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Noteworthy Records of Chelonians from the Chindwin River Basin and Naga Hills of Western Myanmar

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***Abstract.*—The chelonian fauna of Myanmar remains one of the least studied in Asia, and acquiring basic distributional data is an essential prerequisite for effective conservation planning. To this end, we investigated the occurrence, exploitation, and conservation status of chelonians in the Chindwin River basin and Naga Hills of western Myanmar during February-March 2012 and 2013. During this survey, we obtained specimen-based records of Burmese Star Tortoise (*Geochelone platynota*), Yellow or Elongated Tortoise (*Indotestudo elongata*), Myanmar Brown Leaf Turtle (*Cyclemys fusca*), Burmese Black Turtle (*Melanochelys trijuga edeniana*), and Keeled Box Turtle (*Cuora mouhotii*). A *G. platynota* carapace that we obtained at Kani represents a significant northwards range extension and is the only documented occurrence of this tortoise from the west bank of the Chindwin River. Our specimens of *I. elongata* and *M. trujuga edeniana* constitute the first records of either species from the Chindwin River basin. Our specimens of *C. fusca* fill a distributional hiatus between the Chin Hills and Hukaung Valley. The *C. mouhotii* we examined in the Naga Hills are the only post-World War II records of this turtle in Myanmar and represent a significant eastward range extension from neighboring Assam, India. We found no evidence of a commercially-driven harvest of chelonians in western Myanmar. However, opportunistic subsistence harvesting is widespread in agricultural landscapes along the Chindwin River and occurring at levels that are probably unsustainable. In the Naga Hills where human population density is low, villages are widely scattered, and extensive forested habitat remains, chelonian populations are probably secure, at least for the moment.**

Key Words.—Chindwin River; *Cuora mouhotii*; *Cyclemys fusca*; *Geochelone platynota*; *Indotestudo elongata*; *Melanochelys trijuga edeniana*; Myanmar; Naga Hills

Introduction

Understanding species distributions is fundamental to the study of community ecology, ecosystem dynamics, evolutionary processes, and conservation biology (McDiarmid 1994; McCarthy et al. 2011). Acquiring basic distributional data on even common species is an essential prerequisite for prioritizing conservation action (Stuart and Thorbjarnarson 2003) and developing effective conservation plans (Dodd and Franz 1993; Oliver and Beattie 1993; Castellano et al. 2003). Despite high levels of species richness and endemism (25 species; 8 endemic species or subspecies; Platt et al. 2012a), the non-marine chelonian fauna of Myanmar (formerly known as Burma) remains one of the least studied in Asia (van Dijk 1997; Platt et al. 2000). Distributional data for most species are fragmentary with many records originating prior to World War II (van Dijk 1997; Platt et al. 2000). Consequently, species distributions are imperfectly known and must often be inferred from decades-old museum specimens (Iverson 1992), many of which lack meaningful locality data (e.g., Iverson and McCord 1997; Platt et al. 2011). This situation is especially lamentable given that chelonian populations are rapidly being decimated throughout Myanmar by rampant over-harvesting to supply wildlife markets in China and elsewhere, and opportunities for the future study of wild populations will no doubt be limited (Kuchling 1995; Platt et al. 2000).

In particular, the turtle fauna of western Myanmar has received scant scientific attention. Chelonians were among the specimens collected by the Vernay-Hopwood Expedition (1934–

1935) and later deposited in the American Museum of Natural History (Morris 1936). More recently, Kuchling et al. (2004) reported on the occurrence and conservation status of Trionychids in the upper Chindwin River basin, Platt et al. (2005) provided several distributional records from the lower Chindwin River, and Kuchling et al. (2006) published on the population status of the Critically Endangered Burmese Roofed Turtle (*Batagur trivittata*) in the upper Chindwin River. Herein, we present noteworthy distributional records for tortoises and turtles in the Chindwin River basin and adjacent Naga Hills of western Myanmar, and comment on the exploitation and conservation status of chelonians in this region.

Materials and Methods

Study area.—Myanmar's Chindwin River is the largest tributary of the Ayeyarwady River, arising at the confluence of the Tanai, Taby, Tawon, and Tarem Rivers in the Hukaung Valley of Kachin State (Gresswell and Huxley 1965; Roberts et al. 1968). The Chindwin River exits the Hukaung Valley through a narrow rapid-filled gorge and flows southward along the base of the Naga Hills before meeting the Ayeyarwady about 15 km upstream from Pakokku (Chhibber 1933). The length of the Chindwin River from its headwaters to the Ayeyarwady confluence is approximately 1,200 km (Gresswell and Huxley 1965). The Chindwin River is characterized by wide meanders with extensive sandbanks, which are exposed during low water periods. Major tributaries of the Chindwin River include the Uyu, Mu, and Myithar Rivers (Chhibber 1933; Gresswell and Huxley 1968). Herein, we follow local convention and refer to the river downstream from Homalin as the "lower" Chindwin, and upstream from Homalin as the "upper" Chindwin.

Intact forest cover characterizes much of the floodplain along the upper Chindwin River. In contrast, the floodplain of the lower river is densely populated and heavily cultivated. The lower floodplain is characterized by thorn scrub-associations typical of the central dry zone, with a gradual transition into deciduous and tropical evergreen forests following a gradient of increasing rainfall in the upper river basin (Stamp and Lord 1923; Morris 1936). Temporary agricultural and fishing settlements are scattered along the river channel, and agricultural crops are cultivated on sandbanks when soil is exposed by falling water levels during the dry season (November through late May).

The Naga Hills are part of a contiguous chain of mountains linking the Himalayas in the north with the Rakhine Yoma Hills to the south. The central ridge of the Naga Hills forms the political boundary between Myanmar and India. The Naga Hills are characterized by extremely rugged topography consisting of steep ridges separated by narrow stream valleys and deep gorges (Saul 2005). Mount Saramati (3,826 m) is the highest peak in the Naga Hills, but most ridges are considerably lower, ranging in elevation from 1,500 to 1,800 m. Nam Thalet Chaung, originating in the Sema region of India, pierces the central spine of the Naga Hills and flows into Myanmar, eventually debouching into the Chindwin River near Htamanthi. For much of its course, Nam Thalet Chaung is a swift-flowing river characterized by deep pools separated by numerous rapids and waterfalls (Saul 2005).

The vegetation of the Naga Hills in Myanmar is poorly described and recent floristic studies are lacking. Plant communities are largely determined by a combination of slope, aspect, and elevation (Choudhury 2001a). Low elevation habitats are characterized by a mixture of tropical evergreen and semi-evergreen forests, while montane sub-tropical forest, including pine (*Pinus* spp.) forest is present above 1,000 m (Saul 2005). Temperate woody species (e.g., *Quercus*, *Carpinus*, *Ilex*, and *Rhododendron*) and a diverse epiphytic flora of orchids, ferns, and mosses are found at the highest elevations

(Choudhury 2001a; Saul 2005).

The Naga Hills are home to the Naga, an ethnic classification encompassing a number of Indo-Mongoloid tribes (Diran 1999). The Naga inhabit permanent villages on high ridges and mountaintops, and practice swidden cultivation on the surrounding slopes using a system of taungya agriculture (von Furer-Haimendorf 1933; Saul 2005). Hillsides are cleared and burned in the dry season, planted at the onset of the wet season, cultivated for one to three years, and then abandoned. Fallow periods are often lengthy (> 20 y), and consequently, much of the Naga Hills is characterized by secondary vegetation in various stages of succession.

Western Myanmar experiences a tropical monsoonal climate with a wet season extending from early June into late October, followed by a dry season from November through April (Terra 1944). Mean annual rainfall ranges from 75–125 cm along the lower Chindwin River (Stamp and Lord 1923) to over 250 cm in higher elevations of the Naga Hills (Saul 2005). High diurnal temperatures (to 43° C maximum) are typical of the dry season with low nocturnal temperatures (to 4° C minimum) occurring during the winter months (January and February). Temperatures at higher elevations rarely exceed 25° C even in the hottest months and commonly drop below freezing during December and January (Saul 2005).

Data collection.—We conducted fieldwork along the Chindwin River (Fig. 1) and in the Naga Hills (Fig. 2), Myanmar, from 3 February to 17 March 2012 and 24 February to 8 March 2013, as part of a larger investigation into the conservation status of *B. trivittata*. During 2012, we traveled up the Chindwin River from Monywa to Khamti (750 km) aboard a shallow-draft riverboat (6 m wide × 36.5 m long × 1.8 m deep) and made frequent stops at riverside villages and temporary encampments (3 February to 6 March). We then traveled by road from Htamanthi to Lay Shi, hiked through the Naga Hills to remote villages, and returned to the road at Mile 25 Camp (7–17 March). During 2013, we traveled by road from Htamanthi to Mul Don Phai, hiked through the Naga Hills, including a climb to the summit of Mount Saramati, and returned to the road at Mile 25 Camp (24 February to 8 March).

At each village we conducted open-ended interviews (Martin 1995) of fishermen, farmers, bamboo cutters, and hunters regarding the local occurrence of turtles, folk taxonomy (*sensu* Berlin et al. 1966), harvesting methods, and levels of exploitation. Such individuals are generally recognized as an excellent source of information on local cheloniafauna (Thirakhupt and van Dijk 1995 “1994”; Stuart and Platt 2004). In accordance with the protocol of an open-ended interview, we asked each informant a series of questions that included a set of standard questions prepared in advance, and others that arose during the course of conversation (Martin 1995). On several occasions we met with large groups of villagers simultaneously and it was not possible to conduct standard open-ended interviews. In such cases, we used a semi-directive method (Gilchrist et al. 2005), in which information was recorded as questions were asked and discussed more informally. Transcripts and summaries of interviews are contained in field notes archived in the Campbell Museum, Clemson University, Clemson, South Carolina, USA.

During interviews, we also asked to examine any shells or living turtles that might be available in villages. Living turtles and shells were measured (straight-line carapace length [CL; measured along the mid-line from the posterior marginals to the anterior edge of the nuchal scute] and plastron length [PL; measured along the mid-line from the base of the anal notch to the posterior edge of the gular scute]) with calipers and photographed. The sex of *Indotestudo elongata* was determined based on plastral morphology; males exhibit concave plastrons, while in females the plastral concavity is lacking (Ernst and Barbour 1989). In many cases only the carapace was provided making

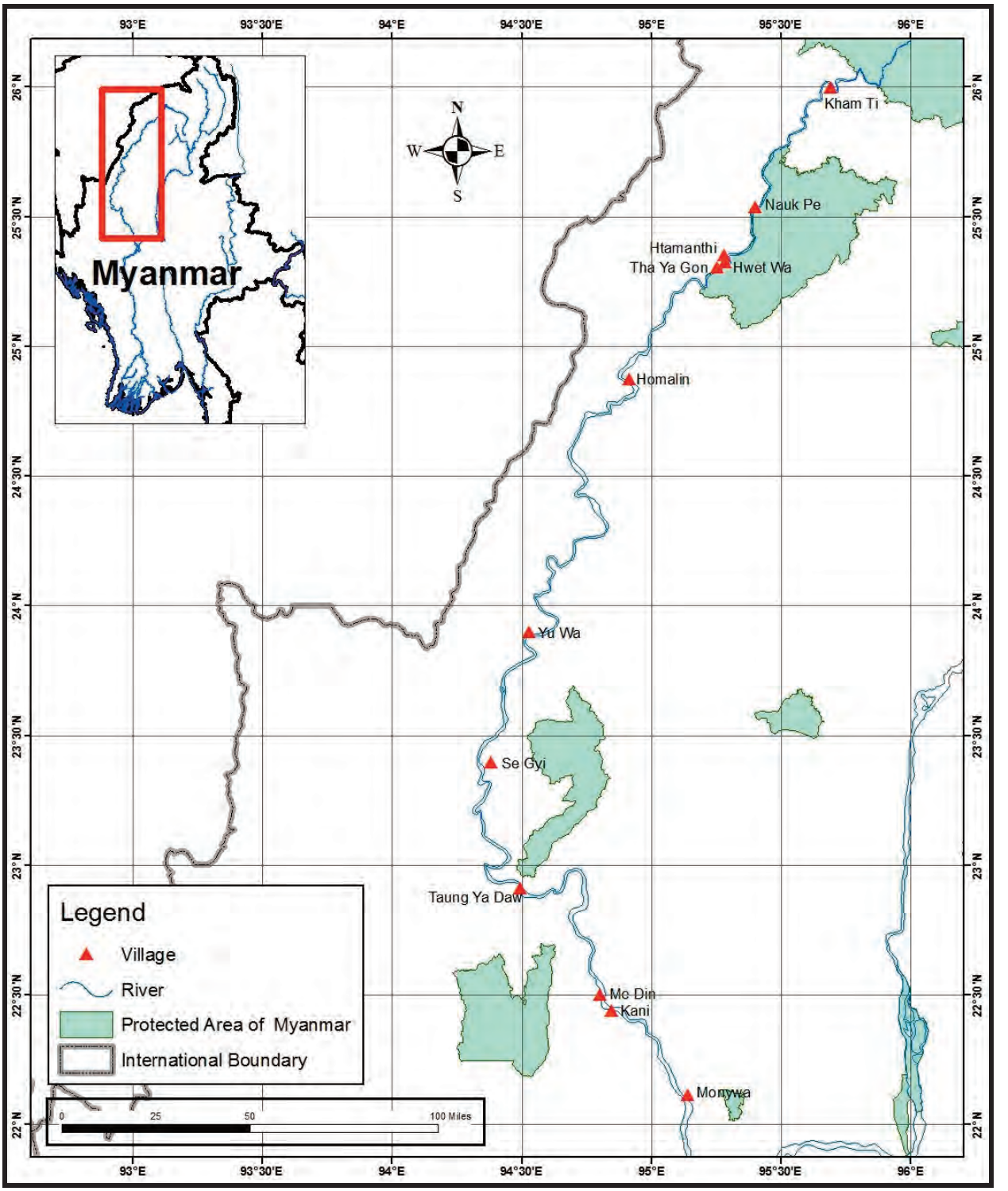

FIGURE 1. Map of the Chindwin River Basin, Myanmar showing villages mentioned in the text and larger towns. Geographic coordinates of each are provided in Table 1. Inset shows location of the study area in Myanmar.

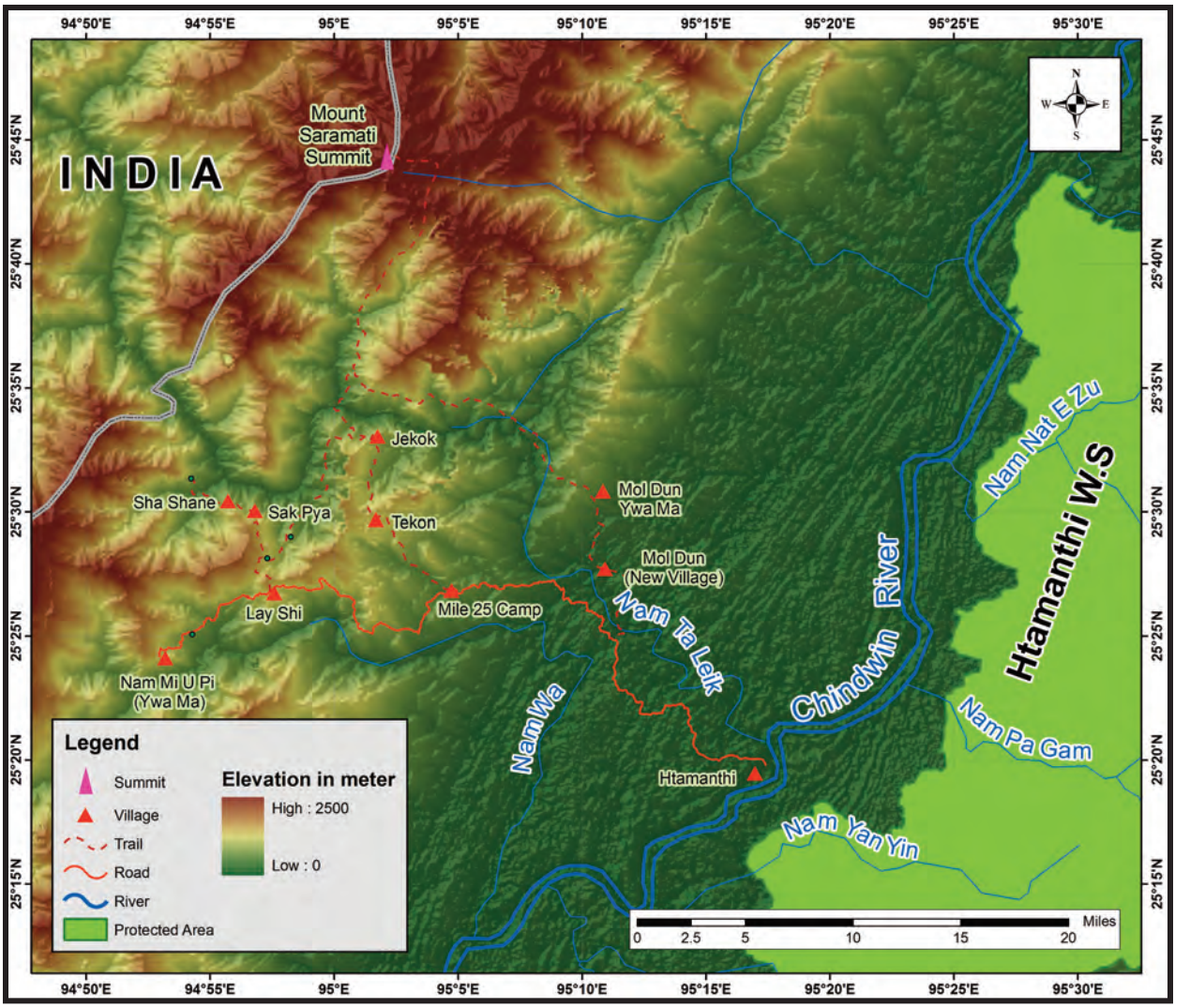

Figure 2. Map of the Naga Hills near Lay Shi, Myanmar showing villages mentioned in the text and routes followed by the expeditions in 2012 and 2013. Geographic coordinates of each village are provided in Table 1.

determination of sex impossible. We were likewise unable to determine the sex of *Cyclemys fusca* and *Cuora mouhotii* based solely on shell attributes; however, living *Cyclemys* were readily sexed by differences in tail morphology. In several instances, we accompanied villagers to specific sites where turtles had been recently captured in order to qualitatively describe the habitat. Mean values for morphometric measurements are reported as ± 1 SD. Geographic coordinates and elevation were determined with a Garmin® GPS 12 (Garmin International, Inc., Olathe, Kansas, USA; Table 1). Place names are in accordance with a countrywide gazetteer currently being compiled by the Myanmar Forest Department.

Results

During this survey we obtained specimen-based distribution records of Burmese Star Tortoises (*Geochelone platynota*), Yellow or Elongated Tortoises (*Indotestudo elongata*), Myanmar Brown Leaf Turtles (*Cyclemys fusca*), Burmese Black Turtles (*Melanochelys trijuga edeniana*), and Keeled Box Turtles (*Cuora mouhotii*).

TABLE 1. Geographic coordinates (latitude and longitude) and elevation of localities mentioned in text (India-Bangladesh Datum). Place names in accordance with countrywide gazetteer currently being compiled by Myanmar Forest Department.

Location	Latitude (N)	Longitude (E)	Elevation (m)
Chaung Wa	25°46.70′	95°31.72′	137
Dane Kalane Away	25°28.12′	94°57.30′	1316
Hmaw Yom Myaing	25°12.06′	95°09.99′	143
Homalin	24°51.73′	94°54.65′	125
Htamanthi	25°19.97′	95°17.64′	137
Jekok	25°33.05′	95°01.76′	1018
Kham Ti	25°59.81′	95°42.10′	144
Kani	22°26.59′	95°51.46′	77
Lay Shi	25°26.74′	94°57.60′	1310
Mo Din	22°30.15′	95°48.46′	83
Mile 25 Camp	25°26.84′	95°04.73′	650
Maokhan	25°04.87′	95°02.31′	134
Monywa	22°07.33′	95°07.48′	78
Mol Dun-New Village	25°27.72′	95°10.92′	274
Mol Dun Ywa Ma	25°30.83′	95°10.48′	633
Nam Mi U Pi	25°24.11′	94°53.20′	1235
Nauk Pe	25°32.11′	95°24.26′	136
Se Gyi	23°23.34′	94°23.27′	117
Sak Pya	25°38.05′	94°56.79′	1125
Sha Shane	25°30.43′	94°55.71′	937
Taung Ya Daw	22°54.48′	94°29.95′	78
Tha Ya Gon	24°12.73′	94°39.77′	128
Tekon	25°29.70′	95°01.69′	1331
Tone Malaw	25°10.39′	95°09.97′	146
Tone Nain	23°14.00′	94°19.53′	92
Yu Wa	23°53.50′	94°32.51′	106

Geochelone platynota.—We obtained a single carapace (CL = 90 mm; Fig. 3) without an accompanying plastron from a hunter in Kani Village. This small tortoise was reportedly captured in dry deciduous forest on a low hill about 2 km north of the village during 2011. Our informants regarded *G. platynota* as extremely rare in the vicinity of Kani, but extant populations were said to occur along the western boundary of Alaungdaw Kathapa National Park.

Indotestudo elongata.—During this survey we examined 11 *I. elongata*, including specimens from Kani (n = 1), and Mo Din (n = 4), Taung Ya Daw (n = 1), Tone Nain (n = 2), Yu Wa (n = 2), and Tha Ya Gon (n = 1) villages along the Chindwin River (mean CL = 199 ± 19 mm; range = 170–220 mm; n = 6; mean PL = 161 ± 37 mm; range = 98–190 mm; n = 5). Our sample consisted of five carapaces without an accompanying plastron, a carapace with plastron, and four plastrons without an accompanying carapace. We were able to determine the sex of five specimens based on plastral morphology (4 males: 1 female). According to our informants, these specimens originated in dry zone thorn scrub and dry deciduous forest near the villages where we

Figure 3. *Geochelone platynota* carapace obtained from a hunter in Kani Village, Myanmar. This is the first specimen-based record of *G. platynota* from the west bank of the Chindwin River and represents a significant northwards extension of the known range. (Photographed Kalyar Platt).

Figure 4. Cyclemys fusca obtained from villagers in the Naga Hills, Myanmar. Note the complete absence of speckling and uniform brown coloration of the head. (Photographed by Kalyar Platt).

obtained them. Most were opportunistically collected as villagers traveled to and from nearby agricultural fields.

Cyclemys fusca.—We examined 12 *C. fusca* from various localities along the Chindwin River; this sample included a plastral fragment and seven intact plastrons (mean PL = 165 ± 36 mm; range = 90–205 mm; n = 7), a single carapace (CL = 190 mm), and three living turtles (CL = 61–89 mm). Shells were obtained from six localities: Tone Nain (n = 1), Yu Wa (n = 1), Maokhan (n = 1), Nauk Pe (n = 1), Hmaw Yom Myaing (n = 1), and Tone Malaw (n = 4) villages. We also captured a juvenile *C. fusca* (CL = 89 mm) in a small stream (23°23.167′N, 94°23.326′E; elevation = 100.8 m) approximately 1 km from Se Gyi Village at 1030 on 11 February 2012. The turtle (Fig. 4) was found in shallow water among boulders beside a deep pool at the base of a waterfall. *Cyclemys fusca* in this stream are believed to be under the protection of a local *Nat* (= Earth Spirit). Villagers hold an annual ceremony every June and provide offerings below the waterfall to propitiate the *Nat*. According to villagers, a number of turtles were reportedly collected and sold to wildlife traders "several years ago." Shortly thereafter the region suffered a devastating flood, which villagers attribute to the anger of the *Nat*.

We captured another *C. fusca* (CL = 55 mm) among rocks in a small tributary creek flowing into the Chindwin River at Linpha Village at 0800 on 20 February 2012, and found a third *C. fusca* (CL = 61 mm) crawling among short grass on the bank of the Chindwin River near Chaung Wa at 1500 on 26 February 2012. Interestingly, Shan villagers dwelling along the Chindwin River consider juvenile and adult *C. fusca* to be distinct folk taxa owing to differences in coloration and behavior. The Shan name for juvenile *C. fusca* translates as "jumping from log turtle" because of their habit of tumbling from logs when disturbed while basking.

We examined six *C. fusca* at villages in the Naga Hills, including two complete shells, three specimens consisting of a carapace only, and a single living turtle (mean CL = 184 ± 33 mm; range = 120–210 mm; Fig. 4). We obtained these specimens from Lay Shi (n = 2), Dane Kalane Away (n = 1), and Nam Mi U Pi (n = 3) villages. According to villagers, these turtles were captured in mountain streams (Fig. 5) at

elevations ranging from 450 to 600 m.

Melanochelys trijuga edeniana.—We examined one incomplete plastron from a turtle collected near Tone Nain Village. The plastron was readily identifiable by a prominent yellow margin bordering the dark central scutes (Fig. 6). *Melanochelys trijuga edeniana* is known locally as *Leik Poke* (= odiferous turtle) owing to the strong odor emitted by the turtle when captured. Because of this strong smell, most villagers are reluctant to butcher these turtles, which are rarely collected for domestic consumption.

Cuora mouhotii.—We examined nine specimens of *C. mouhotii*, including a complete shell, five specimens consisting of a carapace only, one plastron without an associated carapace, and a single living turtle (mean CL = 148 ± 19 mm; range = 106–163 mm; Fig. 7). We obtained these specimens from Sak Pya (n = 3), Sha Shane (n = 2), Mol Dun–New Village (n = 2), Mol Dun Ywa Ma (n = 1), and Jekok (n = 1) villages in the Naga Hills. The Naga refer to *C. mouhotii* as *Lak Lekhaua*, which translates as "crab that moved to the mountains." Many (but not all) Naga regard the flesh of *C. mouhotii* as toxic and consumption is said to cause gall bladder ailments, nervous system disorders, and severe abdominal cramps. One variation of this belief holds that reddish colored juveniles are toxic, while the darker adults are safe to consume. For these reasons, *C. mouhotii* are infrequently harvested in the Naga Hills.

According to villagers, *C. mouhotii* are found in mesic microhabitats such as springs and small streams under forest canopy. The specimens we examined were collected in secondary evergreen broadleaf forests at elevations ranging from 750 to 900 m. We accompanied villagers to two sites where *Cuora mouhotii* were recently captured. The first site was located near Mol Dun Ywa Ma

Figure 5. Example mountain stream at relatively low elevation (to about 600 m) inhabited by *Cyclemys fusca* in the Naga Hills, Myanmar. (Photographed by Khin Myo Myo).

Figure 6. An incomplete plastron of *Melanochelys trijuga edeniana* obtained at Tone Nain Village, Myanmar. Note the prominent yellow margin bordering darker central scutes. This specimen constitutes the first record of *M. t. edeniana* from the Chindwin River basin. (Photographed by Kalyar Platt).

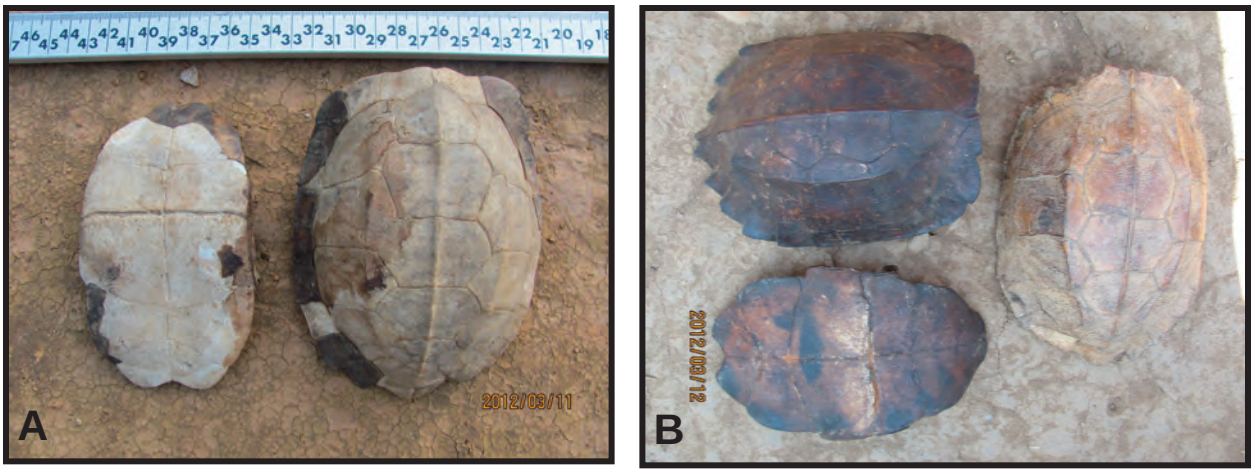

Figure 7. *Cuora mouhotii* shells obtained from Sak Pya (a) and Sha Shane (b) villages in the Naga Hills, Myanmar. These specimens are the only recent (post-1945) records of *C. mouhotii* from Myanmar and represent an eastward range extension from adjacent areas of Assam, India. (Photographed by Khin Myo Myo).

where a turtle was found in late February 2013 among dense bamboo along an intermittent stream while villagers were clearing land to establish taungya fields (25°19.97′N, 95°09.57′E; elevation = 725 m). The second capture site (25°31.68′N, 95°02.21′E; elevation = 701) was located beside a small permanent rocky stream along the trail between Jekok and Tekon villages. The streamside vegetation consisted of a mixture of older second-growth evergreen forest and dense bamboo. Villagers reported observing *C. mouhotii* feeding on mushrooms and fallen fruit beneath *Ficus* trees.

Exploitation.—We found nothing to indicate that a commercially-driven harvest of hard-shelled turtles is currently underway along the Chindwin River or in the Naga Hills, Myanmar. This is probably because most hard-shelled turtles command a relatively low price from wildlife traders and densities are depressed as a result of chronic subsistence harvesting. Therefore, finding sufficient numbers of turtles to make commercial harvesting an economically worthwhile pursuit is difficult. Most importantly, harvesting and selling turtles yields far less income than fishing or farming, the principal livelihoods of most people living in the region. Furthermore, among the Naga, chelonians seem largely ignored, and their renowned hunting skills (Saul 2005) are instead focused on mammals and birds.

While villagers appear to devote little time to purposefully hunting turtles, opportunistic harvesting for domestic consumption is ubiquitous, particularly in agricultural landscapes along the Chindwin River. Indeed, the majority of records we present are based on turtles harvested and consumed by local villagers. Estimating the size of this subsistence harvest is difficult without sustained monitoring. However, crude estimates provided by our informants in agricultural villages along the Chindwin River ranged from < 1 to as many as 2–3 turtles/adult villager harvested each year. To our knowledge, census data for this and other rural areas of Myanmar are currently non-existent. However, the villages we visited were widely spaced along the river (5 to 10 km apart) and based on rough counts of houses, were probably inhabited by 25 to 100 families (assuming one family per house). Although, the per capita annual harvest rate appears low, collectively these estimates suggest that significant numbers of turtles are being removed from the wild in many areas.

Discussion

Our expedition to the Chindwin River basin and Naga Hills yielded a number of significant distributional records for chelonians in this zoologically under-studied region of Myanmar. *Geochelone platynota* is endemic to the dry zone of central Myanmar, although within this general region its distribution remains ill-defined and few specimen-based records are available (Platt et al. 2011). *Geochelone platynota* has not previously been reported north of Budalin (22°25.1′N, 95°10.0′E) in the Chindwin River basin (Platt et al. 2004b), and our record from Kani represents a significant northwards range extension. Moreover, this is the only specimen-based record from the west bank of the Chindwin River. There is an urgent need to further investigate local reports that *G. platynota* occurring along the western boundary, and perhaps within Alaungdaw Kathapa National Park. *Geochelone platynota* is considered among the 25 most Critically Endangered chelonians in the world (Rhodin et al. 2011), and thought to be ecologically extinct throughout its former range, including protected areas (Platt et al. 2011). Therefore, verifying the occurrence of *G. platynota* in Alaungdaw Kathapa National Park would prove extremely important for future *in situ* conservation efforts.

Indotestudo elongata probably occurs or formerly occurred throughout most of Myanmar, although specimen-based records are available only for localities in the dry zone (Zug et al. 1998; Platt et al. 2001a, 2003), central Ayeyarwady Plain (Iverson 1992), Shan Hills near Inle Lake (Platt et al. 2004a), Arakan Yoma Mountains (Iverson 1992; Platt et al. 2007, 2010), and Chin Hills (Platt et al. 2012b). To our knowledge, the specimens we examined are the first records of *I. elongata* from anywhere in the Chindwin Basin. Collectively, this report and others suggest *I. elongata* is a habitat generalist found in dry zone thorn scrub (Platt et al. 2003; this study), degraded secondary hill forests (Platt et al. 2004a, 2012b), tropical deciduous forest (Thirakhupt and van Dijk 1995; Zug et al. 1998; Platt et al. 2001a; this study), and tropical evergreen and bamboo forest (Platt et al. 2007, 2010). Despite being distributed widely and relatively common in some areas (e.g., Platt et al. 2010), the ecology of *I. elongata* remains unstudied in Myanmar.

Two species of dark-bellied *Cyclemys* reportedly occur in Myanmar (Fritz et al. 2008), although few museum specimens are available and the geographic distribution of each is poorly understood and has yet to be fully resolved. *Cyclemys oldhamii* occurs in central and southern Myanmar, and eastwards into Thailand, while *C. fusca* inhabits northern and central Myanmar, and perhaps adjacent parts of India and Bangladesh (Fritz et al. 2008). Because *C. oldhamii* and *C. fusca* are morphologically similar, field identification is challenging; however, the crown of the head is reddish brown with black speckling to near-black in *C. oldhamii*, and uniformly greenish yellow to light brown in *C. fusca* (Fritz et al. 2008). Based on the uniform brown coloration of the head and absence of speckling, we provisionally identified the living turtles examined during this survey as *C. fusca*. Moreover, the Chindwin basin and Naga Hills are within the geographic distribution of *C. fusca* proposed by Fritz et al. (2008). Identification of the *Cyclemys* shells we obtained is problematic as the two species cannot be distinguished solely on the basis of shell attributes. However, because the shells originated from the same area as the living turtles, these specimens are almost certainly assignable to *C. fusca* as well.

Cyclemys fusca has not previously been reported from the lower Chindwin River or Naga Hills, although specimens are available from the Hukaung Valley (Fritz et al. 2008) and Chin Hills (Platt et al. 2012b) in Myanmar, and neighboring regions of Assam, India (Fritz et al. 2008). Our records fill the distributional hiatus in Myanmar between the Chin Hills to the south and the Hukaung Valley to the north. Similar to our findings in the Naga Hills, *C. fusca* in the Chin

Hills occurred at elevations < 550 m (Platt et al. 2012b). These observations suggest that *C. fusca* is restricted to relatively low elevations in the mountains of western Myanmar.

The distribution of *Melanochelys trijuga edeniana*, a subspecies endemic to Myanmar remains ill-defined. The specimen we examined constitutes the first record of *M. t. edeniana* from the Chindwin River basin. Additional records are available from the dry zone near Magwe (Platt et al. 2001b), Mandalay (Iverson 1992), and Tongoo (Theobald 1868) along the Ayeyarwady River between Mandalay and Bhamo (Smith 1931; Platt et al. 2005), "the Karenni foot-hills near Moulmein" (Smith 1931), and the Arakan (= Rakhine) Yoma Mountains (Theobald 1868; Smith 1931). Otherwise virtually nothing is known regarding the distribution and natural history of this turtle in Myanmar.

The geographic distribution of *Cuora mouhotii* extends from Assam, India eastwards into southern China, including Hainan Island (Iverson 1992). A specimen collected near Myitkyina prior to World War II is the single published record of *C. mouhotii* from Myanmar (Iverson 1992). The *C. mouhotii* we examined in the Naga Hills are the only recent records from Myanmar and represent a significant eastward range extension from Assam (Iverson 1992; Choudhury 1996, 1998, 2001b). In the Naga Hills, *C. mouhotii* appears to have an elevational distribution similar to that reported for adjacent areas of India where the upper limit given by Choudhury (2001b) is approximately 1,000 m. *Cuora mouhotii* is thought to be declining throughout Southeast Asia due to the combined effects of over-harvesting and habitat destruction, and identification of additional populations has been accorded high priority by conservationists (Horne et al. 2012). Thus, the occurrence of a hitherto undocumented population subject to minimal harvest pressure (see below) in the Naga Hills of western Myanmar is of global conservation significance. The widespread (although not universal) belief among the Naga that *C. mouhotii* flesh is toxic confers additional protection to these turtles. Indeed, this belief may have a factual basis; the diet of *C. mouhotii* is said to include mushrooms, and Carr (1952) reported humans being poisoned after consuming Eastern Box Turtles (*Terrapene carolina*) which had presumably fed upon toxic mushrooms.

Our observations indicate that opportunistic subsistence harvesting of chelonians is widespread in western Myanmar, particularly in agricultural landscapes along the Chindwin River. Although the per capita harvest rate of turtles appears low, the sustainability of this harvest is nonetheless questionable. Like most long-lived vertebrates, the life-history traits of chelonians severely constrain the ability of populations to respond to chronic increased mortality (Congdon et al. 1993), and even low intensity subsistence harvesting has the potential to decimate turtle populations in areas accessible to humans (Thirakhupt and van Dijk 1995). Indeed, it is doubtful whether any harvest of adult chelonians can be regarded as truly sustainable (Thorbjarnarson et al. 2000). We posit that chelonian populations in agricultural landscapes and adjacent wildlands function as a source-sink system (Hanski and Simberloff 1997) where turtles from unpeopled wildlands (source) disperse into the areas near villages where harvesting is likely to occur (sink). In the long-term, continued subsistence harvesting is likely to result in the eventual extirpation of chelonian populations from most agricultural landscapes along the Chindwin River. However in the Naga Hills where turtles are regarded as a minor food resource, human population density is low, villages are widely scattered, and extensive forested habitat remains, the current level of subsistence harvesting appears to have little impact on turtle populations, which are probably secure, at least for the moment.

Religious beliefs similar to those we noted at Se Gyi Village where turtles are thought to be protected by local *Nats* have been documented elsewhere in Myanmar (Platt et al. 2003). *Nats*

are spiritual guardians of the landscape and must be properly propitiated; failure to do so can result in dire consequences (Spiro 1967). Inhabitants of several agricultural villages in the dry zone believe *G. platynota* and *I. elongata* are protected by local *Nats*, and to harm or even unduly disturb a tortoise is to risk divine retribution in the form of misfortune, sickness, or death (Platt et al. 2003). Platt et al. (2003) attributed the continued survival of these tortoise populations to protection conferred by *Nat* worship. *Nats* also figure prominently in the cobra cults that once existed in central Myanmar (Platt et al. 2012c). Conservation strategies that incorporate existing *Nat* worshiping practices have a high likelihood for success and could prove pivotal in efforts to arrest population declines of chelonians in parts of Myanmar where these beliefs are prevalent (Platt et al. 2003). Future efforts should be devoted to identifying villages where *Nat* worship provides protection for chelonian populations, and working with these communities to develop conservation programs. Such religious-based conservation efforts may provide the only feasible means to protect chelonian populations in agricultural landscapes along the Chindwin River in Myanmar.

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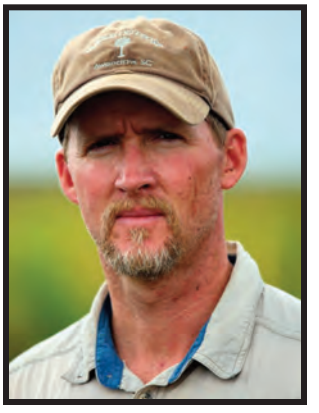

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