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Distribution of the Big-Headed Turtle (*Platysternon megacephalum*, Gray 1831) in Thailand

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Kruewan Pipatsawasdikul, Harold K. Voris, and Kumthorn Thirakhupt (2010) Distribution of the big-headed turtle (*Platysternon megacephalum*, Gray 1831) in Thailand. *Zoological Studies* **49**(5): 640-650. The distribution of the big-headed turtle *Platysternon megacephalum*, Gray 1831 in Thailand was studied from Dec. 2006 to Apr. 2009. Mountain streams of protected and unprotected areas throughout Thailand, except in the southern peninsular region, were ground surveyed. This study confirms the occurrence of *P. megacephalum* in 1 new and 9 previously reported river basins in the northeastern part of Thailand. Among these, 22 new localities at elevations of 430-1350 m were reported. Most *P. megacephalum* individuals were found at night in small, often rapidly flowing mountain streams in dry dipterocarp and montane rainforests. The water temperature of these streams ranged 15.5-20.3°C ($\overline{X}$ = 19.04 ± 2.10°C, *n* = 33), pH values ranged 5.32-8.07, and water depths were 14.0-95.0 cm ($\overline{X}$ = 41.67 ± 25.30 cm, *n* = 33). The turtles appeared to be most abundant at elevations of 630-720 m. *Platysternon megacephalum* populations face serious threats from habitat loss, human consumption, and commercial harvest of turtles. This species urgently needs an aggressive conservation program to ensure its survival. http://zoolstud.sinica.edu.tw/Journals/49.5/640.pdf

Key words: *Platysternon megacephalum*, big-headed turtle, distribution, Thailand.

The big-headed turtle *Platysternon megacephalum* is one of 5 endangered turtles and tortoises in Thailand (Nabhitabhata and Chan-ard 2005). It is classified as an endangered species on the *IUCN Red List* (2008) due to threats posed by habitat degradation and by hunting and trapping for consumption related to traditional Chinese medicine, for the pet trade, and for ex *situ* captive breeding programs (van Dijk and Palasuwan 2000). This small to medium-sized turtle is best known for its huge head that cannot be withdrawn into its shell and a long tail (Burnie and Don 2001).

The geographic range of *P. megacephalum* includes southern China and mountainous areas of Vietnam, Laos, Cambodia, Thailand, and Myanmar (Ernst and Barbour 1989, Bonin et al. 2006). In Thailand, the 1st records of *P. megacephalum* were from Mae Hong Son, Phetchabun, Chaiyaphum, and Kanchanaburi Provinces (Gairdner 1915). Later, Wermuth (1969) extended the range to Chiang Mai Province while Taylor (1970) confirmed that the species had been taken in Chiang Mai, Loei, and Kanchanaburi Provinces (a map showing the provinces of Thailand can be found at http://en.wikipedia.org/wiki/ Provinces of Thailand). This range was later extended to include Skon Nakhon Province (Nutaphand 1979, Humphrey and Bain 1990) and also new sites in Lampang (Unakornsawas 1995) Tak, and Kanchanaburi Provinces (Thirakhupt and van Dijk 1995). Thus, Nabhitabhata and Chan-ard (2005) summarized the species distribution in Thailand as including

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Chiang Mai, Mae Hong Son, Loei, Phetchabun, Chaiyaphum, Kanchanaburi, Phrae, and Tak Provinces.

From the above published reports, this species has been found in ten of the 25 main river basins of Thailand: Mae Nam Salawin, Mae Nam Ping, Mae Nam Kok, Mae Nam Wang, and Mae Nam Yom in the north, Mae Nam Pasak in the center, Mae Nam Khong Mae Num Moon and Mae Nam Chi in the northeast, and Mae Nam Mae Klong in the west.

Prior to this study, our knowledge of the distribution and status of this species was somewhat limited and out of date. The purpose of this study was to explore the present-day distribution of and habitat use by *P. megacephalum* in Thailand and to provide baseline data required for conservation decisions. To this end, we surveyed mountain streams throughout non-peninsular Thailand, compiled literature and museum records, and conducted a questionnaire survey.

MATERIALS AND METHODS

Museum surveys

Specimen data records for *P. megacephalum* from Thailand were requested from numerous major museums. Museum collections containing *P. megacephalum* specimens from Thailand were as follows: American Museum of Natural History (AMNH), NY, USA; Chulalongkorn Univ. Museum of Zoology (CUMZ), Bkk, Thailand ; Field Museum of Natural History (FMNH), Chicago, IL, USA; Florida Museum of Natural History (FLMNH), Gainesville, FL, USA; Institute and Natural History Museum (SMF), Senckenberg, Germany; Museum of Comparative Zoology, Harvard Univ. (MCZ), Cambridge, MA, USA; Museum of Zoology, Univ. of Michigan (UMICH), Ann Arbor, MI, USA; Natural History Museum & Biodiversity Research Center, Univ. of Kansas (KU), Lawrence, KS, USA; Natural History Museum (NHMB), Basel, Switzerland; Thailand Natural History Museum (THNHM), PT, Thailand; The Natural History Museum (BMNH), London, UK; Smithsonian Institution, National Museum of Natural History (USNM), Washington DC, USA; and Zoological Museum, Univ. of Copenhagen (ZMUC), Denmark. Catalog information, including locality data, from each reference specimen was assessed and then used along with the results of the questionnaire survey to plan the ground surveys.

Questionnaire surveys

An initial survey concerning *P. megacephalum* was conducted by mailing 263 brief questionnaires to local forestry offices within Thailand. The offices included national parks, sanctuary units, wildlife research units, and non-hunting units of the national parks, the Wildlife and Plant Conservation Department, and the fisheries offices of the Department of Fisheries, throughout Thailand with the exception of the southern peninsula which lies well outside this turtle's known range. The results of the survey were gathered over a 1-yr period (2006-2007) and they were used to identify localities that merited ground surveys. In addition, based on other informal reports and personal communications, several other parks, sanctuaries, and unprotected areas were surveyed for *P. megacephalum*. The survey questions were in the Thai language and primarily sought knowledge of 1st-hand observations of the big-headed turtle.

Ground surveys

From Dec. 2007 to Apr. 2009, intensive investigations were carried out in areas about which we had positive sighting information. To gain positive confirmation sightings of *P. megacephalum*, we drew upon the knowledge and experience of local hunters and forest rangers who spend at least some of their time in the field. Photographs of the big-headed turtles were used to insure good communication with local rangers, and advice was sought as to which catchments were thought to have turtles. Night surveys were conducted between 19:00 and 24:00 on mountain streams that had been identified. The survey team consisted of one of us (KP), a team of 3 or 4 from the Chiang Dao Wildlife Research Station, and several local rangers. In addition, in some cases, several local villagers joined the search. The search included stream banks, stream riffles and pools, and areas under large rocks and logs within the stream. In addition, some streams were searched during daylight hours. At each location, up to 5 night surveys were conducted per stream depending on sightings. Surveys at a site were discontinued as soon as 1 *P. megacephalum* was observed.

When an animal was observed, it was captured and ecological and morphological data were recorded. Straight-line measurements of

each specimen were taken with dial calipers accurate to 0.1 mm for the carapace length (CL), carapace width (CW), plastron length (PL), plastron width (PW), head length (HL), and tail length (TL).

To assess the overall range of *P. megacephalum* in Thailand, locations of all recent findings were plotted on a map which includes river basins (Fig. 1). In presenting the detailed locality data in figure 1, we have carefully considered both the practical and ethical implications raised by Fong and Qiao (2010). We recognize that there is a risk of the data being used to facilitate exploitation, but because many of the same localities are already published (e.g., Fong and Qiao 2010) or accessible on the Internet (e.g., the EMYS system), we have decided to provide the information to further advance turtle research.

RESULTS

Museum surveys

In total, collection localities of 29 museum specimen records were reviewed. Eight of the 29 specimens were recorded as coming from Thailand, without additional locality details (Table 1). One locality record simply consisted of Laotian mountains. The remaining specimens had detailed location data within Thailand and are shown in figure 1.

Questionnaire surveys

Of the 263 questionnaires distributed, 111 (42.2%) were completed and returned. Of these 111 responses, 63 (~57%) reported some evidence of *P. megacephalum* in their region. Positive reports came from 18 provinces and included 11 of the 25 river basins of Thailand. Each area that had a positive response was visited, and ground surveys were conducted to attempt to verify the current presence of *P. megacephalum*.

Ground surveys

In total, 40 locations were surveyed. At 6 locations, no turtles were observed. At 34 of the 40 locations, *P. megacephalum* was observed within streams. This survey documents that *P. megacephalum* is widely distributed in the same 9 previously reported river basins (Mae Nam Salawin, Mae Nam Ping, Mae Nam Kok, Mae Nam Wang, and Mae Nam Yom in the north; Mae Nam Khong and Mae Nam Chi in the northeast; Mae Nam Pasak in the center; and Mae Nam Mae Klong in the west) plus 1 new river basin (Mae Nam Nan in the north).

Most of these turtles were observed in streams during dry periods between Nov. and Apr. They were observed both at night and during the day, and although nearly all were collected under water, a few were observed resting above the water line on a log or rock within the streambed. Based on the results of this study, *P. megacephalum* was found in 22 new localities in 10 river basins in Thailand (Table 1). *Platysternon* is found in Thailand as far north as the Fang District, Chiang Mai Province in the Mae Nam Kok river basin (20°3'30.6"N, 99°7'14.7"E) and as far south as the Thong Pha Phum District, Kanchanaburi Province in the Mae Nam Mae Klong river basin (14°41'25.7"N, 98°24'28.9"E). In fact, the latter is one of the most-southern localities that has recently been confirmed for the species. Elevations of the localities ranged 430-1350 m.

From observations made in this study, *P. megacephalum* is primarily nocturnal as reported by Kirkpatrick (1995). During the daytime, they were observed underwater beneath logs or rocks and wedged into cracks between boulders near either a small waterfall or a location with rapidly flowing water. At night, they were observed walking along the stream bottom apparently searching for food or waiting for prey. They were seen in rocky mountain streams ranging in width from < 1 to 6.7 m in dry dipterocarp and montane rainforests. The weight of the 34 turtles ranged 15-1625 g, and the following sections present essential new information on traditional morphological characters associated with the 34 *Platysternon* turtles observed in the ground survey.

Carapace and plastron

Among the 34 individuals, 1 dead and 15 live turtles had CLs of < 140 mm and were considered juveniles. The smallest juvenile had a CL of only 52.4 mm and was observed in the Thung Jor watershed management unit. The largest female among the 4 adult females captured was observed at Phu Suan Sai National Park. She had a CL of 209.6 mm and a CW of 148.1 mm. Her plastron measured 164.2 mm long and 121.7 mm wide. The CL ranged 145.2-209.6 mm among the 4 females, while the CW ranged 104.7-148.1 mm. The PL ranged 115.0-164.2 mm among the 4

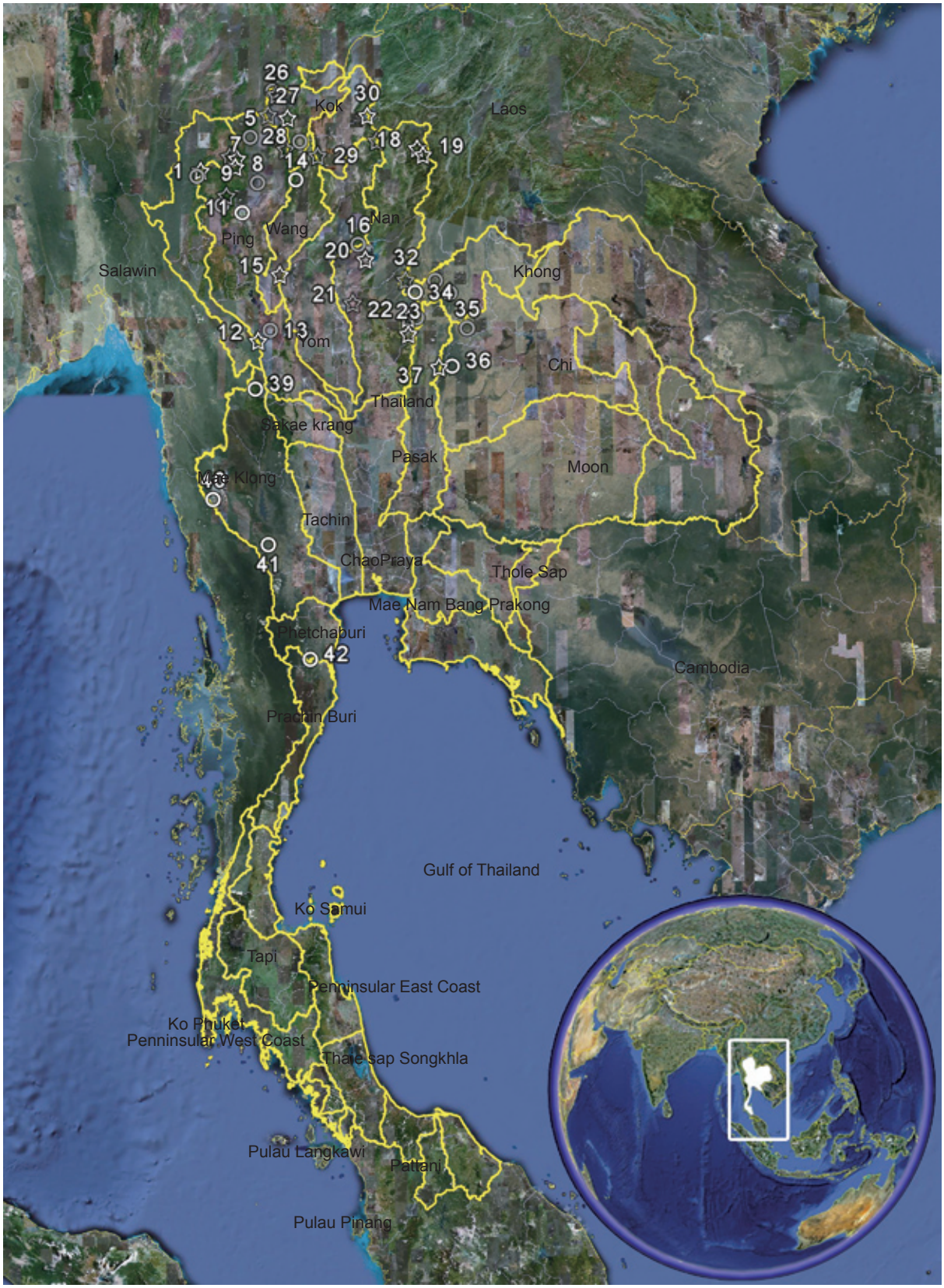

Fig. 1. Distribution of *Platysternon megacephalum* in Thailand combining previously known localities (circles) and 22 new localities (stars). Details on the numbered localities are given in table 1.

Table 1. Localities for *Platysternon megacephalum* in Thailand. In the 2nd and 3rd columns, the numbers in parenthesis refer to the locality numbers in figure 1 and the uppercase letters refer to the following: D, district; P, province; NP, national park; WS, wildlife sanctuary; WU, watershed management unit; DE, dipterocarp forest, MT, montane rainforest

River basin	Locality confirmed from this study	Site	Geo-referenced record		Elevation (m)	Forest type	Authority
			Latitude (N)	Longitude (E)			
Northern							
Mae Nam Salawin	Khun Yuam (D), Mae Hong Son (P, 1)	Mae Surin Waterfall (NP)	18°54'34.4"	98°6'18.6"	1120	DE	Nabhitabhata et al. 2000; Nabhitabhata and Chan-ard 2005; this study
		Mae Hong Son (P)					CUMZ(R) 2008.09.30,1
	Mueang (D), Mae Hong Son (P, 2)	Maesamad (WU)	18°59'18.2"	98°9'24.0"	1300	MT	This study
	Pai D, Mae Hong Son (P, 3)	Mae Lao-Mae Sae (WS)	19°10'21.4"	98°33'5.8"	1004	DE	This study
Mae Nam Ping	Mae Taeng (D), Chiang Mai (P, 4)	Tung Jor (WU)	19°8'59.4"	98°38'43.3"	1250	DE	This study
	Chiang Dao (D), Chiang Mai (P, 5)	Chiang Dao (WS)	19°25'48.3"	98°49'18.9"	920	DE	Nabhitabhata et al. 2000; Nabhitabhata and Chan-ard 2005; this study
	Phrao D, Chiang Mai (P, 6)	Si Lanna (NP)	19°16'4.4"	99°18'50.6"	860	DE	This study
	Samoeng (D), Chiang Mai (P, 7)	Samoeng (WS)	19°2'1.7"	98°37'48.9"	1189	DE	This study
	Mueang (D), Chiang Mai (P, 8)	Doi Suthep-Pui (NP)	18°48'41.2"	98°56'6.7"	605	DE	Nabhitabhata et al. 2000; Nabhitabhata and Chan-ard 2005; this study
		Doi Suthep	18°48'	98°55'			USNM 101652
		Doi Suthep					ZMUC R2402
	Mae Wang (D), Chiang Mai (P, 9)	Khun Wang (WU)	18°38'49.6"	98°31'6.8"	1160	DE	This study
	Mae Chaeam (D), Chiang Mai (P, 10)	Doi Inthanon (NP)	18°31'16.9"	98°27'29.2"	1031	MT	Nabhitabhata et al. 2000; Nabhitabhata and Chan-ard 2005; this study
	Chom Thong (D), Chiang Mai (P, 11)		18°25'	98°44'			USNM 101665
	Mueang (D), Tak (P, 12)	Lan Sang (NP)	16°43'57.6"	98°58'42.4"	900	DE	This study
	Me Taw (D), Tak (P, 13)		16°52'	99°08'			MCZ 29535
		Upper Me-ping at Muang Kuan					SMF 70531
Mae Nam Wang	Mueang Pan (D), Lampang (P, 14)	Chae Son (NP)	18°50'50.1"	99°27'25.1"	700	DE	Unakornsawas 1995; this study
	Si Satchanalai (D), Sukhothai P (15)	Si Satchanalai (NP)	17°35'47.8"	99°15'26.6"	430	DE	This study
Mae Nam Yom	Mueang (D), Phrae (P, 16)	Lum Nam Nan (NP)	17°58'50.6"	100°18'19.7"	1100	DE	Wongkom 2004; CUMZ(R) 2008.09.30.2-5; this study
	Song Khwae (D), Nan (P, 17)	Tham Sakoen (NP)	19°22'15.4"	101°33'21.8"	663	DE	This study
Mae Nam Nan	Pua (D), Nan (P, 18)	Doi Phu Kha (NP)	19°15'53.4"	101°6'25.1"	850	DE	This study
	Bo Khau (D), Nan (P, 19)	Khun Nan (NP)	19°10'32.1"	101°11'8.5"	960	DE	This study
	Nam Pad (D), Uttraradit (P, 20)	Klong Tron Waterfall (NP)	17°47'12.9"	100°24'19.8"	603	DE	This study
	Tha Pla (D), Uttraradit (P, 21)	Lum Nam Nan (WS)	17°13'0.3"	100°14'15.9"	497	DE	This study
	Nakhon Thai (D), Pitsanulok (P, 22)	Phu Hin Rong Kla (NP)	17°0'42.0"	100°58'27.7"	1204	MT	This study
	Khao Kho (D), Phetchabun (P, 23)	Thung Salaeng Luang (NP)	16°48'24.6"	100°58'37.6"	654	DE	This study
Mae Nam Kok	Chai Prakan (D), Chiang Mai (P, 24)	Pha Daeng (NP)	19°44'1.4"	99°3'40.2"	860	DE	This study
	Fang (D), Chiang Mai (P, 25)	Doi Pa Hom Pok (NP)	20°3'30.6"	99°7'14.7"	1350	MT	Nabhitabhata et al. 2000; Nabhitabhata and Chan-ard 2005; this study
	Mae Ai (D), Chiang Mai (P, 26)	Doi Pa Hom Pok (NP)	20°0'42.4"	99°10'11.9"	1310	MT	This study
	Mae Suay (D), Chiang Rai (P, 27)	Doi Wieng Pha (NP)	19°41'20.5"	99°19'50.2"	837	DE	This study
	Wieng Papao (D), Chiang Rai (P, 28)		19°22'	99°30'			USNM 101666
		Northern Thailand					SMF 66464
		Pa Melung, N. Thailand					BMNH 1921.4.1.195-6

females, while the PW ranged 91.8-121.7 mm. The largest male among the 14 adult males was captured at Tad Mog National Park and was nearly as large as the largest female with a CL of 192.3 mm and a CW of 144.5 mm. His plastron measured 148.9 mm long and 144.0 mm wide. The CL ranged 141.1-182.3 mm among the 14 males, while the CW ranged 106.4-144.5 mm. The PL ranged 114.2-148.9 mm among the 14 males, while the PW ranged 95.5-144.0 mm.

The carapace of both sexes is quite flat, squared-off anteriorly and rounded posteriorly. The carapace coloration of adults was variable: light brown, reddish-brown, olive, yellowish-brown, and dark gray (Fig. 2). Carapacial scutes lacked growth annuli in old adults, and had a radiating pattern in young adults. The plastron color also varied: yellow, brownish, olive with yellowish and dark gray with dark brown or light brown seams and a large black blotch in the center (Fig. 2). The

Table 1. (continued)

River basin	Locality confirmed from this study	Site	Geo-referenced record		Elevation (m)	Forest type	Authority
			Latitude (N)	Longitude (E)			
Northern							
Mae Nam Khong	Meaung (D), Prayao (P, 29)	Doi Luang (NP)	19°10'26.3"	99°45'3.9"	685	DE	This study
	Phu Sang (D), Prayao (P, 30)	Phu Sang (NP)	19°42'43.3"	100°25'32.9"	676	DE	This study
Mae Nam Khong	Phu Ruea (D), Loei (P, 31)	Phu Ruea (NP)	17°29'56.9"	101°20'18.5"	1099	DE	Taylor 1970; Nabhitabhata et al. 2000; Nabhitabhata and Chan-ard 2005; this study
	Na Haeo (D), Loei (P, 32)	Phu Suan Sai (NP)	17°30'46.2"	100°56'33.7"	940	DE	This study
	Phu Luang WS, Loei P (33)	Phu Luang (WS)	17°20'1.4"	101°31'48.5"	1220	DE	Chan-ard 2005; THNHM 13561; this study
	Ban Nong Wai, Dan Sai, Loei P (34)		17°21'	101°04'			USNM 141782
Mae Nam Chi	Phu Kradung (D), Loei (P, 35)	Phu Kradung (NP)	16°52'19.5"	101°45'24.9"	1287	MT	Taylor 1970; Nabhitabhata et al. 2000; Nabhitabhata and Chan-ard 2005; this study
	Phu Khiao (D), Chaiyphum (P, 36)	Phu Khiao (WS)	16°23'11.1"	101°33'2.8"	891	DE	Kumsook et al. 2006
Central							
Mae Nam Pasak	Mueang (D), Phetchabun (P, 37)	Tat Mog (NP)	16°22'35.7"	101°22'51.3"	652		This study
	Lomlo Mt. Nam Nao (D), Phetchabun (P, 38)		17°01'	101°05'			KU 40084, KU 129716
		Nam Nao, Phetchabun					Gairder 1915; Nabhitabhata et al. 2000; Nabhitabhata and Chan-ard 2005
West							
Mae Nam Mae Klong	Umphang (D), Tak (P, 39)	Umphang (WS)	16°6'10.6"	98°56'54.6"	645	DE	Thirakhupt and van Dijk, 1995; Nabhitabhata et al., 2000; Nabhitabhata and Chan-ard, 2005; this study
	Thong Pha Phum (D), Kanchanaburi (P, 40)	Thong Pha Phum (NP)	14°41'25.7"	98°24'28.9"	933	DE	Thirakhupt and van Dijk 1995; Nabhitabhata et al. 2000; Nabhitabhata and Chan-ard 2005; this study
	Sai Yoke, Kanchanaburi (P, 41)		14°07'	99°08'			NHMB 8416
Eastern							
Mae Nam Phetchaburi	Mount Angka, Phetchaburi (P, 42)		12°40'	99°41'			MCZ 43056
No specific locality known		Laotian mountains Thailand					BMNH 1882.10.7.1 AMNH R96944; FLMNH 85197-8; 85288-9; 99178; 99561; SMF 72682

carapace of juveniles was more brightly colored; dark brown, greenish-brown, and green with a serrated posterior at the carapacial rim, while the plastron was orange with a large black blotch in the center (Fig. 3).

Head

The head is oversized and triangular such that the turtle cannot withdraw its head into its shell. HW ranged 50.5-70.3 mm, and HL ranged 53.0-88.9 mm in 18 adult animals over 140 mm CL. The following ratios describe the head in proportion to carapace measurements: HW/CW 0.38-0.51 ($\overline{X}$ = 0.47 ± 0.03, *n* = 18), HW/CL 0.31-0.37 ($\overline{X}$ = 0.34 ± 0.02, *n* = 18), HL/CW 0.44-0.68 ($\overline{X}$ = 0.54 ± 0.06, *n* = 18), and HL/CL 2.05-2.87 ($\overline{X}$ = 2.53 ± 0.26, *n* = 18). The top and sides of the turtle's head are covered with large horny scales. The head is yellowish-brown to olive and dorsally may have some dark yellow or brown spots. The snout, chin, jaws, and throat are brown with yellow, orange, pink, or red mottling. The mouth may show either dark or light mottling. Pink or brown blotches also appear in their cheeks or neck.

Limbs

The toes are slightly webbed with strong claws. Four toes of the forelimbs and 5 toes of the hindlimbs are light to dark brown and are covered with large scales. Pink or brown blotches seldom appear on the thighs.

Tail

The tail is long and whiplike, covered with large scales, and is usually as long as the carapace (tail length 140.0-227.6 mm in adult animals over 140 mm CL, TL/CL 0.97-1.39 ($\overline{X}$ = 1.15 ± 0.11, *n* = 18)).

DISCUSSION

A comparison of historical data on the distribution of *P. megacephalum* in Thailand from the literature and museum specimens with the results of our current field surveys show some changes in occurrence over time. We surveyed a

Fig. 2. The different color morphologies of the carapaces of adult big-headed turtles; (A1) brown, (B1) reddish-brown, (C1) olive, (D1) yellowish-brown and (E1) the new morph, dark gray; all with a squared-off front and rounded back end. The plastrons are usually (A2, D2) yellow, (B2) brownish, (C2) olive with yellowish and (E2) the new dark gray morph. These specimens are from (A) the Mae Samard Watershed Management Unit, Mae Hong Son Province in the Salawin river basin, (B) the Umphang Wildlife Sanctuary, Tak Province in the Mae Klong river Basin, (C) the Tad Mok National Park, Phetchabun Province in the Pasak river basin, (D) the Pha Daeng National Park, Chiang Mai Province in the Kok river basin and (E) the Phu Suan Sai National Park, Loei Province in the Khong river basin.

total of 40 locations, and of these, 16 had previous records of big-headed turtles. Of these 16 locations with previous records, we found turtles in 12 locations, but were unable to confirm their presence in 4 locations. Thus, we can confirm that most historical localities in Thailand still have big-headed turtles. We expected that the effect of habitat alteration and hunting pressures over the last 30-50 yr would have resulted in many fewer locations with big-headed turtles, but this was not the case. In addition, our surveys resulted in several new locality records. This result is encouraging, but it may partly be a reflection of our focused survey efforts with the help of local rangers and villagers. Further, the survey results do not inform us about the size or health of the populations.

Combining all of the data from all available published reports, museum specimens, and ground surveys, *P. megacephalum* was found to be present in 11 of 25 river basins of Thailand. However, in contrast to information

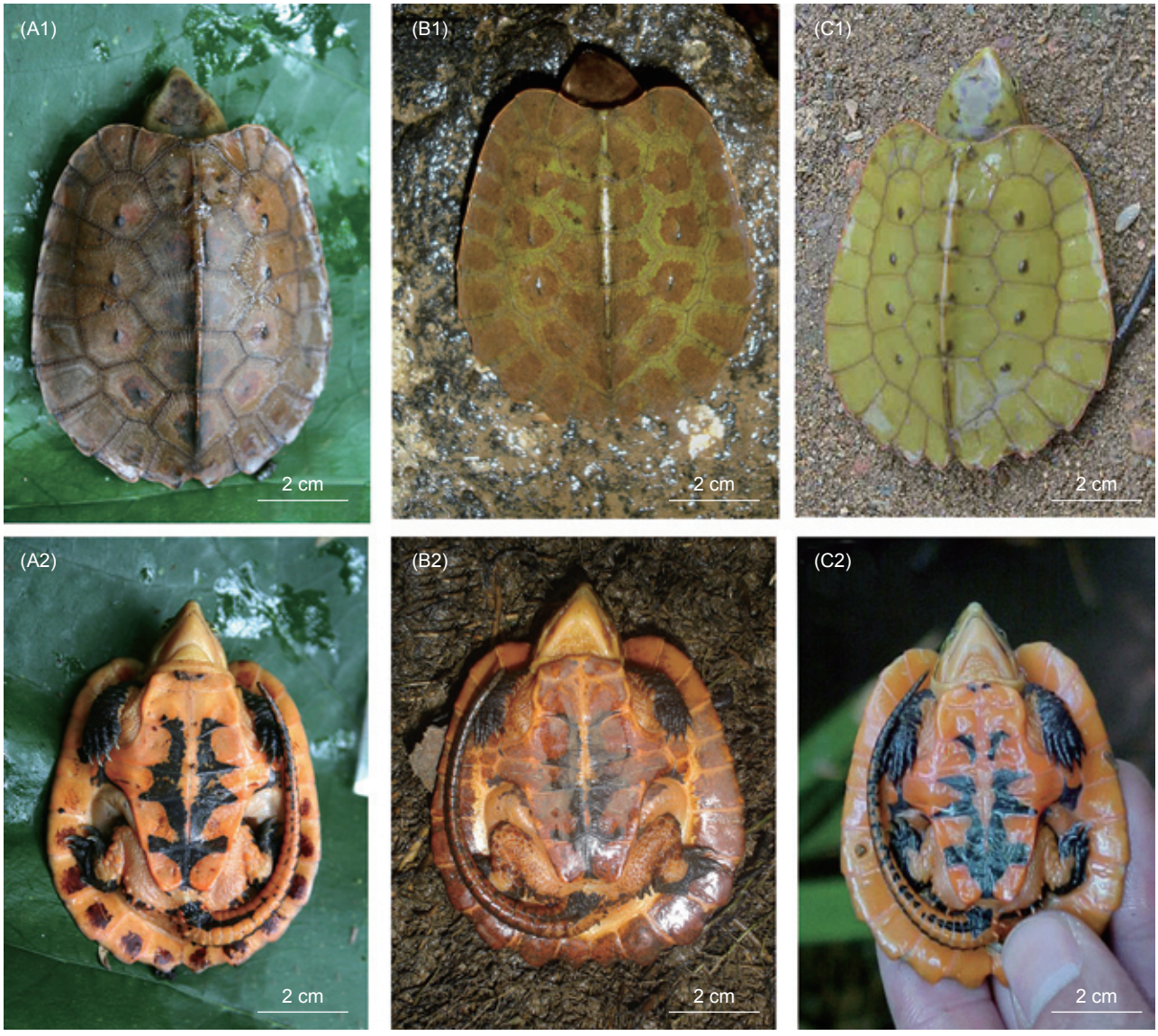

Fig. 3. Carapaces of juvenile big-headed turtles showing the different color morphs of (A1) dark brown, and the new color morph of (B1) greenish-brown and (C1) green; and also showing the more serrated posterior carapacial rim with a yellowish or orangey seam, while the plastron are orange (A2, B2, C2) with a clear dark edging to the seams. These specimens are from (A) the Doi Inthanon National Park, Chiang Mai Province, (B) the Tung Jor Watershed Management Unit, Chiang Mai Province in the Ping river basin and (C) the Lum Nam Nan National Park, Phrae Province in the Yom river basin.

from researchers 20-30 yr ago (Nutaphand 1979, Humphrey and Bain 1990), our recent ground survey did not find *P. megacephalum* in the Mae Nam Moon river basin. Although records of *P. megacephalum* in Phu Khiao District, Chaiyaphum Province in the Mae Nam Chi river basin exist and we obtained positive sightings information from the questionnaire, we could not confirm this by survey due to local security restrictions upon access to the area. In this area, Kamsook et al. (2006) reported that 3 big-headed turtles were found at elevations of 870, 876, and 891 m. Moreover, in the Mae Nam Pasak river basin, *P. megacephalum* was reported in Nam Nao National Park, Phetchabun Province, on several occasions over earlier and recent times (Gairdner 1915, Nabhitabhata et al. 2000, Nabhitabhata and Chan-ard 2005); yet in our study, we did not find any big-headed turtles in Nam Nao National Park, but rather observed them in nearby Tat Mog National Park, Mueang District, Phetchabun Province.

The coloration of *P. megacephalum* shells was reported to be quite variable, ranging from yellowish-brown to olive (Ernst and Barbour 1989, Kirkpatrick 1995, Bonin et al. 2006). In this study, we observed 2 new color morphs: dark-gray carapace in old adults and greenish-brown carapaces in juveniles (Figs. 2, 3). In addition, we noted that the same carapace color was often found at several localities thus questioning the value of color morphs as a marker of subspeciation. In view of this within-locality variation and our small sample sizes, the 3 subspecies proposed by Nutaphand (1979) and Wermuth (1969) are not recognized in this study. However, a comprehensive study of geographic variations in coloration, morphology, and genetic markers is needed to address relationships among big-headed turtle populations within Thailand.

Previous to our work, *P. megacephalum* in Thailand was reported to occur only above 800 m and in streams that are usually narrower than 1 m wide and < 10 cm deep (Kirkpatrick 1995, van Dijk 2002). In contrast, we found that *P. megacephalum* occurred at 430-1350 m with the most common elevations at 630-720 m (n = 7). Moreover, *P. megacephalum* was found in streams both wider and narrower than 1 m, with water depths of 14.0-95.0 cm. Furthermore, while *P. megacephalum* was reported to be restricted to locations with rapidly moving water (Ernst and Barbour 1989, Kirkpatrick 1995), we found 2 individuals in still water, albeit during the dry season. *Platysternon* is known to live in waters at temperatures of 12-17°C (Ernst and Barbour 1989, Kirkpatrick 1995) and even up to 24°C (van Dijk 2002). Our results (15.5-20.3°C) fall within these values.

Results from informal interviews with local people at the various localities visited suggest that *P. megacephalum* is less common now than in the past due to hunting. However, our ground surveys suggest that a few large populations may be present in remote areas that are difficult to access or near villages where turtles are not regularly sold or eaten. These findings strongly support the notion that a monitoring program is needed to detect trends in numbers of big-headed turtles in Thailand.

Unfortunately, in many of the areas visited, we found that *P. megacephalum* was regularly consumed and occasionally traded between villagers or sold at local markets. During this study, the Royal Thai Police seized 81 big-headed turtles (17 live and released, 64 dead) in Loei (4 Dec. 2007); 26 individuals in Phrae (29 Jan. 2008); 25 turtles in Lampang (7 Mar. 2008); 6 dead in Loei (29 July 2008); 5 animals in Loei (2 Aug. 2008); and 2 big-heads in Nan Province (3 Sept. 2008). These incidents demonstrate that *P. megacephalum* is threatened by continued poaching for local consumption and trade. Although the cited raids and confiscations of *P. megacephalum* are known to villagers, recent information indicates that the illegal trade continues. Notwithstanding this situation, Thailand is truly one of the last strongholds of this monotypic genus of turtle. *Platysternon* is far worse off in adjacent countries that are more heavily impacted by the strong Chinese demand for this turtle (Stuart and Timmins 2000).

Habitat availability for big-headed turtles is of major importance and fortunately most areas of occurrence in Thailand are largely within protected areas (van Dijk and Palasuwan 2000). Although *P. megacephalum* was found in protected areas in this and earlier studies, we still know that turtles are being illegally harvested and are likely declining in numbers. Important factors in the long-term persistence of big-headed turtles are the maintenance of appropriate natural forest ecosystems and the elimination of poaching. Based on their current limited distribution and threats, *P. megacephalum* should remain an endangered species in Thailand. Further, we recommend strong legislative action to protect this species and a long-term monitoring program to detect future changes in distribution

and population numbers (e.g., see Chen and Lue 2009). Enforcement authorities should be encouraged to be more vigilant in preventing the consumption and trade. Educational programs that foster national pride in natural resources and conservation awareness should be developed within local communities that share their land with big-headed turtles.

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