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Original article

Diversity, habitat distribution, and indigenous hunting of marine turtles in the Calamian Islands, Palawan, Republic of the Philippines

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ABSTRACT

All of the world's seven species of marine turtle are threatened by a multitude of anthropogenic pressures across all stages of their life history. The Calamian Islands, Palawan, Philippines provide important foraging and nesting grounds for four species: green turtles (*Chelonia mydas*), hawksbill turtles (*Eretmochelys imbricata*), loggerheads (*Caretta caretta*), and leatherbacks (*Dermochelys coriacea*). This work aimed to assess the relative importance of turtle nesting beaches and local threats using a combination of social science and ecological research approaches. Endangered green turtles and critically endangered hawksbills were found to nest in the Calamianes. The most important nesting sites were located on the islands off the west of Busuanga and Culion, particularly Pamalican and Galoc and along the north coast of Coron, particularly Linamodio Island. Opportunistic hunting and egg collection, conducted legally by indigenous communities, is the most significant threat to sea turtles in the area. Sites particularly vulnerable to hunting were found to be Galoc Island, Pamalican Island, and Panlaitan Island. Raising awareness, community engagement, and understanding of socio-cultural drivers of sea turtle exploitation, particularly among indigenous communities, are essential to gain support for any effective conservation program. Additionally, more effective enforcement of laws related to the trade in sea turtle products is required to close the commercial and export markets.

Introduction

Owing to their longevity, slow maturation rates, and complex life histories, marine turtles are highly vulnerable to a multitude of anthropogenic threats operating across their life-history (Wallace et al 2011). They undertake large-scale migrations, utilizing a wide range of habitats but spending the majority of their lives in the deep oceans. Female turtles return annually to their natal beaches to nest (Lohmann et al 2013), allowing critical areas of the nesting habitat to be identified and providing a rare opportunity to evaluate populations and their distribution to inform conservation management. It is impossible to guard against all threats to a given population of marine turtles, or to protect every area of habitat they utilize, so conservation efforts must therefore focus on life-history stages at which they are most vulnerable. Turtles are particularly vulnerable to human exploitation during nesting, when they are easily accessible to coastal populations, usually for subsistence purposes (Humber et al 2014).

Marine turtle populations worldwide are in urgent need of conservation action. Globally, the number of mature females nesting annually has diminished over the past three generations, by 84–97% for hawksbill turtles, *Eretmochelys imbricata* [listed on the International Union for the Conservation of Nature (IUCN) Red List as Critically Endangered; Mortimer and Donnelly 2008] and 48–67% for green turtles, *Chelonia mydas* (listed on the IUCN Red List as Endangered; Seminoff 2004). All seven of the world's species of marine turtle are included within the threatened categories of the IUCN Red List (IUCN 2014) and in Appendix I of the Convention on International Trade in Endangered Species, prohibiting international trade in these species and their products (UNEP-WCMC 2015).

There is a severe deficiency of current scientific research on marine turtles in the Philippines, as is the case for much of

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Southeast Asia (Gomez 1980; Shanker and Pilcher 2003), despite the fact that the country's waters are likely to harbor internationally significant populations. To date, the majority of research in the Philippines has focused on the Turtle Islands, Tawi Tawi, where over one million *C. mydas* eggs are laid each year (Cruz 2002; Lejano and Ingram 2007; Trono 1991). However, *C. mydas*, *E. imbricata*, and olive ridley *(Lepidochelys olivacea)* nesting sites are widespread throughout the Philippines (Cruz 2002; Ramirez-de Veyra 1994). Other sites with published data available include: Mindanao (Byrne and Hines 2005; Quimpo 2013); Northeastern Palawan (Ladra and Laguidao 1992); Panay and Guimaras Islands (Bagarinao 2011); Panikian Island, and Morong (Cruz 2002). Encouragingly, the *Pawikan* (marine turtle) Conservation Project, established in June 1979, has achieved much towards the sustainable management of turtles in the Philippines, including the development and implementation of conservation and protection policies, management and propagation schemes, and nationwide information and education programs (Ramirez-de Veyra 1994; Sagun 2003; Trono 1991).

The Calamian Islands (Figure 1) support a rich diversity of marine habitats including coral reefs, beaches, and seagrass beds (Garces et al 2013; Tupper et al 2015), providing important foraging and nesting grounds for marine turtles. At least four of the world's seven species of marine turtles have been historically reported in the islands' coastal waters (PCSDS 2006a,b,c,d): nesting populations of *C. mydas* and *E. imbricata,* occasional transient loggerheads (*Caretta caretta;* Sagun 2003) and leatherbacks (*Dermochelys coriacea*; Salinas et al 2009). Human exploitation for meat and eggs, combined with degradation of nesting and foraging sites and incidental capture in local fisheries, are major threats (PCSDS 2006a,b,c,d).

The Tagbanua of the Calamianes are one of the few indigenous tribes still practicing their traditional lifestyles in the Philippines. The Philippines' constitution guarantees the rights of indigenous communities to their ancestral land and sea resources (Capistrano 2010; Capistrano and Charles 2012). Fishing, hunting, and foraging define the Tagbanua people's identity and removing this component of their lives would endanger their culture (Dalabajan 2001). The Tagbanua people hunt marine turtles and collect their eggs according to traditional management practices such as cultural taboos and sacred areas (Guieb 2010; Sampang 2007). Additionally, the Philippines' National Protected Area System strongly promotes the inclusion of indigenous peoples and the integration of their traditional ecological knowledge in natural resource management strategies (Capistrano 2010).

Here we report on a rapid assessment of marine turtle populations in the Calamian Islands that combines social and ecological approaches, to provide information urgently required for conservation efforts including distribution of key nesting sites and patterns of exploitation.

Materials and methods

In order to rapidly develop a deeper understanding of marine turtle distribution, we carried out interviews in a total of 15 barangays located throughout the Calamianes (a barangay is the smallest administrative division in the Philippines; a village, district, or ward). Interview-based approaches have been employed in several studies of marine species globally (Moore et al 2010), providing a low-cost, rapid means of acquiring information over large areas. Barangays were selected based on a high occurrence of marine turtle sightings and locally known nesting sites (PCSDS

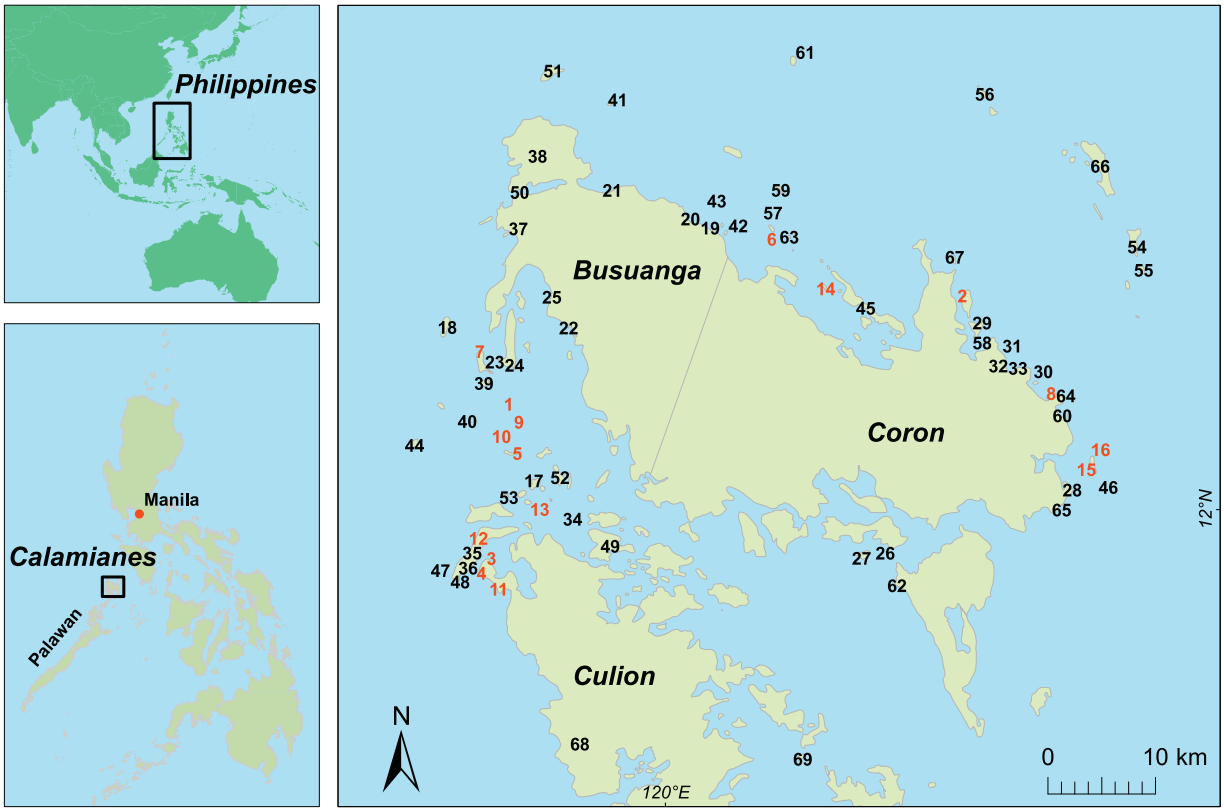

Figure 1. Location of the Calamian Islands showing marine turtle nesting sites identified during the current study, sites labeled in red indicate presence of body pits during surveys (for site names, see Tables 1 and A1).

2006a,b,c,d) and logistical considerations (sites that were remote and difficult to access were not surveyed). Barangay captains, heads of fishing associations, and octopus fishers (who fish in shallow coastal habitats, strongly associated with marine turtles) assisted us in the identification of individuals particularly knowledgeable about turtles and their nesting sites [hereafter referred to as key informants (KIs)]. We utilized a qualitative questionnaire consisting entirely of open answers to maximize the richness and detail of information gained (Newing 2011). We aimed to elucidate information on marine turtle nesting sites and behavior, patterns of exploitation, and local knowledge of conservation status and legal protection.

Interviewees were generally approached in their place of work, and questioned on an individual basis in local dialects. Questions covered the following: marine turtle nesting site distribution, hunting, cultural practices, and understanding of conservation status. We used photographs to confirm species identification with KIs, especially noting key anatomical differences between species. Interviews were undertaken until it was considered that little important new information or understanding relevant to the research questions was being elucidated, i.e., according to the principle of saturation (Newing 2011).

A total of 36 interviews were conducted from November 2014 to February 2015: 16 in Busuanga, 11 in Coron, and nine in Culion. Access to a number of sites was impossible because of the North East Monsoon (amihan). Focus group discussions were therefore also used to gather information from the remotest areas. These discussions were held at a workshop using the qualitative questionnaire to structure the dialogue. KIs were a mixture of fishers, local environmental officials, caretakers and managers of privately owned islands, and a turtle hunter. Ages ranged from 24 years to 69 years, with a mean age of 36 years.

We also conducted rapid assessments of nesting activity from November 2014 to January 2015 using standardized IUCN methods (Schroeder and Murphy 1999) on the principal nesting beaches identified by the aforementioned qualitative interviews and previous studies (PCSDS 2006a,b,c,d; Figure 1, Tables 1 and A1). We aimed to determine the relative importance of beaches for marine turtle nesting and associated patterns of exploitation, with body pit densities providing an indicator of the relative importance of sites. Body pits are excavations made by a female turtle on the beach just prior to digging the egg chamber (Hendrickson 1958). Global Positioning System (GPS) coordinates were taken at the start and end of each surveyed area of beach at the high tide line, with beach length calculated by recording tracks with the GPS. Nesting activity was measured in terms of the total number and density of body pits per km of beach surveyed. The GPS location of each body pit, distance from the high tide line and general habitat was recorded. Body pits were marked to avoid repeat recording. Species-level identification was limited by: (1) the absence of tracks to aid in identification (tracks being more ephemeral in nature compared to body pits (Mortimer and Day 1999) and thus more susceptible to loss to the elements); and (2) the erosion of body pits, which hindered identification based on size and depth.

Turtle remains provided evidence of exploitation at the beaches surveyed. Remains were assumed to be the result of human exploitation: (1) due to their presence on beaches making it unlikely the turtle died at sea; and (2) from any marks visible on the remains. Remains were identified to species level when possible and their location recorded. Obvious signs of damage (e.g., contact of flippers with propellers, hooks, or other man made instruments, or penetration of the carapace) indicated cause of death. Where the turtle appeared to have been killed for food, notes were made on what meat had been taken and what had been left behind.

Results

All KIs were aware of the presence of marine turtles in the Calamianes; species mentioned in descending frequency were *C. mydas* (31 respondents, $n = 36$, 86.1%), *E. imbricata* (27 respondents, $n = 36$, 75.0%), *D. coriacea* (4 respondents, $n = 36$, 11.1%), and *C. caretta* (2 respondents, $n = 36$, 5.6%). *C. mydas* and *E. imbricata* were confirmed by KIs as nesting in the area. *D. coriacea* and *C. caretta* were only reported to be observed at sea. Nesting sites identified by qualitative interviews and focus group discussions are given in Tables 1 and A1. A total of 37 beaches were surveyed *in situ* and a total of 47 turtle body pits were recorded at 16 beaches (Table 1). Pamalican Island, Linamodio–Buenavista and Galoc–Tototan were identified as the beaches with the highest nesting densities of > 10 body pits/km (Table 1).

Qualitative interviews suggested that marine turtles nest all year round in the Calamianes, since there was no consensus established among KIs on peak nesting seasons (January, 7 respondents, 19.4%; February, 5 respondents, 13.9%; March, 5 respondents, 13.9%; April, 6 respondents, 16.7%; May, 14 respondents, 38.9%; June, 7 respondents, 19.4%; July, 6 respondents, 16.7%; August, 7 respondents, 19.4%; September, 4 respondents, 11.1%; October, 5 respondents, 13.9%; November, 10 respondents, 27.8%; and December, 7 respondents, 19.4%; $n = 36$). Most respondents (26 respondents, $n = 36$, 72.2%) had observed hatchlings emerging from nests and swimming in the open ocean among *Sargassum* algae. Respondents recalled observing predominantly *C. mydas* hatchlings (15 respondents, $n = 26$, 57.7%), but also *E. imbricata* (10 respondents, $n = 26$, 38.5%). In general, KIs had an accurate understanding of marine turtle reproductive and foraging ecology, although, notably, most (32 respondents, $n = 36$, 88.9%) did not know the age at which turtles reach sexual maturity.

KIs all noted that opportunistic hunting was a major threat to marine turtles in the Calamianes and it was clear that hunting and egg collection continued to be actively practiced in the area, focusing on nesting sites (Tables 1 and A1). Hunters were noted to be primarily Tagbanua (12 respondents, $n = 36$, 33.3%), but also residents of Tara (1 respondent, $n = 36$, 2.8%) and Maglalambay (1 respondent, $n = 36$, 2.8%) Islands, and migrants from the Visayas (3 respondents, $n = 36$, 8.3%), Mindoro (3 respondents, $n = 36$, 8.3%), Cuyo Islands (1 respondent, $n = 36$, 2.8%), and the Batangas (1 respondent, $n = 36$, 2.8%). Turtles were not only hunted for subsistence as a reliable, cheap source of protein (25 respondents,

Table 1. Details of beaches in the Calamian Islands where evidence of turtle nesting was observed *in situ* during surveys.

	Site (municipality) *	No. of body pits	Body pit density/km	Known for hunting	Turtle remains
1	Pamalican Island (B)	6	19.47	✓	✓
2	Buenavista–Linamodio (Co)	3	16.30	–	–
3	Galoc–Tototan (Cu)	3	10.49	✓	–
4	Galoc–Dikabinton (Cu)	3	8.00	✓	–
5	Maltatayoc (B)	3	7.67	–	–
6	Club Paradise (Co)	3	7.01	–	–
7	Panlaitan Island (B)	8	6.84	✓	–
8	Turda–Kalibunan (Co)	5	5.92	–	–
9	North Cay (B)	2	5.56	–	–
10	South Cay (B)	1	4.85	–	–
11	Galoc–Labinton (Cu)	3	3.97	✓	–
12	Galoc–Sabang (Cu)	1	3.47	✓	–
13	Papachilin (B)	1	2.88	–	–
14	Decabobo–Decapedian (Co)	3	2.31	–	–
15	Diwaran Island West (Co)	1	1.60	✓	–
16	Diwaran Island East (Co)	1	0.98	✓	–

B = Busuanga; Co = Coron; Cu = Culion.

* Site number corresponds to the map in Figure 1.

$n = 36$, 69.4%), but were also sold for income (7 respondents, $n = 36$, 19.4%); one KI mentioned that Chinese residents in Coron were regular buyers. Cultural traditions of the Tagbanua were also discussed, with turtle meat typically served as the main dish at weddings, birthdays, and funerals.

The primary turtle hunting tools were spears (18 respondents, $n = 36$, 50.0%), fishing nets (11 respondents, $n = 36$, 30.6%), and hooks (7 respondents, $n = 36$, 19.4%). Spears with a line attached were used in the open ocean and hunters believed that a few drops of their saliva on the spearhead would ensure that the turtle could not escape. Nets and hooks were also commonly used at sea, with hooks employed to pierce the neck and flippers. Mataya Reef on the east coast of Coron was mentioned as an important hunting ground (Figure 1; Table A1). On nesting beaches, turtles were caught by hand with the hunter straddling the turtle's back and immediately tying up the flippers with rope. One KI also noted that turtles were sometimes accidentally trapped in fish corrals. Prices for turtle meat ranged from US$ 4.50 for a live subadult; US$ 0.70/kg meat up to US$ 33.50–67.00/kg for boiled and dried scutes.

During the beach surveys, three *C. mydas* remains were encountered: (1) a carapace at Pamalican beach, suspected to have been used for cooking due to burn marks on the carapace and remains of cooking fires in the area; (2) a head on the beach at Mabinchilao Island and (3) a plastron hanging from a tree in Baktatan, Galoc Island. The meat had already been taken, and the plastron was destined to be made into a local guitar. In addition, it was also mentioned that *E. imbricata* were not hunted, as eating their meat "causes all your previous sicknesses to come back" and the eggs are unpalatable because of their strong flavor of fish.

The majority (28 respondents, $n = 36$, 77.8%) of KIs were aware of local and national laws that protect marine turtles and prohibit hunting. It was widely noted that marine turtle populations were in need of protection to ensure their sustainability and stated that local residents and fisher folk should be the stakeholders primarily responsible for their conservation.

Discussion

Our data show that marine turtles are widely distributed throughout the Calamianes, albeit at relatively low densities, including confirmed nesting populations of *C. mydas* and *E. imbricata* (Figure 1). The extensive seagrass beds around the islands are likely to be important foraging grounds for *C. mydas* and the coral reefs critical habitat for *E. imbricata* (Garces et al 2013; Tupper et al 2015). Thus, the Calamian Islands may be considered a critical site for marine turtles because they provide a full complement of habitats to support multiple life history stages. Isolated, small islands, in particular Pamlaican and the islands south of Busuanga and off the northwest of Culion, appear to host important nesting beaches (Figure 1). No clear peak nesting season was determined in this study, although a previous study in the vicinity noted a peak during the North East Monsoon between October and March (Ladra and Laguidao 1992).

The Tagabanua were identified as the most prolific turtle hunters in the Calamianes and are legally permitted to take turtles according to their ancestral rights and cultural traditions (Guieb 2010). The growing black market for turtle products, including the presence of overseas buyers, is of particular concern, as it becomes increasingly difficult to distinguish between legal indigenous harvest and illegal commercial exploitation (Humber et al 2014). Restricted logistical access to isolated islands which host nesting sites also hinders effective law enforcement.

Engagement with the indigenous communities of the region, to whom these species are traditionally and culturally valuable, will be a first step in ensuring that any permitted turtle harvest is sustainable. Balancing indigenous rights with conservation goals will be particularly challenging. It is important that local communities understand turtle life history, in particular slow maturation rates and ramifications for susceptibility to overexploitation. Furthermore, addressing overseas demand for turtle products must be a focus of wildlife law enforcement agencies. Clearly, areas that combine evidence of high levels of nesting activity and exploitation should be prioritized for protection. The sites which were found to host significant nesting sites, but which were also noted as hunting grounds included: Galoc Island, Pamalican Island, and Panlaitan Island. Approaches to marine turtle research and conservation that capitalize on traditional knowledge may also provide an opportunity to involve the Tagbanua in marine conservation initiatives. The traditional ecological knowledge of the Tagbanua could provide intergenerational evidence of changes in marine turtle occurrence in the Calamianes and this information could complement scientific data to provide more effective and inclusive management of turtle populations (Berkes et al 2000).

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Appendix A

Table A1. List of marine turtle nesting sites identified by key informants in the Calamian Islands.

	Site	Municipality	Nesting assessment conducted	Known for hunting	Turtle Remains
17	Mabichilao	Busuanga	✓	–	✓
18	Black Island	Busuanga	✓	✓	–
19	Cheey	Busuanga	✓	–	–
20	Cheey–Sitio Minuit	Busuanga	✓	–	–
21	New Quezon	Busuanga	✓	–	–
22	Old Busuanga	Busuanga	✓	–	–
23	San Isidro 1	Busuanga	✓	–	–
24	San Isidro 2	Busuanga	✓	–	–
25	San Rafael	Busuanga	✓	–	–
26	Lajala–Coron Youth Club Beach	Coron	✓	–	–
27	Lajala–Dimanlit	Coron	✓	–	–
28	Marcilla	Coron	✓	–	–
29	Buenavista–Napascud	Coron	✓	–	–
30	Turda–Batacalan	Coron	✓	–	–
31	Turda–Floro	Coron	✓	–	–
32	Turda–Kalampisaw	Coron	✓	–	–
33	Turda–Matoyoctoyoc	Coron	✓	–	–
34	Pass Island	Culion	✓	–	–
35	Galoc–Daladan	Culion	✓	✓	–
36	Galoc–Baktatan	Culion	✓	✓	✓
37	Buluang	Busuanga	–	✓	–
38	Calauit Island	Busuanga	–	✓	–
39	Debotunay Island	Busuanga	–	✓	–
40	East Nalaut Island	Busuanga	–	✓	–
41	Malatnubung Island	Busuanga	–	✓	–
42	Midpid Island	Busuanga	–	✓	–
43	Sitio Lakdayan	Busuanga	–	✓	–
44	West Nalaut Island	Busuanga	–	✓	–
45	Cabilauan Island	Coron	–	✓	–
46	Mataya Reef	Coron	–	✓	–
47	Galoc–Simparan	Culion	–	✓	–
48	Galoc–Timpas	Culion	–	✓	–
49	Lamud Island	Culion	–	✓	–

Table A1 (*continued*)

	Site	Municipality	Nesting assessment conducted	Known for hunting	Turtle Remains
50	Bagonbon	Busuanga	–	–	–
51	Dimipac Island	Busuanga	–	–	–
52	Malcatop Island	Busuanga	–	–	–
53	Mangenguey Island	Busuanga	–	–	–
54	Bantak Island	Coron	–	–	–
55	Calangayawen Island	Coron	–	–	–
56	Camanga Island	Coron	–	–	–
57	Club Paradise–Hidden Beach	Coron	–	–	–
58	Dibalangkok	Coron	–	–	–
59	Diboyayan Island	Coron	–	–	–
60	Dimilat	Coron	–	–	–
61	Dumunpalit Island	Coron	–	–	–
62	Kalampisaw Cove	Coron	–	–	–
63	Malpagalen Island	Coron	–	–	–
64	Naglapos	Coron	–	–	–
65	Pinaluyan	Coron	–	–	–
66	Tara Island	Coron	–	–	–
67	Tinol Island	Coron	–	–	–
68	Binudac	Culion	–	–	–
69	Malcapuya Island	Culion	–	–	–

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