, we included concepts of local ecological knowledge, indigenous knowledge, or oral and community knowledge (Berkes, 1999). Our understanding of TEK had no temporal restrictions, *inter alia* we considered traditionally and recently acquired knowledge following the approach by Mallory, Gilchrist, Fontaine, and Akearok (2003).

Beliefs and values form the foundations of human thinking and influence the attitudes that humans attribute to wildlife conservation measures (Fulton, Manfredo, & Lipscomb, 1996; Teel et al., 2007). Manfredo, Vaske, and Decker (1995, p. 18) defined an attitude as an "evaluation or a feeling state about a person, object, or action." Researching cultural beliefs and associated attitudes helps "predict and influence human behavior" (Manfredo, 2008, p. 76). In Timor-Leste, we assumed that cultural beliefs attributed to saltwater crocodiles are intimately linked to the creation myth and the *lulik* cosmos, in which wildlife, culture, and religion are fused (Manfredo & Dayer, 2004). How local stakeholders see crocodiles within this creation myth today will underpin successful crocodile management in Timor-Leste.

Cultural beliefs and TEK are interrelated in a knowledge-practice-belief complex where cultural beliefs "shape environmental perception and give meaning to the observation of the environment" (Berkes, 1999, p. 14). Exploring the TEK of local stakeholders also provides a valuable source of information in the remote parts of Timor-Leste where almost no scientific information is available. In this context, TEK can be another pillar of crocodile management, forming a common information basis for joint decision-making by wildlife managers and local authorities (Olsson, Folke, & Berkes, 2004).

In this article, we present results of stakeholder interviews conducted with local authorities, national experts, and Timorese citizens, aimed at answering two fundamental questions. First, are cultural beliefs and TEK related to attitudes and behaviors relevant to crocodile management in Timor-Leste? Second, what options for crocodile management are likely to be acceptable to local stakeholders within the cultural context of Timor-Leste?

Methods

Study Area and Context

Timor-Leste is a sovereign island nation of 14,954 km^2 in maritime Southeast Asia. The nation shares Timor Island with West Timor, Indonesia (Figure 2). Timor Island has a high ethnocultural diversity that is based on three waves of immigration by Austronesian, Melanesian, and Proto-Malays starting around 40,000 BC, although the oldest human occupation of Timor island can be traced back to 42,600 BC (Hawkins et al., 2017). Before colonization by the Portuguese and Dutch, Timor Island was fragmented into several small dominions ruled by executive rulers, the so-called Liurais (Hägerdal, 2007). In 1515, Portuguese colonialists landed in Timor; in 1640 the island was separated into a westerly Dutch part and an easterly Portuguese part (Durand, 2016). Timor-Leste declared independence from Portugal in 1975, but was subsequently occupied by Indonesia, which initiated a 24-year period of occupation resisted by a guerrilla army led by the President (2002–2007)

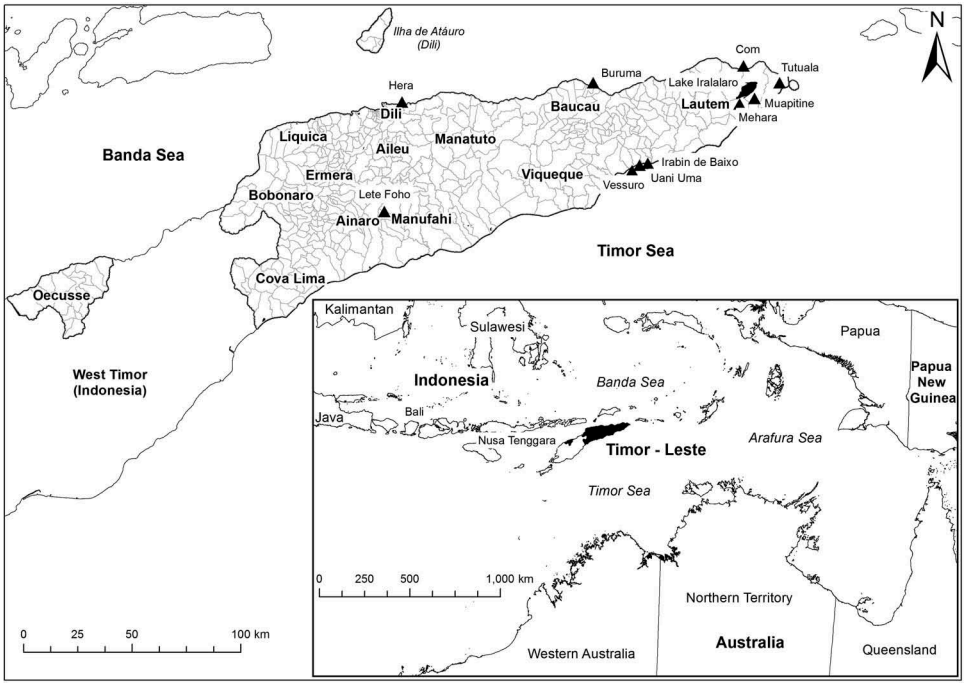

Figure 2. Timor-Leste consists of 13 municipalities (formerly districts) and is located in Southeast Asia between Indonesia and northern Australia.

and Prime Minister (2007–2015) Xanana Gusmao. In 2002, independence was achieved after a three-year UN-led transition period.

Today, Timor-Leste is considered a resilient democracy despite various post-colonial and economic challenges (Croissant & Lorenz, 2018). Many rural communities are difficult to access and most subsist by farming and fishing. Although about 98% of the population are Catholic, traditional beliefs are ingrained within Timorese culture (McWilliam & McWilliam, 2013; Trindade, 2011). Traditional spiritual matters are managed by the *Dato Lulik* or *Lia Nain*, the traditional elder, and are subject to a traditional legal system titled *tara bandu* (Henriques, Narciso, & Branco, 2011). *Tara bandu* is a complex system that evolved historically to negotiate access to natural resources (The Asia Foundation, 2013). The *Xefe Suku* is a secular leader responsible for the country´s smallest administrative unit, the *Suku*. The 442 *Sukus* of Timor-Leste are highly diverse and home to 16 constitutionally recognized ethnolinguistic groups.

Saltwater crocodiles are the largest (Britton, Whitaker, & Whitaker, 2012) and most aggressive (Brien, Webb, Lang, McGuinness, & Christian, 2013) of all crocodilians in the world. They occupy all coastal wetlands and have sea-going capabilities (Webb & Manolis, 1989). HCC in the form of fatal and non-fatal crocodile attacks by saltwater crocodiles on humans has increased as a consequence of successful conservation efforts in Timor-Leste (Brackhane et al., 2018a), India (Das & Jana, 2018), Sri Lanka (Amarasinghe et al., 2015), Indonesia (including West Timor; Sideleau, 2016), Australia (Fukuda, Manolis, & Appel, 2014) and the Solomon Islands (van der Ploeg et al., 2019).

Stakeholder Interviews

We conducted semi-structured interviews as applied by Huntington (1998, 2000) with Inuit people in Alaska. Conducting the interviews in the style of a dialogical conversation was considered more suitable than more structured approaches (Harvey, 2017; Kaiser et al., 2013), given the seriousness of both the cultural values and HCC being discussed.

We developed a list of questions "for prompting further discussions when there is a lull" (Huntington, 2000, p. 1271) based on four major themes: (a) the cultural status of saltwater crocodiles in Timor-Leste; (b) HCC, including attack assessments; (c) knowledge of habitat and biology of saltwater crocodiles in Timor-Leste; and (d) opinions on implemented, planned, approved, or disapproved management options. Not all of these themes were addressed by all interviewees in the semi-structured interviews, where "the direction and scope of the interview are allowed to follow the associations identified by the participant" (Huntington, 1998, p. 238). However, semi-structured interviews "allow unanticipated information to emerge" (Gagnon & Berteaux, 2009, p. 19), which is important when scientifically validated knowledge is unavailable and where major gaps in the understanding of human-crocodile interactions exist.

Interviews were conducted in the capital Dili and during field surveys with representatives from the *Sukus* of Com, Tutuala, Mehara, Muapitine, Irabin de Baixo, Uani Uma, Lete Foho, Vessuro, Buruma, and Hera (Figure 2). These *Sukus* were recommended by the national Crocodile Task Force as priority areas for saltwater crocodile management, due to: (a) the number of reported attacks on humans; (b) the proximity to major tourist destinations (Com and Tutuala); and/or (c) the location of premium crocodile habitat, such as Lake Iralalaro (Mehara, Malahara, Los Palos), Rio Irabere, and surrounding waterbodies in Irabin de Baixo, Uani Uma, and Vessuro. The interviews were held in the Tetum language, but translated to the survey team by a research assistant.

We distinguished among three stakeholder groups. The first group included national experts and authorities (n = 10) who were directly involved in the management of crocodiles and/or other wildlife species. These included staff of the Ministry of Industry, Commerce, and Environment (MCIE: n = 7), Ministry of Agriculture and Fisheries (MAF; n = 2) and Maritime Police (n = 1) whom we selected by purposive sampling. Two experts on wildlife management from the MCIE identified potential contributors who were then contacted by an email or telephone call, or during a crocodile management workshop held in Dili in December 2014. The interviews were conducted individually, either during the workshop or later at the workplaces of the experts. We recorded statements made by four national experts (State Secretary for Environment, State Secretary for Fisheries, National Director for Nature Conservation, and the Co-head of the Crocodile Task Force) during the 2014 national workshop elucidating the crocodile management strategy of the Timorese government.

The second group included regional and local authorities (n = 25) who were also interviewed during the 2014 national workshop and/or during two field surveys (2014 to 2017) (Brackhane & Pechacek, 2016). All regional and local authorities were chosen by purposive sampling, selected by the head of the Crocodile Task Force based on his knowledge of communities with high rates of HCC. Nineteen interviews were conducted individually, but in Lete Foho, Uani Uma, and Buruma, both the *Xefe Suku* and the *Lian Nain* were present during the interview and could respond to the questions.

The third group included local residents (n = 15), including six fishermen, of different ages and sexes, selected by convenience sampling. Here, the sampling method and limited number of interviewees did not allow for any representative or generalizable conclusions about the resident population as a whole. However, the TEK of rural and urban residents can be a valuable additional source of information and may set the basis for future attitudinal research. Interviewees were contacted individually through accidental encounters in Dili (8) and during field surveys in the following rural communities: Buruma (1), Com (1), Hera (1), Tutuala (2), and Uani Uma (2).

Data Analysis

We analyzed the interviews by coding segments according to three themes: (a) TEK about the natural history of saltwater crocodiles and HCC in Timor-Leste; (b) cultural beliefs and associated attitudes and behaviors about saltwater crocodiles; and (c) attitudes toward possible saltwater crocodile management measures. We used MAXQDA 10 (VERBI software, 2010) with both deductive (predefined) and inductive (defined a posteriori) coding, much in the style of Gagnon and Berteaux (2009). For example, statements expressing cultural beliefs toward crocodiles comprised codes such as "the crocodile is our ancestor" and "the crocodile is sacred," but we also assumed that calling crocodiles respectfully "Avo Lafaek-Grandfather Crocodile" during the interviews indicated cultural beliefs. TEK and reports on relevant behavior assessed during interviews were more descriptive and included codes such as "crocodiles can be found throughout the year in the lagoon Be Malae" or "the crocodile numbers increased since independence in Irabin de Baixo."

We ensured the validity of our observations and conclusions based on three strategies described by Maxwell (2013): (a) "respondent validation;" (b) "intensive, long-term involvement;" and (c) "comparison." The first two rounds of interviews were conducted in 2014 and 2015, and were analyzed in 2015 and 2016. Major findings and obscurities were integrated into a second round of interviews during two field surveys in 2017 where five of the communities (Com, Los Palos, Uani Uma, Irabin do Baixo, Vessuro) were revisited and feedback was solicited from respondents ("respondent validation"). We also considered the repeated observations made by co-author F.M.E. Xavier during his long-term involvement (since 2007) with Timorese crocodile management, and personal communications made by co-author G. Webb during a technical workshop in Dili in spring 2014, to develop the design of the study and validate our observations and conclusions ("intensive, long-term involvement"). Interviews were carried out in 10 communities in five municipalities (Baucau, Dili, Manufahi, Lautém, Viqueque), which allowed us to compare and validate statements from a variety of spatially separated interviewees ("comparison").

Results

Traditional Ecological Knowledge

All interviewees (i.e., national experts, local stakeholders, residents) knew that saltwater crocodiles are a sea-going species and a potential risk to people along the coast and within the rivers of the entire country. Four residents, four local authorities, and one national expert made statements about saltwater crocodile population dynamics

and assumed that the country's saltwater crocodile population had expanded as a consequence of protective measures introduced after independence from Indonesia. Two residents and two local authorities reported that saltwater crocodiles were hunted during the periods of Indonesian and Portuguese occupation, and two local authorities reported that the number of attacks prior to independence was low, but increased since then concomitant with the expanding saltwater crocodile population. However, these respondents could not quantify the numbers of crocodiles at a regional or national level:

> "The crocodile population has been increasing from what I know. The reason is because there is no control on the population. At least the Indonesian army used to shoot and catch them for various economic purposes (selling their skins, etc…)"- *Local Fisherman from Buruma*

> "There were no crocodile attacks during Portuguese and Indonesian occupation. There are frequent attacks since independence because people do not believe in the old traditions anymore."- *Xefe Suku of Vessuro*

Two residents from Uani Uma reported that during the period when UN peacekeeping forces were in Timor-Leste, soldiers of the Thai Battalion shot every saltwater crocodile they found in the municipalities of Baucau, Lautém, and Viqueque, and actively approached local fishermen to serve as hunting guides:

> "The UN soldiers were bored. There was nothing to do in the rural communities. They spent their time at the beach and actively looked for and shot all the crocodiles they could find. They asked rural community members, including me, to show them the places where crocodiles could be found. Nobody wanted to guide them, although the soldiers offered money for doing so."- *Local resident 1 from Uani Uami*

Two local authorities from Irabin de Baixo indicated that relocation measures conducted by Indonesian occupying forces were responsible for HCC:

> "During the Portuguese time, there were less people in the area. The crocodile stayed in sacred places. The local people knew about those places and avoided them. They went fishing in a very organized manner. The Lia Nain conducted a ritual before every fishing trip to open the gate. During the Indonesian occupation, Timorese people were relocated from the cities to remote, rural areas to weaken resistance. The new arrivals are not aware of local traditions. They ignore local traditions and enter the sacred places where they are attacked by the crocodiles." -*Lia Nain and Xefe Suku of Irabin de Baixo*

Nine respondents showed current saltwater crocodile habitat to us, on site or on maps during field surveys, that we could use for developing a preliminary saltwater crocodile habitat map for Timor-Leste (Brackhane et al., 2018b). One local authority reported ongoing habitat depletion with negative consequences for saltwater crocodile reproduction. He linked this to the increasing human population, which he found to be correlated with increasing HCC:

> "The increasing crocodile attacks are due to the increasing human population – people are moving closer to the crocodile habitat. Lately, I could not find any crocodile nest anymore, because people are moving toward the river." – *Lia Nain from Los Palos*

Cultural Beliefs about Crocodiles

All interviewees had perceptions about crocodiles, but they were heterogeneous within and among the three groups. Among residents of the capital Dilí who were interviewed, perceptions included fear for what they considered a dangerous animal (four respondents) and respect for the country`s iconic species (four respondents), but these perceptions were not mutually exclusive. Statements indicating cultural significance of crocodiles were made by two citizens in the capital Dili and one fisherman in the capital's rural coastal outskirt Hera. Eighteen local authorities (72%) from the coastal communities of the rural municipalities had culturally determined beliefs toward saltwater crocodiles. Seven local authorities (18%) did not make any statement that could be linked to a specific cultural status of saltwater crocodiles.

Cultural beliefs were implicated in behavior in some communities. Seven local authorities reported that ceremonies are conducted for saltwater crocodiles in their community, which often included the ritual killing of a water buffalo, pig, or chicken specifically to feed wild crocodiles. Rituals or ceremonies are conducted to retrieve body parts after a crocodile attack (two respondents) or prior to fishing trips to protect local fishermen (two respondents):

> "The Lia Nain performs a ritual before every fishing trip to communicate with the crocodile and to open the gate for the fishermen." – *Lia Nain from Uani Uma*

At least four local authorities and one national expert differentiated between local ancestor crocodiles and invasive "troublemaker" crocodiles. Two local authorities stated that the local ancestor crocodiles hide from strangers and cannot be tracked by anybody other than the associated clans and traditional elders who are thought to be able to communicate with crocodiles. "Troublemaker" crocodiles are believed to come from other communities or from abroad specifically to create trouble, such as stealing or attacking people, whereas ancestor crocodiles are part of *lulik* and usually taboo (i.e., they are under the protection of the community). Crocodiles are not only seen as ancestors but also occupy the role of messengers sent from "nature" to announce and enforce "natural law":

> "The crocodile is the natural justice. It is fair and does not fail, unlike human judges." – *National expert, Ministry of Agriculture and Fisheries*

Three local authorities interpreted the appearance of a saltwater crocodile within a village or at unusual high elevations as a messenger for future natural hazardous events. For example, when a saltwater crocodile appeared in a pond at an unusually high elevation of 422 m above sea level in Lete Foho in 2017 (S. Brackhane, personal observation), one participant explained that:

> "This crocodile delivers a message from Mother Nature. We must take care of it. If it gets hurt, we will be punished. The sea will take our land as it already has happened in the past." – *Lia Nain from Lete Foho*

In regions with distinct ancestor worship, victims of saltwater crocodile attacks are believed to have been punished for bad actions (e.g., crimes against nature or the crocodile itself) or for coming from a "bad" family, which was reported by four local authorities, and one local fisherman. In some regions, as reported by one respondent from Tutuala,

Lautém and one respondent from Vessuro, Viqueque, these perceptions include children, who, if attacked, are believed to come from bad families:

> "A young boy was attacked by a crocodile on the beach on 31st October 2014. He did something wrong. His body was brought back by the crocodile after the Lia Nain conducted a ritual." – *Lia Nain from Betano*

Cultural beliefs and associated behavior seem to differ among regions, community members, and clans within a community. Cultural beliefs including ancestor worship are especially, but not exclusively, manifested in the eastern municipality of Lautém where all six respondents from this area saw crocodiles in a cultural light. In coastal communities of other municipalities, ancestor worship seems to be less abundant, and in some regions crocodile hunting for subsistence is common. Local resident 1 from Uani Uma (Viqueque) claimed that crocodiles are hunted for meat by some community members in Luca, Beaco, and Uani Uma (Viqueque municipality), which is congruent with personal observations made by F.M.E. Xavier during his fieldwork.

Crocodile Management

Three national authorities associated with saltwater crocodile management expressed their respect for the country's iconic species, but also underlined that mitigating HCC is a priority:

> "The government pays respects to rural communities honoring the crocodile, but the government will take action if it attacks people."- *State Secretary for the Environment*

Five local authorities emphasized the necessity to integrate local, traditional management approaches into a national saltwater crocodile management regime:

> "The integration of local leaders into crocodile management is needed."
> -Xefe Suku from Los Palos

In coastal communities where local authorities had cultural beliefs toward crocodiles, there was usually one clan who was believed to be able to communicate with crocodiles (F. M.E. Xavier, personal observation). Within that clan, a traditional elder (*Dato lulik* or *Lia Nain*) is responsible for various issues concerning crocodiles, including conducting ceremonies to crocodiles. One local fisherman reported that other traditional elders are indirectly involved with crocodiles such as by applying the traditional legal system *tara bandu* in saltwater crocodile habitat, *inter alia* a specific lagoon or river and the fish resources within it, but not for the crocodile itself:

> "Many fishermen were attacked in the Lagoon Malai Wai. But, after the Lia Nain responsible for the lagoon applied *tara bandu* and imposed a taboo for fishing in the lagoon, no more people were attacked." – *Local fisherman from Uani Uma*

Within a community, the presence and activity of a traditional elder is a key factor sustaining the cultural beliefs toward saltwater crocodiles. He or she passes the creation myth and traditional knowledge from one generation to the next (F.M.E. Xavier., 2017, personal observation).

Where existent, the cultural belief of two different types of crocodiles, "troublemakers" and ancestor crocodiles, was implicated in varying attitudes toward management:

> "There are two types of crocodiles, migrating crocodiles from other *Sukus* (villages) and local crocodiles. The migrating ones are troublemakers. They should be captured and removed by the government. Local "*Suku*" crocodiles do not cause problems. They will disappear when (staff from) the government appears and cannot be captured."- *Xefe Suku of Betano*

How to deal with problem crocodiles is discussed in the community council, featuring the traditional elder and the *Xefe Suku*. When a fatal attack occurs, the police or Crocodile Task Force ask the relevant traditional elder for permission to remove or kill the crocodile responsible for the attack, which can usually be identified. Permission is usually granted for "troublemaker" crocodiles, but not in all cases for ancestor crocodiles. In the aftermath of some attacks, family members of the victim have killed the problem crocodile themselves.

> "It is possible to shoot problem crocodiles. The local Lia Nain is usually consulted after a crocodile attack. He has to decide whether the crocodile can be killed. One problem crocodile could be killed in Baucau. It was necessary to bury the body of a young boy it has attacked before. In other cases, the Lia Nain did not allow to shoot the crocodile. In 2013 in the village of Com, for example, the local Lia Nain did not agree to kill a problem crocodile." – *Commandante Polizia Maritima*

Culturally valued crocodiles in a local community can still be killed when they attack people or pose a risk to the community, as was reported by one local authority in Com, Lautém. Killed crocodiles are buried at the coast within a traditional ceremony that asks "mother nature" (*Ina lou ou rai inan*) for forgiveness (Figure 1(d)).

In the context of a governance regime, two local authorities advocated the appointment of local focal points, *inter alia* a local contact person in charge for crocodile related issues who reports to the Crocodile Task Force. Improved communication channels and improved availability of information and training of local stakeholders were requested by three local authorities. Crocodile egg collection and problem crocodile removal were mentioned by one local stakeholder from Lautém as one possible measure to control the crocodile population in Lake Iralalaro.

Discussion

Traditional Ecological Knowledge

The cultural status of saltwater crocodiles and human-crocodile interactions in rural, coastal Timor-Leste has resulted in a wealth of TEK. Traditional elders and some clan members have special relationships to certain local crocodiles, which they consider "ancestor crocodiles" and claim to be able to differentiate from other crocodiles. Human-crocodile interactions involve frequent ceremonies, where traditional elders call and feed crocodiles that are in some way habituated to human behavior. In general, local stakeholders claimed there had been an increase in the saltwater crocodile population after crocodile hunting by foreign soldiers stopped, suggesting intrinsic recovery of the population. But, they also recognized that some of these are "troublemaker" crocodiles, assumed to be migrant crocodiles from elsewhere, that mostly roam along the coastline. Ongoing depletion of saltwater crocodile habitats and damage to nesting sites, caused by resource extraction, was reported by one local authority, potentially contributing to ongoing dispersal of saltwater crocodiles.

TEK will continue to be a crucial source of information to assess the natural history and status of crocodiles in Timor-Leste. Crocodile habitat is mostly in remote areas in rough terrain

where conventional monitoring programs would be difficult to implement, even if technical resources were available. Brackhane et al. (2018b) have used TEK to identify saltwater crocodile core habitats, including potential breeding sites, in areas with limited accessibility.

Cultural Beliefs

Perceptions of the country's iconic animal were heterogeneous and ranged from respect but fear in urbanized areas of the capital Dili, to distinct ancestor worship among various rural communities along the coastline. Here, the *lulik* belief system remains omnipresent despite the influence of Christian missionaries (Bovensiepen & Delgado Rosa, 2016; McWilliam et al., 2014). In the capital Dili, which is an ethnic "melting pot," traditions and local beliefs were subject to more rapid change (The Asia Foundation, 2013).

The main conclusions drawn from of our research were that the coastal communities of Timor-Leste, which were visited during our field surveys, identify three broad categories of culturally specific crocodiles. First, local ancestor crocodiles ("Grandfather Crocodiles") are part of the spiritual component of the *lulik* belief system. They are passive and hide from outsiders, and are not considered to cause HCC problems. The traditional elder can communicate with them through rituals. Second, "messenger" crocodiles are thought to enforce natural law. These crocodiles are part of the physical component of *lulik*. They are active, visible to foreigners, and can attack and kill people who can be considered guilty for a crime against nature. Third, "troublemaker" crocodiles originate from other communities or other countries. They do not possess any cultural value to the community and can be removed by the government. The first two categories may not always be clearly delimited and many subcategories for crocodiles being part of *lulik* may exist among the different ethnicities in Timor-Leste. However, these three identified categories constitute an important baseline for assessing culturally appropriate management options. Some 72% of local authorities from the communities most affected by HCC perceive crocodiles as being culturally significant wildlife. The success of any future crocodile management plan aimed at containing the increasing rate of crocodile attacks on people will need to be sensitive to cultural beliefs and values (Brackhane, Xavier, Araujo, Mälicke, & Marcal, 2017).

Using Cultural Beliefs to Raise Public Awareness

The cultural status of saltwater crocodiles and associated local taboos on crocodile hunting, with the exception of following fatal attacks, facilitate the enforcement of strict crocodile protection enshrined in Timorese law (Diploma Ministerial, 2005). When community members consider crocodiles as part of *lulik*, it "immediately puts them in place for a moment, they pay full attention, they pay full respect, they are afraid, and it makes them obey without hesitation" (Trindade, 2011, pp. 4–6). Taboos on fishing in saltwater crocodile core habitat, exerted through the local resource management system *tara bandu*, have reduced the risk of attacks and may have the potential to prevent reported ongoing saltwater crocodile habitat depletion. Hence, our research suggests that *lulik* and *tara bandu*, as integral parts of conservation education (Skupien, Andrews, & Larson, 2016), are likely to be key factors for raising public awareness and engendering local support for management (Bovensiepen, 2014). However, ongoing attacks on fishermen suggest that

rituals and ceremonies, conducted by traditional elders to prevent local fishermen from attacks, are not particularly effective and may be creating a false sense of security.

Reducing the Effect of Problem Crocodiles

Local authorities recognize and apply different values to at least two types of crocodiles, which has implications for problem crocodile management. Removing "troublemaker" crocodiles may be relatively conflict-free, but interfering with "messenger" crocodiles, believed to attack people as punishment for acts against nature, is a sensitive issue. Further attitudinal research will be needed to resolve the circumstances in which culturally significant crocodiles can be removed. After a crocodile attack, the community council containing the relevant traditional elder must be consulted before any actions can be taken and approved.

Placing permanent crocodile traps near hotspots of attacks, or in urban areas, have the potential to significantly reduce the risk of attacks from crocodiles moving around the coast. In the Northern Territory of Australia, 250–300 problem crocodiles are trapped and removed from Darwin Harbor annually to mitigate HCC (Fukuda et al., 2014). This type of program may be culturally acceptable if problem crocodiles are mostly considered to be "troublemakers." A first step in this direction was the establishment of an enclosure for problem crocodiles in Hera in 2015, which currently hosts two problem saltwater crocodiles (S. Brackhane, 2017, personal observation). Expanding a strategic trapping program is perhaps constrained more by a lack of financial and technical resources than by cultural sensitivities.

Novel approaches may be necessary to evaluate the magnitude of migratory "troublemaker" crocodiles roaming along the Timorese coasts and being held responsible for many of the attacks on humans (Brackhane et al., 2018a). If these are indeed coming from the Northern Territory of Australia, as hypothesized by Brackhane et al. (2018a), collaborative monitoring schemes between Timorese and Australian authorities may be required.

Governance Implications

TEK is an important source of information on local crocodiles and cultural beliefs, and the integration of local authorities with TEK into a national crocodile management regime will be crucial to its success. Assigning a local person as a focal point for crocodile affairs in a given area could enhance communication between local and national institutions, and help achieve standardization of reporting and assessments, especially for crocodile attacks.

Integrating traditional cultural values about crocodiles into modern management programs has various precedents. In the Northern Territory of Australia, Aboriginal people have strong cultural beliefs about crocodiles (Lanhupuy, 1987), which are integrated into the management program (Saalfeld, Fukuda, Duldig, & Fisher, 2016), successfully advancing both conservation and mitigation of HCC (Pooley, 2018). In Papua New Guinea (PNG) and the Solomon Islands, strong cultural attachments to crocodiles shape perceptions about HCC (Telban, 1998; van der Ploeg et al., 2019), and are integrated into a management program based on sustainable use by local people in PNG (Hollands, 1987). In Africa, cultural beliefs about the West African crocodile (*Crocodylus suchus)* and Nile crocodile (*Crocodylus niloticus*) are integrated into management (Pooley, 2016) in countries such as Tanzania (Scott & Scott, 1994), Benin (Kpéra et al., 2014) and Madagascar (General Directorate for Forests,

Ministry of Environment and Forests of Madagascar, 2013). In Laos and Cambodia, TEK and cultural beliefs help to conserve the critically endangered Siamese crocodile (*Crocodylus siamensis*) (Daltry, Chheang, & Nhek, 2004; Platt, Oudomxay, Outhenekone, & Rainwater, 2018). These case studies indicate that concepts of distinct cosmologies, ancestor worship, TEK, taboos, and HCC implicated in the spiritual relevance of crocodiles are widespread among traditional and rural people in areas where management interventions are also needed to reduce HCC (Pooley, 2016).

Conclusion

In Timor-Leste, cultural beliefs influence human-crocodile interactions and options for crocodile management in communities severely affected by HCC. We identified categories of how stakeholders perceive crocodiles, and discussed options and limitations for using them in crocodile management with local participation to reduce HCC. Extending attitudinal research to other communities and ethnicities, including Indonesian West Timor where similarly high rates of HCC and cultural affinities to crocodiles exist, could help ensure management is participatory and more effective.

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References

Amarasinghe, A. T., Madawala, M. B., Karunarathna, D. S., Manolis, S. C., de Silva, A., & 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*, 7111–7130. doi:10.11609/JoTT.o4159.7111-30

The Asia Foundation. (2013). *Tara Bandu: Its role and use in community conflict prevention in Timor-Leste*. San Francisco, CA: Author.

Barua, M., Bhagwat, S. A., & Jadhav, S. (2013). The hidden dimensions of human–Wildlife conflict: Health impacts, opportunity and transaction costs. *Biological Conservation*, *157*, 309–316. doi:10.1016/j.biocon.2012.07.014

Berkes, F. (1999). *Sacred ecology: Traditional ecological knowledge and resource management*. London, UK: Taylor and Francis.

Bhatia, S., Redpath, S. M., Suryawanshi, K., & Mishra, C. (2016). The relationship between religion and attitudes toward large carnivores in Northern India? *Human Dimensions of Wildlife*, *22*, 30–42. doi:10.1080/10871209.2016.1220034

Bovensiepen, J. (2014). *Lulik*: Taboo, animism, or transgressive sacred? An exploration of identity, morality and power in Timor-Leste. *Oceania*, *84*, 121–137. doi:10.1002/ocea.2014.84.issue-2

Bovensiepen, J., & Delgado Rosa, F. (2016). Transformations of the sacred in East Timor. *Comparative Studies in Society and History*, *58*, 664–693. doi:10.1017/S0010417516000311

Brackhane, S. (2015). *Human-crocodile conflict in Timor-Leste – Assessment and recommendations for management* (unpublished master´s thesis). University of Freiburg, Baden-Württemberg, Germany.

Brackhane, S., & Pechacek, P. (2016). Community-based monitoring (CBM) in Rahmen des Übereinkommens über die biologische Vielfalt (CBD): Das Leistenkrokodil (*Crocodylus porosus*) in Timor–Leste als Fallbeispiel. *BfN-Skript*, *436*, 167–173.

Brackhane, S., Webb, G., Xavier, F. M. E., Gusmao, M., & Pechacek, P. (2018a). When conservation becomes dangerous: Human-crocodile conflict in Timor-Leste. *Journal of Wildlife Management*, *82*, 1332–1344. doi:10.1002/jwmg.21497

Brackhane, S., Xavier, F. M. E., Araujo, O., Mälicke, M., & Marcal, G. (2017). *Community-based monitoring of saltwater crocodile (Crocodylus porosus) in Timor-Leste*. London, UK: Rufford Foundation.

Brackhane, S., Xavier, F. M. E., Gusmao, M., & Fukuda, Y. (2018b). Habitat mapping of the saltwater crocodile (*Crocodylus porosus*) in Timor-Leste. *Herpetological Review*, *49*, 439–441.

Brien, M. L., Webb, G. J., Lang, J. W., McGuinness, K. A., & Christian, K. A. (2013). Born to be bad: Agonistic behaviour in hatchling saltwater crocodiles (*Crocodylus porosus*). *Behaviour*, *150*, 737–762. doi:10.1163/1568539X-00003078

Britton, A. R., Whitaker, R., & Whitaker, N. (2012). Here be a dragon: Exceptional size in a saltwater crocodile *(Crocodylus porosus*) from the Philippines. *Herpetological Review*, *43*, 541–546.

Browne-Nuñez, C., & Jonker, S. A. (2008). Attitudes toward wildlife and conservation across Africa: A review of survey research. *Human Dimensions of Wildlife*, *13*, 47–70. doi:10.1080/10871200701812936

Byers, T. (1999). Perspectives of aboriginal peoples on wildlife research. *Wildlife Society Bulletin*, *27*, 671–675.

Croissant, A., & Lorenz, P. (2018). Timor-Leste: Challenges of creating a democratic and effective state. In A. Croissant & P. Lorenz (Eds.), *Comparative politics of Southeast Asia* (pp. 331–366). Cham, Switzerland: Springer.

Daltry, J. C., Chheang, D., & Nhek, R. (2004). *A pilot project to integrate crocodile conservation and livelihoods in Cambodia*. Crocodiles: Proceedings of the 17th Working Meeting of the Crocodile Specialist Group (pp. 290–301). Gland, Switzerland: IUCN.

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*, 661–668. doi:10.1017/S0030605316001502

Decker, D. J., Riley, S. J., & Siemer, W. F. (2012). *Human dimensions of wildlife management*. Baltimore, USA: Johns Hopkins University Press.

Dickman, A. J. (2010). Complexities of conflict: The importance of considering social factors for effectively resolving human–Wildlife conflict. *Animal Conservation*, *13*, 458–466. doi:10.1111/acv.2010.13.issue-5

Dickman, A. J., & Hazzah, L. (2016). Money, myths and man-eaters: Complexities of human–Wildlife conflict. In F. Angelici (Ed.), *Problematic wildlife* (pp. 339–356). Basel, Switzerland: Springer.

Diploma Ministerial. (2005). Diploma Ministerial No. 04/115/GM/IV/2005: Lista das especies aquaticas protegidas.

Dunham, K. M., Ghiurghi, A., Cumbi, R., & Urbano, F. (2010). Human–Wildlife conflict in Mozambique: A national perspective, with emphasis on wildlife attacks on humans. *Oryx*, *44*, 185–193. doi:10.1017/S003060530999086X

Durand, F. (2016). *History of Timor-Leste*. Chiang Mai, Thailand: Silkworm Books.

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. *Journal of Wildlife Management*, *78*, 1239–1249. doi:10.1002/jwmg.767

Fulton, D. C., Manfredo, M. J., & Lipscomb, J. (1996). Wildlife value orientations: A conceptual and measurement approach. *Human Dimensions of Wildlife*, *1*, 24–47. doi:10.1080/10871209609359060

Gagnon, C. A., & Berteaux, D. (2009). Integrating traditional ecological knowledge and ecological science: A question of scale. *Ecology and Society*, *14*, 19. doi:10.5751/ES-02923-140219

General Directorate for Forests, Ministry of Environment and Forests of Madagascar. (2013). *2013 - Madagascar crocodile project final report*. Geneva, Switzerland: Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Hägerdal, H. (2007). Rebellions or factionalism? Timorese forms of resistance in an early colonial context, 1650-1769. *Bijdragen Tot De Taal-, Land-En volkenkunde/Journal of The Humanities and Social Sciences of Southeast Asia*, *163*, 1–33.

Harvey, G. (2017). *Animism. Respecting the living world*. London, UK: C. Hurst and Co Publishers.

Hawkins, S., O'Connor, S., Maloney, T. R., Litster, M., Kealy, S., Fenner, J. N., … Piotto, E. (2017). Oldest human occupation of Wallacea at Laili Cave, Timor-Leste, shows broad-spectrum foraging responses to late Pleistocene environments. *Quaternary Science Reviews*, *171*, 58–72. doi:10.1016/j.quascirev.2017.07.008

Henriques, P. D., Narciso, V., & Branco, M. (2011). *The role of traditional land use systems in the well-being of rural Timor-Leste* (Working Paper No. 2011_08). Évora, Portugal: Center for Advanced Studies in Management and Economics of the Universidade de Évora.

Henschke, R., & Wirawan, H. (2016, August 8). Where crocodiles are sacred. *British Broadcasting Corporation*. Retrieved from http://www.bbc.com/news/36987666

Hollands, M. (1987). The management of crocodiles in Papua New Guinea. In G. J. W. Webb, S. C. Manolis, & P. J. Whitehead (Eds.), *Wildlife management: Crocodiles and alligators* (pp. 73–89). Chipping Norton, Australia: Surrey Beatty & Sons.

Huntington, H. P. (1998). Observations on the utility of the semi-directive interview for documenting traditional ecological knowledge. *Arctic*, *64*, 237–242.

Huntington, H. P. (2000). Using traditional ecological knowledge in science: Methods and applications. *Ecological Applications*, *10*, 1270–1274. doi:10.1890/1051-0761(2000)010[1270:UTEKIS]2.0.CO;2

Infield, M., Entwistle, A., Anthem, H., Mugisha, A., & Phillips, K. (2018). Reflections on cultural values approaches to conservation: Lessons from 20 years of implementation. *Oryx*, *52*, 220–230. doi:10.1017/S0030605317000928

Inskip, C., & Zimmerman, A. (2009). Human felid conflict: A review of patterns and priorities worldwide. *Oryx*, *43*, 8–34. doi:10.1017/S003060530899030X

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

Kaiser, H., Taylor, D., Heacox, S., Landry, P., Sanchez, C., Ribeiro, A. V., … O'Shea, M. (2013). Conservation education in a post-conflict country: Five herpetological case studies in Timor-Leste. *Salamandra*, *49*, 74–86.

Käslin, E. (2015). Management of culturally significant wildlife—The saltwater crocodile. In National Biodiversity Working Group (Ed.), *Timor—Leste's fifth national report to the convention on biological diversity* (pp. 38–45). Dili, Timor-Leste: Democratic Republic of Timor-Leste.

Kpéra, G. N., Aarts, N., Tossou, R. C., Mensah, G. A., Saïdou, A., Kossou, D. K., … van der Zijp, 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*, 316–333.

Lanhupuy, W. (1987). Australian Aboriginal attitudes to crocodile management. In G. J. W. Webb, S. C. Manolis, & P. J. Whitehead (Eds.), *Wildlife management: Crocodiles and alligators* (pp. 145–147). Chipping Norton, Australia: Surrey Beatty & Sons.

Lévi-Strauss, C. (1963). *Structural anthropology*. New York, NY: Basic Books.

Mallory, M. L., Gilchrist, H. G., Fontaine, A. J., & Akearok, J. A. (2003). Local ecological knowledge of Ivory Gull decline in arctic Canada. *Arctic*, *56*, 293–298. doi:10.14430/arctic625

Manfredo, M. J. (2008). *Who cares about wildlife: Social science concepts for exploring human-wildlife conflicts and conservation issues*. New York, NY: Springer-Verlag.
Manfredo, M. J., & Dayer, A. A. (2004). Concepts for exploring the social aspects of human–wildlife conflict in a global context. *Human Dimensions of Wildlife*, *9*, 1–20. doi:10.1080/10871200490505765
Manfredo, M. J., Vaske, J. J., & Decker, D. J. (1995). Human dimensions of wildlife management: Basic concepts. In R. L. Knight & K. J. Gutzwiller (Eds.), *Wildlife and recreationists: Coexistence through management and research* (pp. 17–31). Washington, DC: Island Press.
Marshall, K., White, R., & Fischer, A. (2007). Conflicts between humans over wildlife management: On the diversity of stakeholder attitudes and implications for conflict management. *Biodiversity and Conservation*, *16*, 3129–3146. doi:10.1007/s10531-007-9167-5
Maxwell, J. A. (2013). *Qualitative research design: An interactive approach*. Thousand Oaks, CA: Sage.
McWilliam, E. G., & McWilliam, A. (2013). *Land and life in Timor-Leste: Ethnographic essays* (pp. 264). Canberra, Australia: Australian National University Press.
McWilliam, E. G., Palmer, L., & Shepherd, C. (2014). *Lulik* encounters and cultural frictions in East Timor: Past and present. *The Australian Journal of Anthropology*, *25*, 304–320. doi:10.1111/taja.12101
Olsson, P., Folke, C., & Berkes, F. (2004). Adaptive co-management for building resilience in social-ecological systems. *Environmental Management*, *34*, 75–90. doi:10.1007/s00267-003-0101-7
Platt, S., Oudomxay, T., Outhenekone, P., & Rainwater, T. R. (2018). Notes on traditional ecological knowledge and ethnoherpetology of Siamese Crocodile in Lao PDR. *Crocodile Specialist Group Newsletter*, *37*, 6–11.
Pooley, S. (2015). Using predator attack data to save lives, human and crocodilian. *Oryx*, *49*, 581–583. doi:10.1017/S0030605315000186
Pooley, S. (2016). A cultural herpetology of Nile crocodiles in Africa. *Conservation and Society*, *14*, 391–405. doi:10.4103/0972-4923.197609
Pooley, S. (2018). Descent with modification: Critical use of historical evidence for conservation. *Conservation Letters*, *11*, e12437. doi:10.1111/conl.12437
Quintão, P. (2016, April 28). Traditional elders opposed to crocodile management plan. *The Dili Weekly*. Retrieved from http://www.thediliweekly.com/en/news/13679-traditional-elders-opposed-to-crocodile-management-plan
Ruiz-Mallén, I., & Corbera, E. (2013). Community-based conservation and traditional ecological knowledge: Implications for social-ecological resilience. *Ecology and Society*, *18*, 12. doi:10.5751/ES-05867-180412
Saalfeld, W. K., Fukuda, Y., Duldig, T., & Fisher, A. J. (2016). *Management program for the saltwater crocodile in the Northern Territory of Australia, 20162020*. Darwin, Australia: Northern Territory Department of Land Resource Management.
Schneider, H. (2018). What role for culture in conservation? *Oryx*, *52*, 199–200. doi:10.1017/S0030605318000248
Scott, R., & Scott, H. (1994). Crocodile bites and traditional beliefs in Korogwe District, Tanzania. *British Medical Journal*, *309*, 1691. doi:10.1136/bmj.309.6970.1691
Sideleau, B. (2016). Notes on the current status of the saltwater crocodile, *Crocodylus porosus*, within East Nusa Tenggara Province, Indonesia. In *Crocodiles: Proceedings of the 24th working meeting of the crocodile specialist group* (pp. 149–152). Gland, Switzerland: IUCN.
Sideleau, B., Edyvane, K., & 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*, 801–809. doi:10.1071/MF15354
Skupien, G. M., Andrews, K. M., & Larson, L. R. (2016). Teaching tolerance? Effects of conservation education programs on wildlife acceptance capacity for the American alligator. *Human Dimensions of Wildlife*, *21*, 264–279. doi:10.1080/10871209.2016.1147624
Teel, T. L., Manfredo, M. J., & Stinchfield, H. M. (2007). The need and theoretical basis for exploring wildlife value orientations cross-culturally. *Human Dimensions of Wildlife*, *12*, 297–305. doi:10.1080/10871200701555857
Telban, B. (1998). *Dancing through time: A Sepik cosmology*. Oxford, UK: Clarendon Press.
Treves, A., Wallace, R. B., & White, S. (2009). Participatory planning of interventions to mitigate human-wildlife conflicts. *Conservation Biology*, *23*, 1577–1587. doi:10.1111/j.1523-1739.2009.01242.x

Trindade, J. (2008). Reconciling the conflicting paradigms: An East Timorese vision of the ideal state. In D. Mearns (Ed.), *Democratic governance in Timor-Leste: Reconciling the local and the national,* 1-25. Darwin, Australia: Charles Darwin University.

Trindade, J. (2011). *Lulik*:The core of Timorese values. In M. Leach, N. C. Mendes, A. B. Da Silva, B. Boughton, & A. Da Costa Ximenes (Eds.), *Peskiza foun kona ba/Novas investigações sobre/New research on/Penelitian Baru mengenai Timor-Leste*. Melbourne, Australia: Swinburne Press.

Trindade, J. (2015). *Relational dimensions within Timor-Leste customary society*. Paper presented to the 5th Timor-Leste Studies Association Conference, Liceu Campus, National University of Timor-Lorosa`e, Dili, Timor-Leste.

Usher, P. J. (2000). Traditional ecological knowledge in environmental assessment and management. *Arctic*, *53*, 183–193. doi:10.14430/arctic849

van der Ploeg, J., Ratu, F., Viravira, J., Brien, M., Wood, C., & Hurutarau, J. (2019). *Human-crocodile conflict in Solomon Islands*. Honiara, Solomon Islands: MECDM & WorldFish.

van Wouden, F. A. E. (1968). *Types of social structure in Eastern Indonesia*. The Hague, Netherlands: Martinus Nijhoff.

VERBI software. (2010). *MAXQDA 10 [Computer software]*. Berlin, Germany: Author.

Webb, G. (2014). *Wildlife conservation: In the belly of the beast*. Darwin, Australia: Charles Darwin University Press.

Webb, G., & Manolis, S. C. (1989). *Crocodiles of Australia*. Sydney, Australia: Reed Books.

Woodroffe, R., Thirgood, S., & Rabinowitz, A. (2005). *People and wildlife, conflict or co-existence?* Cambridge, UK: Cambridge University Press.