

Distribution and Population Status of the Narrow-Headed Softshell Turtle *Chitra* spp. in Thailand

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ABSTRACT.—The distribution range and status of *Chitra* spp. in Thailand were investigated. *Chitra chitra* Nutphand, 1986 is so far known only from the Mae Klong and Chao Phraya river systems. Another species, *Chitra vandijki* McCord and Pritchard, 2002, was reported to occur in the Salween river system located along the Thailand-Myanmar border. At present, the status of *Chitra* spp. is very rare everywhere and the natural population seems to be declining. Conservation and management action in behalf of this Genus is urgently needed.

KEY WORDS: Trionychidae, *Chitra chitra*, *Chitra vandijki*, softshell turtle, distribution, conservation

INTRODUCTION

The Siamese narrow-headed softshell turtle, *C. chitra* Nutphand, 1986, is probably the largest softshell turtle in the world. Pritchard (2001) estimated the maximum leathery carapace length (LCL) of *C. chitra* as 122 cm. A female, 152 kg with leathery carapace length of 123 cm, was found in 1967 (Nutphand, 1986). The largest female found in Thailand was recorded as weighting 202 kg in 1986 (The Royal Institute, 1992).

Thirakhupt and van Dijk (1994) reported that *C. chitra* was an endemic turtle species of

Thailand. Information subsequently presented by Engstrom et al. (2002), Engstrom and McCord (2002), and McCord and Pritchard (2002) now indicates that populations representing this species also extend into peninsular Malaysia and Indonesia (to Java). Of the six major river drainages recognized in Thailand by Vidthayanon et al. (1997), including the Salween, Mae Klong, Chao Phraya, Southern Peninsula, Southeastern part, and Mae Kong (Fig. 1), only the first three are now known to contain *Chitra* populations. The recently described species called *Chitra vandijki* (McCord and Pritchard, 2002) inhabits the Salween river system along the Thailand-Myanmar border. *C. chitra* is known to occur in the Mae Klong river system of western Thailand (Thirakhupt and van Dijk, 1994) and was also recently discovered in the Mae Ping River of the Chao Phraya drainage (Kitimasak

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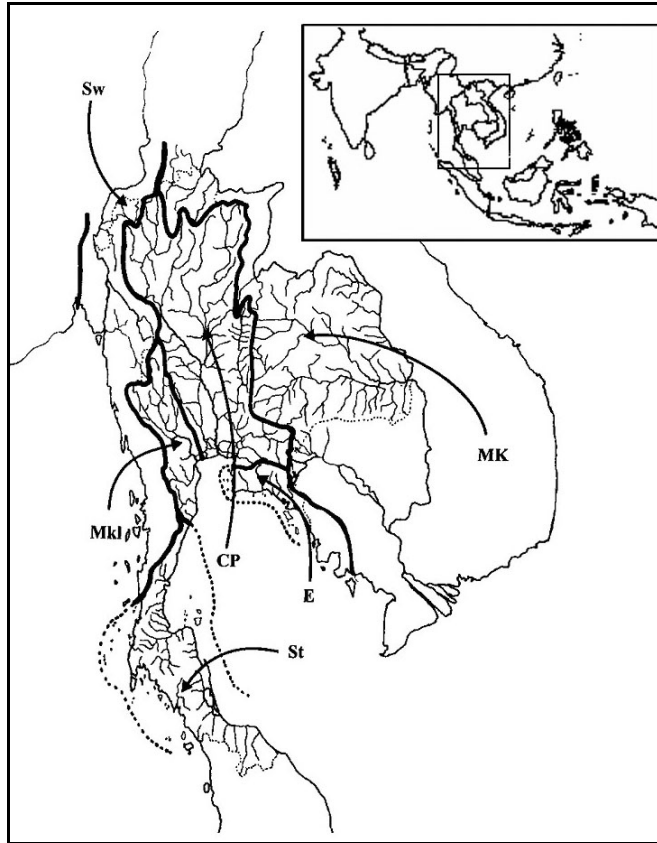


FIGURE 1. The river system of Thailand was classified into six major river drainages; the Salween (SW), Mae Klong (Mkl), Southern Peninsula (St), Southeastern part (E), Chao Phraya (CP) and Mae Kong river systems (MK) (after Vidthayanon et al., 1997).

and Thirakhupt, 2002). Previously Thirakhupt and van Dijk (1994) had questioned why *C. chitra* was restricted only to the Mae Klong basin although it was connected to the Chao Phraya and Tha Chin rivers. The discovery of *C. chitra* in the Mae Ping River suggests that its presence in these rivers may have been overlooked by zoologists, perhaps as the result of greatly reduced populations from levels of former abundance due to human exploitation and habitat destruction. *Chitra* presence in the Tha Chin River has not yet been verified, however, and *Chitra*'s possible former and present distribution elsewhere in Thailand requires further investigation.

To date, the information on the distribution and status of this species is incomplete. Greater knowledge of its distribution range and population size as well as its habitat characteristics would be very useful for its conservation and management in the future.

MATERIALS AND METHODS

This study was conducted by sending 129 questionnaires to the local fisheries offices, Department of Fisheries, Agricultural and Cooperative Ministry, throughout Thailand. Intensive investigations were carried out in every province that provided positive information concerning *Chitra* spp. In addition,

the locality data of live specimens and preserved specimens from all sources both in Thailand and abroad were recorded. Museum collections containing *C. chitra* examined in this study are the Natural History Museum, London U.K., formerly the British Museum of Natural History (BMNH); Museum of Comparative Zoology, Harvard University, USA (MCZ); and Chulalongkorn University, Museum of Zoology, Bangkok, Thailand (CUMZ).

RESULTS

Eighty-three completed questionnaires (64.3%) were received. There were seventeen (20.5%) with positive information indicating that *C. chitra* might be, or once was present in the Salween, Mae Klong, Southern Peninsula, Southeastern part and Chao Phraya river systems (Table 1). Intensive investigations were conducted in the areas from which positive information was received and the results are described below.

Salween River System

There were no published records of *Chitra* spp. from the Salween River system in the region of Thailand. However, in this study,

positive information concerning *C. vandijki* presence there was obtained from fisheries officials at Mae Sot District, Tak Province.

A field study was conducted in November 2001. Five specimens of *C. vandijki*, 4 live specimens and 1 carapace, were found. They were captured by local people in the river near the Thailand-Myanmar border but there were no exact data concerning their specific collection localities, so they might have been collected in either Myanmar or Thailand or both.

One of the collected individuals had a dark-yellow carapace when it was seen the first time. Its carapace then changed to light yellow when it was moved to Kanchanaburi Inland Fisheries Research and Development Center (KIFRDC) after a few days.

Mae Klong River System

Field studies were conducted several times in the Mae Klong River and its tributaries, the Kwae Noi and Kwae Yai Rivers during 1998-2001.

Kwae Yai River and Srinagarind Reservoir

One female, *C. chitra* was caught in October 1997 with a fishing hook on a bank line by a local fisherman in the Srinagarind

TABLE 1. Distribution of *Chitra* in Thailand

River systems	Sources of Data		
	Literature review	Questionnaire and interview	Field study
Salween	X	√	√
Mae Klong	Kwae Noi, Kwae Yai, Mae Klong, Srinagarind Reservoir	Kwae Noi, Kwae Yai, Mae Klong	Kwae Noi, Kwae Yai, Mae Klong, Srinagarind Reservoir, Vajiralongkorn Reservoir
Southern Peninsula	X	√	X
Southeastern part	√	√	X
Chao Phraya	Chao Phraya	Chao Phraya, Nan	Chao Phraya, Nan, Mae Ping
Mae Kong	X	X	-

√ = positive information; X = negative information; - = not investigated

Reservoir, located at $14^{\circ} 56.360' N 99^{\circ} 10.764' E$. The angler estimated that its weight was 270 kg. It was killed and was sold for food. Follicles, approximately one cm in diameter, were said to be found in the ovaries.

Additional information concerning the presence of two other *C. chitra*, approximately 70 and 150 kg, from the Ong Thung area in the Srinagarind Reservoir was obtained from a fisherman. Their sexes were unknown and they may still be living in that area.

In 1998, KIFRDC obtained two *C. chitra* hatchlings from a fisherman at Srinagarind Reservoir. He told us that 20 hatchlings were found in July 1998 from a small island located at $14^{\circ} 39.819' N 99^{\circ} 03.606' E$. They were observed climbing out from their nest and were moving into the reservoir. He excavated the nest and found that the nest was ~ 40 cm in depth and ~ 10 m from the water's edge. There were approximately 60-70 dead hatchlings in the nest. The clutch size was estimated at about 100 eggs. It is likely that the female laid its eggs nearer to the water but during the incubation period Srinagarind Dam released water from the reservoir for generating electrical power. Therefore, during the hatching time, the water level had decreased to about 10 m below the initial egg-laying site. There were many hatchlings that could not climb out of the nest but some that did apparently reached the water before the fisherman encountered them.

In April 2001, one female *C. chitra*, about 80 kg, was caught by a fishing hook in Srinagarind Reservoir. She laid three eggs in a fiber tank after being moved to Ayuthaya Province. Synthetic oxytocin was injected by one of us to induce further oviposition. Later on, 32 eggs were obtained and were incubated in a styrofoam box. However, only one egg hatched after incubation.

There is no record of *C. chitra* being found below Srinagarind Dam in the Kwaie Yai River during the last decade. The area along the river was surveyed and it was considered that the habitat was probably not suitable because there were no sandbanks available for egg laying

sites, and the areas along the river bank were mostly settled by humans.

Kwaie Noi River and Vajiralongkorn Reservoir

On January 7, 2000, fishermen found a *C. chitra* female laying its eggs near the water at midnight on a small island in the Vajiralongkorn Reservoir (located at $14^{\circ} 59.995' N 98^{\circ} 33.071' E$). It was caught by a spear and was sold to local people. The animal died on the following day, was dissected and about 100 eggs were found in the oviducts. The skull and carapace were donated to CUMZ (CUBMZ (R) 2001.14). The nest was excavated and 60 eggs were found. Two eggs were broken, the rest were incubated under 10 cm of sand in a circular container. Twelve days later, the eggs were investigated by one of us and only five were found to be fertile. None of these eggs hatched after an incubation period of two months.

A survey was conducted by the authors in the Vajiralongkorn Reservoir in 2000. Two skulls and one carapace of *C. chitra* were found at a fisherman's house. One skull and one carapace of the same animal were donated to CUMZ (CUBMZ (R) 2001.15). The fisherman mentioned that the skull and the carapace were collected more than 10 years ago.

From interviews, it was determined that *C. chitra* was regularly collected along the Kwaie Noi River from the past until the present. Surveys were conducted along the Kwaie Noi River several times during 1999-2001. It was found that when the water level was low there were many suitable sandbanks for egg laying along the river. Local people estimated that more than 100 *C. chitra* in the Kwaie Noi River were caught during the last decade. Most of them were hatchlings and juveniles. Kwaie Noi River, most sandbanks are regularly flooded when water is released from the dam, thereby rendering them useless as *Chitra* nesting sites.

Mae Klong River and Mae Klong Reservoir (formerly called Vajiralongkorn Reservoir)

Mae Klong (formerly called Vajiralongkorn) Dam began construction in 1964 and was

completed in 1970. The dam is located at about 14 km below the junction of the Kwaie Yai and Kwaie Noi Rivers. Some local people living along this waterway were interviewed concerning the presence of *Chitra*. They provided information that there were many sandbanks and many *C. chitra* in this portion of the Mae Klong River before the dam was constructed. After the water level rose and flooded all the sandbanks in the reservoir, *C. chitra* rapidly disappeared and nobody has caught or seen them in this reservoir for at least the last 10 years.

Below the Mae Klong Dam, *C. chitra* has seldom been caught and it is thought to be continuously decreasing in numbers. The probable distribution of *C. chitra* in the Mae Klong River extends to Damnoen Saduak Canal, the canal that joins the Mae Klong River to the Tha Chin River. A monk who lived near Damnoen Saduak Canal said that *C. chitra* was found in the canal when he was young, which was about 30 years ago. In 1999, one adult male was caught in an irrigation canal, located between the Mae Klong Reservoir and Damnoen Saduak Canal, and was transported to KIFRDC. These results suggest that the range of *C. chitra* could include at least part of the southern Chao Phraya river system. It is possible that *C. chitra* can disperse between the Mae Klong river system and Chao Phraya river system through small tributaries that connect the two river systems. However, there is no evidence that *C. chitra*'s range extends to the brackish water area at the mouth of Mae Klong River.

Southern Peninsula River System

There were three sources of positive information concerning *Chitra* spp. from the Southern Peninsula river system; from a questionnaire, a local person in Chumphon Province, and an animal trader in Narathiwat Province. However, field studies and interviews with other local people in the areas did not provide any evidence of *Chitra* spp. and there is no record of its presence there in the past.

Southeastern Part River System

One positive questionnaire was received from Sa Kaeo Province. In 1995, van Dijk and Thirakhupt (1995) stated that *C. chitra* was found in the Bangpakong River at the turn of century. However, the field study in this area did not acquire any positive evidence of *Chitra* spp. presence.

Chao Phraya River System

There were 6 positive responses received in questionnaires from Nan, Phichit, Lop Buri, Ang Thong, Phra Nakhon Si Ayutthaya and Sing Buri Provinces, indicating the possibility that fishermen in these provinces had seen *Chitra* spp. in the wild.

Field surveys were carried out along the Chao Phraya, Mae Ping and Nan Rivers. It was found that some local people, living along these rivers, have known *C. chitra* and provided information that the population of *C. chitra* was very rare as early as 10-20 years ago. A fisherman at Wat Bot District, Phitsanulok Province said that he had caught big softshell turtles in the Nan River just a few years ago. The details of the softshells' descriptions mentioned by the fisherman were similar to those of *C. chitra*, especially the stripe pattern on its neck. The local people called the turtle "Tao", "Bunlai" or "Kore-Sak-Yan" (tattoo pattern, similar to the shape of a pagoda on its neck).

DISCUSSION

Distribution

It could be concluded that currently *Chitra* spp. is distributed in three river systems of Thailand: the Salween, Mae Klong and Chao Phraya (Table 1). *C. vandijki* is found in the Salween River system and *C. chitra* is found in the Mae Klong River system (Kwaie Noi, Kwaie Yai, and Mae Klong Rivers; Srinagarind, Vajiralongkorn and Mae Klong Reservoirs) and Chao Phraya river system (Mae Ping, Nan and Chao Phraya Rivers).

The previous records of the distribution of *C. chitra* in Thailand were also mainly in the

Mae Klong river system (van Dijk and Thirakhupt, 1995; Iverson, 1992; Liat and Das, 1999; Nutphand, 1979; Nutphand, 1986; Nutphand, 1990; Smith, 1931; Taechacharern-sukchera, 1991; Thirakhupt and van Dijk, 1994; Youngprapakorn, 1993). In addition, all localities of *C. chitra* in many other collections from Thailand were from the Mae Klong river system (Table 2).

There were two records of *C. chitra* in the Chao Phraya River system. The first record was from the Chao Phraya River (The Royal Institute, 1992). A female, 202 kg, was caught in a canal, a branch of the Chao Phraya River (CP), at Tambon Soun Yai, Mueang District, Nonthaburi Province on May 19, 1986. It was released at the Phutthamonthon area and was not seen again. The latter, Kitimasak and Thirakhupt (2002) also described the extension of the range of *C. chitra* into the Mae Ping River, a tributary of the Chao Phraya River system, providing further evidence of its presence here.

The distribution of *C. chitra* above the dams was previously recorded in Srinagarind Reservoir (Thirakhupt and van Dijk, 1994) and Bhumipol Reservoir (Kitimasak and Thirakhupt, 2002). In this study, the identification of *C. chitra* in Vajiralongkorn Reservoir provides a new record.

C. chitra is primarily found in large rivers with sandy or muddy bottoms. Its habitat is similar to that of *C. indica* reported by Das (1991, 1995), Ernst and Barbour (1989) and Tikader and Sharma (1985). The distribution of *C. chitra* probably only includes freshwater sections of rivers. There is no record of *C. chitra* in brackish water in either the Chao Phraya or Mae Klong River estuaries.

C. chitra has traditionally been associated with clean and clear water, as recorded by van Dijk and Thirakhupt (1995). Nevertheless, a few turbid water habitats containing *C. chitra* in the Mae Klong River were identified in this study, perhaps due to the increasing siltation of the river as a whole, and representing less than optimal habitat conditions for this species.

The Salween *Chitra* has been described as a valid species in the study of Engstrom et al. (2002). They studied phylogenetic diversity of *Chitra* from Bangladesh, Myanmar, Thailand, Malaysia and Indonesia. The results showed that phylogenetic analysis of sequence data from the mitochondrial ND4 gene revealed three deeply divergent patterns within *Chitra*: *C. indica* from Bangladesh, *C. chitra* from Thailand, Malaysia and Indonesia and the third from the Salween River of Myanmar recently described as *C. vandijki* referred to above.

TABLE 2. Localities and Catalog Numbers of *C. chitra* specimens from Thailand.

No.	Localities	Catalog Number	Museums
1	Mae Klong River, Banpong, Ratchaburi Province	1921.4.1.197	BMNH
2	Mae Klong River, Banpong, Ratchaburi Province	1974.2451	BMNH
3	Kanchanaburi Province	1962.12.16.1	BMNH
4	Kanchanaburi Province	29486	MCZ
5	Mae Klong River, Banpong, Ratchaburi Province	29487	MCZ
6	Mae Klong River, Banpong, Ratchaburi Province	29488	MCZ
7	Thailand	1994-4-21,1	CUMZ
8	Kwae Yai River, Kanchanaburi Province	CUBMZ (R) 2001.10	CUMZ
9	Thailand	CUBMZ (R) 2001.11	CUMZ
10	Thailand	CUBMZ (R) 2001.12	CUMZ
11	Thailand	CUBMZ (R) 2001.13	CUMZ
12	Vajiralongkorn Dam, Kanchanaburi Province	CUBMZ (R) 2001.14	CUMZ
13	Vajiralongkorn Dam, Kanchanaburi Province	CUBMZ (R) 2001.15	CUMZ
14	Thailand	CUBMZ (R) 2001.16	CUMZ

Status

C. chitra was described as a new species in 1986 (Nutphand, 1986). In 1996 and 2000, IUCN listed *C. chitra* as a critically endangered species due to its extremely high risk of extinction (Baillie and Groombridge, 1996; Hilton-Taylor, 2000), while Thirakhupt and van Dijk (1994) recommended *C. chitra* as the first priority of turtles requiring conservation action in Thailand.

In Thailand, the main causes of *C. chitra*'s decline are: 1) hunting, 2) habitat degradation from dam construction and inundation of nesting sites due to periodic water releases from associated reservoirs, and 3) habitat destruction from sand mining and other human activities.

1. Hunting

C. chitra is protected under WARPA law (Wild Animals Reservation and Protection Act B.E. 2535) in Thailand. However, local people have continuously captured *C. chitra* for food and for sale in the international or local pet trade. Moreover, most eggs that are found by local people would be collected for sale or for captive hatching, due to the high price of live hatchling turtles in the pet trade. *C. chitra* of all sizes have been captured for years, mainly from Mae Klong river system (Table 3).

2. Dam construction

The status of *Chitra* spp. in reservoirs and below dams is a serious problem. After the dams were constructed, water periodically flooded all *C. chitra*'s habitats and nest sites. In this study, two nests in Srinagarind Reservoir and Vajiralongkorn Reservoir were investigated. Both nests were laid on the banks of small islands that formerly were hill tops. The banks are composed mainly of gravel and rock, and differ substantially from the natural sand bank along the Mae Klong river system. Moreover, the island bank in Vajiralongkorn Reservoir was covered with shrubbery, which inhibits laying activity. Even though *C. chitra* could lay eggs along these island banks, the successful hatching rate was very low. The failure of successful incubation of eggs from Vajiralongkorn Reservoir might be because eggs were laid in very humid condition (Kitimasak, 1996). Below the dam, all nest-sites would be flooded due to the fluctuating water levels in the river following the release of water for electrical power and agricultural purposes. It was found that *C. chitra* naturally laid its eggs on sandbanks at low water levels in the dry season. As a result, all eggs would be flooded and embryos drowned before hatching. Therefore, at present, populations of *C. chitra* cannot successfully reproduce either above or

TABLE 3. Numbers and localities of *C. chitra* specimens that were caught from river systems in Thailand. Interview data were obtained from fishermen, local people and traders.

River System	≤ 1996	1997	1998	1999	2000	2001	2002
Salween	-	-	-	-	-	{20}	{1}
Mae Klong	[8], {20}	[5]	[3], (20)	[2]	[1], (20)	[3], {3}, (22)	-
Southern Peninsula	-	-	-	-	-	-	-
Southeastern Part	-	-	-	-	-	-	-
Chao Phraya	[3], {1}	{1}	[1]	-	-	{1}	-
Mae Kong	-	-	-	-	-	-	-
Total	[11], {21}	[5], {1}	[4], (20)	[2]	[1], (20)	[3], {24}, (22)	{1}

[] adult; { } juvenile; () hatchling

below the dams. The *C. chitra* populations in Thailand continue to decline rapidly as a result.

Changes in river flow patterns and floodplain development may also increase river turbidity and siltation. These changes may negatively affect *Chitra* by inhibiting its sight-feeding foraging abilities, and by potentially silting over sandy nesting site, thereby rendering them unsuitable for use.

3. Habitat destruction due to sand mining and other human activities

Due to country development, many human activities, such as road and building construction require a large amount of sand. Sand has been removed from both Chao Phraya and Mae Klong riverbanks for decades to serve this purpose. It represents another probable cause of population decline, by eliminating or degrading the quality of sand beach nesting habitats.

Recommendations

The results of this study indicate that *Chitra* spp. is now very rare in Thailand. Its populations appear to have declined rapidly in the last two decades and currently it is nowhere common. This genus is surely going to be extinct in the wild in the near future if it does not receive special conservation action immediately. Extensive field surveys throughout their range during our study period did not result in the observation of a single live specimen in the wild. Its populations have been severely affected by hunting and habitat alterations described above. Due to its present status, *C. chitra* should be considered the first priority of all Thai turtles in receiving special concern and action. We recommend that long-term conservation of this critically endangered species should be accomplished by the implementation of the following proposed procedures:

1. Captive Breeding Program

A captive breeding program should be one of the first priorities to be carried out in order to produce eggs, hatchlings, juveniles, and

breeding adults. Moll and Moll (2000) stated that captive breeding of riverine turtles is expensive, and requires large tracts of land, elaborate enclosures, and a permanent staff. It should usually be employed only after existing habitat has been destroyed and/or when the population becomes too small and scattered for natural reproduction to be effective. Parental stock of known locality origin should then be collected and housed in range, and their captive-bred offspring are suggested to be released at the same location whenever suitable habitat is judged to remain (and other threats which reduced populations initially are minimized or eliminated).

Chitra chitra meets most of these requirements and captive breeding is considered to be the best methodology under present circumstances for restoring populations to viable levels. Facilities at KIFRDC are suitable to support the needs of this program.

2. Habitat protection

The restoration and conservation of suitable habitat is most important for *C. chitra*, both for maintaining and rebuilding existing populations and for reintroduced populations. Areas where *Chitra* is protected from hunting, and areas where suitable nesting sites are abundant and protected from flooding, mining, and poaching are vitally important if *Chitra* is to be conserved.

Since several rare species may be effectively conserved in protected areas, some existing habitats of *C. chitra* that are not currently protected (e.g., in the Kwa Noi River) should be considered for sanctuary status as well.

3. Translocation and reintroduction

Translocation refers to the release of an animal outside its original range. This method may have limitations in that *C. chitra* may have potential negative effects on the new host ecosystem, or may not be able to adapt to the new environment. Reintroduction within the original habitat should be considered as the first choice in the release of captive turtles. In case the existing areas are not suitable due to habitat

alteration or other reasons then translocation may be considered. The monitoring of released individuals should be performed regularly after the reintroduction or translocation to the extent possible in order to assess the effects and level of success of the procedure.

4. Public relations and education

Public relations and education are vitally important to promote conservation programs for *Chitra*. Villagers, fishermen and NGO's should be informed of the requirements and status of *Chitra* by researchers. Local cooperation and participation in conservation action stimulated by such input is fundamentally important in the conservation of *Chitra* populations.

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