SURVEYS OF SIAMESE CROCODILE (*Crocodylus siamensis*) HABITAT IN THE MAHAKAM RIVER, EAST KALIMANTAN, INDONESIA

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SUMMARY

A recent survey (9-21 June 2005) was undertaken to collect information on *C. siamensis* habitats and possible locations where *C. siamensis* occur in the lower Makaham River, East Kalimantan. Interviews with local villagers confirmed that *C. siamensis* are still encountered, and that breeding still occurs. Specific wild habitats visited (Tanah Liat, Paya, Belibis, Amir and Mesangat Lakes) have changed greatly since 1995-1996 (Ross *et al.*, 1998), but weeds and sedimentation were identified as impacting negatively on the habitats now. Fishing pressure has increased in recent years, and young crocodiles are being caught during fishing activities. Around 360 *C. siamensis* are currently in captivity at two crocodile farms and in villages in the Mahakam River area. Hybridisation with *C. porosus* has occurred on one of the farms.

INTRODUCTION

The Siamese crocodile (*Crocodylus siamensis*) is regarded as one of the world’s most endangered crocodilians (Ross, 1998), and is included on CITES Appendix I and is listed as “Critically Endangered” by the IUCN-World Conservation Union (Hilton-Taylor, 2000). The IUCN-SSC Crocodile Specialist Group (CSG) considers the conservation of *C. siamensis* to be a high priority (SCWG 2004).

Historically, *C. siamensis* was distributed in Thailand, Vietnam, Laos PDR, Cambodia, Indonesia and Malaysia (Fig. 1). However, *C. siamensis* is probably extinct in Malaysia, and populations in Vietnam and Thailand are represented a few individuals, and reinsertion programs are underway there (Temsiripong *et al.* 2004; Polet 2004). Recent surveys undertaken in Lao PDR suggest that the population is small and fragmented (Bezuijen and Photitay 2005). Cambodia is considered the stronghold for *C. siamensis* in the region, and the wild population there is considered to include less than 200 adults (Simpson and Han 2004; Heng 2004).

![Figure 1. Distribution map of *Crocodylus siamensis* (yellow color).](http://www.flmnh.ufl.edu)
In Indonesia, *C. siamensis* is only found in its natural habitat in the lower Mahakam River system, East Kalimantan, as reported by Ross *et al.* (1998) (see Fig. 5). Surveys in 1995 and 1996 (Ross *et al.* 1998) concluded that the population was highly disjunct, and estimated that the population at that time consisted of "several hundred individuals" (Cox 2004). The current status of the *C. siamensis* population is unknown (SCWG 2004), but it is thought to be very small or extinct (Simpson and Han, 2004).

In April 2005, the CSG Chairman, Professor Grahame Webb, met with Government and industry CSG members in Jakarta (CSGN 2005). All participants agreed that it was important for Indonesian scientists to become more involved with *C. siamensis* and *T. schlegelii* conservation efforts in Indonesia, in partnership with the local crocodile industry. As a result of this meeting, this survey was planned and undertaken as a first step towards the development of a future systematic survey program and conservation and management plan.

**AIMS AND METHODS**

Given the remoteness and small number of villages present and the reported shy nature of *C. siamensis* (prefers not to live near people), it was necessary to prioritise the locations/areas that could be visited during the survey period (9-21 June 2005).

The specific goals of the survey were:

1. To visit crocodile farms in Balikpapan and Samarinda that were known to have *C. siamensis*, and interview the owners to determine the origin/source of the crocodiles.
2. To interview local people about: the historical and current distribution of crocodiles in areas with which they are familiar; the types of crocodile that are present in the river and lakes near their villages; and, to learn about the daily activities of the local people near crocodile habitats.
3. To assess potential crocodile habitats, based largely on the types of plants present in the habitats, and in adjacent areas. Locations of habitats were positioned using GPS.
4. To identify threats that may have negative impacts on crocodile populations and their habitats.

**RESULTS**

**A. CROCODILE FARMS**

In East Kalimantan there are two crocodile farms that have collected live *C. siamensis* and *C. porosus* from the Mahakam River and its tributaries. CV Surya Raya Crocodile Farm is located in Balikpapan and PT Makmur Abadi Permai Crocodile Farm is in Samarinda. The owners of the two farms have different reasons why they keep *C. siamensis*.

1. CV Surya Raya Crocodile Farm (Balikpapan)

   There are 41 *C. siamensis* reported to be on the farm (14 males, 27 females; Fig. 2). The owner (Mr. Tarto Sugianto) stated that the crocodiles are kept solely for exhibition and display, and not for commercial proposes. The Siamese crocodiles were received since 1990-1991, and were collected by local people from Muara Muntai, Bongan and Muara Ancalong Villages. Muin and Ramono (1994) reported 20 *C. siamensis* on this farm in late 1993, and Ross *et al.* (1998) reported 37 individuals by September 1996 (mainly juveniles and sub-adults; Cox 2004).
The crocodiles were taken from Tanah Liat, Belibis and Mesangat Lakes. Their average size was 1-2 m. Mr. Tarto Sugiarito knows the places where most of his crocodiles were collected because he and his staff picked them up from the villages where the crocodiles were kept after being caught.

After 14 years in captivity, the average length of the crocodiles is now about 3 m. In August, 1-2 nests are produced by some females in semi-natural enclosures, but to date none of the artificially-incubated eggs have produced hatchlings.

2. PT Makmur Abadi Permai Crocodile Farm (Samarinda)

PT Makmur Abadi Permai Crocodile Farm estimates that it has holds 314 *C. siamensis* (180 females and 134 males; Figs. 3 and 4). The owner (Mr. Welly Mawengkang) cannot remember the exact number of wild *C. siamensis* that were originally received in 1985 and 1986, but thinks it was around 200 individuals. Average size of the crocodiles is 2-3 m. Muin and Ramono (1994) reported 316 *C. siamensis* on this farm in late 1993.

All original *C. siamensis* were from the lower Mahakam River. Mr. Mawengkang did not know exactly where the animals were collected, because some crocodile collectors from the Mahakam River brought live crocodiles directly to the farm in Samarinda. He recalled that the villages were around Jempang Lake, where most of the collectors stay.

Mr. Mawengkang initially thought that all of his crocodiles were *C. porosus*, and had placed all of them (*C. porosus* and *C. siamensis*) together, a semi-natural enclosure (Fig. 3). The two species of crocodiles grew and bred in this breeding enclosure for about 10 years. Hybridization between the two species was apparent (see Fig. 4). In 2000, the two species were separated into two different ponds. Some progeny, which may have been hybrids, were placed with the parent *C. siamensis* stock.

Based on an interview with the crocodile keeper, *C. siamensis* lay eggs between October and November, with 30-40 eggs per nest. Only 6-7 nests per year are produced. The owner thought that skins and meat of *C. siamensis* could be exported. However, he was aware of the regulations relating to CITES Appendix-I animals such as *C. siamensis*.
Figure 3. *Crocodylus siamensis* at PT Makmur Abadi Permai Crocodile Farm, Samarinda, East Kalimantan (Photograph by H. Kurniati).

Figure 4. Juvenile *C. siamensis* (hybrids?) at PT Makmur Abadi Permai Crocodile Farm, Samarinda, East Kalimantan (Photograph by H. Kurniati).
B. INTERVIEWS WITH LOCAL PEOPLE

Based on information received from crocodile farms in Balikpapan and Samarinda (see above), we interviewed local people in several villages in the Mahakam River area. Some local people still keep 1-3 *C. siamensis* at their homes. Results of the interview are as follows:

1. Muara Muntai Village (S 00° 21’ 40” and E 116° 23’16”)

   In this village, a man, Mr. Sahran, keeps three adult *C. siamensis* (average size of 1.5 m). He bought the crocodiles as hatchlings in 1995. They originated from small lakes close to Jempang Lake. One of the crocodiles laid eggs in December 2004.

2. Bongan Village (S 00° 28’ 56” and E 116° 17’25”)

   This village is very close to Tanah Liat, Belibis and Amir Lakes. People in this village usually find nests, hatchlings or juvenile *C. siamensis* trapped by fishhook or traditional fish trap (called *bu bu*). Some people release the trapped crocodiles, but others kill and eat them as they are considered to be traditional medicine for mangy skin. If they find nests, all of the eggs are usually taken and the infertile ones are boiled and eaten. Siamese crocodile nests are usually located in April or May.

3. Muara Ancalong Village (N 00° 25’ 48.6” and E 116° 40’52.6”)

   In this village, an old woman has one Siamese crocodile. Based on interview with her, she got the animal from Mentelang River about 20 years ago. The crocodile was trapped in a traditional fish trap when it was a "baby" (hatchling/juvenile). According to her, the condition of the Mentelang River has changed drastically. Right now, there are many villages along the river.

4. Benoa Baru Village (N 00° 27’ 6.7” and E 116° 43’2.3”)

   There was one Siamese crocodile in this village, which was caught 10 days before we arrived. The 1 m long crocodile was trapped accidentally by fishhook in Mesangat Lake. The owner of the crocodile wants to keep it and wait for somebody to buy it, but he does not know why it is not easy to sell the crocodile right now.

Villagers confirmed that there were many more crocodiles present historically, but due to increased boat traffic and human settlement inside and around the large lakes (Jempang, Semayang, Melintang), *C. siamensis* seek refuge in the smaller lakes.

C. HABITAT ASSESSMENT

Based on our visit to the crocodile farms in Balikpapan and Samarinda and interviews with the local people in several villages, we planned to survey Siamese crocodile habitats in the Mahakam River area. Specific areas surveyed were Tanah Liat, Paya, Belibis, Amir and Mesangat Lakes. The locations of the lakes are shown on Figure 5.
Figure 5. Site map of *C. siamensis* habitats (indicated by small arrows) in the lower Mahakam River system.

1. Tanah Liat Lake

Tanah Liat Lake lies at 00°29′20″ S and 112°15′48″ E; elevation 0 m above sea level (asl). The size is considered small with an open system around 3 km. The dominant plants are *Hanguana malayana*, *Phragmites karka* and floating grass, and swamp forest is found along the edge (Fig. 6). Tanah Liat Lake was considered to be in a severe condition, since 40% of the lake surface was covered by *Eichornia crassipes*. The type of crocodile present in the lake is *C. siamensis*.

Compared to the 1995-96 survey, habitat in Tanah Liat Lake has changed significantly. In June 2005, *H. malayana* and *E. crassipes* covered more than 50% of lake surface (Fig. 7). Local people fish in Tanah Liat Lake, and use many types of fishing gear, including electro-fishing. They know that electric fishing is harmful for juvenile fish, but continue to use the method as they can catch a lot of fish with this equipment.
Figure 6. Condition of Tanah Liat Lake in 1995. At top of photo is the entranceway to the center of Tanah Liat Lake (Photograph by Jack Cox).

Figure 7. Condition of Tanah Liat Lake in 2005. At top of photo is the entranceway to the center of Tanah Liat Lake (Photograph by H. Kurniati).
2. Paya River and Paya Lake

Paya Lake was originally a river, and was formed when the river became blocked by sedimentation of mud. Paya Lake lies beside Tanah Liat Lake. During our survey, we could not enter Paya Lake because of low water levels, and we stopped at the mouth of the lake. The mouth position is 00°27’13.6” S and 116°16’30.1” E; elevation 0 m asl.

Based on interviews with local people, the habitat of Paya Lake is similar to the Paya River (Fig. 8). In Paya Lake, fishermen usually find hatchling or juvenile Siamese crocodiles trapped by fishing gear such as fishhook or bu bu (traditional fish trap). Last year (May 2004), a fisherman found a *C. siamensis* nest in the lake. In 1995-1996, the LIPI-Smithsonian Institution team did not survey this habitat because the Paya River had been used as a shortcut between Bongan Village and Jempang Lake.

![Figure 8. Paya River. At top of photo is the entranceway to Paya Lake (Photograph by H. Kurniati).](image)

3. Belibis and Amir Lakes

The GPS position of Belibis Lake is 00° 27’ 21” S and 116° 17’04” E; elevation 0 m asl, and Amir Lake is located beside Belibis Lake. Amir Lake was formed by sedimentation of Belibis
Lake. In 1996, Belibis Lake and Amir Lake were one lake (Ross et al., 1998). However, sedimentation separated Belibis Lake into two parts; the new one is now Amir Lake. Currently Belibis and Amir Lake cannot be entered by boat or canoe except with high water levels. Local people have to walk about 100 m in muddy swamp to enter the lakes.

Based on interview with the local people, H. malayana is the dominant plant in the two lakes. People who live in Bongan Village regularly go to Belibis and Amir Lakes for fishing. However, since 2002 they don't fish in Belibis Lake because H. malayana covers most of the water surface.

4. Mesangat Lake

Mesangat Lake lies at 00°31’06” S and 116°41’47” E; elevation 0 m asl. Swamp flora in this lake comprises mainly H. malayana, Leersia hexandra, Thoracostachyum sumatranum and Scleria spp. Mesangat Lake is categorized as good habitat since the habitat has not been extensively damaged. However, based on our observations Mesangat Lake is not a typical lake, but is rather like a large freshwater swamp. We could not find any body of open, but many floating plant patches were everywhere. Almost all of the water surface is covered with floating plants (Fig. 9).

Based on interviews with local people, there are two species of crocodiles in Mesangat Lake, namely C. siamensis and Tomistoma schlegelii. During our visit to the lake, one possible C. siamensis nest was found (Fig. 10). A fisherman (Bapak Yus) explained that C. siamensis (or Buaya Badas Hitam) usually build nests among grassy areas or H. malayana (Fig. 10), whereas T. schlegelii (or Buaya Sapit) build nests in the forest (forest means land with many big trees) (see Fig. 11).

The habitat in Mesangat Lake has almost never changed. However, the number of people fishing in this lake has increased 3-fold since 1996 (to about 50 fishermen).
Figure 10. Based on interviews with local people in Mesangat Lake, this is a *C. siamensis* nest. Built in early April, it was destroyed by flooding at the end of May (Photograph by H. Kurniati).

Figure 11. A *T. schlegelii* nest found in Mesangat Lake in 1996 (Photograph by Jack Cox).

D. THREATS

More than half of the local people in lower Mahakam River are fishermen. They know that Siamese crocodile habitats are a source of fish, and that floating plants are home of juvenile fish. To their knowledge, most of the habitats surveyed in 1995-1996 have not changed. Nevertheless, we identified several threats that are gradually destroying the habitats. These threats were categorised as "direct" or "indirect".

1. Direct Threats

*Hanguana malayana* and *E. crassipes* (water hyacinth; introduced from South America), fishing and mud sedimentation have been impacting *C. siamensis* habitats (Fig. 12).
Weeds are a natural enemy of crocodile habitats, with the capacity to change the floral structure considerably. The process of sedimentation is accelerated with the growth of weeds. Belibis Lake is one of the *C. siamensis* habitats where weeds and mud sedimentation have "dried up" the lake, preventing access except during periods of high water levels. Weeds and sedimentation have also been impacting on Tanah Liat, Paya, Amir and Mesangat Lakes.

The number of fishermen in the Mahakam River is increasing, due to increasing numbers of villagers and also due to an influx of new people from other areas. Currently, the Indonesian Government has closed many legal logging companies, and many ex-workers have needed to find new work; many have turned to fishing.

Figure 12. Floating plants such as *H. malayana* (background) and *E. crassipes* (foreground) have been impacting on *C. siamensis* habitat in Tanah Liat Lake (Photograph by H. Kurniati).
2. Indirect Threats

Although the Indonesian Government has closed several logging companies in the upper Mahakam River, illegal logging still continues (Fig. 13). Interviewees believe that high flood levels over the last 3-4 years during the rainy season are caused by forest degradation in the upper Mahakam River. It is unclear whether there is a relationship between logging and increased flooding, but certainly increased sediment in floodwaters due to erosion may be a result of logging. This may then have a negative impact on the people living in the lower Mahakam River through habitat change. The Siamese crocodile is potentially affected by this also. Floodwaters invade human settlements and cover crocodile nests, resulting in egg mortality.

![Logs from illegal logging](image)

**Figure 13.** Logs from illegal logging (Photograph by H. Kurniati).

DISCUSSION

This survey confirmed previous reports (Ross *et al.*, 1998) that Mesangat Lake consists of stable permanent water. There are no serious threat of weeds and mud sedimentation so far, although fishing pressure has increased over the last decade. Both *C. siamensis* and *T. schlegelii* are reported to be present in this lake. This lake represented the least disturbed habitat visited during the survey.

Mesangat Lake is an isolated lake, and is not affected by water flows associated with the Mahakam River. On the other hand, Tanah Liat Lake and nearby lakes receive water from the river, which contains sediment, especially in the rainy season. As a result of sedimentation, large areas of water are now covered by invasive plants such as *H. malayana* and *E. crassipes*. One informant indicated that *C. siamensis* may use *H. malayana* for nesting, but the long-term impacts of the changes in vegetation on the habitats are unknown.

None of the principal habitats of Siamese crocodile in the lower Mahakam River are protected. Wetland International-Indonesia Program has proposed Mesangat Lake, together with other lakes in Mahakam River system (Jempang, Semayang and Melintang), to be fully protected (Wibowo, 1997). However, Forestry Department of Indonesian Government has not approved the proposal.
Most of the people in the lower Mahakam River are fishermen. Numerous waterways in crocodile habitats are fished intensively with fishing nets, hooks and fish traps. These types of equipment catch hatchlings and juvenile crocodiles. The use of electro-fishing equipment may also have a detrimental effect on the crocodile population.

In Indonesia, *C. siamensis* is protected under Indonesian Law [UU No. 5/1990 and PP No. 7 & No. 8/1999 (Departemen Kehutanan, 2003)], and all activities related to the commerce of this species are prohibited. This was not clear to local people and also to some of the local crocodile industry members. For example, Muin and Ramono (1994) reported four *C. siamensis* and 6 *T. schlegelii* being held by a villager at Muara Muntai Village in 1993. We interviewed a villager in the same village, who had three *C. siamensis* that he had obtained in 1995. One villager had a crocodile that had been obtained 20 years ago, and one *C. siamensis* was caught as recently as 10 days before this survey was undertaken.

Captive breeding has not been successful at one of the farms visited, and only infertile eggs were produced (see Cox 2004). There has been limited success at another farm, but adult *C. siamensis* and *C. porosus* were housed in a common enclosure, and there has been hybrid offspring produced. The *C. siamensis* on the crocodile farms represent a significant source of adult stock that could be used to produce crocodiles for re-stocking, should that prove to be a strategy to adopt in the future. Care should be taken to ensure that hybridisation is controlled, and if possible eliminated. The separation of adult *C. siamensis* and *C. porosus* at the farm where hybrids were encountered is a step in the right direction. Phenotypic characteristics alone were unable to separate hybrid *C. rhombifer-C. siamensis* hybrids from pure *C. siamensis* in Vietnam, and DNA testing was required to establish identity (N. Fitzsimmons, pers. comm.). Genetic testing would probably be required in Kalimantan for possible future re-stocking of depleted populations.

Overall, pressure on the existing *C. siamensis* habitat is high, and it may not be easy to minimize the threats caused by activities of local people. Community-based conservation is a possible conservation strategy which may be suitable for the local community in the Mahakam River area. As has been shown in other countries, long-term conservation may be dependent on some form of use.

This survey has confirmed that *C. siamensis* are still present in the upper Makaham River, and breeding still occurs. However, more detailed systematic surveys over a wider area are required to assess the current status of the wild *C. siamensis* population.

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