

Chapter 6

Distribution and Status of the Siamese Narrow-headed Softshell Turtle Chitra chitra Nutphand, 1986 in Thailand

Abstract

The distribution range and status of Chitra chitra Nutphand, 1986 in Thailand were investigated. C. chitra was found in the Mae Klong and Chao Phraya river systems. Another species, C. burmanica Jaruthanin 2002 or C. vandijki, McCord & Pritchard, 2002, was reported to occur in the Salween river system located along the Thailand-Myanmar border. At present, the status of C. chitra is very rare everywhere and the natural population is declining. Conservation and management action in behalf of this species is urgently needed.

Key words: Chitra chitra, Distribution, Status, Thailand

Introduction

The Siamese narrow-headed softshell turtle, Chitra 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 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 (SW), Mae Klong (Mkl), Chao Phraya (CP), Southern Peninsula (St), Southeastern part (E), and Mae Kong (MK) (Figure 6.1), only the first three are now known to contain Chitra populations. The recently described species called either C. burmanica (Jaruthanin, 2002) or C. vandijki (McCord & Pritchard, 2002) inhabits the Salween river system along the Thailand-Myanmar border. Chitra chitra is known to occur in the Mae Klong river system of western Thailand (Thirakhupt and van Dijk, 1994) and has recently was discovered in the Mae Ping River of the Chao Phraya drainage also (Kitimasak and Thirakhupt, 2002; chapter 5 this volume). 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 zoologist-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.

From the past to present, C. chitra has been threatened by hunting, water pollution, reservoir creation and other forms of habitat destruction and alteration (Thirakhupt and van Dijk, 1994). These events have negatively affected its natural distribution and population size. In 2000, IUCN listed C. chitra as a critically endangered species, while Thirakhupt and van Dijk (1994) recommended C. chitra as the first priority of turtles requiring conservation action in Thailand. To date, the information on the distribution and status of this species is very 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.

Methodology

This study was conducted by sending 129 questionnaires to the local fisheries offices, Fisheries Department, Agricultural and Cooperative Ministry, throughout Thailand. Intensive investigations were carried out in every province that had positive information of C. chitra. In addition, the locality data of live specimens and preserved specimens from all sources were recorded both in Thailand and abroad. Museum collections containing C. chitra examined in this study are the Natural History Museum, London (BNHM); Museum of Comparative Zoology, Harvard University (MCZ); and Chulalongkorn University Bangkok, Museum of Zoology (CUBMZ).

Results

Eighty-three completed questionnaires (64.34%) 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 6.1). 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 C. chitra from the Salween river system in the past. However, in this study, positive information concerning its presence there was obtained from fisheries officials at Mae Sot District, Tak Province.

The field study was conducted in November 2001. Five specimens of Chitra sp., 4 live specimens (Figure 6.2) and 1 carapace were found. All specimens were C. burmanica Jaruthanin, 2002 or C. vandijki McCord & Pritchard, 2003. They were captured by local people in the river near the Thailand-Myanmar border line but there were no exact data concerning their specific localities.

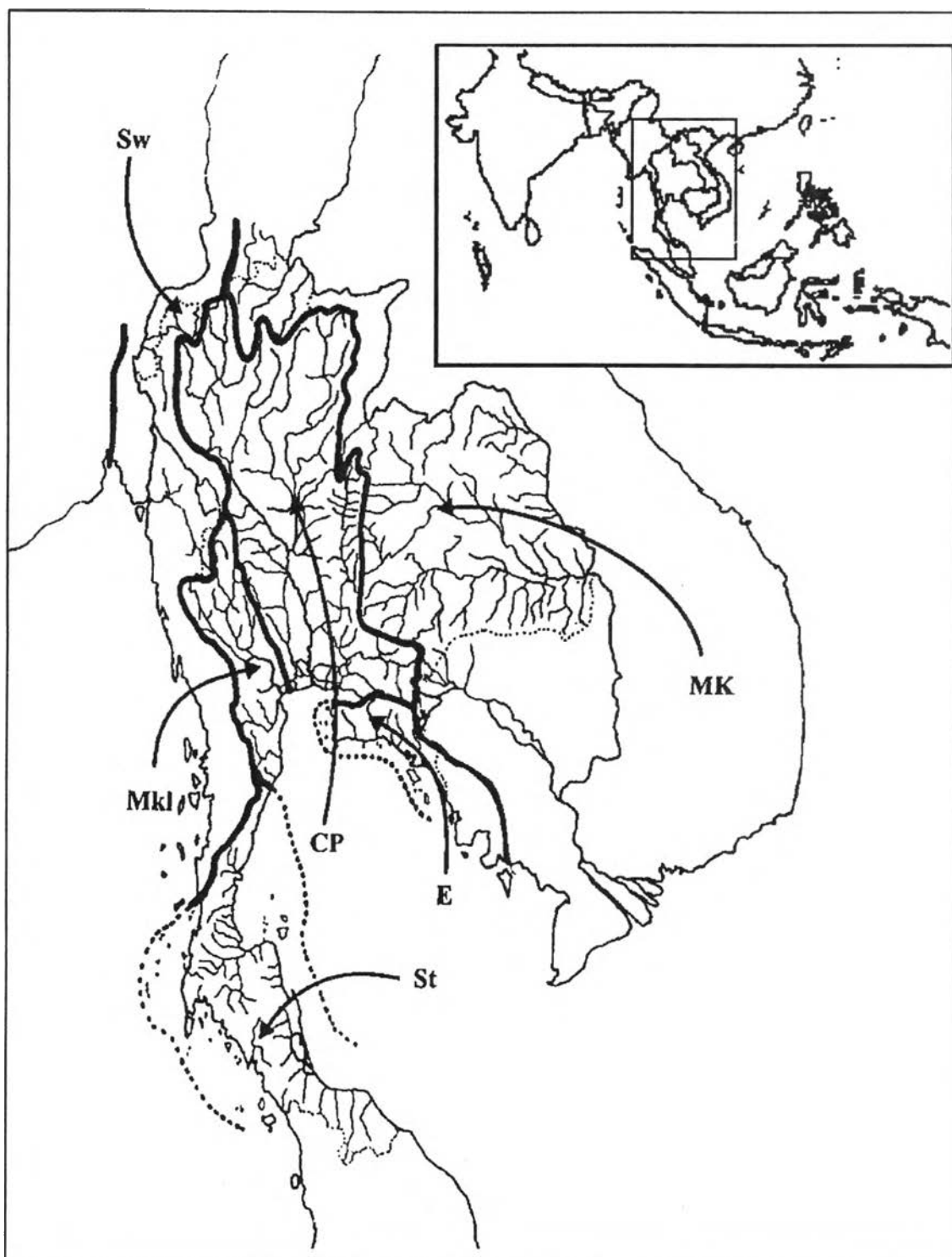


Figure 6.1 The river system of Thailand was classified into six major river drainages; the Salween (SW), Mae Klong (Mkl), Southern Peninsula (St), Southeastern part (E), Chao Phraya (CP) and Mae Kong river systems (MK) (After Vidthayanon, et al., 1997).

Table 6.1 Distribution of Chitra in Thailand

River systems	Sources of Data		
	Literature review	Questionnaire and interview	Field study
Salween	X	√	√
Mae Klong	Kwae Noi, Kawe Yai, Mae Klong, Srinagarind Reservoir	Kwae Noi, Kawe Yai, Mae Klong	Kwae Noi, Kawe 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*

The external characters of this turtle differed from those of C. chitra and C. indica. The stripe patterns on their carapaces, necks and fore limbs and body color are different from both C. chitra of the Mae Klong river system and C. indica. One of them had a dark-yellow carapace when it was seen the first time (Figure 3), which then changed to light yellow when it was moved to Kanchanaburi Inland Fisheries Research and Development Center (KIFRDC) after a few days (Figure 6.2A). The middle stripes on the necks of all specimens are longer than C. chitra and their stripe patterns on the carapace have more light color than C. chitra. They also have stripes on their forelimbs which are not found in C. chitra. Moreover, they have several unique short stripe patterns along the carapace edge (also see descriptions in McCord and Pritchard, 2002).

Mae Klong River System

The location of the Mae Klong River system is shown in Figure 6.1. The Kwaie Yai River and Kwaie Noi River join together at Mueang District, Kanchanaburi Province, in the western part of Thailand. The natural habitats of C. chitra in the Mae Klong river system were blocked by several dams. The earlier waterways of the Kwaie Noi River and Kwaie Yai River were blocked by Vajiralongkorn Dam (formerly called Khao Leam Dam) and Srinagarind Dam, respectively. Moreover, the Kwaie Yai River was also blocked by Tha Thung Na Dam below Srinagarind Dam. Furthermore, the Mae Klong River was also blocked by the Mae Klong Dam (formerly called Vajiralongkorn Dam). Field studies were conducted several times in the Mae Klong River and its tributaries, the Kwaie Noi and Kwaie Yai Rivers during 1998-2001.

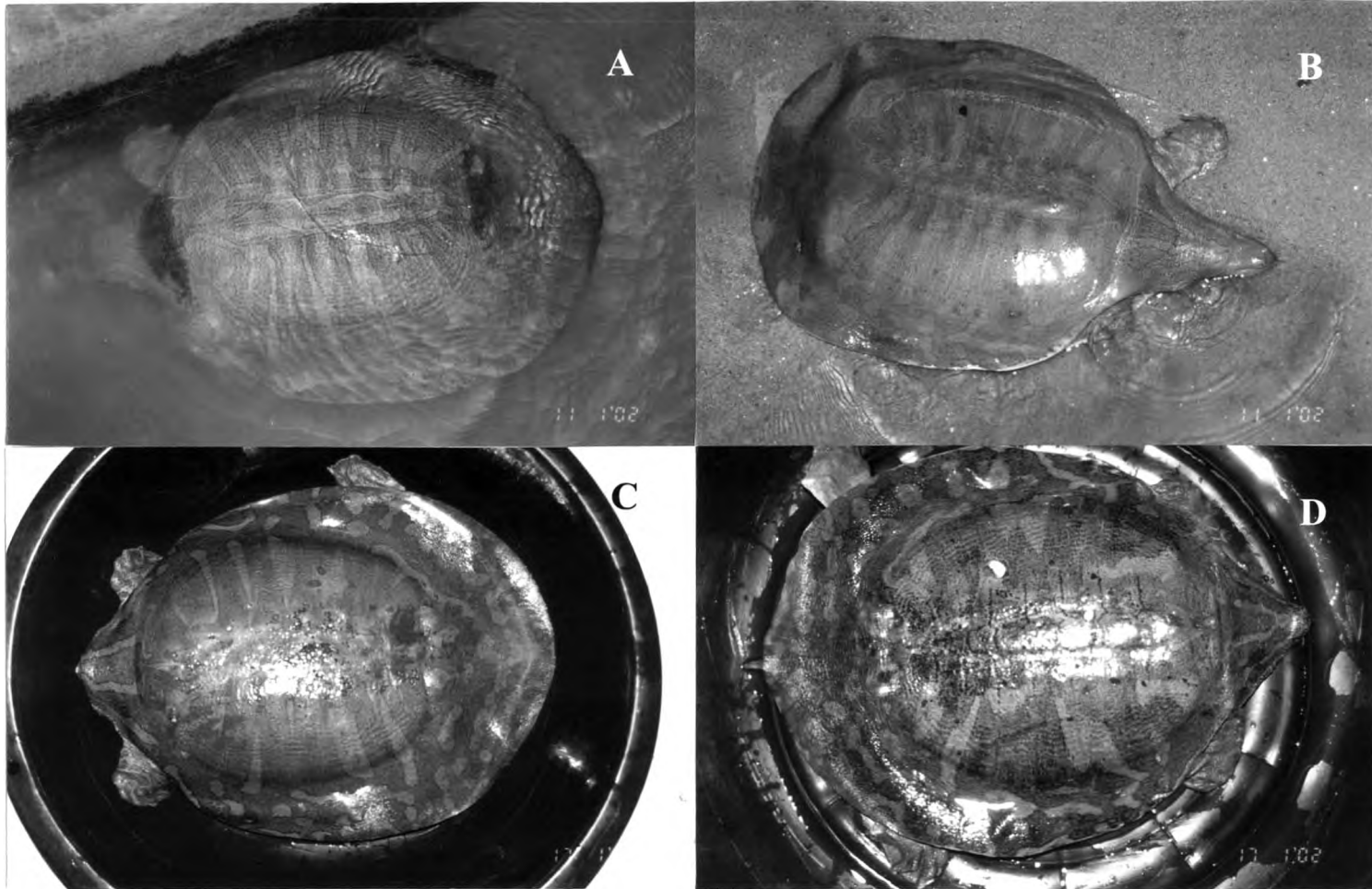


Figure 6.2 Stripe pattern of C. burmanica or C. vandijki. (A, B at KIFRDC and C, D at Personal Collection) from Salween river system. The Leathery Carapace Lengths (LCL) of A, B, C and D were 44 cm, 45.5 cm, 36.5 cm, and 28.2 cm, respectively.



Figure 6.3 The color of C. burmanica or C. vandijki was darker before it was moved to KIFRDC. Turtle in this picture is the same turtle in Figure 6.2A.

Kwae Yai River and Srinagarind Reservoir

One female, C. chitra was caught by a fishing hook in the Srinagarind Reservoir, located at $14^{\circ} 56.360' N$ $99^{\circ} 10.764' E$, in October 1997 (Figure 6.4). 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 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 are probably living in that area.



Figure 6.4 An adult female of C. chitra caught in Srinagarind Reservoir in October 1997. The site is located at $14^{\circ} 56.360' N$ $99^{\circ} 10.764' E$.

In 1998, KIFRDC obtained two C. chitra hatchlings from a fisherman at Srinagarind Reservoir. He reported that 20 hatchlings were found in July 1998 from the small island located at $14^{\circ} 39.819' N$ $99^{\circ} 03.606' E$ (Figure 6.5). 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 distant from the water's edge. There were approximately 60-70 dead hatchlings in the nest. The eggshells were counted roughly to about 100. 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 reached the water before the fisherman encountered them.



Figure 6.5 A nest site in Srinagarind Reservoir, located at $14^{\circ} 39.819' \text{ N } 99^{\circ} 03.606' \text{ E}$

In April 2001, one C. chitra female, 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 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 found that the habitat was not suitable because there were no sandbanks available for egg laying sites. Besides, the areas along the river bank were mostly settled by humans.

Kwae Noi River and Vajiralongkorn Reservoir (formerly called Khao Laem Reservoir)

There has been no report of C. chitra in Vajiralongkorn Reservoir since the Vajiralongkorn Dam was constructed. However, in 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 $14^{\circ} 59.995' N$ $98^{\circ} 33.071' E$) (Figure 6.6). 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 oviduct. The skull and carapace were donated to CUBMZ (CUBMCZ (R) 2001.14). The nest was excavated and 60 eggs were found in the nest. Two eggs were broken, the rest were incubated under 10 cm of sand in a circular container. Twelve days later, the eggs were investigated and only five fertile eggs were found. However, no egg hatched after being incubated for two months.



Figure 6.6 A nest site in Vajiralongkorn Reservoir, located at $14^{\circ} 59.995' N$ $98^{\circ} 33.071' E$

A survey was conducted 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 CUBMZ (CUBMCZ (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 (Figure 6.7). Local people estimated that more than 100 C. chitra in the Kwaie Noi River were caught in the last decade. Most of them were hatchlings and juveniles. However, at present, most sandbanks are flooded when water is released from the dam, thereby rendering them useless as Chitra nesting site.



Figure 6.7 Natural habitat of C. chitra at Kwaie Noi River, located at $14^{\circ} 20.384' \text{ N } 98^{\circ} 56.448' \text{ E}$

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

Mae Klong (formerly called Vajiralongkorn) Dam was constructed since 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. They provided the 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 been seldom caught and is thought to be continuously decreasing in number. The distribution range 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 Damnorn Sadowg 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 record 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 C. chitra 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 C. chitra and there was 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's 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 C. chitra 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 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 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 as "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 the distribution range of Chitra spp. is in three river systems of Thailand, the Salween, Mae Klong and Chao Phraya (Table 6.1). C. chitra was found in the Mae Klong River system (Kwae Noi, Kwae 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 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; Taechacharernsukchera, 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 6.2).

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). The latter, a C. chitra 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. Kitimasak and Thirakhupt (2002), also described the extension of the distribution range of C. chitra into the Mae Ping River, tributary of the Chao Phraya River system, providing further evidence of its presence here.

The distribution range of C. chitra above the dams was previously recorded as Srinagarind Reservoir (Thirakhupt and van Dijk, 1994) and

Bhumipol Reservoir (Kitimasak and Thirakhupt, 2002). From 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), Das (1995), Ernst and Barbour (1989) and Tikader and Sharma (1985). The distribution range of C. chitra 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.

In this study, a recently described Chitra sp. specimen that has distinguishable characters from C. chitra and C. indica was found from the Salween river system near the Thailand-Myanmar border. Jaruthanin (2002) named it as Chitra burmanica in Fish Zone magazine. He reported that the stripe pattern of C. burmanica differed from C. chitra and C. indica as discussed previously. However, this scientific name, C. burmanica, is rejected by McCord (personal communication) in that the species description of Jaruthanin (2002) is inadequate by ICZN standard and the proposed name should not be accepted. McCord and Pritchard (2002) described this new softshell species as C. vandijki.

Table 6.2 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	BNHM
2	Mae Klong River, Banpong, Ratchaburi Province	1974.2451	BNHM
3	Kanchanaburi Province	1962.12.16.1	BNHM
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	CUBMZ(R)
8	Kaew Yai River, Kanchanaburi Province	CUB MZ R 2001.10	CUBMZ(R)
9	Thailand	CUB MZ R 2001.11	CUBMZ(R)
10	Thailand	CUB MZ R 2001.12	CUBMZ(R)
11	Thailand	CUB MZ R 2001.13	CUBMZ(R)
12	Vajiralongkorn Dam, Kanchanaburi Province	CUB MZ R 2001.14	CUBMZ(R)
13	Vajiralongkorn Dam, Kanchanaburi Province	CUB MZ R 2001.15	CUBMZ(R)
14	Thailand	CUB MZ R 2001.16	CUBMZ(R)

This Salween softshell has been supported as a valid species by 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 either C. burmanica or C. vandijki referred to above.

Status

C. chitra was described as a new species in 1986 (Nutphand, 1986). Since 1996, it has been listed as “critically endangered” by IUCN (IUCN, 1996, IUCN, 2000) due to its extremely high risk of extinction.

In Thailand, the main causes of C. chitra's decline are: 1) hunting, 2) dam construction 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 were found by local people would be collected for sale or for captive hatching, due to the high price of live hatchlings turtles in the pet trade. C. chitra of all sizes have been captured for years, mainly from Mae Klong river system (Table 6.3).

2. Dam Construction

The status of C. chitra in reservoirs and below dams is a serious problem. After the dams were constructed, water 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 gravels and rocks, differ totally from the natural sand bank along the Mae Klong river system (Figures 6.5, 6.6 and 6.7). 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 tended to be 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 embryos drowned before hatching. Therefore, at present, populations of C. chitra cannot successful reproduce either above or 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.

Table 6.3 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

Recommendation

The results of this study indicate that C. chitra is now very rare in Thailand. Its populations appear to have declined rapidly in the last two decades and nowadays it is nowhere common. This species is surely going to be extinct in the wild in the near future if it does not receive special conservation action immediately. Field surveys throughout their distribution areas during the study period did not result in the observation of a single live specimen in the wild. Its population is severely affected by hunting and habitat alterations described above in its present status, C. chitra should be considered the first priority of all Thai turtles to receive special concern and action. The long-term conservation of this critically endangered species is to be accomplished by the implementation of the following proposal 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, requiring large tracts of land, elaborate enclosures, and a permanent staff. However, captive breeding should be employed after existing habitat has been destroyed or when the population becomes too small and scattered for natural reproduction to be effective. The parental stock of known locality 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 initials are minimized or eliminated).

C. 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.

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 C. 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 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 C. chitra. Villagers, fishermen and NGO's should be informed of the requirements and status C. chitra by researchers. Local cooperations and participation in conservation action stimulated by such input is fundamentally important in the conservation of Chitra populations.

References

- Baillie, J., and Groombridge, B. (Eds.). 1996. IUCN Red List of Threatened Animals. Gland, Switzerland: IUCN.
- Das, I. 1991. Colour Guide to the Turtles and Tortoises of the Indian Subcontinent. Great Britain: The Longdunn Press.
- Das, I. 1995. Turtles and Tortoises of India. Bombay: Oxford University Press.
- van Dijk, P. P., and Thirakhupt, K. 1995. Southeast Asian Chitra. From Distinction to Extinction in 15 Years? In Soptom (Ed), Proceedings International Congress of Chelonian Conservation. Gonfaron France 6-10 July 1995.
- Engstrom, T. N., and McCord, W. P. 2002. Molecular support for the taxonomic conclusions of McCord and Pritchard (2002), regarding Chitra. Hamadryad. 27(1): 57-61.
- Engstrom, T. N., Shaffer, H. B., and McCord, W. P. 2002. Phylogenetic diversity of endangered and critically endangered Southeast Asian softshell turtles (Trionychidae: Chitra). Biological Conservation. 104(2): 173-179.
- Ernst, C. H., and Barbour, R. W. 1989. Turtles of the world. Wahington, D.C.: Smithsonian Institution Press.
- Hilton-Taylor, C. (Compiler). 2000. 2000 IUCN Red List of Threatened Species. Gland, Switzerland and Cambridge, UK: IUCN.
- Iverson, J. B. 1992. A Revised Checklist with Distribution Maps of the Turtles of the World. Richmond, Indiana: Privately printed.
- Jaruthanin, K. 2002. Salaween: The Dangerous River. Fish Zone. 3(19): 27-40.
- Kitimasak, W. 1996. Effect of humidity on hatching rate and effect of food-type on growth rate of Asiatic softshell turtle *Amyda cartilaginea* hatchlings. Master's thesis, Department of Biology, Faculty of Science, Chulalongkorn University.

- Kitimasak, W., and Thirakhupt, K. 2002. New record of Chitra chitra Nutphand, 1986 in Mae Ping River, Thailand. The Natural History Journal of Chulalongkorn University 2(1): 62-63.
- Liat, L. B., and Das I. 1999. Turtles of Borneo and Penninsular Malaysia. Kota Kinabala: Natural History Publications.
- McCord, W. P., and Pritchard, P. C. H. 2002. A review of the softshell turtles of the genus Chitra, with the description of new taxa from Myanmar and Indonesia (Java). Hamadryad. 27(1): 11-56.
- Moll, E. O., and Moll, D. 2000. Conservation of river turtles. Pages 126-155 In M. W. Klemens (ed). Turtle conservation. Washington and London: Smithsonian.
- Nutphand, W. 1979. The Turtles of Thailand. Bangkok: Siam Farm Zoological Garden.
- Nutphand, W. 1986. "Man Lai" the world's biggest softshell turtle. Thai Zoological Magazine 1(4): 64-70. (in Thai)
- Nutphand, W. 1990. Softshell turtles. Bulletin of the Thai Zoological Center 5(56): 93-104. (in Thai)
- Pritchard, P. C. H. 2001. Observations on body size, sympatry, and niche divergence in softshell turtles (Trionychidae). Chelonian Conservation and Biology 4: 5-27.
- Smith, M. A. 1931. The Fauna of British India. Florida: Ralph Curtis Book.
- Taechacharernsukchera, V. 1991. Incubation of Chitra chitra eggs in captivity. Journal of Wildlife in Thailand. 1(1): 8-14. (in Thai)
- Taylor, E. H. 1970. The turtles and crocodiles of Thailand and adjacent waters. The University of Kansas Science Bulletin. 49: 87-179.
- The Royal Institute. 1992. Man-lai. Encyclopedia of Thailand. 23: 14791-14795.
- Thirakhupt, K., and van Dijk, P. P. 1994. Species diversity and conservation of the turtles of Western Thailand. Natural History Bulletin of the Siam Society 42:209-259.

- Tikader, B.K., and Sharma, R.C. 1985. Handbook Indian Testudines. Calcutta, India: The Radiant Process Private Limited.
- Vidthayanon, C., Karnasute, J., and Nabhitabhata, J. 1997. Diversity of Freshwater Fishes in Thailand. Bangkok: Office of Environment Policy and Planning.
- Youngprapakorn, P. 1993. Tapab Manlai. Samut Prakan: Crocodile Farm and Samut Prakan Zoo. 16 pp.