Journal of Sustainability Science and Management *ISSN: 1823-8556*
Monograph Issue No. 1 2018

SPECIES DIVERSITY OF FRESHWATER TURTLES AND TORTOISES IN TERENGGANU, MALAYSIA

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Abstract: The diversity of freshwater turtles and tortoises (FTTs) in the Peninsular Malaysia has been studied for years. The diversity of FTTs is therefore, very well known. This study is intended to provide the information on the occurrence of FTTs in Terengganu in support of future conservation efforts. The data examined in this paper were based on both primary and secondary information. Terengganu supports a total of 13 species (68%) of FTTs known to occur from the whole of Peninsular Malaysia. The presence of the FTTs in Terengganu demonstrates that there is a disjunctive distribution pattern with very few species occurred throughout the state. However, we concur that the distribution pattern of FTTs in Terengganu will be better understood should a comprehensive study is conducted. There are more species expected to be found in Terengganu since its habitat availability is suitable for the livelihood of other genera.

Keywords: Testudines, IUCN Red List, lowland forest, streams and rivers, wetlands.

Introduction

Studies on the distribution and composition of freshwater turtles and tortoises (FTTs) in Peninsular Malaysia are scarce. There are few and widely published information regarding FTTs distribution since this group of organisms were only encountered or recorded alongside the herpetofaunal surveys. Based on the review of previous studies, there are almost no data on FTTs occurrence were documented for many known places in Peninsular Malaysia, which including its many recreational and reserved forests. This might be due to the nature of these species being only recorded as opportunistically during herpetofauna surveys. The presence of FTTs in Terengganu was first reported by Dring (1979), followed by several publications by Dr. Dionysius S. K. Sharma from 1999 up to 2007 (see Reference section). Brophy (2002) and Brophy (2004) added the presence of *Malayems macrocephala* and *Malayemys subtrijuga* in Southeast Asia which includes Peninsular Malaysia. The latest publications that reported the presence of FTTs in Terengganu were Norhayati *et al*. (2013), Muin *et al*. (2014), Sumarli *et al*. (2015), Bartholomew *et al.* (2016) and Nur Amalina *et al.* (2017).

Freshwater turtles and tortoises are cryptic in nature; this is especially a nature for the forest species. The presence of FTTs in the wild, particularly the terrestrial species, is very hard to detect since no vocalization is produced, unlike most anurans which are more visibly different and pronounce call, or reptile species which are agile and relatively easy to spot during a survey (Humphries *et al.,* 2016; Parker *et al.,* 2014). Even the geckos are frequently noted because of their vocalizations (Lim *et al.,* 1995) or pronounce display by those species of reptiles. Besides that, the terrestrial FTTs had never leave any obvious tracks unlike the

hoofprints of ungulates like the pigs, or footprints of the carnivores such as wild cats and bear (Lim *et al.,* 1995) or even with snakes that left behind the skin after molting. In addition, the dark and dull colour of turtle carapace helps them to blend well with the forest environment and thus, it is very hard to be noticed by any researcher. The background matching its physical colour promotes better camouflage to help them from being an easy target by the predators (Xiao *et al.,* 2016) as well as during herpetological surveys.

There are 20 species of freshwater turtle found in the Peninsular Malaysia, of which two of them are introduced species; they are *Trachemys scripta* and *Pelodiscus sinensis* (Sharma *et al.,* 1999). Freshwater testudines are known to inhabit a wide range of habitat from the highland to lowland areas. Freshwater turtles are mostly generalist and some are specialist species, thus they inhabit a wide range of habitat including hilly stream, pristine lowland stream, swamp, sandbank, riverine near to the coast (Nohayati *et al.,* 2013; Auliya *et al.,* 2016; Muslim *et al.,* 2016) and they venture away from water bodies when looking for food. Even though FTTs are very elusive, they are prone to the illegal hunters and are widely collected especially in Asia for food, medicine and pets. Softshell turtles are heavily harvested by indigenous people and they are often sold to the Chinese as food delicacy (Sharma & Tisen, 2000; Jensen & Das, 2008). Auliya *et al.* (2016) also stated similar findings in their study. The softshell turtles were extensively harvested by indigenous people and sold to the local Chinese as food delicacy (Auliya *et al.,* 2016). Malaysia is listed as the potential sources of turtle trade (Jensen & Das, 2008). In 1999, almost 2.5 million live turtles were exported and almost 1 million individuals were of native species and they were collected from the wild (Sharma & Tisen, 2002).

Previous surveys on herpetofaunal had recorded the presence of FTTs in lowland forest, streams and riverine from northern to southern part in Terengganu, such as at Lata Belatan and Gunung Tebu (Muin *et al.,* 2014; Sumarli *et al.,* 2015), Gunung Lawit (Dring, 1979), Setiu (Chan & Chen, 2011; Chen & Wong, 2015), Sg. Tembat, Kenyir Forest Reserve (Norhayati *et al.,* 2013), Sg. Rembau (Bartholomew *et al.,* 2016), Pasir Raja Forest Reserve, Jerangau Forest Reserve and Jengai Forest Reserve by Sharma *et al.* (2006) and Bukit Labohan Forest Reserve and Turtle Sanctuary Ma'daerah, Kerteh by Sharma *et al.* (2007). Besides that, Sharma (1999) and Sharma and Tisen (2002) had also mentioned on the occurrence of FTTs species (*Batagur affinis, Batagur borneoensis, Malayemys macrocephala, Siebenrockiella crassicollis, Amyda cartilaginea, Dogania subplana, Pelochelys cantorii)* in Terengganu.

This study is the first to compile the recorded occurrence and to map the distribution of the FTTs species in Terengganu. This study is expected to provide a clear picture of the distribution and preferred habitat of FTTs species in Terengganu. Brief discussion is made on the current state of FTTs trade, use and conservation in Peninsular Malaysia.

Materials and Methods

Study Area

Terengganu is located in the north-eastern of Peninsular Malaysia with a total land area of 12,955 km^2 which are divided into eight administrative districts. Terengganu has approximately 544,118 hectares of permanent forest reserve (FR) which represents almost 42% of total land area of Terengganu (Malaysia Timber Certification Scheme, 2002) wherein teeming with numerous species of aquatic and terrestrial wildlife. Data collection for this study was made at several lowland streams in forest reserves and recreational areas, as well

as information gathered from the locals. Sampling sites that were visited, including Lata Belatan Forest FR, Lata Tembakah FR, Kuala Terengganu, Gong Badak, Sungai Pur in Kuala Berang, Sekayu FR, and Chemerong FR (Figure 1).

Data Collection

Compilations of data on the distribution of the FTTs were done based on previously published papers and fresh collection gathered at several selected locations in Terengganu. Distribution data of FTTs were obtained from various sources, including those from the unpublished data, dissertation, published literature, on personal communication and current sampling. Previous studies on reptiles that have been conducted in Terengganu were examined to gather data on the occurrence of FTTs. Visual encounter survey (VES) and baited traps were used to catch the FTTs in selected study areas. A total of 20 traps was placed in suitable and potential habitats during the sampling. The identification of FTTs was based on Auliya (2007). Captured locations for each species were recorded to generate the geographic distribution of FTTs in Terengganu using ArcMap 10.3.

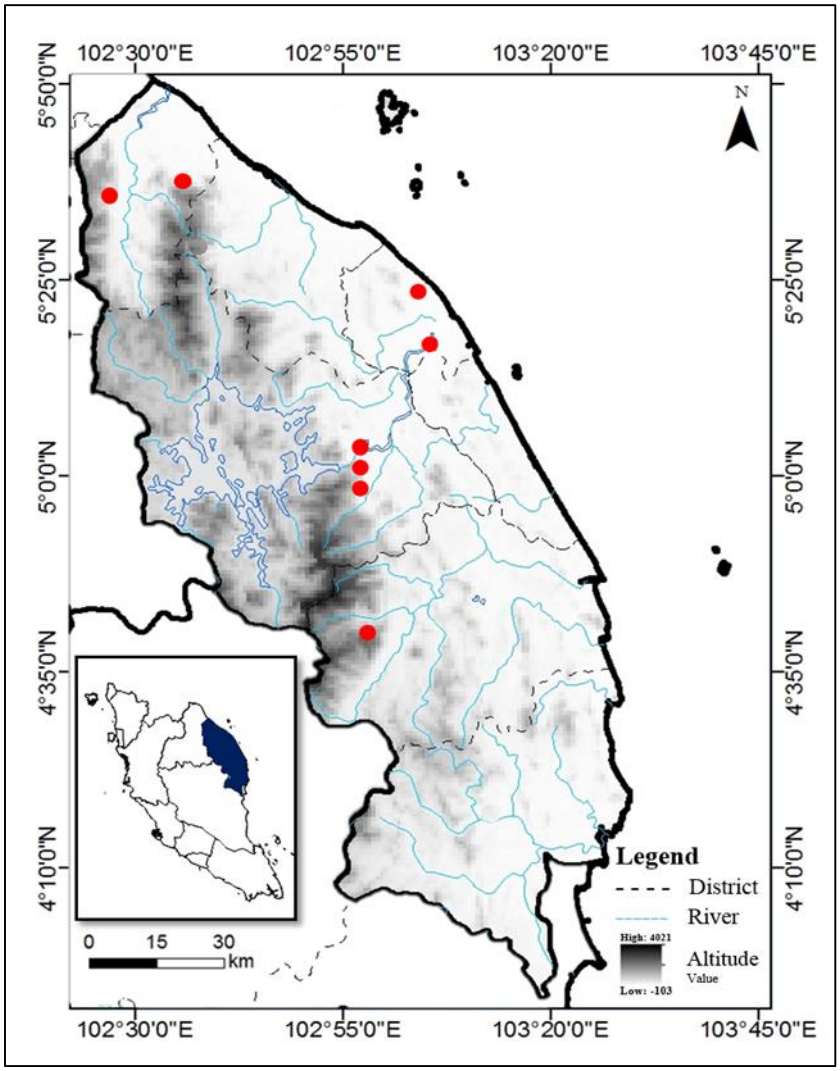

Figure 1: Map of Terengganu showing the sampling sites (red dots). Inset is the map of Peninsular Malaysia showing the state of Terengganu.

Results and Discussion

A total of 13 species of FTTs was documented in Terengganu based on current surveys and secondary materials examined where available since the 1997, in which including one introduced species (Table 1). Seven out of 13 species have been encountered at Terengganu at first hand from the present survey. The FTTs community in Terengganu comprises of four families including one which is an introduced species from family Emydidae, eight species of hardshell turtles from Geoemydidae, a single tortoise species from Testudinidae and three species of softshell turtles from Trionychidae. The IUCN Red List showed that there were two critically endangered (CR), three endangered (E) and one near threatened (NT) species found in the Terengganu. The rest is either vulnerable (VU) or least concern (LC).

Table 1: Checklist of testudine species of Terengganu, Malaysia based on previous records and current surveys. The symbol asterisk (*) designates the introduced species collected from wild. Pound sign (#) denotes species found in this study.

No.	Species	IUCN Red list status
	Emydidae	
1.	*Trachemys scripta* (Schoepff, 1792)*#	LC
	Geoemydidae	
2.	*Batagur affinis* (Cantor, 1847)#	CR, Previously reported as *Batagur baska*
3.	*Batagur borneonsis* (Schlegel & Müller, 1844)	CR, Previously reported as *Callagur borneoensis*
4.	*Coura amboinensis* (Riche in Daudin, 1801)#	VU
5.	*Cyclemys dentata* (Gray, 1831)#	NT
6.	*Heosemys spinosa* (Gray, 1830)	EN
7.	*Malayemys macrocephala* (Gray, 1859)	VU, Previously reported as *Malayemys subtrijuga*
8.	*Notochelys platynota* (Gray, 1834)#	VU
9.	*Siebenrockiella crassicollis* (Gray, 1830)#	VU
	Testudinidae	
10.	*Manouria emys* (Schlegel & Müller, 1840)	EN
	Trionychidae	
11.	*Amyda cartilaginea* (Boddaert, 1770)	VU
12.	*Dogania subplana*# (Geoffroy Saint-Hilaire, 1809)	LC, Previously listed under genus *Trionyx*
13.	*Pelochelys cantorii* Gray 1864	EN, Previously reported as *Pelocheys bibroni*

Freshwater Turtles and Tortoises in Terengganu

Family Emydidae

Emydids turtles are hard-shelled freshwater turtles and do not have a distinguishing suite of superficial characters. In some species, the carapace is domed, while most have a low-arching carapace. The plastron is hinged and movable in some (e.g., *Emys orbicularis*) while fixed in

others (e.g., *Malaclemys terrapin, Glyptemys muhlenbergii)*. Species under this family was not native to Peninsular Malaysia and there was only one species found in the study.

***Trachemys scripta* (Schoepff, 1792) (Common slider)**
Plate 1a & 1b

Common slider is an introduced species in Peninsular Malaysia. This species was known to be available in Peninsular Malaysia prior to 1999 in captive breeding activity and had been exported to Hong Kong (Sharma & Tisen, 2000). This species is very popular as pet and easily found in almost every pet shop. Massive imports of this turtle as pet had turned the population of this species high in number (Cadi *et al.,* 2004; Cadi & Joly, 2004). *Trachemys scripta* was listed as Least Concern (LC) (International Union for Conservation for Nature (IUCN), 2011). Few pet shops and markets at Kuala Nerus and Kuala Terengganu that had been visited in 2016 were found selling the juveniles of this exotic species. It was also found in the wild nowadays as a result of releasing the pets into natural habitat when they had grown bigger and needed higher-maintenance (Cadi & Joly, 2004). The adults, as reported from Sungai Berua, were known to be hunted by indigenous people for medicinal purposes (Bartholomew *et al.,* 2016). A 1.3 kg of an adult male was found in a pond which connected with small stream (a tributary of Sg. Bubu) at Taman Pertanian Sekayu, Kuala Berang. This species was so far found in the middle part of Terengganu.

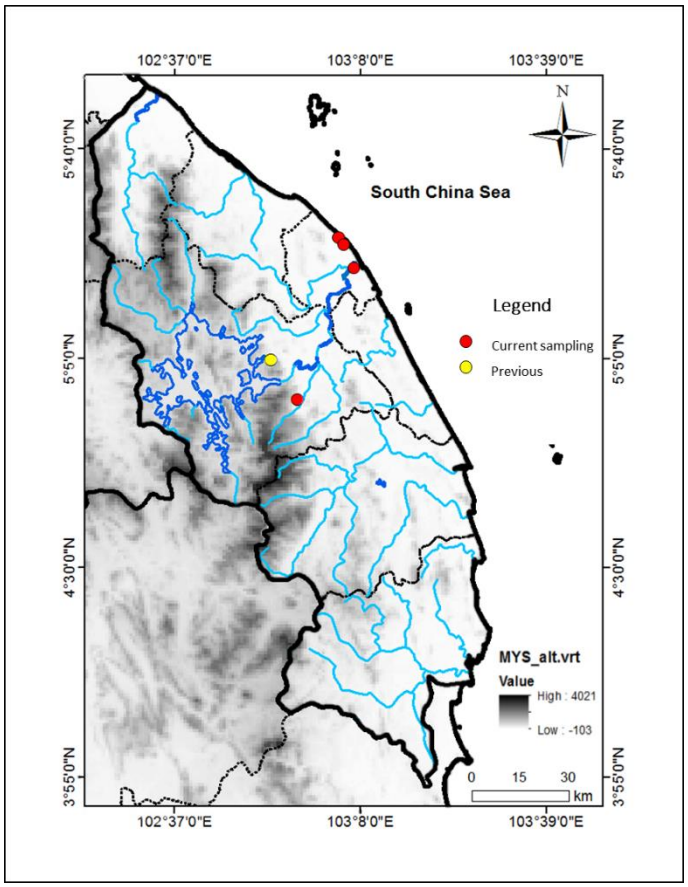

Plate 1a: Distribution of *Trachemys scripta* in Terengganu based on current and previous survey.

Plate 1b: *Trachemys scripta*

FAMILY: GEOEMYDIDAE

Turtles under the family of Geoemydidae are hard-shell turtles and formerly were classified as Bataguridae (Sharma, 1999). Based on morphological characteristics, geoemydids were considered to be paraphyletic with respect to other tortoises (Testudinidae) (Shaffer, 2009). However, they have well adapted feet for aquatic and terrestrial locomotion. Turtles under this family are diverse and a total of eight species was found in Terengganu out of 11 species known to occur in Peninsular Malaysia.

***Batagur affinis edwardmolli* (Cantor, 1847) (Southern River Terrapin)**
Plate 2a & 2b

All the population of Southern River Terrapin that inhabiting east and west of Peninsular Malaysia were considered conspecific with the northern species, *B. baska* until 2007 (Moll *et al.,* 2009). Praschag *et al*. (2009) concluded that *B. affinis edwardmolli* occurs in eastern Peninsular Malaysia and is distinct from *B. affinis affinis* that occurs in the western Malay peninsula. This species is restricted to estuarine and coastal areas and listed as critically endangered (CR) species (IUCN, 2016). *B. affinis edwardmolli* nesting site can be found in Setiu such as at Tebing Pasir Penarik, Kuala Baharu, Tebing Pasir Pak Lah/Pak Yong (Chan & Chen, 2011). A group of adult River Terrapin and dozens of hatchlings under captivity were observed in at Terrapin Conservation Center, Kuala Berang of Department of Wildlife Nature and Parks (DWNP). The adults and collected eggs of this species that present at this center are mostly from Temir River (Kuala Berang) and Ular River (Setiu). The eggs of River Terrapin in Terengganu River and Dungun River were collected for incubation and released (Chan & Chen, 2011). River terrapin was recently discovered to inhabit Kemaman River at Pok Yok sandbank (Chen & Wong, 2015). This species is not only confined to coastal areas but also to the inland rivers in the state of Terengganu.

ISSN: 1823-8556

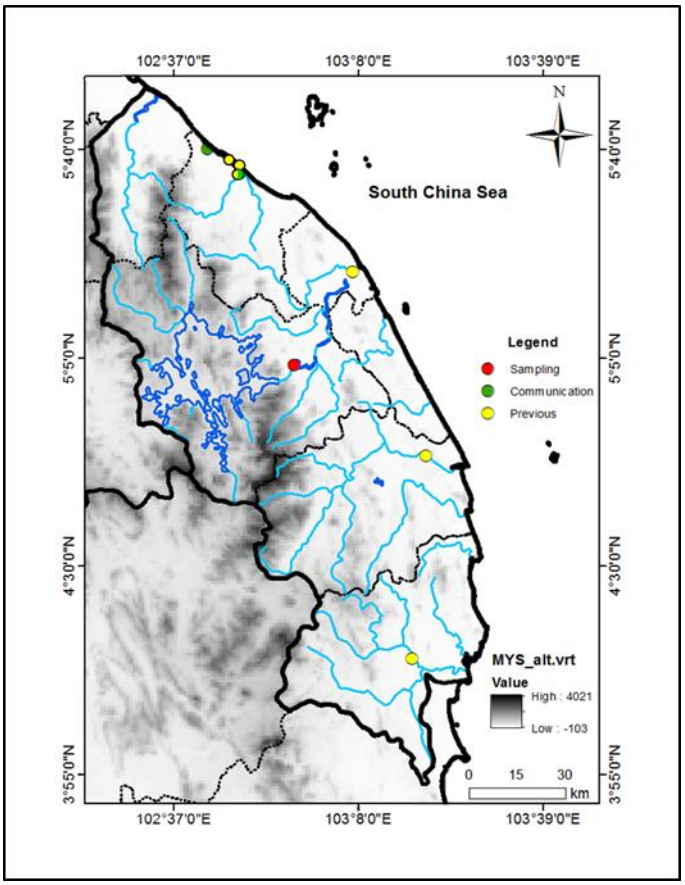

Plate 2a: Distribution of *Batagur affinis edwardmolli* in Terengganu based on current and previous survey.

Plate 2b: *Batagur affinis edwardmolli*

***Batagur borneoensis* (Schlegel & Müller, 1844) (Painted Terrapin)**
Plate 3

Painted Terrapin formerly known as *Callagur borneoensis* before it was reclassified into the genus *Batagur*. *Batagur borneoensis* had also been found ascending in Pak Lah Teh sandbank, Setiu River (Chan & Chen, 2011). Paka River had also been a preferred nesting site for this species (Sharma, 1999) in Terengganu. Sharma *et al.* (2007) recorded that this species were present at Ma'daerah Turtle Sanctuary, Kemaman nesting beach. The present of this species in other various coastal areas is thus possible. To date, its distributions in the state of Terengganu is considered to be widespread.

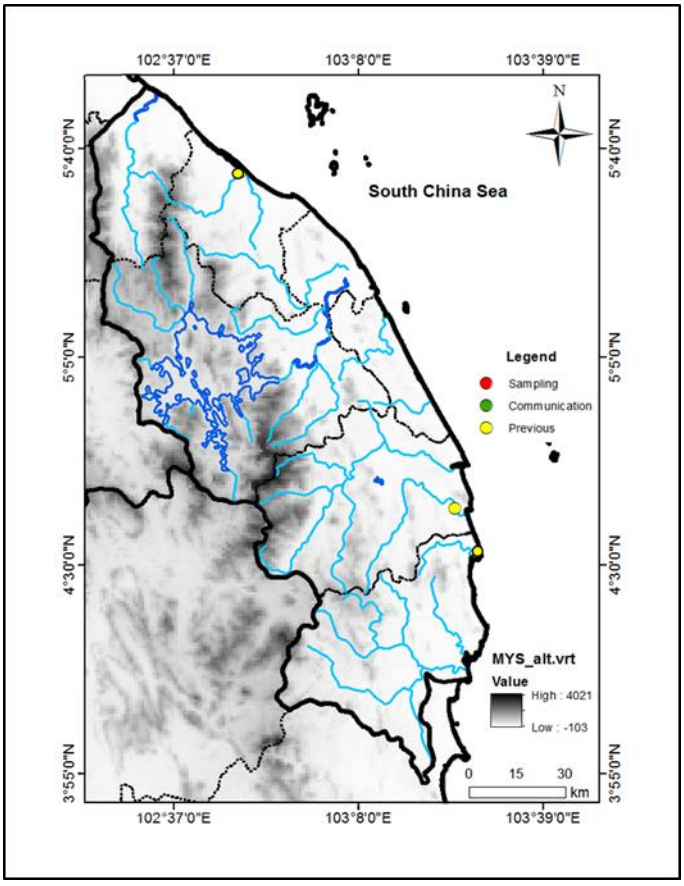

Plate 3: Distribution of *Batagur borneoensis* in Terengganu previous survey.

***Coura amboinensis* (Riche in Daudin, 1801) (Southeast Asian Box Turtle)**
Plate 4a & 4b

The Southeast Asian Box Turtle is a common native and a generalist type species. They were found to inhabit a variety of habitats. Though this species were found widely, they were listed as Vulnerable (VU) species (IUCN, 2000). This is due to the heavy exploitation of this turtle from the wild as an international food luxury, pet and medicinal trade (Schoppe & Das, 2011). One adult individual was captured in 2014 as it was found resting near a pond interconnecting a small stream at Universiti Malaysia Terengganu campus. A second individual, a juvenile box turtle was observed on June 2016 crossing a road; it was seen to appear coming from the same pond and was led to a swamp. In early 2017, this turtle had

been observed crossing a road in Kuala Nerus area. Another juvenile was found to be on sale in the Kuala Terengganu morning market with a tag price of RM10.00 on February 2017. A juvenile was also found on March 2017 nearby Sungai Tersat by the locals in Kampung Bukit Gemuruh, Kuala Berang and was kept as a pet before being released. One juvenile was found in Merchang in 2015 in a black water coastal swamp (Azwar Farid, pers. Comm.) and the other was caught accidentally with fishing rod at Kg. Jenang, Marang on October 2016 from a small swampy area connected to the tributary of Sungai Marang (Mohd Fajiha Alaihis, pers. comm.). Previously, one individual was observed at the lowland swamp in Jerangau FR in 2006 (Sharma *et al.,* 2006). In 2003 at Bukit Labohan FR one individual was seen in a pool of rainwater alongside a forest trail, and one individual was observed in a tall grass on 2000 in the same place (Sharma *et al.,* 2007). This species have a wide distribution in Terengganu.

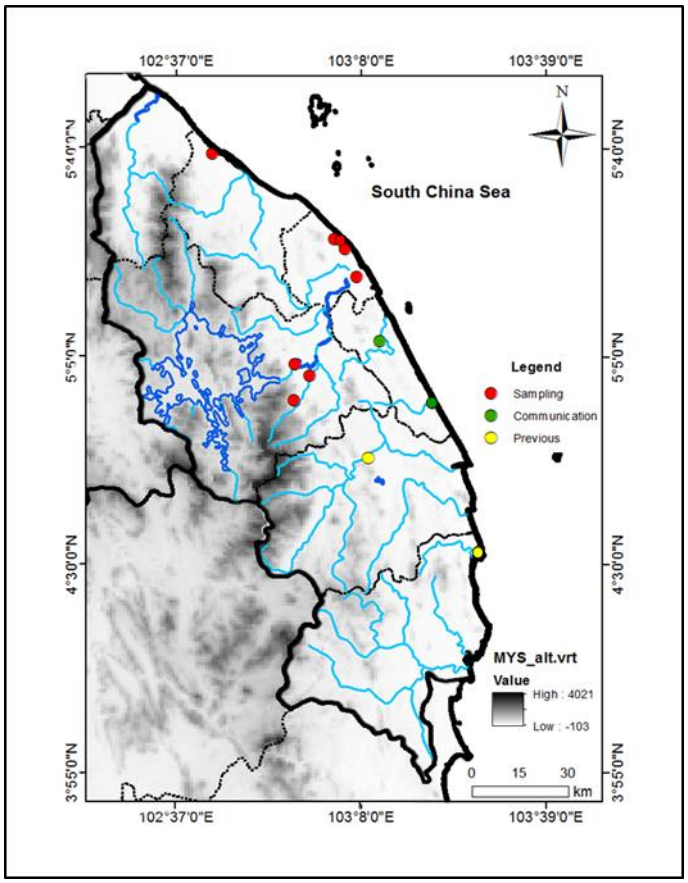

Plate 4a: Distribution of *Coura amboinensis* in Terengganu based on current and previous survey.

Plate 4b: *Coura amboinensis*

***Cyclemys dentata* (Gray, 1831) (Asian Leaf Turtle)**
Plate 5a & 5b

Cyclemys dentata is one of the most common freshwater turtles, and is usually found inhabiting forested streams between 300-1200m a.s.l.. This turtle was listed as Near Threatened (NT) species (IUCN, 2000). An adult male was caught from the current survey at Lata Belatan tributary on March 2017. The presence of an individual was also recorded to be found in the Sekayu Forest Reserve in 2014 (unpubl. data). A pair of adults was found trapped in small mammal cage-trap baited with bananas and peanut butter at Belukar Bukit in September 2015 (Z. Amirah Azizah, pers. comm.). Sharma *et al.* (2006) saw a juvenile crossing a logging road in Pasir Raja Forest Reserve on June 2004. The distribution of this species in Terengganu may be much wider than what it was thought to be, however more study is needed to ensure.

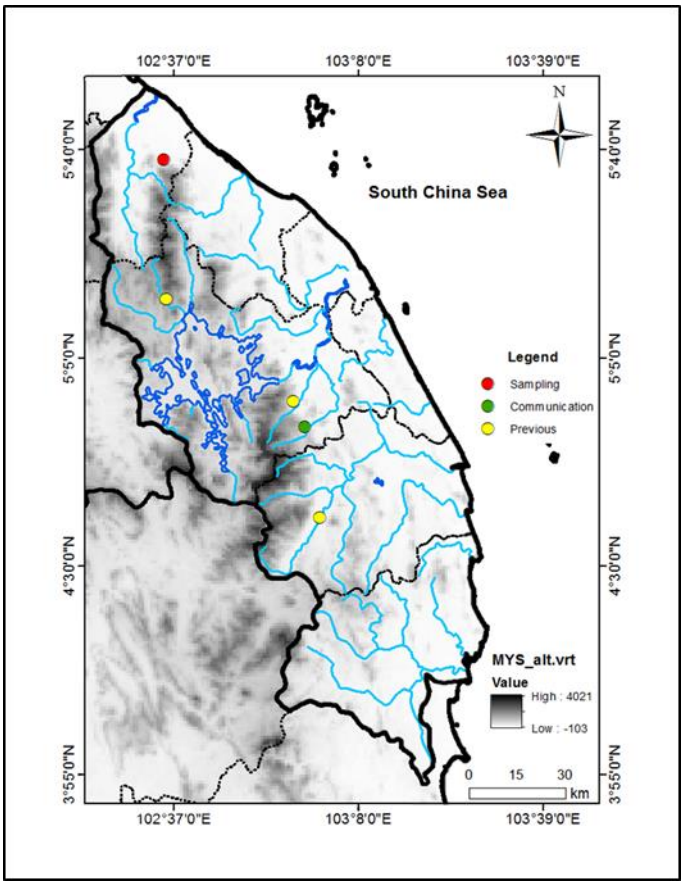

Plate 5a: Distribution of *Cyclemys dentata* in Terengganu based on current and previous survey.

Plate 5b: *Cyclemys dentata*

***Heosemys spinosa* (Gray, 1830) (Spiny Turtle)**
Plate 6

This species inhabit forested hills and is usually encountered hidden under leaf litters close to

the streams. This turtle was listed as an Endangered (EN) species (IUCN, 2000). *Heosemys spinosa* was recorded in the swampy area at Lata Belatan Forest Reserve where an adult male was encountered during an expedition on July 2012 (Sumarli *et al.,* 2015), another observation found two individuals of male and female (Muin *et al.,* 2014). A juvenile was found on the trail of Gunung Lawit on June 2012 (Sumarli *et al.,* 2015). From a herpatofaunal survey at Peladang Agro, Setiu, one individual was found near a small stream on 6 October 2015 (Z. Amirah Azizah, pers. comm.). Sharma *et al.* (2006) found that an adult male was captured in Compartment 35 of the Jerangau Forest Reserve and the younglings were often captured within the streams. This species was mostly reported to be found in the northern part of Terengganu which confined to hilly and foothill of forest.

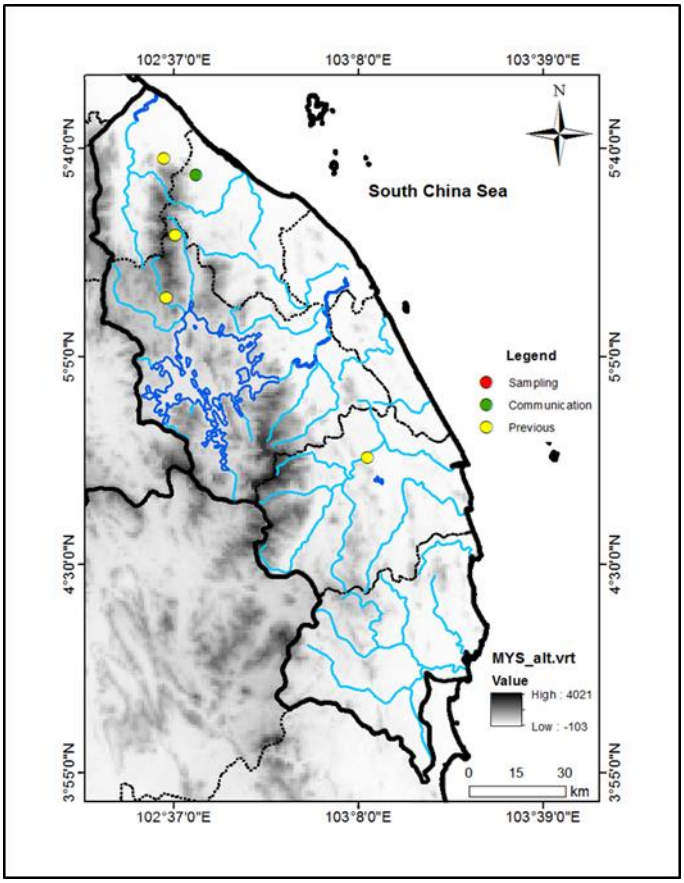

Plate 6: Distribution of *Heosemys spinosa* in Terengganu based on current and previous survey.

***Malayemys macrocephala* (Gray, 1859) (Malayan Snail-eating Turtle)**
Plate 7

In the 90's the Malayan Snail-eating Turtles in Peninsular Malaysia was identified as *Malayemys subtrijuga* (Sharma, 1999). Brophy (2004) had reviewed the systematics of the genus *Malayemys* and argued that there is evident for the presence of two taxonomically distinct species. Later it has been confirmed that the species present in Peninsular Malaysia is *M. macrocephala* (Brophy, 2002; Brophy, 2004; Auliya; 2007). The only evidence of *M. macrocephala* present in Terengganu was found in the *Melaleuca* swamps of Jambu Bongkok Forest Reserve (Sharma & Tisen, 2000; Brophy, 2002; Brophy, 2004). This species was listed as Vulnerable (VU) species (IUCN, 2000). The actual distribution of this species in Terengganu was not really known and it may be restricted to a certain locality. Nevertheless, the turtle was expected to be found at *Melaleuca* swamps or the rice fields in Terengganu

since those are their most preferred habitat (Brophy, 2004). However, none was found during the current survey.

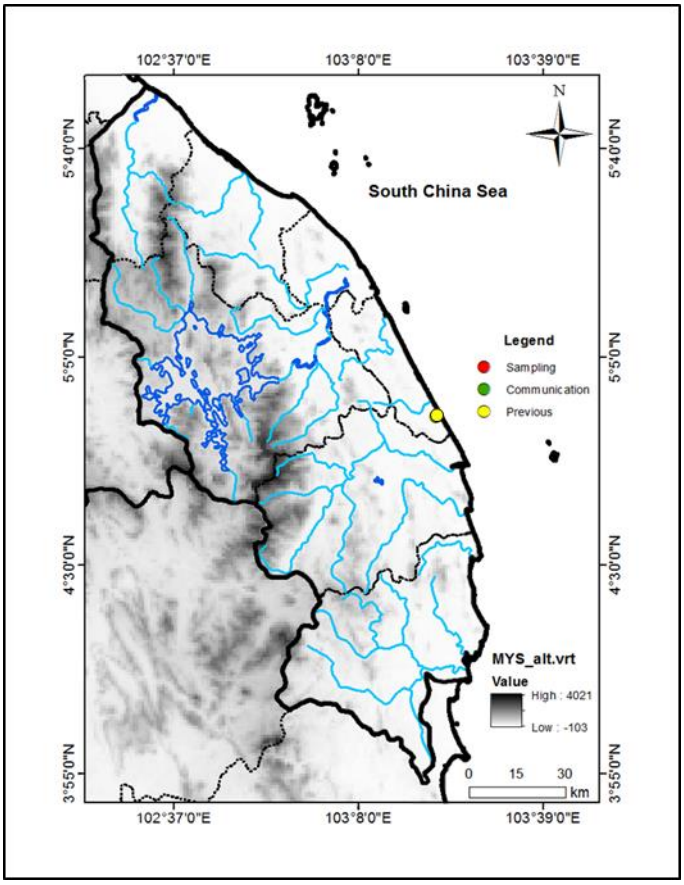

Plate 7: Distribution of *Malayemys macrochepala* in Terengganu based on current survey.

***Notochelys platynota* (Gray, 1834) (Malayan Flat-shelled Turtle)**
Plate 8a & 8b

The Malayan Flat-shelled Turtle is typically found in clear streams and small rivers of pristine area (Moll & Khan, 1990; Norhayati *et al.,* 2013). According to the previous record, an individual was found in Sg. Tembat, Kenyir FR on 2007 (Norhayati *et al.,* 2013). An individual was also captured accidently in net from fish sampling at Sg. Pur in 2015. Based on the current survey which commenced from July to November 2016 in the Sekayu FR, a male and two females adult were observed separately in a small, shallow and fast flowing stream of Sungai Peres and its tributary. One juvenile (April, 2017) of this turtle type and two hatchlings with leftover embryo sac on their plastron (August, 2017) were also found in a tributary of Sungai Bubu in Sekayu FR. From the survey at Lata Belatan FR in March 2017, an adult male has been recorded in the tributary of Belatan stream. An adult female was then also being caught at Lata Tembakah FR on April 2017. It was also recorded from Tembat FR recently (Amalina *et al*., 2017). All recorded species were found in undisturbed forests. Its distribution in Terengganu could be much wider than known should more undisturbed forests were surveyed in the future.

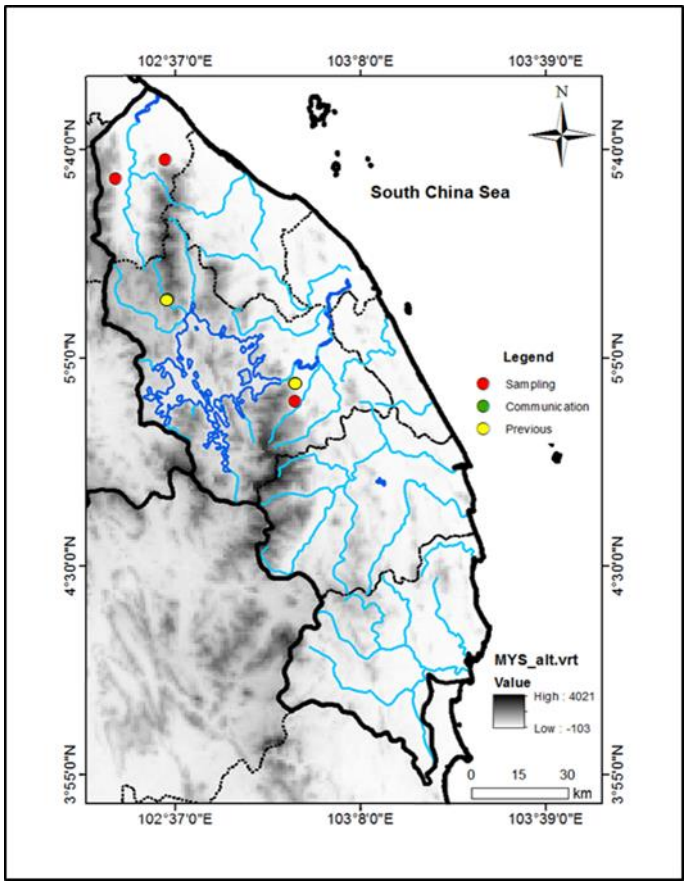

Plate 8a: Distribution of *Notochelys platynota* in Terengganu based on current survey.

Plate 8b: *Notochelys platynota*

***Siebenrockiella crasssicollis* (Gray, 1830) (Black Marsh Turtle)**
Plate 9a & 9b

Siebenrockiella crassicollis is listed as Vulnerable (VU) species (IUCN, 2000) and was considered abundant after *C. amboinensis* and mainly available at the lowland areas in both natural and man-made habitats. This turtle can be easily seen during the monsoon season nearby roadside located near to swamps, lakes or streams. The distribution of *S. crassicollis* in Terengganu was reported from Kuala Nerus to Kemaman. During the recent survey, three individuals were observed in Gong Badak, Kuala Nerus of which two separate individuals were recorded in Universiti Malaysia Terengganu (UMT) and one individual was reported in Jan 2017 about 300m away from UMT campus area. An adult individual accidentally caught at Sungai Rengas, Kubang Tangga in 2015. In December 2016, one adult was found nearby *Melaleuca* swamp at Bukit Payung, Kuala Terengganu and later another adult was caught accidentally on the fishing hook in Sept 2017 (Jamilah Mohd Salim, pears. comm.). Indigenous people at Sungai Berua, Telemong use to hunt this species for consumption (Bartholomew *et al.,* 2016). In Dungun, one individual was found in a shallow and stagnant water body in Jerangau FR (Sharma *et al.,* 2006). In Kemanan, an adult male and a female were spotted at Bukit Labohan FR, Kerteh on a shallow stream (Sharma *et al.,* 2007) and one individual was seen crossing the road at Kg. Paya Berenjut, Chukai (Mrs. Ros, pers. comm.). This species might have an extensive distribution in Terengganu in consideration to their adaptation ability to inhabit most of apt habitats.

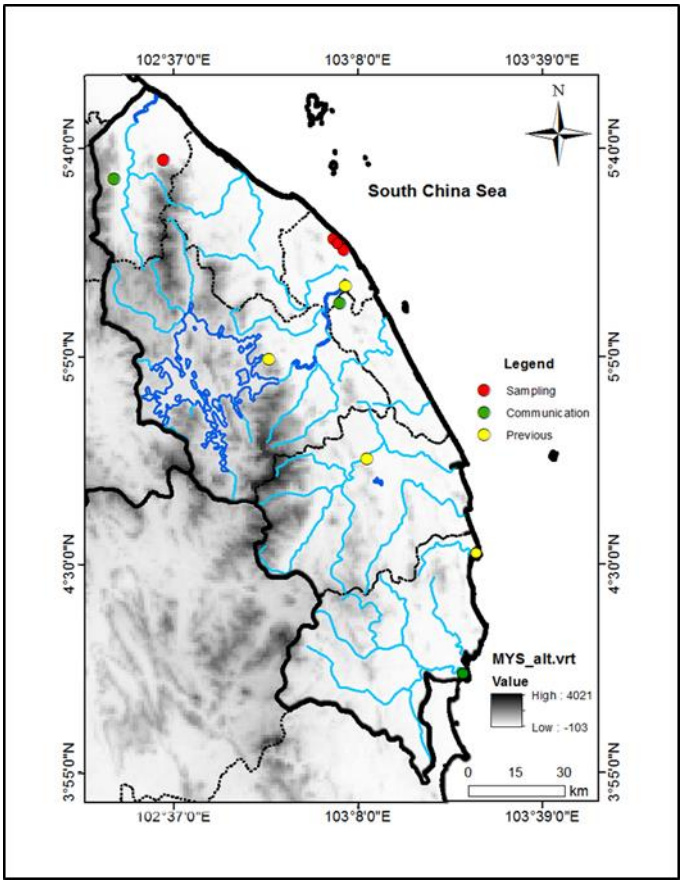

Plate 9a: Distribution of *Siebenrockiella crassicollis* in Terengganu based on current and previous survey.

Plate 9b: *Siebenrockiella crassicollis*

FAMILY TESTUDINIDAE (TORTOISES)

Species under the family of Testudinidae is generally being called tortoises. Tortoises have sturdy and stump leg features making them adaptable to a better locomotion on land. In Peninsular Malaysia, there are known three species from this family. In Terengganu, only one species was reported to date.

***Manouria emys* (Schlegel & Müller, 1840) (Asian Brown Tortoise)**
Plate 10

Asian brown tortoises prefer a well-drained area with dense undergrowth as their shelter (McKeown *et al.,* 1991; Jacobsen & Tabaka, 2004). Adult *M. emys* was found previously alongside the logging track in Sg. Kelebang, Gunung Lawit by Dring (1979). Three adult males and a pair of *M. emys* were observed at Jengai FR and Jerangau FR, respectively in moist areas around ginger and dense undergrowth (Sharma *et al.,* 2006). There is information from a forestry officer of Kuala Berang regarding this species, they were used to be found by the team deep in the Sekayu FR and is known as "Baning*"* in Malay. Since there was lack of evidence on the occurrence, the presence information is not shown in the map. The distribution of this species in Terengganu is expected to be much wider and more surveys are needed to confirm.

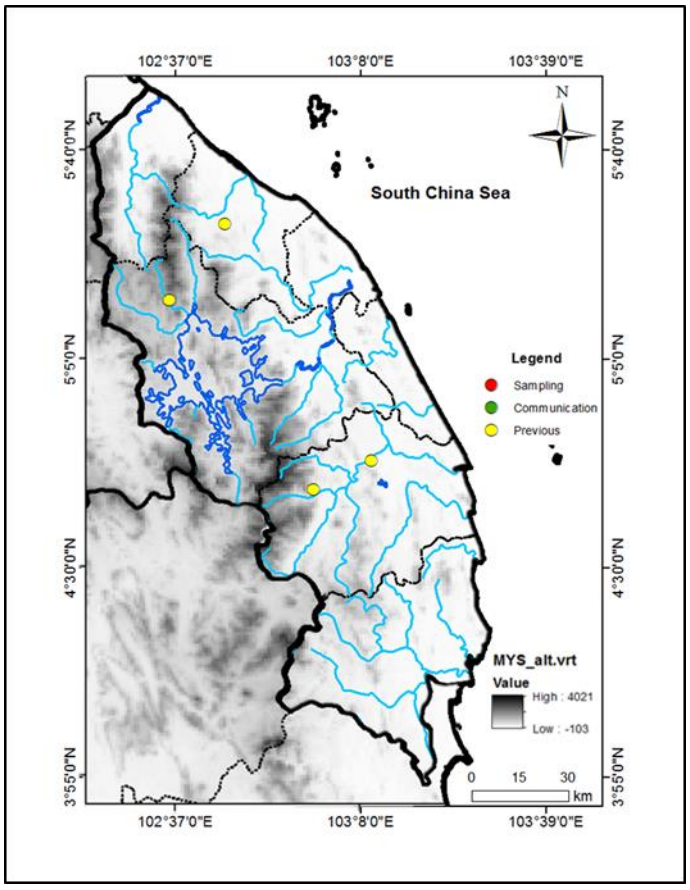

Plate 10: Distribution of *Manouria emys* in Terengganu based on previous survey.

FAMILY TRIONYCHIDAE (SOFTSHELL TURTLE)

Species under the family of Trionychidae is generally known as softshell freshwater turtles. They have webbed feet with sharp claws features for a better locomotion in aquatic and on land. In Peninsular Malaysia, there are four known species under this family. Three species were reported in Terengganu.

Amyda cartilaginea (Boddaert, 1770) (Southeast Asian Softshell Turtle)
Plate 11

Southeast Asian Softshell Turtle can be found inhabiting from the hill streams to rivers, and swamps (Auliya *et al.,* 2016). It was listed as Vulnerable (VU) species (IUCN, 2000). Based on herpetofaunal survey in Sekayu FR on 2013, an individual of *A. cartilaginea* was recorded. On May 2016, an adult was reported at Kg. Jenagor, Kuala Berang which had been accidentally caught on fishing hook by locals. Very little is known about the distribution of this species in Terengganu. However, during the survey in Kuala Berang there was information from the locals regarding their observation on a large sized species of softshell turtles found to be nesting alongside the riverbank of Sungai Tersat. So far no evidence was found from the survey conducted to the several locations that had been mentioned by the informers. However, the description given by the informers did resemble the characteristics of *Amyda cartilaginea* and a list of FTTs picture showed to the informers had confirmed on the presence of this species. Therefore, the distribution of this species might be also widespread in large river but still need efforts to confirm.

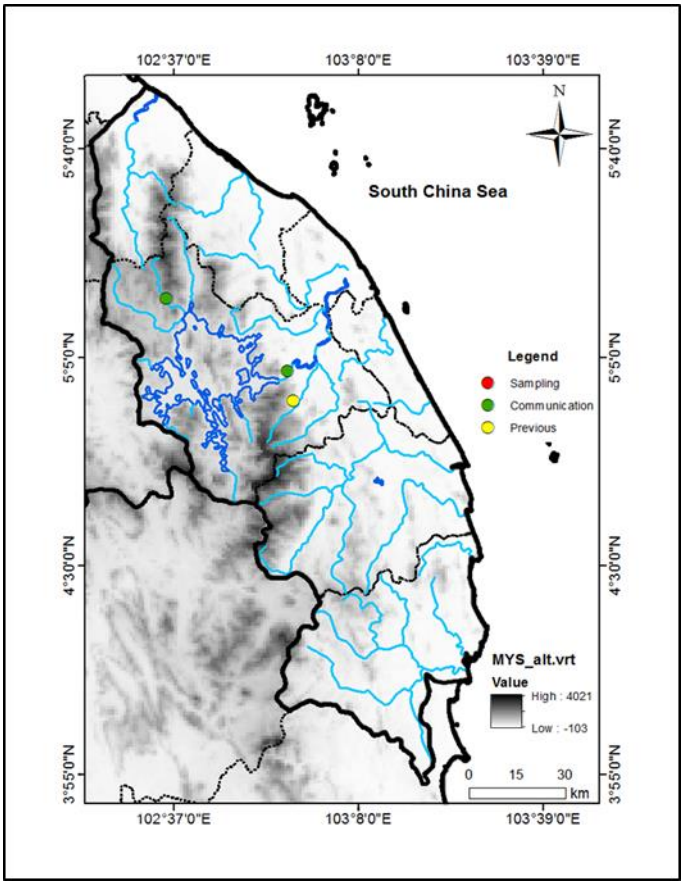

Plate 11: Distribution of *Amyda cartilaginea* in Terengganu based on current and previous survey.

***Dogania subplana* (Geoffroy Saint-Hilaire, 1809) (Malayan Softshell Turtle)**
Plate 12a & 12b

Dogania subplana was previously known as *Trionyx subplana* (Dring, 1979) and is also known as hill softshell turtle. This species is listed as Least Concern (LC) species (IUCN, 2000). It can be found in sandy stream and prefers to rest on rocky ledge of waterfall at night for a quick escape from their predators or any form of threats. Three individuals were observed in Sg. Belatan on sandy areas and numerous boulders (Muin *et al.,* 2014). Two adults were reported from the area of Gunung Lawit, one in an interconnecting streams with shallow muddy pools at Sg. Petuang and another in Sg. Kelebang at a shallow stream nearby camp site (Dring, 1979). In 2014, an adult was captured accidently from Sg. Jeneris trapped in fishing-net for fish sampling. There are also information gathered on the occurrence of *D. subplana* being found on February 2016 at Sg. Saok Waterfall and Sg. Tembat, Kenyir (Amirah Azizah, pers. comm.). A female adult was seen at a roadside proximate to a stream with a fishing hook on its mouth at Sg. Peres, Sekayu. This species have wide distributions in Terengganu and are expected to be found generally in most streams.

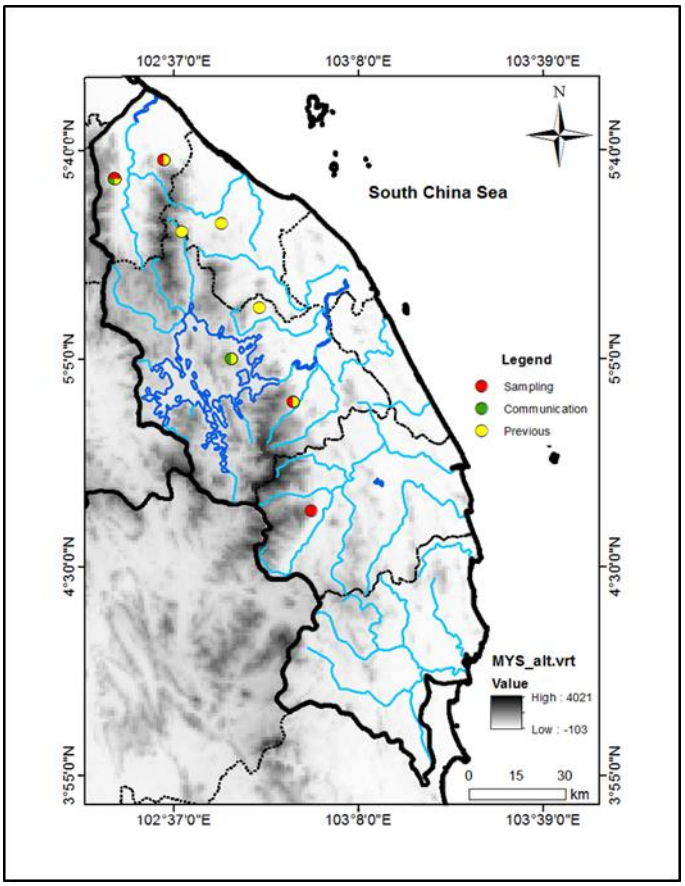

Plate 12a: Distribution of *Dogania subplana* in Terengganu based on current and previous survey.

Plate 12b: *Dogania subplana*

***Pelochelys cantorii* (Asian Giant Softshell Turtle)**
Plate 13

The Asian Giant softshell turtles are able to inhabit a variety of habitat, such as lakes, rivers and coastal areas. This species was listed under Endangered (EN), (IUCN, 2000). *Pelochelys*

cantorii was reported to be seen quite in fair numbers by locals in Setiu, whom were used to fish in Sungai Setiu (Sharma & Tisen, 2000) and had stated that the turtles have been harvested extensively for pets (Das, 2008). One individual weighted of 15 kg was caught on the fishing hook by the local in May 2016 nearby Kuala Besut Jetty (Mohd Shakimi, pers. comm.). In August 2017, an adult female was handed to the Terengganu Conservation Society (TCS) by a local woman who bought it from a fisherman at Kemaman. Later in September 2017, one more turtle was rescued by a local at Chukai, Kemaman whom found the turtle had a fishing hook in its mouth and then was being released safely. However, the present status is unknown since there are no assessments had been made on the populations of this species in Peninsular Malaysia. This species is found to be confined at estuarine and coastal areas in the state of Terengganu.

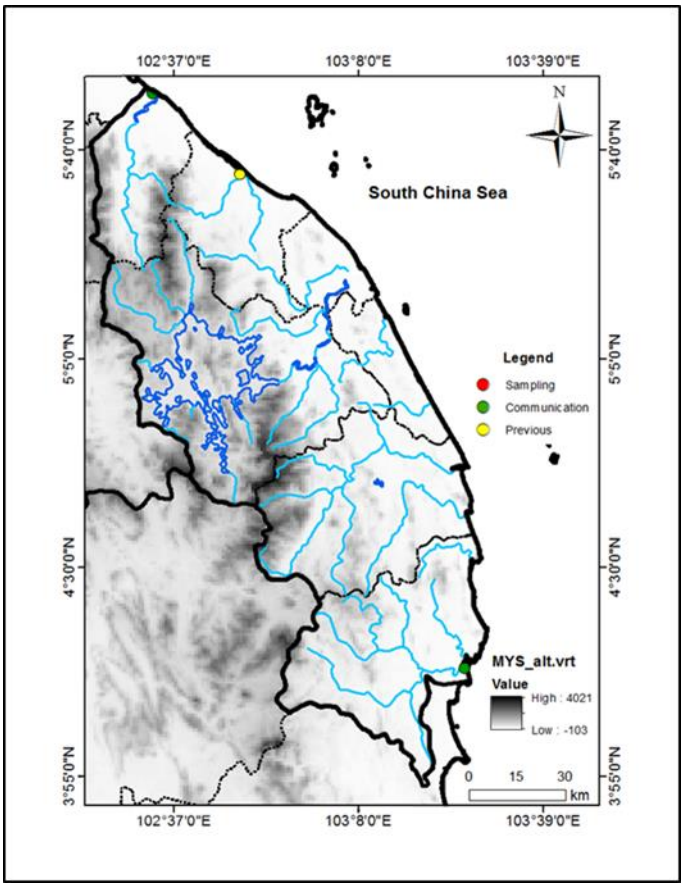

Plate 13: Distribution of *Pelochelys cantorii* in Terengganu based on current and previous survey.

The most dominant species in Terengganu are *Siebenrockiella crassicollis* and *Coura amboinensis*. Both of these species are known as generalist species which have the ability to adapt in altered habitats (Schoppe & Das, 2011). They are found either in natural or human made habitat, such as streams, swamps, estuaries, rice fields, lakes, ponds and also in irrigation canals. There are four species of FTTS in Terengganu that are classified into forested species and are restricted to pristine areas, namely *Cyclemys dentata, Notochelys platynota, Heosemys spinosa* and *Manouria emys.* Only two species, *C. dentata* and *N. platynota* were successfully recorded during the current survey. *C. dentata* was classified as peat swamp turtle at the Southernmost Thailand (Chan-ard *et al.,* 2011) however, in Peninsular Malaysia this species were found in the forest streams and habitats with lesser disturbances (Sharma & Tisen, 2000). Based on the recent survey, only one individual was caught at a small tributary of Sungai Belatan rubber plantation close to the forest reserve.

Nonetheless, species such as *H. spinosa* and *M. emys* were known to inhabit at the foothills or hilly areas. According to distribution maps, the localities of these species were closely situated in areas with higher altitude (Figures 6 and 10). Thus, this indicates that *H. spinosa* and *M. emys* were preferable to inhabit the hilly terrains in the forested area, which are similar to what has been reported before (Pan, 1990; Dring, 1979; Muin *et al.,* 2014; Sharma & Tisen, 2000, Sharma *et al.,* 2006; Sumarli *et al*., 2015).

Although *M. emys* live in forested areas and is very secretive, they were still being hunted for international export (Sharma, 1999). The current status of this species in areas where it was previously reported are in doubt, as it was almost 20 years span since the species were last documented in Terengganu. The population of this species might be at risk since the exploitation had taken place since a very long time ago. Total exports of *M. emys* that was reported by the Department of Wildlife and National Parks (DWNP) harvested from the Peninsular Malaysia in 1990, 1991 and 1993 were more than a thousand individuals (Sharma, 1999). There was no report on *M. emys* found from the recent publication or during the current survey in Terengganu. It might be due to the cryptic nature of this animal itself. However, it is quite surprising that not even a single individual was reported to be seen since the year 2000 in Terengganu.

Several species of FTTs were almost exclusively aquatic dependent species which have restricted habitat preferences to the aquatic environment for their survival, feeding and breeding (Auliya, 2007). Four of these species were known to be found in Terengganu. Two of them were under CR status namely, *Batagur affinis edwardmolli* (CR)*, B. borneoensis* (CR)*, A. cartilaginea* (VU)*,* one under EN status (*P. cantorii*) and the other is regarded as LC (*D. subplana*). *Batagur affinis edwardmolli, B. borneoensis* and *P. cantorii* can be found mostly in the large rivers, estuaries and coastal areas. A few smaller species such as *Amyda cartilaginea* and *D. subplana* can be found in small streams in the forested areas, and *D. subplana* can be commonly spotted at the hilly streams. These groups of turtles are mostly hunted for their shells, meats and also for their eggs. Through a personal communication with the local egg collector (W. I. Wan Razali, pers. comm.) at Kuala Berang and northern part of Terengganu, we are informed that the indigenous people hunt the turtles seasonally. The distribution of this group of species is expected to be widespread, but the population size is unknown which needed to be assessed, and to be monitored regularly in order to avoid population depletion.

The distribution of *Malayemys macrocpehala* was not firmly known in Terengganu. It has been reported from only one locality in Terengganu. *Malayemys* sp. population in Peninsular Malaysia remained dubious since no firm records in more than a decade. Sharma and Tisen (2000) reported that the species was found in Perlis and Terengganu, but they are also expected to occur in Kedah and Kelantan. This is in view of their habitat where this species were usually reported to be found at paddy field and *Melaleuca* swamp (Sharma, 1990; Brophy, 2002; Brophy, 2004; Pewphong *et al.,* 2016). The instance of *M. macrocephala* in Terengganu was reported to occur in Jambu Bongkok Recreational Forest (Sharma & Tisen, 2000). Further study and extensive sampling is needed to assure the actual status of this species in Terengganu and generally in Peninsular Malaysia.

There are two species that had never been reported to date in Terengganu, they are *Heosemys grandis* and *Hieremys annadali* (Family Geoemydidae). Therefore, the distribution of these species was not shown in this study. *Heosemys grandis* was reported to be found mostly in the northern part of Perlis and Kedah, Peninsular Malaysia and that they inhabit

rice fields, irrigation canals and grass swamps. From these observations, Sharma and Tisen (2000) suggested that *H. grandis* could be found in Terengganu and Kelantan as well, since there are abounded suitable habitats for the species. On the other hand, *H. annandalii* was also reported to be restricted to the northern part Peninsular Malaysia (Sharma & Tisen, 2000) and this species was said to be found in *Malaleuca* forest and blackwater swamps in Terengganu but without its accurate location, to this account, the species were not included in the list of FTTs from Terengganu.

There are two well-known introduced species in Peninsular Malaysia; they are *Pelodiscus sinensis* (Chinese Softshell Turtle) and *Trachemys scripta* (Common Slider), of which they had been introduced by way of consumption and pets. *Pelodiscus sinensis* was reported to be found in Chinese restaurants all across Peninsular Malaysia and had also been exported to Hong Kong (Sharma, 1999; Sharma & Tisen, 2000). In Terengganu, some Chinese restaurants served them as special dishes (W. I. Wan Razali, pers. comm.). However, there are no details of its presence in the wild of Terengganu to date. According to Lee *et al.* (2007) specimens of *P. sinensis* were bought from a turtle farm in Malaysia and transferred to the National University of Singapore for research. This shows that there is a farm in Malaysia that breeds this type of species for local trades and exports (Sharma, 1999). As for *Trachemys scripta,* this popular species are found at many pet shops and even in the fresh markets, they were being sold for RM10.00 per juvenile individual. This species was also recorded in the wild quite often. Possibly due to large size of this species when it grows older, pet keepers releases them to the natural habitats. This species was reported to be hunted by the local in Kuala Berang, Terengganu for medicinal purposes (Bartholomew *et al.,* 2016). It is a question of how far this species had been dispersed in our ecosystem, and does it poses any threat to the local environment, since this species is easily breed and have highly adaptable abilities to a new environment (Cadi *et al.,* 2004; Pupins, 2007).

Those introduced species have high chances to turn into an invasive species should the condition permit. When an introduced species were proliferated, it has a high potential to instigate damages to the native species and their ecosystem. Most invasive species, once established are very hard to be totally eliminated (Threshsher & Kuris, 2004; Arfan *et al.,* 2014). *Trachemys* sp. is the most common pet turtle globally and it was reported to be as a disease reservoir that have potentially detrimental to human (Hersey *et al.,* 1963; Center for Disease Control and Prevention, 2010). Pet turtles have been considered as the most important reservoir for *Salmonella* (Briones *et al.,* 2004; Hidalgo-Vila *et al.,* 2007; Hidalgo-Vila *et al.,* 2008) and although several studies had proven that there is a low prevalence of *Salmonella* in free-living turtles (Mitchell & Mc-Avoy, 1990; Richards *et al.,* 2004; Readel *et al.,* 2010). Thus, in the case where the introduced FTTs are found in natural habitats, care and concern should be given, and proper monitoring should be done to ensure no diseases are found that could potentially spread to human.

Conclusion

Population of FTTs is found to be in a decreasing trend at nearly everywhere including Malaysia, and several species were found to be not recorded anymore in this study. Beside of being exploited unsustainably, the habitat of FTTs is being fragmented, destroyed, modified and polluted greatly without the potential of being restored. In order to avoid local extinction of FTTs, we urge that further studies covering more areas to be conducted and the local status of FTTs should be thoroughly investigated. Utilisation of FTTs by local indigenous people and eggs harvesting of several species should be carefully monitored. Though the ecological

importance of this organism in not clearly understood, FTTs often serves as a keystone species and which benefited other animals and plants (Rhodin *et al.,* 2011; Turtle Conservation Fund, 2002). The findings of this study could shed some lights on FTTs species richness in the less explored region in Peninsular Malaysia and also highlights the need for more studies of these elusive charismatic species.

Acknowledgements

Forestry Department Peninsular Malaysia and Department of Wildlife and National Parks, Malaysia are greatly appreciated for granting us access to the forest reserves and permits to study the FTTS in Terengganu. We wish to thank the Biodiversity Research Group, especially Mohammad Aqmal Naser, Siti Najwa Sawawi and Muhammad Fahmi Ahmad for all their superb help during the field works. We also wish to thank Universiti Malaysia Terengganu for the equipment provided to conduct this study. This study was funded by Malaysian Nature Society (MNS) through the Young Environmental Research Grant (YERG 16-06) to the first author.

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Postscript

Three juveniles of *Heosemys spinosa* (Figure 14) were recorded from a small stream, a tributary of Sungai Peres, in Sekayu FR on two occasions on 16th Aug 2018, 23rd Nov 2018 and 22nd Dec 2018, after the manuscript has been accepted. The first individual was spotted at the stream edge at night and the second individual was caught during the day on the sand near the same stream while the third individual was found on stream bank within the same area.

Figure 14: *Heosemys spinosa.*