

Siamese Crocodile *Crocodylus siamensis*

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Common Names: Siamese crocodile, Buaya kodok (Indonesia), Jara Kae Numchued (Thailand), Kropeu (Cambodia); ‘Ke’/‘Kae’ (Laos; as for Thailand), ‘Rabur’ (local name of Mangkong, Ta Oy and Ka Tong ethnic groups in southern Laos), Cá sau xiêm (Vietnam)

Range: Cambodia, Indonesia (Kalimantan), Laos, Thailand, Vietnam, (possibly Malaysia, Myanmar)



Figure 1. Current distribution of *Crocodylus siamensis*. Populations in Thailand and Vietnam were reintroduced (Pang Sida National Park and Cat Tien National Park respectively).

Conservation Overview

CITES: Appendix I

CSG Action Plan:

Availability of survey data: Poor in most Range States, moderate for Cambodia and Laos

Need for wild population recovery: Highest

Potential for sustainable management: Low-Moderate

2009 IUCN Red List: CR (Critically Endangered. Criteria A1ac. Severe decline in numbers and area >80% decline in three generations; IUCN 2009) (last assessed in 1996).

Principal threats: Habitat loss, illegal hunting/trade, incidental capture/drowning in fish traps, extremely low and fragmented remaining populations.



Figure 2. Adult *C. siamensis*. Photograph: Grahame Webb.

Ecology and Natural History

Crocodylus siamensis is one of the world's most endangered crocodylians. In 1992 it was reported as virtually extinct in the wild (Thorbjarnarson 1992) and in 1996 it was accorded IUCN Red List status of 'Critically Endangered'. Since 1996, new status assessments have resulted in the discovery of wild populations and information on its global distribution and ecology, although it remains one of the least known of crocodylians.

The Siamese crocodile occurs in a wide range of freshwater habitats, including slow-moving rivers and streams, lakes, seasonal oxbow lakes, marshes and swamplands (Smith 1931; Daltry *et al.* 2003; Bezuijen *et al.* 2006b; Cox and Phohtitay 2008). During the wet season, individuals disperse across

flooded landscapes (eg radio-tracked individuals have moved up to 25 km before returning to dry season sites; Simpson *et al.* 2006b). The use of burrows excavated into the banks of rivers or lakes has been reported, with up to five individuals utilizing a single burrow at one time (Simpson *et al.* 2006b). Generally preferring lowland elevations, the species has been recorded up to 600 m (Daltry *et al.* 2003).

Crocodylus siamensis is a medium-sized species, with males reportedly reaching up to 4 m in length, although most individuals probably do not exceed 3.5 m (Smith 1919). Nesting occurs towards the end of the dry season (February–April), with females constructing a mound nest on floating vegetation mats or on the banks of lakes or rivers. Hatchlings emerge in the wet season after 70–80 days incubation. Site fidelity has been recorded (Simpson *et al.* 2006a). Wild clutches found in Cambodia, Laos and Vietnam contained up to 31 eggs (MOSTE 1992; Simpson and Han 2004; Bezuijen *et al.* 2006b; Platt *et al.* 2006; Cox and Phothitay 2008), and up to 50 eggs have been laid by captive females in Thailand (Youngprapakorn *et al.* 1971).

Similar to many other crocodylians, *C. siamensis* feeds on a wide variety of prey such as invertebrates, frogs, reptiles, birds and mammals, including carrion (Daltry *et al.* 2003; Bezuijen, in press). Preliminary information is available on phylogeography and population genetics (Gratten 2003), seasonal sperm cycles (Kitiyant *et al.* 1994) and the antimicrobial properties of its blood (Merchant *et al.* 2006). Hybridisation of captive *C. siamensis* with *C. rhombifer* and *C. porosus* has been documented (Chavananikul *et al.* 1994; Thang 1994), and the chromosome number of *C. siamensis* and hybrids, as well as DNA methods to distinguish them, have been identified (Youngprapakorn 1991; Fitzsimmons *et al.* 2002).

Conservation and Status

Historically, *C. siamensis* was widely distributed across mainland Southeast Asia, and possibly on some islands of Indonesia and Malaysia. Its current distribution is greatly diminished and fragmented, and remnant populations comprise small numbers of scattered individuals, with very few colonies confirmed to be reproductively active.

Cambodia: Extensive conservation efforts have been initiated since the 1998 CSG Action Plan, including nation-wide field surveys and a long-term field conservation project implemented by the Forestry Administration and Fauna & Flora International. Field studies began in the late 1990s, following earlier reports suggesting the species was widespread and relatively abundant (Thuok and Tana 1994). Systematic assessments have been completed in many of the major waterways and likely crocodile habitats (Daltry and Chheang 2000; Daltry *et al.* 2003; Platt *et al.* 2004, 2006; Simpson and Han 2004; Simpson *et al.* 2006a; Timmins 2007; Bezuijen *et al.* in press). These have revealed a severely depleted and fragmented population, with *C. siamensis* confirmed from 35 sites on 21 river systems across 11 provinces. Many of these

sites are outside protected areas and contain only one or two individuals. The national wild population could comprise fewer than 150 adults (Cambodian Crocodile Conservation Programme database). Important river systems for crocodile conservation include the Srepok, Sekong, Sre Ambel, Pursat, Koi, Kep, Tatai and Areng Rivers and Veal Veng Marsh.

Since 2001, nesting has been recorded at 10 locations in 8 provinces, however threats continue to reduce breeding success, and the number of active nest sites has been declining (Simpson *et al.* 2006a). Veal Veng Marsh and the Areng River, both in the Cardamom Mountains, hold the largest wild populations, and each produces one to three nests annually. These sites and the Sre Ambel River are now the focus of enforcement patrols and community-based conservation management, which have demonstrated success in reducing poaching (Daltry *et al.* 2006; Simpson and Ratanapich 2007; Simpson *et al.* 2006). Additional community sanctuaries are planned in the northeast.

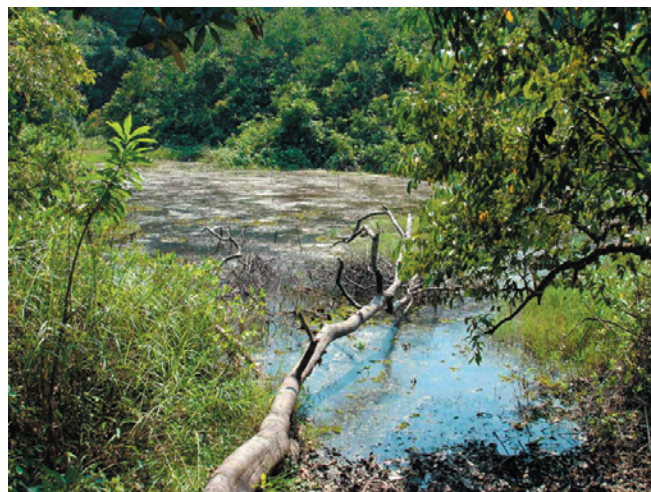


Figure 3. Nesting site for *C. siamensis* off the Sre Ambel River, Cambodia. Photograph: Charlie Manolis.

Human activities continue to impact heavily on most *C. siamensis* populations in Cambodia. Many river systems, including those in protected areas, have hydroelectric power dams approved or proposed, which are likely to cause the loss of approximately half of the remaining breeding colonies within the next 10 years. Cambodia has more than 900 crocodile farms or raising facilities, mostly situated around the Tonle Sap Great Lake (Jelden *et al.* 2005). Illegal capture of wild crocodiles for supply to farms is an ongoing threat, as well as incidental capture/drowning in fishing nets and traps and habitat loss (SCWG 2004). Despite ongoing conservation efforts the long-term viability of remnant populations is uncertain. The Cambodian Government, conservation groups and CSG have initiated a re-introduction plan to bolster wild stocks and maintain viable populations.

Indonesia: The Siamese crocodile is currently confirmed to occur in a single river system, the Mahakam, in East Kalimantan Province (Cox 2004; Cox *et al.* 1993; Muin and Ramono 1994; Ross *et al.* 1998; Kurniati *et al.* 2005). There are unconfirmed local reports of *C. siamensis* from Central

Kalimantan Province (Ross *et al.* 1998). These are the only recent reports of *C. siamensis* outside mainland Southeast Asia and these populations are genetically distinct from mainland conspecifics (Gratten 2003). Historically, *C. siamensis* occurred in Java (Ross 1990, 1992), but given the severe loss of wetland habitats there it is unlikely any populations remain. Follow-up surveys and conservation initiatives are planned for the Danau Mesangat area in the Mahakam River system in late-2009/2010 (Dacey 2008, pers. comm.).

Laos: The first systematic field surveys for *C. siamensis* were undertaken between 2003 and 2008 (Thorbjarnarson *et al.* 2004; Bezuijen *et al.* 2006b; Cox and Phothitay 2008). These confirmed previous reports (Salter 1993; Sawathvong 1994) that many local populations had been extirpated and remnant populations were small and scattered. Intensive hunting in the mid-20th century, principally for skin harvest and supply of live crocodiles to crocodile farms, appears to be the principle cause of these declines. The largest remnant populations documented in Laos are in 8 river systems, the Xe Champhone, Xe Banghiang, Xe Bangfai and Xe Xangxoy (Savannakhet Province), Xe Pian, Xe Khampho, Xe Kong (Attapu Province) and Xe Don (Salavan Province) (Bezuijen *et al.* 2006b; Cox and Phothitay 2008). Since 2003, nesting has been recorded in at least 6 sites, but evidence of successful recruitment (hatchlings) has been confirmed at only two sites. Most documented localities are outside protected areas, within community wetlands.

Remnant populations are threatened by loss of wetland habitats and incremental loss of adults or young by occasional capture in fishing nets or egg collection. The only known captive population is at Ban Kuen Zoo, which supports around 1000 individuals, most of which are suspected to be hybrids (Phothitay *et al.* 2005; Cox *et al.* 2008). At least three factors are key to *C. siamensis* conservation in Laos; community-based conservation approaches outside of the national protected areas system, habitat-level management of a range of permanent and seasonal wetlands (rivers, lakes and ponds), and, protection of confirmed breeding sites. Community workshops were held in 2006 and 2007 to document local knowledge of crocodiles (Bezuijen *et al.* 2006a; Mollot *et al.* 2007). In 2008, a new crocodile conservation project was initiated (Cox *et al.* 2008), which included preparation of a crocodile management plan for Savannakhet Province (Cox and Somvongsa 2008). This is a further management plan for crocodiles in Laos.

Malaysia: Smith (1919) reports a single specimen of *C. siamensis* from Peninsular Malaysia. The eastern and western coasts of Peninsular Malaysia previously supported extensive lowland wetland habitats contiguous with the wetlands of southern Thailand, and it seems likely that *C. siamensis* occurred there. There are no documented records from Sarawak or Sabah (Sebastian 1993). Hatchling *C. siamensis* were exported recently (2005-2007) from Thailand to farm/s in Sabah (source: UNEP-WCMC database).

Myanmar: At least one historical reference indicates that *C. siamensis* occurred in Myanmar (Garnier 1996). The most likely area to support any remnant populations is the Mekong

River in southeastern Myanmar, which flows into northern Laos. Unconfirmed local reports of crocodiles from the Mekong River in northern Laos (Salter 1993; Bezuijen *et al.*, in prep.) also suggest that *C. siamensis* may have occurred in Myanmar. The section of Mekong River in Myanmar (~200 km) is under restricted access and off-limits for biological surveys. Habitats along this river section (and where it enters northern Laos and Thailand) have been impacted by recent blasting to remove rapids and deepen the channel for boats, and increasing shipping activity. Any remnant populations are probably small and severely threatened.

Thailand: Historically, *C. siamensis* was widely distributed in some parts of Thailand (Platt *et al.* 2002), but most populations have been extirpated. The extremely threatened national status of the species appears unchanged since the 1992 CSG review. Surveys since the early 1990s have confirmed a highly fragmented and scattered population persisting in marginal habitats (Kreetiyutanont 1993; Ratanakorn and Leelapatra 1994; Ratanakorn *et al.* 1994; Platt *et al.* 2002; Temsiripong 2003). One hatchling was discovered at Pang Sida National Park in 2002 (Temsiripong 2003). A re-introduction project has been initiated by the Royal Thai Forest Service and the Crocodile Management Association of Thailand with 20 crocodiles being released in a pilot project in Pang Sida National Park in 2005 and 2006 (Temsiripong 2001, 2006). Monitoring by ranger patrols and camera trapping has detected few of the released animals (Temsiripong 2006). Further releases and sites are being considered. Many thousands of Siamese crocodiles are held on crocodile farms. Hybridization between *C. siamensis* and *C. porosus* has been noted as a concern .



Figure 4. Captive adult *C. siamensis*. Photograph: Charlie Manolis.

Vietnam: Viable breeding populations no longer appear to exist in Vietnam. Early reviews (Cuc 1994; Cao and Jenkins 1998) indicated that populations had been severely affected by massive habitat loss, intensive hunting, and live capture for crocodile farms. Surveys of some localities in 1999 failed to locate crocodiles (Platt and Tri 2000). Surveys of Ha Lam Lake (Phu Yen Province), where crocodiles were apparently abundant, detected only two individuals (Nguyen *et al.* 2005). The Ha Lam Lake area is now being flooded by the newly

constructed Ba River hydroelectric dam. A re-introduction of 60 adults/sub-adults to Bau Sau Lake in Cat Tien National Park was carried out in 2001-2004 (Polet 2002; Murphy *et al.* 2004), with at least one nest being produced in 2005. Regular monitoring indicates that few adults remain (at least 25% were killed in 2004 by local residents). A visit to the park in July/August 2009 detected hatchlings and juveniles, confirming that successful breeding continues (J. Thorbjarnarson, pers. comm.). Over 1000 crocodile farms and raising facilities, based almost exclusively on *C. siamensis*, are located in southern Vietnam (Jelden *et al.* 2008). Hybridization between *C. siamensis* and *C. rhombifer* has been noted as a concern (Jelden *et al.* 2008).



Figure 5 Captive adult *C. siamensis*. Photograph: Charlie Manolis.

Cambodia and Laos support the largest known remnant populations, but all known breeding populations are small and highly threatened. There are sufficient wild populations to provide a basis for recovery, although some locations may require augmentation or re-introduction if they are to be viable. *Crocodylus siamensis* is well represented in captivity, with over 700,000 individuals held on farms in Thailand, Cambodia and Vietnam (Temsiripong *et al.* 2004; Jelden *et al.* 2005, 2008), as well as farms in China and zoos in Europe, North America and Asia. Hybridisation with *C. porosus* and *C. rhombifer* has been reported on farms in Thailand, Vietnam and Cambodia (Chavananikul *et al.* 1994; Thang 1994; Jelden *et al.* 2008) and confirmed by DNA testing (Fitzsimmons *et al.* 2002). These farms (and farming associations) represent a considerable potential resource (financially and for genetically-pure source stock) for future conservation initiatives within Range States. Farms in Thailand and Vietnam have already provided genetically pure *C. siamensis* for wild re-introductions. To be assured of success, however, re-introduction programs must first address the complex and extreme threats facing *C. siamensis* in the wild.

In 2005 and 2008, at the request of national government agencies, the CSG conducted a review of *C. siamensis* in Cambodia and Vietnam respectively, to improve conservation and management of captive and wild *C. siamensis* (Jelden *et*

al. 2005, 2008). The CSG recommendations covered areas of legislation and regulations, CITES compliance obligations, captive management and monitoring, surveys and conservation initiatives, control of illegal trade, regional conservation initiatives and restocking options, and are contributing to current efforts by national agencies. Similar CSG reviews for crocodile management (including *C. siamensis*) were previously conducted in Indonesia (Webb and Jenkins 1991a) and Thailand (Webb and Jenkins 1991b). In Thailand, the Crocodile Management Association of Thailand (CMAT) has initiated a *C. siamensis* re-introduction program. A National Crocodile Management Plan was prepared for Indonesia (PHPA 1997).

Priority Projects

High priority

1. **Dialogue between neighbouring states:** Control of trade between neighbouring States is difficult for one country to achieve on its own. A dialogue process, perhaps through a regional working group under an appropriate body (eg ASEAN Wildlife Trade Initiative and/or Mekong River Sub-regional CITES Working Group), to address regional issues and problems with *C. siamensis*, is considered an important action to control illegal trade.
2. **Implementation of crocodile management and conservation programs in Cambodia and Laos:** These nations support the largest documented populations of *C. siamensis*. Management priorities and plans have been developed in both countries, but are currently focused on a small number of sites and are hindered by low funding. A critical priority is to secure long-term funds to support, strengthen, and expand current crocodile conservation activities in both countries. Both local stakeholder and high-level Government support are critical to ensuring this species and its habitats are safeguarded. Field activities should be complemented by national and regional dialogue to address any current illicit trade of wild crocodiles, particularly between Cambodia, Laos, Thailand and Vietnam.
3. **Status surveys and development of crocodile management and conservation programs in Indonesia (Kalimantan):** Initiate conservation actions to protect documented populations in East Kalimantan Province and locate any additional wild populations.
4. **Continue and strengthen current re-introduction programs for *C. siamensis* in Thailand and Vietnam:** Implement regular monitoring and reporting to assess the success and status of existing re-introduction initiatives.

Moderate priority

5. **Strengthen links between conservation of wild *C. siamensis* populations and national crocodile farms:** Crocodile farms in Thailand and Vietnam (and to a lesser degree in Cambodia) are a significant potential resource

for financial and technical support of local conservation initiatives and should be lobbied for support.

6. **Clarify the distribution and status of *C. siamensis* in marginal Range States:** Conduct status surveys and reviews of museum specimens to clarify the status of *C. siamensis* in Indonesia (including unconfirmed records from Sulawesi and Sumatra), Malaysia, and Myanmar.
7. **Maintain pure stocks of *C. siamensis* in crocodile farms:** Most captive *C. siamensis* populations are in large crocodile farms in Thailand, Cambodia and Vietnam, where interbreeding with *C. porosus* and/or *C. rhombifer* occurs (Starr *et al.* 2009). Farms should be encouraged to segregate genetically pure *C. siamensis* of known origin for conservation, in addition to the hybrids that are promoted for skin production.

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