



# SOCIETY FOR THE STUDY OF AMPHIBIANS AND REPTILES

*Publisher of Journal of Herpetology, Herpetological Review, Herpetological Circulars, Catalogue of American Amphibians and Reptiles, and three series of books, Facsimile Reprints in Herpetology, Contributions to Herpetology, and Herpetological Conservation*

## Officers and Editors for 2015-2016

### President

AARON BAUER  
Department of Biology  
Villanova University  
Villanova, PA 19085, USA

### President-Elect

RICK SHINE  
School of Biological Sciences  
University of Sydney  
Sydney, AUSTRALIA

### Secretary

MARION PREEST  
Keck Science Department  
The Claremont Colleges  
Claremont, CA 91711, USA

### Treasurer

ANN PATERSON  
Department of Natural Science  
Williams Baptist College  
Walnut Ridge, AR 72476, USA

### Publications Secretary

BRECK BARTHOLOMEW  
P.O. Box 58517  
Salt Lake City, UT 84158, USA

### Immediate Past-President

ROBERT ALDRIDGE  
Saint Louis University  
St Louis, MO 63013, USA

### Directors (Class and Category)

ROBIN ANDREWS (2018 R)  
Virginia Polytechnic and State University, USA  
FRANK BURBRINK (2016 R)  
College of Staten Island, USA  
ALISON CREE (2016 Non-US)  
University of Otago, NEW ZEALAND  
TONY GAMBLE (2018 Mem. at-Large)  
University of Minnesota, USA  
LISA HAZARD (2016 R)  
Montclair State University, USA  
KIM LOVICH (2018 Cons)  
San Diego Zoo Global, USA  
EMILY TAYLOR (2018 R)  
California Polytechnic State University, USA  
GREGORY WATKINS-COLWELL (2016 R)  
Yale Peabody Mus. of Nat. Hist., USA

### Trustee

GEORGE PISANI  
University of Kansas, USA

### Journal of Herpetology

PAUL BARTELT, Co-Editor  
Waldorf College  
Forest City, IA 50436, USA  
TIFFANY DOAN, Co-Editor  
State College of Florida, Manatee-Sarasota  
Bradenton, FL 34207, USA

### Herpetological Review

ROBERT W. HANSEN, Editor  
16333 Deer Path Lane  
Clovis, CA 93619, USA

### Contributions to Herpetology

KRAIG ADLER, Editor  
Cornell University  
Ithaca, NY 14853-2702, USA

### Facsimile Reprints in Herpetology

AARON BAUER, Editor  
Villanova University  
Villanova, PA 19085, USA

### Catalogue of American Amphibians and Reptiles

CHRISTOPHER BELL, Co-Editor  
University of Texas, Austin  
Austin, TX 78712, USA  
TRAVIS LADUC, Co-Editor  
University of Texas, Austin  
Austin, TX 78758, USA

### Herpetological Circulars

JOHN J. MORIARTY, Editor  
Three Rivers Park District  
Plymouth, MN 55441, USA

### Herpetological Conservation

JOSEPH C. MITCHELL, Editor  
Mitchell Ecol. Res. Service  
P.O. Box 5638  
Gainesville, FL 32627-5638, USA

Dear Author,

Attached please find a gratis pdf file of your article/note published in *Herpetological Review*. You are receiving this pdf at no charge as a benefit of SSAR membership, and it is for your personal use only (see copyright notice below).

Sincerely,  
SSAR Publications Office

Notice warning concerning copyright restrictions: The copyright law of the United States (title 17, United States Code) governs the making of copies or other reproductions of copyrighted material such as PDFs. One of these specific conditions is that the copy or reproduction is not to be "used for any purpose other than private study, scholarship, or research." If a user makes, or later uses, a PDF, copy, or reproduction for purposes in excess of "fair use," that user may be liable for copyright infringement. The Society for the Study of Amphibians and Reptiles (SSAR) holds the copyright to this PDF. SSAR authorizes the author to use this PDF to fill reprint requests for private study, scholarship and research purposes. It is a violation of SSAR's copyright to distribute this PDF via mass emails, or by posting this pdf on any website for download — Except the author's own personal (not business) website / webpage.

# Marine Turtles and Estuarine Crocodiles in Lampi Marine National Park, Myanmar: A Conservation and Threat Assessment with Recommendations

National parks, wildlife sanctuaries, and other protected areas often figure prominently in successful species conservation strategies (Stohlgren et al. 1994; Bruner et al. 2001). Protected areas can safeguard habitats for the long-term maintenance of biodiversity while at the same time serving as baselines against which biological and ecosystem change can be measured (Stohlgren et al. 1994). To realize these objectives, protected area managers require species inventories, accurate assessments

of conservation status, and an understanding of existing and potential anthropogenic threats (Stohlgren et al. 1994; Castellano et al. 2003; Tuberville et al. 2005). Such information is essential for effectively targeting conservation efforts, formulating management policies, prioritizing research, and designing appropriate monitoring protocols, especially where cryptic, rare, and threatened species are concerned (Oliver and Beattie 1993; Stohlgren et al. 1994; Castellano et al. 2003; Tuberville et al. 2005).

The protected area system in Myanmar plays a pivotal role in the national and regional conservation of marine turtles (Oliver and Beattie 1993; Stohlgren et al. 1994; Tuberville et al. 2005). For example, Thamihla (also spelled “Thameehla”) Kyun Wildlife Sanctuary hosts nesting populations of *C. mydas*, *L. olivacea*, *C. caretta*, and *E. imbricata*, Moscos Island Wildlife Sanctuary is an important nesting area for *E. imbricata* and Meinmahla Kyun Wildlife Sanctuary harbors the only viable population of *C. porosus* remaining in Myanmar and one of the few known in the region (Thorbjarnarson et al. 2000a, 2000b; Rao et al. 2002; Thorbjarnarson et al. 2006; Onishi 2009; Beffasti and Galanti 2011; Holmes et al. 2014).

Lampi Marine National Park (LMNP; 10°50'N; 98°12'E) encompasses parts of the Myeik (formerly “Mergui”) Archipelago in Tanintharyi Region (formerly “Division”) of southernmost Myanmar (Beffasti and Galanti 2011). Reconnaissance surveys conducted in the 1980s (Blower 1983) and 1990s (Rabinowitz 1995) documented the occurrence of marine turtles and estuarine crocodiles within the park and concluded these reptiles

## STEVEN G. PLATT

Wildlife Conservation Society–Myanmar Program,  
Aye Yeik Mon 1st Street, Yadanamon Housing Ave., Yangon, Myanmar

## KALYAR PLATT

Turtle Survival Alliance–Myanmar Program, Aye Yeik Mon 1st Street,  
Yadanamon Housing Ave., Yangon, Myanmar

## ME ME SOE

Turtle Survival Alliance–Myanmar Program, Aye Yeik Mon 1st Street,  
Yadanamon Housing Ave., Yangon, Myanmar

## KHIN MYO MYO

Wildlife Conservation Society–Myanmar Program,  
Aye Yeik Mon 1st Street, Yadanamon Housing Ave., Yangon, Myanmar

## KATHERINE E. HOLMES

Wildlife Conservation Society, Global Conservation Program,  
2300 Southern Boulevard, Bronx, New York 10460-1099, USA

## THOMAS R. RAINWATER\*

Baruch Institute of Coastal Ecology and Forest Science,  
Clemson University, Georgetown, South Carolina 29440, USA

\*Corresponding author; e-mail: [trainwater@gmail.com](mailto:trainwater@gmail.com)

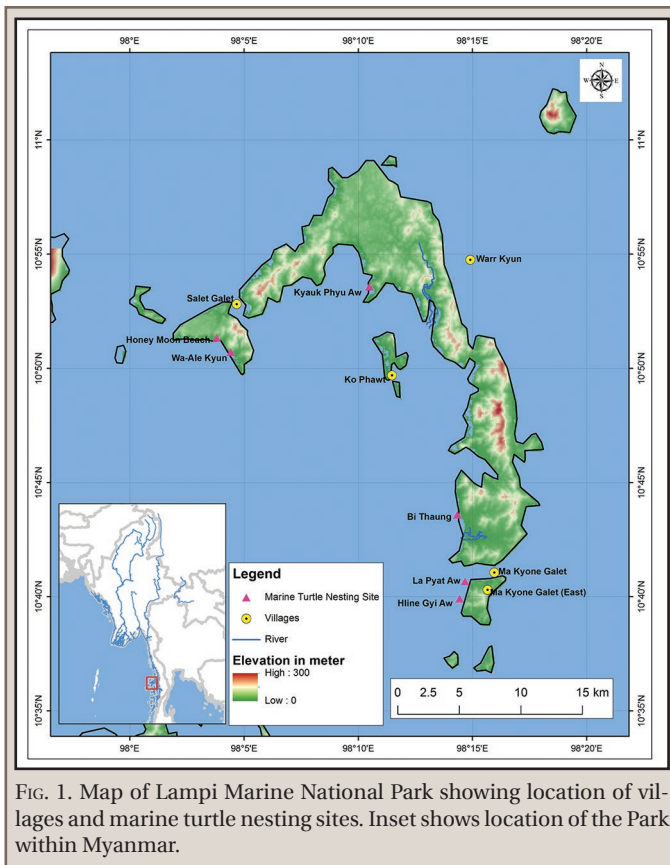


FIG. 1. Map of Lampi Marine National Park showing location of villages and marine turtle nesting sites. Inset shows location of the Park within Myanmar.

were imperiled by various anthropogenic threats. More recently, Beffasti and Galanti (2011) included three species of marine turtles on a faunal checklist of LMNP, but noted few data were available to assess their conservation status. Recent information regarding *C. porosus* in LMNP is likewise scant, although attacks on humans elsewhere in the Myeik Archipelago (Platt et al. 2012a, 2014a; www.crocodile-attack.info) suggest crocodiles could be present in the park.

This situation is not unique to LMNP as most protected areas in Myanmar lack data on the occurrence and conservation status of even common species, in large part due to the paucity of financial and technical resources available to park managers (Rao et al. 2002). More generally, there is an overall paucity of information on Myanmar's herpetofauna (Leviton et al. 2008), and in particular, few studies of marine turtles and crocodiles are yet available in the peer-reviewed scientific literature (but see Thorbjarnarson et al. 2000a, 2000b, 2006). As a first step towards addressing this need, we conducted a conservation assessment of marine turtles and estuarine crocodiles in LMNP with the objectives of 1) determining if populations of marine turtles and estuarine crocodiles occur within the park, 2) locating critical nesting habitat for marine turtles and estuarine crocodiles, 3) identifying and evaluating potential anthropogenic threats to these populations, and 4) developing a set of conservation recommendations based on our findings.

#### LAMPI MARINE NATIONAL PARK

Lampi Marine National Park (205 km<sup>2</sup>; Fig. 1) was established in 1996 to protect coastal fauna and flora, particularly coral reefs (Beffasti and Galanti 2011). The park consists of Lampi Island and adjacent satellite islands, surrounded by a no-fishing exclusion

zone extending offshore approximately 3.2 km from the high tide mark. The park is located approximately 25 km from mainland Tanintharyi and the intervening sea is shallow (mean depth = 12 m) with a maximum depth of 24 m. The islands within the park are characterized by steep terrain (to 455 m) supporting relatively undisturbed tropical evergreen forest (Beffasti and Galanti 2011; Blower 1983; Rabinowitz 1995). The park is well-watered with two spring-fed perennial rivers (Me Gyaung Chaung and Labi Chaung) and numerous smaller streams flowing from the uplands into the Andaman Sea. Extensive seagrass beds occur in shallow offshore waters, and mangrove forests are present along the two perennial rivers. Most of the coastline is rocky, although limited areas of sand beach are scattered around the island (Beffasti and Galanti 2011).

Although permanent settlements are prohibited on Lampi Island, four large villages (Ma Kyone Galet, Warr Kyun, Ko Phawt, and Salet Galet) containing a total of 3,000 residents are located on satellite islands encompassed by the boundaries of LMNP (Beffasti and Galanti 2011). These communities consist of ethnic Burmese, Karen, and Moken (also known as "Salone" within Myanmar). The latter are one of several semi-nomadic peoples, collectively known as "Sea Gypsies," who inhabit coastlines and islands of the Andaman Sea (Andrews 1962; Diran 2001). Harvesting marine resources (primarily fish, squid, and sea cucumbers) provides the principal source of income for island communities (Beffasti and Galanti 2011; Platt et al. 2014b). Wildlife and forest resources within LMNP are completely protected under Myanmar law; however, commercial poaching of wildlife, often by organized gangs from mainland urban centers, has been reported, and illegal timber-felling is widespread, but largely confined to the vicinity of permanent settlements (Rabinowitz 1995; Beffasti and Galanti 2011; Platt et al. 2014b). In addition to national protected area status, LMNP is recognized as an ASEAN Heritage Site and an Important Bird Conservation Area (Beffasti and Galanti 2011). The natural and cultural resources of LMNP are described in greater detail by Beffasti and Galanti (2011) and Platt et al. (2014b).

#### METHODS

We conducted fieldwork in LMNP from 10–21 December 2013. During this period we traveled throughout the park, stopping at villages and fishing encampments where we conducted semi-directed, opened-ended interviews (Martin 1995; Gilchrist et al. 2005) of fishermen and other knowledgeable individuals regarding the past and present occurrence of marine turtles and crocodiles, local ecological knowledge (*sensu* Anadón et al. 2009) about these species, folk taxonomy (*sensu* Berlin et al. 1966), the whereabouts of marine turtle and crocodile nesting sites, exploitation of turtles and crocodiles, fishing practices, and potential threats to turtles and crocodiles. While recognizing the limits of local ecological knowledge (Huntington 2000), our experience (Platt et al. 2004, 2005; Thorbjarnarson et al. 2006) and that of others (Thirakhupt and van Dijk 1995; Zhou et al. 2008; Anadón et al. 2009; Kanagavel and Raghavan 2012) indicates such individuals can be reliable sources of information concerning the occurrence, abundance, natural history, and local exploitation of turtles and crocodilians.

In accordance with the format of a semi-directed interview, we asked informants a series of questions that included standard questions prepared in advance and others that arose during the course of conversation. We guided the discussion, but the direction and scope of each interview was allowed to follow the

TABLE 1. Vernacular names of marine turtles found in Myanmar.

Species	Vernacular name and comments
Marine turtles (generic name)	<i>Pinle Leik</i> = Sea Turtle
<i>Dermochelys coriacea</i>	<i>Leik Zaung Lyar</i> = Star Fruit Turtle; name based on resemblance of carapacial ridges to longitudinal ridges on fruit of <i>Averrhoa carambola</i> .
<i>Caretta caretta</i>	<i>Leik Khway</i> = Dog Turtle; facial appearance, particularly prominent eyes, is said to be suggestive of a domestic dog.
<i>Chelonia mydas</i>	<i>Pyin Thar Leik</i> = non-descriptive name of uncertain meaning.
<i>Eretmochelys imbricata</i>	<i>Leik Kyat Tu Yway</i> = Parrot Turtle; name derived from the distinctive beak which resembles that of a parrot.
<i>Lepidochelys olivacea</i>	<i>Leik Laung</i> = Immature Turtle; so named because adults of this species are smaller than other marine turtles.

TABLE 2. Marine turtles found during a survey of Lampi Island Marine National Park, Myanmar in December 2013.

Species	Comments
<i>Dermochelys coriacea</i>	Fisherman stated that a small turtle (CL ca. 40 cm) fitting the description of a leatherback was found dead on a baited hook set in offshore waters in 2012.
<i>Chelonia mydas</i>	Carapace (CL = 415 mm) in possession of a fisherman in Ma Kyone Galet; reportedly removed from a turtle found dead on a nearby beach.
<i>Eretmochelys imbricata</i>	A disintegrating carapace (CL = 273 mm) obtained from a villager in Ma Kyone Galet who recovered it from a nearby beach; carapacial and plastral scutes along with bony elements found during a search of Honey Moon Beach.

participants' train of thought (Huntington 1998). Semi-directed interviews are more of a conversation than a typical question and answer session, and rather than rigidly adhering to a set of prepared questions, the interview provides an opportunity for collecting and discussing unanticipated information (Huntington 2000; Gilchrist et al. 2005). We conducted interviews of individuals as well as groups ranging in size from 3 to 36 people. Interviews were conducted by native Burmese speakers and later translated into English and transcribed. During interviews we also asked to examine any turtle shells that might be available in villages. We then measured straight-line carapace length (CL) with tree calipers ( $\pm 1$  mm) and photographed each specimen. We later visited beaches where marine turtles were reported to nest as well as other sites that appeared likely nesting habitat. At each site, we searched for crawls (trackways made by nesting female turtles), nests, and other signs of activity. Crawls were identified on the basis of characteristics outlined in Pritchard and Mortimer (1999). Interview transcripts, voucher photographs of specimens, and field notes are archived in the Campbell Museum, Clemson University, Clemson, South Carolina, USA. Place names are in accordance with a national gazetteer currently being compiled by the Myanmar government. We determined geographic coordinates (India-Bangladesh Datum) with a Garmin® GPSmap76.

#### RESULTS

**Marine turtles.**—We interviewed about 110 villagers (ca. 83 men and 27 women) at various locations in LMNP during this survey. Obtaining a precise count proved difficult because interviews were often conducted in a group setting and

individuals tended to wander in and out of the meeting venue. The information on marine turtles that we obtained often proved difficult to categorize to species as most people refer to marine turtles (except *D. coriacea*) generically (*Pinle Leik*) without distinguishing among species. Although vernacular names are available for each species (Table 1), these are apparently used by only the most knowledgeable individuals. We nonetheless were able to document the occurrence of *D. coriacea*, *C. mydas*, and *E. imbricata* within LMNP. Our records of *C. mydas* and *E. imbricata* are based on physical remains obtained from villagers or found while searching beaches, whereas our inclusion of *D. coriacea* is based on information provided by two fishermen (Fig. 2; Table 2). The physical remains we examined originated from dead turtles that washed ashore. We found no evidence for the occurrence of *C. caretta* or *L. olivacea* during our survey. A group of divers (N = 8) who harvest sea cucumbers (Echinodermata: Holothuroidea) from October–April reported encountering at least one marine turtle during about 50% of their nocturnal dives.

According to our informants, *C. mydas* figures prominently in Moken *Nat* worshiping practices. In Moken culture, *Nats* are spiritual guardians of the land- and seascape that must be properly propitiated; those who fail to do so risk divine retribution in the form of misfortune, sickness, or even death (Spiro 1967). Each of the two Moken communities in LMNP annually sacrifices a single large subadult or adult *C. mydas* to sea-dwelling *Nats*. The source of the turtles used in this ceremony is unclear, but most are probably captured from waters within or adjacent to the park. Importantly, we found nothing to suggest nesting female turtles are harvested for this ceremony. As part of this *Nat* worshiping ceremony, the turtle is killed and beheaded;



FIG. 2. Carapace of Green Turtle (*Chelonia mydas*) (above) and Hawksbill (*Eretmochelys imbricata*) (below) obtained from fishermen in Ma Kyone Galet. Both turtles were found dead on beaches in Lampi Marine National Park.

TABLE 3. Geographic coordinates of beaches used by nesting marine turtles in Lampi Marine National Park, Myanmar.

Beach	Latitude (°N)	Longitude (°E)
Bi Thauang	10.7265	98.2390
Hline Gyi Aw	10.6652	98.2350
Honey Moon Beach	10.8556	98.0633
Kyauk Phyu Aw	10.8930	98.1746
La Pyat Aw	10.6778	98.2445
Wah Ale Kyun	10.8453	98.0735

the head is proffered to the *Nats*, while the meat is consumed in a raucous village feast. Consumption of turtle meat outside of this ceremony is believed offensive to the *Nats* and could invite misfortune upon the community. We found no evidence that other ethnic groups dwelling within the park consume marine turtles. However, we cannot rule out this possibility owing to the reticence of informants to discuss illegal practices.

We identified six beaches in LMNP used as nesting sites by marine turtles: Bi Thauang, Kyauk Phyu Aw, Wah Ale Kyun, Honey Moon Beach, Hline Gyi Aw, and La Pyat Aw (Table 3; Fig. 1). In

general, these beaches are characterized by a wide expanse of deep sand fronted by low dunes with a deep-water approach. Evidence of recent nesting activity was noted on Wah Ale Kyun and La Pyat Aw. We found two fresh (< 48 h) crawls made by nesting females at Wah Ale Kyun on 15 December 2013; large holes excavated at the apex of each trackway and numerous human footprints indicated fishermen had harvested both clutches. Based on crawl width (>100 cm), parallel lines of symmetrical flipper marks, and straight, well-defined tail-drag marks, we attributed these crawls to nesting female *C. mydas*. We also found an indistinct crawl and large excavation on La Pyat Aw where fishermen reportedly collected a clutch of turtle eggs on 6 December 2013. No sign of recent (<1 month) nesting activity was found at the other beaches.

Based on information provided by fishermen, we estimate that about 20 clutches of marine turtle eggs are annually collected from various beaches in LMNP. We were unable to determine which species of turtles nest on these beaches because informants invariably used the generic *Pinle Leik* when describing nesting activity. Most nesting is said to occur from early November through late March. Fishermen opportunistically monitor nesting beaches during this period, follow any tracks they find, and harvest the eggs, which are sold in local markets or retained for domestic consumption. Fishermen receive 100 Myanmar Kyats per egg (about US \$0.10) and a large clutch represents a significant income if sold. According to observations made by our informants, semi-feral dogs (*Canis familiaris*) and monitors (*Varanus* sp.) also excavate nests and consume turtle eggs in LMNP. Although we observed numerous macaques (*Macaca* sp.) on beaches in LMNP, these primates were surprisingly not among the nest predators described by informants.

In addition to anthropogenic nest predation, our informants identified several other potential threats to marine turtles in LMNP. Foremost among these are commercial trawlers that regularly, albeit illegally, operate within the exclusion zone surrounding LMNP. Interviewees were unanimous in their condemnation of commercial trawlers (often foreign-owned boats) which frequently damage or sweep away artisanal fishing gear. We likewise observed fishing trawls legally operating in shallow waters just beyond the exclusion zone on several occasions during our survey. Other potential threats to marine turtles identified by interviewees include long-line fisheries (lines of baited hooks, sometimes extending >1 km) and dynamite fishing. Fishermen also reported occasionally finding marine turtles entangled in discarded monofilament fishing nets; if alive, the turtle is cut free and any wounds are treated with turmeric powder, which is believed to promote healing. About 50% of our informants had found dead marine turtles or their remains on area beaches within the past five years.

In contrast to commercial fisheries, the artisanal fishers we interviewed claimed to capture few marine turtles either intentionally or as by-catch. Artisanal fishermen maintain that they respect marine turtles as long-lived organisms and believe that to kill such an animal will bring misfortune to an individual. Our examination of floating wire cage traps (N = 30), one of the most common methods used by artisanal fishers to catch fish and squid in LMNP, suggests these pose little threat to marine turtles because the diameter of the funnel-shaped opening is too small to permit entry except by the smallest of turtles.

*Estuarine Crocodiles.*—Our interview data suggest *C. porosus* is no longer extant within LMNP. Indeed, <25% of our informants had knowledge of crocodiles, but because one of the two pe-

renial rivers on Lampi Island is known as Me Gyaung Chaung (= Crocodile Creek), most people assumed crocodiles once occurred locally. Several older individuals stated that in the past, crocodile eggs were harvested for domestic consumption and juveniles and adults were captured and sold to buyers in neighboring Thailand. A subadult *C. porosus* (TL ca. 150 cm) we examined at a monastery in Ma Kyone Galet was reportedly captured on the coast of Rakhine State near the Myanmar-Bangladesh frontier and transported to Lampi Island for exhibition as a curiosity. In contrast to Lampi Island, our informants stated crocodiles persist in other parts of the Myeik Archipelago. Two *C. porosus* (TL ca. 180 and 300 cm) believed responsible for a spate of attacks on humans were killed in 2013 near Mine Twin Village (Kyun Su Township, Ye Ngan Aw Group), approximately 90–120 km N-NW of LNMP.

#### DISCUSSION

*Marine turtles.*—Our survey documented the occurrence of three species of marine turtle within LMNP, which are classified as Endangered (*C. mydas*) and Critically Endangered (*D. coriacea* and *E. imbricata*; IUCN 2014; Wallace et al. 2011). Our results complement an earlier survey that reported *C. mydas*, *L. olivacea*, and *C. caretta* in the park (Beffasti and Galanti 2011). In contrast to our findings, neither *E. imbricata* nor *D. coriacea* had previously been reported in LMNP (Beffasti and Galanti 2011). The occurrence of *E. imbricata* and *C. mydas* in LMNP is especially encouraging because both species are endangered and the former is approaching extinction in Myanmar (Thorbjarnarson et al. 2000b; Limpus 2012; Holmes et al. 2014). Our record of *D. coriacea* is likewise important as this species is considered the rarest marine turtle in Myanmar (Maxwell 1911; Thorbjarnarson et al. 2000b).

Based on characteristics of turtle crawls, the species known to inhabit area waters, and reports from nearby Moscos Island (Beffasti and Galanti 2011; Limpus 2012), it is probable that most clutches deposited on beaches in LMNP are those of *C. mydas* and *E. imbricata*. Nesting populations of both species in Myanmar have declined from “thousands” in the early 1900s (Maxwell 1911) to a “few tens” today (Limpus 2012; Holmes et al. 2014). Thus, even though a relatively small number of clutches are apparently deposited in LMNP, these are nonetheless extremely important from a local conservation standpoint. Protecting these nests will undoubtedly prove challenging as egg harvesting has a long history in the Mergui Archipelago (Andrews 1962) and appears to be culturally entrenched in island communities (Rabinowitz 1995). Nevertheless, nest protection should be accorded high priority by park authorities as chronic over-harvesting of eggs has been implicated in the long-term decline and near-extirpation of several species of marine turtles in Southeast Asia, most notably for *D. coriacea* in Malaysia (Chan and Liew 1996; Thorbjarnarson et al. 2000b; Chan 2006).

The construction of commercial eco-tourist resorts at two of the seven known nesting beaches in LMNP (Bi Thaug and Honey Moon Beaches) is also cause for concern. Although the presence of resorts and their security staff are likely to deter egg poachers, these establishments nonetheless pose two distinct threats to marine turtles. First, resort construction could result in the direct loss of critical nesting beach habitat. Such habitat is limited in LMNP, where most of the coastline is rocky and few suitable beaches are available for nesting turtles. Second, because neonates emerging from nests are attracted to light,

any unmanaged artificial lighting generated by the resorts could disorient hatchlings, thereby increasing the time spent on beaches with the concomitant risks of predation and desiccation (Lorne and Salmon 2007).

Our study is the first to describe some of the cultural beliefs of indigenous maritime communities in southern Myanmar regarding marine turtles. The veneration of marine turtles as long-lived organisms seems to reflect a wider belief among rural Burmese that misfortune will befall anyone who intentionally harms an organism that has endured years of hardship to attain advanced age (e.g., Platt et al. 2008). Among some communities, to accidentally capture and then liberate such an animal is viewed as a means of gaining karmic merit and the release is often accompanied by an elaborate ceremony (Platt et al. 2008). The *Nat*-worshiping practices we documented among the Moken are not unusual. *Nat*-worship is widespread in Myanmar (Spiro 1967) and *Nats* are perceived as guardians of tortoises (Platt et al. 2003), some species of freshwater turtles (Platt et al. 2013a), and King Cobras (*Ophiophagus hannah*; Platt et al. 2012b). Although generally quite localized and occasionally even restricted to a single community (Platt et al. 2013a), these beliefs are nonetheless consistent with conservation objectives and can be harnessed to this end (Platt et al. 2003). For example, a conservation program for the critically endangered Burmese Star Tortoise (*Geochelone platynota*) premised on reinforcing local *Nat* worshiping practices has to date proven highly successful (Platt et al. 2014c). The cultural taboos of the Moken therefore warrant further investigation as a potential tool for marine turtle conservation in LMNP, perhaps as part of a community-based conservation initiative (see below).

The potential anthropogenic threats faced by marine turtles in LMNP are representative of those confronting marine turtles throughout the region (Chan 2006; Diamond et al. 2012; Settle 1995; TRAFFIC 2004). We consider fishing trawlers to pose the most serious potential threat to turtles in LMNP despite the existence of an exclusion zone where commercial fishing is prohibited. Although trawls deployed anywhere in the territorial waters of Myanmar are legally required to be outfitted with turtle excluder devices (TEDs), compliance is difficult to monitor and appears minimal in most areas (Aung Hlaing Win and Maung Maung Win 2012; Holmes et al. 2014). This is unfortunate because the installation of TEDs has repeatedly been demonstrated to significantly reduce drownings of marine turtles by trawls (Jenkins 2012; National Research Council 1990). When not equipped with TEDs, fishing trawls are the primary source of mortality of subadults and adults in many marine turtle populations (National Research Council 1990). Long-line and dynamite fishing are also likely to pose a risk to turtles (Chan et al. 1988; Chan 2006), and although strictly prohibited by park regulations, legal enforcement to date has been weak or non-existent. However, we stress that our assessment of these threats must be considered tentative pending the completion of more detailed investigations to quantify mortality among marine turtles in LNMP.

Given the lack of historic baseline data, conclusions regarding long-term population trends of marine turtles in LMNP are at best speculative. Although encounter rates reported by fishermen suggest marine turtles are still fairly common within the protected waters of the park, illegal fishing practices appear commonplace and could be killing turtles at unsustainable levels. That said, corroborative evidence in the form of stranding and carcass surveys (Shaver and Teas 1999) is lacking and must be obtained

before this conclusion can be uncritically accepted. Moreover, the annual loss of turtle nests to predation and anthropogenic harvest must be quantified before its impact on turtle populations can be accurately assessed. What little data are available from elsewhere in Myanmar suggests a similar suite of threats has resulted in population declines among all species, including the near-extirpation of *E. imbricata* (Thorbjarnarson et al. 2000b; Limpus 2012; Holmes et al. 2014). Indeed, Limpus (2012) concluded that without dramatic improvements in the effectiveness of conservation measures, all species of marine turtles will be approaching extinction in Myanmar by 2030.

*Estuarine Crocodiles.*—That *C. porosus* occurred on Lampi Island within the recent past is unequivocal. Estuarine Crocodiles are known to occur elsewhere in the Mergui Archipelago (Andrews 1962), and both Blower (1983) and Rabinowitz (1995) reported fishermen collecting crocodile eggs for domestic consumption on Lampi Island. Additionally, a freshwater river (Me Gyaung Chaung) on Lampi Island is almost certainly named for the crocodiles that once inhabited it. Place names often attest to the past occurrence of fauna, flora, and habitats which are no longer extant (Platt and Brantley 1997; Sousa and García-Murillo 2001). The fact that most (but not all) informants had no knowledge of crocodiles is not unexpected given the relatively brief duration of “community memory” regarding locally extinct species (Turvey et al. 2010). Indeed, Turvey et al. (2010) demonstrated that even charismatic megafaunal species are rapidly forgotten by communities once they cease to be encountered on a regular basis.

The extirpation of *C. porosus* from LMNP probably resulted from egg collection for domestic consumption (Andrews 1962; Rabinowitz 1995) and harvesting of the demographically important adults for illegal sale to wildlife traffickers in Thailand. During the 1970s and 1980s, there was a heightened demand among Thai crocodile farmers for *C. porosus* to hybridize with the more readily obtainable Siamese Crocodiles (*Crocodylus siamensis*). Hybrid progeny are commercially desirable because they exhibit rapid growth rates, attain large body sizes, and yield high-quality skins (Suvanakorn and Youngprapakorn 1987). As far as we could determine, the last crocodiles collected from LMNP were three adults captured and sold in 1986, although eggs were still being harvested as late as the early 1990s when Rabinowitz (1995) visited the islands. Given this timeframe, *C. porosus* was probably extirpated from LMNP by 2000 or shortly thereafter.

*Recommendations.*—We consider the absence of effective law enforcement to be the single greatest obstacle to preserving the biological integrity of LMNP. Although existing regulations appear adequate to protect marine turtles, crocodiles, and other wildlife resources, without rigorous enforcement of these legal statutes, the continued erosion of biodiversity from the park is inevitable. This state of affairs stems not from any lack of will on the part of Myanmar conservation authorities, but is instead due to the paucity of resources available to park staff, particularly boats and communications equipment. Therefore, it is imperative that government authorities and non-governmental organizations (NGOs) tasked with managing LMNP make every effort to address this situation and adequately equip those responsible for enforcing park regulations. Without vastly improved enforcement capabilities, preventing the illegal incursions of commercial trawlers, enforcing compliance with fishing regulations, and safeguarding marine turtle nesting sites are unrealistic expectations. Eco-tourist lodges now being established within the park could play a significant part in enhancing law enforcement capacity, particularly if this role is mandated by the Myanmar

government in exchange for being granted a development concession within a national park. Eco-tour operators could collaborate with Forest Department rangers and local NGOs to conduct joint patrols, report violators, provide boat transportation, and facilitate radio communication. Importantly, incentives would be aligned because eco-tour operators have a vested financial interest in maintaining and protecting the biodiversity their clients are paying to view (Zander et al. 2014).

A community-based conservation initiative (Campbell and Vainio-Mattila 2003) offers further options for strengthening the protection of marine turtles in LNMP. We recommend that such a program be developed as a partnership between park authorities, NGOs, eco-tour operators, and local communities with the goal of protecting nesting beaches, bolstering hatchling recruitment, and reducing the incidental take of larger turtles in fisheries operations. The latter is critically important, given the demographic importance of the larger size classes (Congdon et al. 1993; Heppell et al. 2003), and best addressed through a community education campaign emphasizing turtle-friendly fishing practices, proper disposal of used fishing gear (especially monofilament nets), and protection of nesting beaches. Importantly, local *Nat* worshiping beliefs consistent with conservation goals should be integrated into all levels of any community education program. Furthermore, fishing regulations mutually developed by local communities and government authorities would go far toward protecting marine turtles in the park. Such regulations are perhaps the best approach for limiting potentially harmful fishing practices and gear and designating areas closed to fishing (Johannes 2002).

As an immediate first step in implementing a community-based conservation program, we recommend that a beach-monitoring and egg collection program be initiated whereby local fishermen are recruited as “beach wardens” to monitor known nesting sites in the park. Wardens will notify Forest Department staff when a turtle has nested so the clutch can be collected and transferred to a secure incubation area for hatching. A similar program along the upper Chindwin River has been instrumental in reversing the decline of the only remaining wild population of Burmese roofed turtles (*Batagur trivittata*) in Myanmar (K. Platt et al. 2013).

Again, ecotourist resorts being constructed in LMNP could be important partners in this aspect of marine turtle conservation, especially if tasked by the Myanmar government to do so. The resorts could host and manage the hatchery and assist with transporting park staff to nesting sites, hiring beach wardens, and releasing neonates. Additionally, donations or even a small fee levied on tourists could partly offset costs incurred by the tour operators participating in the project (Meletis and Harrison 2010; Zander et al. 2014). Furthermore, the marine turtle conservation program could serve as an attraction for tourists desiring to participate in an actual conservation project. Such “experiential” tourists could be involved in monitoring beaches, collecting and transporting eggs, and releasing neonates. Similar participatory conservation programs for marine turtles have enjoyed success in the United States and elsewhere (Tisdell and Wilson 2002; Wilson and Tisdell 2003; Ballantyne et al. 2009). That said, given the brief temporal distribution of nesting activity by a what appears to be a relatively small number of females (ca. 20 nests/year), an ecotourist venture based solely on marine turtles is unlikely to prove economically viable (Troëng and Drews 2004). However, marine turtles are just one of the many natural attractions of LNMP likely to appeal to ecotourists; others include scuba diving and snorkeling, hiking, bird-watching, and viewing marine

mammals, all of which can serve as the foundation for successful ecotourism ventures.

Despite being locally extirpated, the recovery of *C. porosus* in LMNP can probably be accomplished if adequate levels of protection are afforded to crocodiles. Crocodilian populations are resilient to over-exploitation and often respond dramatically to timely and well-planned conservation measures (Bayliss 1987). For example, a 10- to 20-fold increase occurred among *C. porosus* populations in northern Australia following the enactment of legal protection (Webb et al. 2010). This dramatic response is largely due to a suite of life-history traits that crocodilians possess (e.g., high fecundity, rapid growth of offspring, high adult survival, and extended parental care of offspring) which are unique among large predators (Bayliss 1987). Given the proximity of potential source populations on other islands in the Myeik Archipelago as well as the Tanintharyi mainland (Platt et al. 2012a, 2014a) and the fact that long distance movements between widely separated island populations are commonplace among *C. porosus* (Campbell et al. 2010), natural re-colonization of Lampi Island will almost certainly occur without direct human interventions. Given the small number of likely founders, however, the time to recovery could prove lengthy.

Alternatively, translocating wild-caught individuals or reintroducing captive-bred crocodiles to LMNP could facilitate the recovery of *C. porosus* in a comparatively brief period, although we urge caution if this option is pursued by management authorities. First, capturing wild subadult or adult crocodiles from elsewhere in Myanmar (e.g., Meinmahla Wildlife Sanctuary) and releasing them on Lampi Island is unlikely to prove successful due to the tendency of translocated crocodiles to return to their original home range (Lang 1987); e.g., unidirectional movements >100 km are commonplace among translocated *C. porosus* (Read et al. 2007). Second, the demographic consequences of removing even a small number of crocodiles from Meinmahla Kyun Wildlife Sanctuary (the likely source of crocodiles for any reintroduction) are unclear and could threaten the continued viability of this small population (Thorbjarnarson et al. 2000a). That said, captive-bred *C. porosus* are available from the government-operated Thaketa Crocodile Farm near Yangon. However, the genetic integrity of this population has likely been compromised by hybridization with Siamese Crocodiles obtained from Cambodia during the 1960s (Platt et al. 2013b). Therefore, it must first be determined that any crocodiles selected for reintroduction from the farm are indeed genetically pure *C. porosus*. Moreover, because the farm has experienced repeated disease outbreaks, it is imperative that crocodiles be thoroughly screened for infectious diseases before being released into the wild (Platt et al. 2013b).

In our opinion, a more desirable option would be to obtain crocodiles for reintroduction to LMNP from a head-starting program using eggs and hatchlings collected from Meinmahla Wildlife Sanctuary. Removal of eggs and hatchlings from the wild has minimal demographic impacts on crocodilian populations and survival of head-started juveniles released into the wild is typically high (Elsey et al. 1998, 2000). Importantly, any future reintroduction of crocodiles to LMNP should be closely monitored to determine the fate of released animals (Dodd and Seigel 1991).

**Acknowledgments.**—We thank the Minister of the Ministry of Environmental Conservation and Forestry, Director General and Deputy Director General of the Planning and Statistics Department of the Ministry of Environmental Conservation and Forestry, Director General and Deputy Director General of the Forest Department and the

Director of Nature and Wildlife Conservation Division for granting us permission to conduct this survey. Field assistance was provided by U Thein Naing Aung and Forest Department rangers from Lampi Marine National Park. Research in Myanmar was made possible by generous grants from Andy Sabin and the Sabin Family Foundation and Turtle Conservation Fund. U Than Myint, U Saw Htun, Colin Poole, and Rick Hudson were instrumental in insuring the success of our field work. We also thank Brandon Sideleau for sharing information from the Crocodile Attack Database and Ruth Elsey and Madeline Thompson for providing relevant literature. Comments by Lewis Medlock and an anonymous reviewer improved an early draft of this manuscript.

## LITERATURE CITED

- ANADÓN, J., A. GIMÉNEZ, R. BALLESTER, AND I. PÉREZ. 2009. Evaluation of local ecological knowledge as a method for collecting extensive data on animal abundance. *Conserv. Biol.* 23:617–625.
- ANDREWS, G. P. 1962. *Burma Gazetteer: Mergui District*. Vol. A. Government Printing Office, Rangoon. 156 pp.
- AUNG HLAING WIN, AND MAUNG MAUNG WIN. 2012. Interaction between fishing activities and marine turtles in Myanmar. *In* Proceedings 11<sup>th</sup> SEASTAR2000 Workshop, pp. 5–7. SEASTAR2000, Bangkok.
- BALLANTYNE, R., J. PARKER, AND K. HUGHES. 2009. Tourists' support for conservation messages and sustainable management practices in wildlife tourism experiences. *Tourism Manage.* 30:658–664.
- BAYLISS, P. 1987. Survey methods and monitoring within crocodile management programmes. *In* G. J. W. Webb, S. C. Manolis, and P. J. Whitehead (eds.), *Wildlife Management: Crocodiles and Alligators*, pp. 157–175. Surrey Beatty & Sons Pty. Ltd., Sydney.
- BEFFASTI, L. AND V. GALANTI. 2011. *Myanmar Protected Areas: Context, Current Status, and Challenges*. Instituto Oikos and BANCA, Ancora Libri, Milan. 86 pp.
- BERLIN, B., D. E. BREEDLOVE, AND P. H. RAVEN. 1966. Folk taxonomies and biological classification. *Science* 154:273–275.
- BLOWER, J. H. 1983. Report on a reconnaissance of part of the Pakchan Reserved Forest and Lampi Island, Tenasserim. Nature Conservation and National Parks Project Field Report (FO/BUR/80/006). Food and Agriculture Organization, Rome. 15 pp.
- BRUNER, A. G., R. E. GULLISON, R. E. RICE, AND G. A. B. DA FONSECA. 2001. Effectiveness of parks in protecting tropical biodiversity. *Science* 291:125–128.
- CAMPBELL, L. M., AND A. VAINIO-MATTILA. 2003. Participatory development and community-based conservation: opportunities missed or lessons learned? *Human Ecol.* 31:417–437.
- CAMPBELL, H. A., M. E. WAITS, S. SULLIVAN, M. A. READ, S. CHOUKROUN, S. R. IRWIN, AND C. E. FRANKLIN. 2010. Estuarine crocodiles ride surface currents to facilitate long-distance travel. *J. Anim. Ecol.* 79:955–964.
- CASTELLANO, C. M., J. L. BEHLER, R. P. COOK, AND D. K. BROTHERTON. 2003. National parks in the northeast: preserving America's herpetological heritage. *Herpetol. Rev.* 34:192–193.
- CHAN, E. H. 2006. Marine turtles in Malaysia: on the verge of extinction? *Aq. Ecosyst. Health & Manage.* 9:175–184.
- , AND H. C. LIEW. 1996. Decline of the leatherback population in Terengganu, Malaysia, 1956–1995. *Chelon. Conserv. Biol.* 2:196–203.
- , ———, AND A. G. MAZLAN. 1988. The incidental capture of sea turtles in fishing gear in Terengganu, Malaysia. *Biol. Conserv.* 43:1–7.
- CONGDON, J. D., A. E. DUNHAM, AND R. C. VAN LOBEN SELS. 1993. Delayed sexual maturity and demographics of Blandings turtles (*Emydoidea blandingii*): implications for conservation and management of long-lived organisms. *Conserv. Biol.* 7:826–833.
- DIAMOND, J., V. BLANCO, AND R. DUNCAN. 2012. Knowing sea turtles: local communities informing conservation in Koh Rong Archipelago, Cambodia. *Cambodian Nat. Hist.* 2012:131–140.
- DIRAN, R. K. 2001. *The vanishing tribes of Burma*. Sterling Publishing, New York. 240 pp.



- DODD, C. K., JR. AND R. A. SEIGEL. 1991. Relocation, repatriation, and translocation of amphibians and reptiles: are they strategies that work? *Herpetologica* 47:336–350.
- ELSEY, R. M., E. B. MOSER, L. MCNEASE, AND R. G. FREDERICK. 1998. Preliminary analysis of survival of farm-released alligators in southwestern Louisiana. *Proc. Ann. Conf. Southeast. Fish and Wildl. Agencies* 52:249–259.
- , L. MCNEASE AND T. JOANEN. 2000. Louisiana's alligator ranching programme: a review and analysis of releases of captive-raised juveniles. In G. C. Grigg, F. Seebacher, and C. E. Franklin (eds.), *Crocodylian Biology and Evolution*, pp. 426–441. Surrey Beatty and Sons, Chipping Norton, Australia.
- GILCHRIST, G., M. MALORY, AND F. MERKEL. 2005. Can local ecological knowledge contribute to wildlife management? Case studies of migratory birds. *Ecol. Soc.* 10:20–31.
- HEPPELL, S. S., M. L. SNOVER, AND L. B. CROWDER. 2003. Sea turtle population ecology. In P. L. Lutz, and J. A. Musick (eds.), *Biology of Sea Turtles*, pp. 275–306. CRC Press, Boca Raton, Florida.
- HOLMES, K., TINT TUN, KYAW THINN LATT, A. E. HOSTETLER, S. KHADKEE, AND M. SUBEDEE. 2014. Marine conservation in Myanmar: The current knowledge of marine systems and recommendations for research and conservation. Report to Wildlife Conservation Society, Bronx, New York.
- HUNTINGTON, H. P. 1998. Observations on the utility of the semi-directed interview for documenting traditional ecological knowledge. *Arctic* 51:237–242.
- . 2000. Using traditional ecological knowledge in science: methods and applications. *Ecol. App.* 10:1270–1274.
- IUCN. 2014. IUCN Redlist of Threatened Species. [www.iucnredlist.org; accessed 6 June 2014].
- JENKINS, L. D. 2012. Reducing sea turtle bycatch in trawl nets: a history of NMFS turtle excluder device (TED) research. *Mar. Fish. Rev.* 74:26–44.
- JOHANNES, R. E. 2002. The renaissance of community-based marine resource management in Oceania. *Ann. Rev. Ecol. Syst.* 33:317–340.
- KANAGAVEL, A., AND R. RAGHAVAN. 2012. Local ecological knowledge of the threatened Cochin Forest cane turtle *Vijayachelys silvatica* and Travancore tortoise *Indotestudo travancorica* from the Anamalai Hills of the Western Ghats, India. *J. Threat. Taxa* 4:3173–3182.
- LANG, J. W. 1987. Crocodylian behavior: implications for management. In G. J. W. Webb, S. C. Manolis, and P. J. Whitehead (eds.), *Wildlife Management: Crocodiles and Alligators*, pp. 273–294. Surrey Beatty & Sons Pty. Ltd., Sydney, Australia.
- LEVITON, A. E., G. R. ZUG, J. V. VINDUM, AND G. O. U. WOGAN. 2008. *Handbook of the Dangerously Venomous Snakes of Myanmar*. California Academy of Sciences, San Francisco, California. 122 pp.
- LIMPUS, C. 2012. Assessment of turtle conservation actions at Thamehla Island, Myanmar. Report to Department of Fisheries, Yangon, Myanmar. 16 pp.
- LORNE, J. K., AND M. SALMON. 2007. Effects of exposure to artificial lighting on orientation of hatchling sea turtles on the beach and in the ocean. *Endang. Spec. Res.* 3:23–30.
- MARTIN, G. J. 1995. *Ethnobotany: a Methods Manual*. Chapman Hall, London. 268 pp.
- MAXWELL, F. D. 1911. Report on inland and sea fisheries in the Thangwa, Myaungmya, and Bassein districts and the turtle-banks of the Irrawaddy Division. Government Printing Office, Rangoon. 57 pp.
- MELETIS, Z. A., AND E. C. HARRISON. 2010. Tourists and turtles: searching for balance in Tortuguero, Costa Rica. *Conserv. Soc.* 8:26–43.
- NATIONAL RESEARCH COUNCIL. 1990. *Decline of the sea turtles: causes and prevention*. National Academy of Sciences Press, Washington, D.C. 259 pp.
- OLIVER, I., AND A. J. BEATTIE. 1993. A possible method for the rapid assessment of biodiversity. *Conserv. Biol.* 7:562–568.
- ONISHI, S. 2009. Situation of large reptiles in the Ayeyarwady Delta after the cyclone hit. *Tigerpaper* 36:1–6.
- PLATT, K., S. G. PLATT, K. THIRAKHUPIT, AND T. R. RAINWATER. 2008. Recent records and conservation status of the critically endangered mangrove terrapin, *Batagur baska*, in Myanmar. *Chelon. Conserv. Biol.* 7:261–265.
- , ME ME SOE, WIN KO KO, KHIN MYO MYO, AND KYAW MOE. 2013. TSA and WCS join forces to save Myanmar's imperiled turtles. *Turtle Survival* 2013:39–42.
- PLATT, S. G., AND C. G. BRANTLEY. 1997. Canebrakes: An ecological and historical perspective. *Castanea* 62:8–21.
- , WIN KO KO, LAY LAY KHAING, KHIN MYO MYO, THANDA SWE, TINT LWIN, AND T. R. RAINWATER. 2003. Population status and conservation of the critically endangered Burmese star tortoise *Geochelone platynota* in central Myanmar. *Oryx* 37:464–471.
- , KALYAR, AND T. R. RAINWATER. 2004. Inle Lake turtles, Myanmar with notes on Intha and Pa-O ethnoherpetology. *Hamadryad* 29:5–14.
- , WIN KO KO, LAY LAY KHAING, KHIN MYO MYO, TINT LWIN, THANDA SWE, KALYAR, AND T. R. RAINWATER. 2005. Noteworthy records and exploitation of chelonians from the Ayeyarwady, Chindwin, and Dokhtawady rivers, Myanmar. *Chelon. Conserv. Biol.* 4:942–948.
- , K. PLATT, WIN KO KO, KHIN MYO MYO, AND ME ME SOE. 2012a. Estuarine crocodiles in southern Myanmar. *Croc. Special. Group Newsl.* 31(2):18–20.
- , WIN KO KO, AND T. R. RAINWATER. 2012b. On the cobra cults of Myanmar. *Bull. Chicago Herpetol. Soc.* 47:17–20.
- , K. PLATT, KHIN MYO MYO, KYAW MOE, ME ME SOE, THET ZAW NAING, NAING LIN, AND T. R. RAINWATER. 2013a. Noteworthy records of chelonians from the Chindwin River basin and Naga Hills of western Myanmar. *Herpetol. Conserv. Biol.* 8:335–350.
- , WIN KO KO, AND KHIN MYO MYO. 2013b. Husbandry and conservation at Thaketa Crocodile Farm, Myanmar. *Croc. Special. Group Newsl.* 32(1):17–21.
- , K. PLATT, ME ME SOE, AND KHIN MYO MYO. 2014a. An estuarine crocodile population on the coast of southern Myanmar. *Croc. Special. Group Newsl.* 33(2):20–22.
- , ———, KHIN MYO MYO, AND ME ME SOE. 2014b. An Ecological Reconnaissance of Lampi Island Marine National Park, Myanmar. Report to Wildlife Conservation Society, Bronx, New York. 47 pp.
- , ———, ME ME SOE, WIN KO KO, KHIN MYO MYO, TINT LWIN, AND KYAW MOE. 2014c. TSA/WCS Team strives to save Myanmar's critically endangered turtles. *Turtle Survival* 2014:45–48.
- PRITCHARD, P. C. H., AND J. A. MORTIMER. 1999. Taxonomy, external morphology, and species identification. In K. L. Eckert, K. A. Bjorndal, F. A. Abreu-Grobois, and M. Donnelly (eds.), *Research and Management Techniques for the Conservation of Sea Turtles*, pp. 21–40. IUCN/SSC Marine Turtle Specialist Group Special Publication No. 4, Gland, Switzerland.
- RABINOWITZ, A. 1995. Lampi Island, Mergui Archipelago, Myanmar (28 March–7 April 1995). Trip Report to Wildlife Conservation Society, Bronx, New York. 7 pp.
- RAO, M., A. RABINOWITZ, AND SAW TUN KHAING. 2002. Status review of the protected-area system in Myanmar, with recommendations for conservation planning. *Conserv. Biol.* 16:360–368.
- READ, M. A., G. C. GRIGG, S. R. IRWIN, D. SHANAHAN, AND C. E. FRANKLIN. 2007. Satellite tracking reveals long distance coastal travel and homing by translocated estuarine crocodiles, *Crocodylus porosus*. *PLoS ONE* 2(9): e949. doi:10.1371/journal.pone.0000949.
- SETTLE, S. 1995. Status of nesting populations of sea turtles in Thailand and their conservation. *Mar. Turtle Newsl.* 68:8–13.
- SHAVER, D. J., AND W. G. TEAS. 1999. Stranding and salvage networks. In K. L. Eckert, K. A. Bjorndal, F. A. Abreu-Grobois, and M. Donnelly (eds.), *Research and Management Techniques for the Conservation of Sea Turtles*, pp. 152–155. IUCN/SSC Marine Turtle Specialist Group Special Publication No. 4, Gland, Switzerland.
- SOUSA, A., AND P. GARCÍA-MURILLO. 2001. Can place names be used as indicators of landscape changes? Application to the Doñana National Park, Spain. *Landscape Ecol.* 16:391–406.
- SPIRO, M. E. 1967. *Burmese Supernaturalism*. Prentice-Hall, Englewood Cliffs, New Jersey. 280 pp.
- STOHLGREN, T. J., J. F. QUINN, M. RUGGIERO, AND G. S. WAGGONER. 1994. Status of biotic inventories in US national parks. *Biol. Conserv.* 71:97–106.

- SUVANAKORN, P., AND C. YOUNGPRAPAKORN. 1987. Crocodile farming in Thailand. *In* G. J. W. Webb, S. C. Manolis, and P. J. Whitehead (eds.), *Wildlife Management: Crocodiles and Alligators*, pp. 341–343. Surrey Beatty & Sons Pty. Ltd., Sydney, Australia.
- THIRAKHUPT, K., AND P. P. VAN DIJK. 1995. Species diversity and conservation of turtles in western Thailand. *Nat. Hist. Bull. Siam Soc.* 42:207–259.
- THORBJARNARSON, J., S. G. PLATT, AND SAW TUN KHAING. 2000a. A population survey of the estuarine crocodile in the Ayeyarwady Delta, Myanmar. *Oryx* 34:317–324.
- , ———, AND ———. 2000b. Sea turtles in Myanmar: past and present. *Mar. Turtle Newsl.* 88:10–11.
- , ———, WIN KO KO, KHIN MYO MYO, LAY LAY KHAING, KALYAR, AND B. HOLMSTROM. 2006. Crocodiles in Myanmar: species diversity, historic accounts, and current population status and conservation. *Herpetol. Nat. Hist.* 10:77–89.
- TISDELL, C., AND C. WILSON. 2002. Ecotourism for the survival of sea turtles and other wildlife. *Biodiv. Conserv.* 11:1521–1538.
- TRAFFIC SOUTHEAST ASIA – INDOCHINA. 2004. The trade in marine turtle products in Viet Nam. Report prepared for Marine Turtle Conservation and Management Team, Viet Nam. TRAFFIC Southeast Asia, Kuala Lumpur, Malaysia. 56 pp.
- TROËNG, S., AND C. DREWS. 2004. Money talks: economic aspects of marine turtle use and conservation. World Wildlife Fund – International, Gland, Switzerland. 260 pp.
- TUBERVILLE, T. D., J. D. WILLSON, M. E. DORCAS, AND J. W. GIBBONS. 2005. Herpetofaunal species richness of southeastern national parks. *South-east. Nat.* 4:537–569.
- TURVEY, S. T., L. A. BARRETT, H. YUJIANG, Z. LEI, Z. XINQIAO, W. XIANYAN, H. YADONG, Z. KAIYA, T. HART, AND W. DING. 2010. Rapidly shifting baselines in Yangtze fishing communities and local memory of extinct species. *Conserv. Biol.* 24:778–787.
- WALLACE, B. P., A. D. DiMATTEO, A. B. BOLTEN, M. Y. CHALLOUPKA, B. J. HUTCHINSON, E. A. ABREU-GROBOIS, J. A. MORTIMER, J. A. SEMINOFF, D. AMOROCHO, K. A. BJORNDALE, J. BOURJEA, B. W. BOWEN, R. B. DUEÑAS, P. CASALE, B. C. CHOUDHURY, A. COSTA, P. H. DUTTON, A. FALLEBRINO, E. M. FINKBEINER, A. GIRARD, M. GIRONDOT, M. HAMANN, B. J. HURLEY, M. LÓPEZ-MENDILHORSU, M. A. MARCOVALDI, J. A. MUSCIK, R. NEL, N. J. PILCHER, S. TROËNG, B. WITHERINGTON, AND R. B. MAST. 2011. Global conservation priorities for marine turtles. *PLoS ONE* 6(9):e24510.
- WEBB, G. J. W., S. C. MANOLIS, AND M. L. BRIEN. 2010. Saltwater crocodile, *Crocodylus porosus*. *In* S. C. Manolis, and C. Stevenson (eds.), *Crocodiles: Status Survey and Conservation Action Plan, Third Edition*, pp. 99–113. IUCN/SSC Crocodile Specialist Group, Darwin, Australia.
- WILSON, C., AND C. TISDELL. 2003. Conservation and economic benefits of wildlife-based marine tourism: sea turtles and whales as case studies. *Human Dimen. Wildl.* 8:49–58.
- ZANDER, K. K., S. T. PANG, C. JINAM, A. A. TUEN, AND S. T. GARNETT. 2014. Wild and valuable? Tourist values for Orang-utan conservation in Sarawak. *Conserv. Soc.* 12:27–42.
- ZHOU, T., T. BLANCK, W. P. MCCORD, AND P. P. LI. 2008. Tracking *Cuora mc-cordi* Ernst, 1988: The first record of its natural habitat; a re-description; with data on captive populations and its vulnerability. *Hama-dryad* 32:57–69.