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# Status of the Freshwater Crocodile (*Crocodylus siamensis*) in Song Hinh District, Phu Yen Province, Viet Nam

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# Status of the Freshwater Crocodile (*Crocodylus siamensis*) in Song Hinh District, Phu Yen Province, Viet Nam

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# Acknowledgements

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# Abbreviation and Acronyms

| | |
|---|---|
| amsl | above mean sea level |
| CSG | Crocodile Specialist Group of the Species Survival Commission, IUCN |
| DARD | Department of Agriculture and Rural Development |
| DoNRE | Department of Natural Resources and Environment |
| EIA | Environmental Impact Assessment |
| FFI | Fauna & Flora International |
| FIPI | Forest Inventory and Planning Institute - MARD |
| GIS | Geographic Information System |
| GPS | Global Positioning System |
| IUCN | The World Conservation Union |
| ITB | Institute of Tropical Biology |
| MARD | Ministry of Agriculture and Rural Development |
| MWBP | Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme |
| PC | People's Committee |
| PECC 1 & 4 | Electricity Construction Consulting Companies No. 1 (in Ha Noi) and 4 (in Nha Trang), belonging to Viet Nam Electricity Corporation (EVN) |
| PRA | Participatory Rapid Appraisal |
| SHFMB | Song Hinh Reservoir Fishery Management Board |
| SIERES | Sub-Institute of Ecology, Resources and Environmental Studies, belonging to the ITB |
| SSC | Species Survival Commission, IUCN |
| SubFIPI III | Sub-Institute of Forest Inventory and Planning for the South Central and Central Highlands |
| UTM | Universal Transverse Mercator Coordinate System |
| WP | Waypoint |

## Local E De minority terms

| | |
|---|---|
| Be | Crocodile |
| Bàu | The word means lake in Viet Namese language (e.g. Hà Lầm Lake). E De Ethnic group also call a river section with deep water as 'Bàu'. In such cases, it is translated as 'lake' in quotation marks (e.g. KLay 'Lake') |
| Buôn | Village |
| Ea | water or wetlands |
| E De | A minor ethnic group, indigenous to the Central Highlands and Song Hinh District, majority in Ea Lam and Song Hinh Communes. |
| Y | Mister (e.g. Mr Y Leo) |
| H' or Hờ | Miss (e.g. Ms H'Dem) |
| Ma | Father (e.g. Ma H'Dem is father of a daughter, namely H'Dem) |
| Oi | Grandfather (e.g. Oi Đức means grandfather of Y Đức). Therefore, an E De person may have two or three names. |

# Executive Summary

This report describes surveys that were carried out for the critically endangered freshwater crocodile (*Crocodylus siamensis*) in the Song Hinh District of Phu Yen Province, Viet Nam. Freshwater crocodiles are considered effectively extinct in Viet Nam. Surveys were undertaken in June 2005 after a socio-economic study in December 2004 uncovered information regarding wild crocodiles from the Song Hinh hydropower reservoir. Funding and technical support for the project was provided by the Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP), and implemention was carried out by the Institute of Tropical Biology (ITB) in co-operation with Fauna and Flora International (FFI) Cambodia Programme, and local government authorities.

The aim of the project was to confirm and assess the status of wild freshwater crocodiles in Song Hinh District, and recommend follow-up conservation actions. The mission conducted daylight searches for signs and direct sightings of crocodiles, nocturnal spotlight searches for crocodile 'eye-shine', and interviews with local people. Survey effort was focused in two localities in Song Hinh District; Ha Lam Lake and Song Hinh Reservoir, and extended to the surrounding areas, including nearby reaches of the Krong Hnang and Ba Rivers.

Song Hinh Hydropower Reservoir: the Hinh River (= Song Hinh) was dammed in 1999, flooding approximately 15km of the Hinh River and numerous tributaries, to form the 41km$^2$ reservoir for hydro-electric power generation. For the first three years after damming, the reservoir was stocked with 200 million fish fry which formed the basis of a now thriving fishing industry.

Spotlight surveys covering 182km of the reservoir shoreline failed to find any sign or sightings of crocodiles, however several local reports indicate that one to two crocodiles have been seen infrequently over the past year. Reports also indicate three crocodiles were caught or killed by fishermen from the reservoir between July and December 2004. The crocodiles reported from the reservoir over the past several years were probably resident in the Hinh River or nearby tributaries before the river was dammed. These crocodiles were then displaced by the raising water levels but continue to reside in the reservoir.

The reservoir is presently unsuitable for wild crocodiles to survive, particularly in the dry season, due to hunting, intensive fishing and unsuitable habitat. The high annual water level fluctuations in the reservoir and human-induced disturbances, like farming and cattle grazing, result in an environment that is unsuitable for crocodile habitation. Illegal electro-fishing is rampant in the reservoir and crocodiles are actively hunted by some fishermen.

Ha Lam Lake: surveys confirmed the presence of at least two wild freshwater crocodiles in Ha Lam Lake. One fresh track of a large individual was found on a steep lake bank during a daytime search, while a direct observation of another adult individual was made during a spotlight survey. Research findings suggest there is probably a small group of wild crocodiles inhibiting this lake which is found within the Krong Trai Nature Reserve.

Previous hunting and land clearing for agriculture has reduced the crocodile population in this lake. The remaining habitat is still suitable however, and when coupled with an

increased protection from local forestry officers and an increased awareness campaign amongst local people, could provide a basis for recovery. Because the construction of Lower Ba River Hydropower Dam will submerge the area within the next year the habitat and survival of these crocodiles is really at stake. At present there are no conservation plans for these crocodiles or protected habitats set aside for wildlife conservation in any man-made hydropower reservoirs.

Other areas: interviews with numerous villagers, including indigenous minority groups, have revealed that freshwater crocodiles may still be present in various rivers and streams in more remote areas of Song Hinh District and neighbouring Gai Lai province.

## Recommendations

Freshwater crocodiles are considered effectively extinct in Viet Nam, so the discovery of a small number in Ha Lam Lake is highly significant for crocodile conservation in Viet Nam, and for the species.

Follow-up priority conservation actions are urgently needed to save the last wild crocodiles of Song Hinh District (and most likely of Viet Nam). There is a suite of actions which need to be conducted at all levels, including an awareness raising campaign, an assessment of possible solutions for Ha Lam Lake crocodiles, capacity building among wildlife officers and further surveys in potential crocodile sites. These actions are urgent and time-bound since the Ha Lam Lake is scheduled to be submerged by the end of 2006 due to the proposed Lower Ba River Hydropower Project.

Priority actions are recommended as below:

1. Carry out awareness raising activities on the National laws, regulations and the global significance of the Song Hinh district crocodiles, specifically at Ha Lam Lake, Song Hinh reservoir and protected areas of Krong Trai, Ea So and Yok Don (sections 5.1 and 5.4).
2. Conduct an urgent assessment on the conservation solutions for Ha Lam Lake crocodiles (see section 5.2). The research findings should be finalised by the end of 2005 (before impoundment of the Lower Ba River Reservoir scheduled in 2006) to inform and influence the decision making process relating to the Lower Ba River Dam Project.
3. Undertake further crocodile surveys to prospective localities in the Central Highlands particularly in the Krong Hnang and Ba Rivers in Gia Lai and Phu Yen provinces (section 5.3).
4. Increase protection for Ha Lam Lake crocodiles through the development of community-based warden programme to undertake regular patrols of the crocodile habitat (section 5.1).
5. Increase the capacity of local Government agencies and the management of the Krong Trai Nature Reserve to ensure that the Ha Lam Lake crocodiles are provided with appropriate protection and management (section 5.4).
6. Hold stakeholder workshops at district, provincial and national levels with the participation of relevant stakeholders to present the survey findings, draw attention to the crocodiles and discuss a conservation action plan and priority activities (section 5.4).

7. **Capture and temporarily relocate wild crocodiles to captivity.** If any crocodiles are found in adverse situations which endanger their continued survival, they should be captured and relocated to a captive crocodile facility where future options can be assessed. (See section 5.2).
8. **Develop proposals to seek funding for implementation of the above-mentioned priority actions** with the support of crocodile conservation programmes in Cambodia and Lao PDR and international conservation agencies and donors (section 5.4).

# 1. Introduction

## 1.1. Background

The freshwater or Siamese crocodile (*Crocodylus siamensis*) is one of the world's most endangered crocodilians and listed as "Critically Endangered" by the the World Conservation Union (IUCN 2004). Once found throughout the wetlands of Southeast Asia, the species has been forced to the brink of extinction through the loss of its wetland habitat, hunting, and collection of animals for crocodile farms. Populations from Indonesia, Malaysia, Myanmar, Thailand and Viet Nam are now extremely depleted or extinct (Ross 1998), with the most significant populations now restricted to small scattered groups, mostly in Cambodia and Lao PDR (Daltry *et al*. 2003; Simpson and Han 2004; Thorbjarnarson 2003). The total population probably comprises less than 250 adults.

Freshwater crocodiles were once relatively abundant in Viet Nam but habitat destruction, through logging and conversion of wetland habitats for agriculture, has seriously decreased their habitat. Hunting and the collection of live animals for crocodile farms has also impacted heavily on the species. Freshwater crocodiles are now considered to be effectively extinct in the wild after surveys in 1999 failed to find any crocodiles (Platt and Tri 2000). Platt and Tri (2000) suggest that viable populations no longer exist after they surveyed and assessed the most likely crocodile habitats, although they could not get permission to survey the Tay Son Lake[1] located in Krong Trai Nature Reserve (Phu Yen Province), where there was once (1981) an estimated population of about 200 crocodiles (Cuc 1994). However, reports from the Tay Son Lake area now suggest that crocodiles are rare and subject to continued exploitation (Platt and Tri 2000). The Sere Pok River may contain remnant populations although these are also under threat from fishing and hunting (Platt and Tri 2000). Crocodiles are known to occur across the border in Cambodia (Simpson and Han 2004). In 2002, a programme was established to re-introduce the freshwater crocodile into the Bau Sau wetland, Cat Tien National Park. Sixty crocodiles were released over a two year period and have been monitored monthly (Murphy *et al.* 2004), although there is some doubt as to how many remain in the wetland as up to 25% are known to have been killed.

The freshwater crocodile is now afforded complete protection in Viet Nam and listed in the Red Book under the category of Endangered, and in Group I of Decree No. 48/2002/ND-CP promulgated by the Government of Viet Nam on April 22, 2002 that strictly bans the exploitation and use of the species in the wild.

## 1.2. The MWBP/ITB/FFI Initiative

In December 2004, ITB uncovered reports from local villagers and fishermen of wild crocodiles in Song Hinh hydropower reservoir, Phu Yen Province. Song Hinh district is a remote area of Phu Yen Province and possibly among the last wilderness frontiers for any remaining wild freshwater crocodiles in Viet Nam. Given the urgent situation, the Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP) provided

[1] Refer to section 2.1.1 for discussion on possible connection between Tay Son Lake and Ha Lam Lake.

funding and support that enabled the ITB in co-operation with FFI Cambodia, and Government authorities (District PC of Song Hinh, Phu Yen DARD and DoNRE) to conduct a ten-day field survey in Song Hinh district in June 2005 to confirm these reports and assess the status of the crocodiles.

## 1.3. Survey Objectives

The surveys primarily aimed to:

- Confirm the presence of the wild, freshwater crocodiles in Song Hinh district.
- Determine the origin of the captured crocodiles from the Song Hinh hydropower reservoir.
- Access the status and distribution of crocodiles in Song Hinh district.
- Identify the current threats to the crocodiles in the area.
- Elicit local cooperation in their protection.
- Recommend follow-up conservation actions.

# 2. Survey Methods

## 2.1. Study Area

Song Hinh District in Phu Yen Province is situated in the transition zone between the Central Highlands and the coastal zone of south-central Viet Nam. It used to be a remote and inaccessible area, home to indigenous people and wildlife even until the late 90's (ITB 2004). The area, however, has experienced a rapid development, better roads and improved public works coupled with immigration in the last several years. Indigenous to Ea Lam and Song Hinh communes are the E De and Ba Na ethnic minority groups.

Survey efforts were focused in two localities, the Song Hinh hydropower Reservoir and Ha Lam Lake both in Song Hinh district, and also included areas in the surrounding vicinity including the Ba River[2] (Ea Lam commune), Krong Hnang river[3] (Gia Lai province) and the upstream area of Song Hinh reservoir in Dac Lac province.

### 2.1.1 Ha Lam Lake

Ha Lam Lake (see Map 1 and Map 2) is located in Ea Lam commune, which is a remote commune of Song Hinh district (Phu Yen province) with an area of 3,841 hectares and a total population of 2,053 inhabitants, among which 89% are the E De minority people living in five villages. The remaining 11% are Kinh people living in one newly established village. The Ha Lam lake is incorporated into the decreed 27,290 ha Krong Trai Nature Reserve (Birdlife and FIPI, 2004), for the single purpose of crocodile conservation (SubFIPI III 2004). Ha Lam Lake is also probably the Tay Son Lake of the Krong Trai Nature Reserve mentioned in recent crocodile reports (Cuc 1994; Cao and Jenkins 1998; Platt and Tri 2000). This protected area was first established in 1979 under the name of Tay Son Protected Forest (the same as the old name of the district[4] where it is situated), although the local E De minority people call the lake 'Ha Lam'. Erroneous co-ordinates from previous reports have hampered an accurate location of Tay Son Lake from the literature (Cuc 1994; Platt and Tri 2000).

Ha Lam Lake is an elongated lake, draining to the Ba River in the rainy season. During the survey (dry season), the lake covers an area of ca. 20 - 30 hectares[5] stretching over a length of four kilometres and the width varying from several metres at the east end to 100-200 metres in the central lake. The lake has an average depth of one to two metres, surrounded by farm lands, bamboo shrubby, grassy lands and submerged forest stand dominated by woody tree species of *Neolamarckia cadamba*, *Neonauclea sp.* and *Careya sphaerica*. Some areas of the lake are heavily vegetated by large floating grass mats, lotus, water hyacinth and water morning glory. Rainfall is the main source of water supply with much higher water levels in the rainy season covering a larger area and providing more

[2] Ba River is the biggest river in Central Viet Nam with ca. 320 km length, rising in the Truong Son Ranges, central South Viet Nam, and flowing South past An Khe to Krong Pa, then South East and East past Son Hoa to the South China Sea at Tuy Hoa City.

[3] A tributary river of Ba river, flowing in the land of Dac Lac and Gia Lai procinces

[4] The former Tay Son District was later divided into two current districts of Song Hinh and Son Hoa (Huynh Xuan Quang - Phu Yen DARD, pers. comm.)

[5] The figure is a rough estimation based on GIS data available.

favorable conditions for the wildlife like crocodiles, fish and waterfowls. Villagers fish in the lake mainly in the rainy season for their home consumption.

The E De people used to live in the upland surrounding Ha Lam Lake. Because the Ba River record flood in 1993 caused heavy damage, local authorities moved villagers to higher land area near the present commune center and ca. two kilometres away from the lake. Major livelihoods of the locals are farming, cow raising and fishing in the lake. Villagers still commute on foot daily to their agricultural field surrounding the lake to work. Local villagers presently use Ha Lam Lake for watering their crops, fishing and washing in dry season. Major crops observed during the survey are dry rice field, sesame, corn, red bean and main catch from the lake includes swamp eel, eel, edible snail, broadhead catfish and so other species. Agricultural lands fringe more than three quarters of the lake, while a small disturbed forest forms the remainder of the riparian vegetation on the steep southerly slope (unsuitable for agriculture).

Local E De people use different names for sections of Ha Lam lake, specifically from upper to lower parts (i.e. west to east): Hàm Ngách ('Clear Water', where there is an abandoned pump station that used to irrigate 4.5 ha nearby field); Bàu Sen ('Lotus Lake'); Bàu Lầm and Bàu Chao (ca. 0.8km upstream of the lake's east end, 150 m wide and 2-3 m deep).

### 2.1.2 Song Hinh Reservoir

Constructed in 1999 on the Hinh River (=Song Hinh) for electricity generation, the Song Hinh Reservoir (see Map 1 and Map 3) is administratively located on the land of three communes within Song Hinh District, namely Song Hinh, Duc Binh Dong and Ea Trol. Many ethnic minority villages situated along the river where relocated to nearby higher ground before the dam was built and continue to live traditional lifestyles in these new villages. Damming the river caused approximately 15km of the Hinh River to be flooded, including the partial flooding of six smaller rivers or tributaries which flow into the Hinh. The subsequent Song Hinh Reservoir has a surface area of 4,100 hectares at high water level[6]. During the low water level (August-September), as much as 2,100-3,350 ha (48-56%) of the reservoir is exposed (CITEC & IEM, 1996). This exposed area was barren or intensively used for agriculture and cattle grazing during the survey (low water level). Many tree stumps and standing dead trees were seen in shallow water areas and embayment (Photos 13 and 14). Good watershed protection forests exist to the west and the upstream mountainous areas of the reservoir, however much of the fringing reservoir habitat remains degraded or used for agricultural lands.

Primarily formed for hydropower generation, the reservoir also supports an intensive fishery which was established soon after damming the river, with the introduction 200 million carp fingerlings over three years. Although the reservoir has 50 registered fishermen, it is estimated that more than 500 fishermen use the lake during the fishing season (Mr Mr Tinh SHFMB, pers com). Numerous fishing methods are used including nets (deep water triple layer, lift, gill, seine, scoop, funnel, cast), traps, angling, hand capture and electro-fishing. Numerous fishing nets were observed during the survey, as well as the extensive use of illegal electro-fishing gear.

[6] High water level of the reservoir is 209 m amsl and low water level 196 m amsl (CITEC & IEC 1996).

## 2.2. Study Methods

The surveys were carried out over ten days from 10 to 20 June 2005 by a team comprising four SIERES/ITB researchers, crocodile specialist from FFI Cambodia, two provincial officials from Phu Yen Province DoNRE and DARD and local guides. Surveys were undertaken at the end of the dry season with the occurrence some occasional rains[7]. Water levels in Song Hinh reservoir and Ha Lam Lake were near their lowest levels, which offered favorable conditions for the survey since crocodiles would be confined in smaller water bodies.

The surveys involved a range of standardised scientific methods, including daytime search for signs (dung, tracks, slides, burrows and other sign) and direct sightings of crocodiles, and nighttime spotlighting to search for crocodile 'eye-shine', and participatory rapid appraisal (PRA) tools.

Daylight surveys: daylight surveys were conducted in Ha Lam Lake, Song Hinh reservoir, tributary rivers of Song Hinh reservoir (Thay Nghe 1 and Thay Nghe 2 rivers), and a six kilometre section of Ba river bordering north of Ea Lam Commune to actively search for crocodile signs and sighting and assess habitat and navigability.

Spotlight surveys: nocturnal spotlight surveys were conducted in Ha Lam Lake from small canoes and on foot, and in Song Hinh reservoir from two small motored boats (one outboard motored boat and one inboard motored boat) hired from local fishermen. Strong rechargeable handheld sixvolt searchlights (model YD-9000,) were used for nighttime spotlighting. Spotlight boat surveys followed the shoreline and were maintained within 100 metres of the shoreline where ever possible.

Semi-structured interviews: interviews were conducted with fishermen, villagers and local key informants and officials concerning historical distribution, recent sightings, hunting and general knowledge of crocodiles. Interviews were conducted in the field or at their home, but were focused on individuals who lived or worked in the area and had direct knowledge of crocodiles. Guidance questions used for semi-structured interviews are presented in Appendix 2.

Extended searches: whenever possible, rapid assessments were made to other sites when local reports of crocodiles arose during the surveys or interviews, especially with ethnic minority villages along Krong Hnang River in Gia Lai province and Ba River in Ea Ba commune (Song Hinh district).

Impact assessment: the team obtained relevant documents relating to the development plan for hydropower plants in the basin of the Ba and Krong Hnang rivers to assess the impact on any crocodiles and propose solutions to mitigate threats.

Garmin GPS receivers were used for positioning and recording survey routes and special events in the field in pre-determined UTM coordinate system (zone 49, northern hemisphere, WGS-84). Distance traveled was measured in ArcView GIS by connecting GPS waypoints

[7] PhuYen province has yearly average rainfalls ranging from 1,600 mm to 1,700 mm with heavy rains concentrating from September to November

recorded along each survey route, consequently slightly underestimating the actual distance traveled. It also means that survey routes depicted in maps are simplified forms of the more complex routes in the field. Other survey equipment used included digital cameras and topographical maps of various scales (1:10,000 to 1:50,000). A detailed description of each survey route is provided in Appendix 1.

# 3. Survey Results

Survey efforts were focused in two localities, Ha Lam Lake and Song Hinh Reservoir, and briefly extended to the surrounding vicinity, including reaches of Krong Hnang River and Ba River, and upstream reaches of Song Hinh Reservoir.

## 3.1. Ha Lam Lake

### 3.1.1 Surveys

The deeper 2.5km downstream section of the lake was surveyed at least five times, resulting in a total of 14.5 km of nocturnal surveys. Two large crocodiles were identified from Ha Lam Lake. One adult crocodile was seen during these spotlight surveys (UTM coordinates 260674 / 1446833) (Table 1, Map 2), while a fresh track of a large crocodile was found on a steep sandy slope of the northern bank during a daytime search at the east end of the lake (UTM coordinates 261385 / 1448043) (see Map 2). The belly width measured 48cm, with a ventral scale row height of 4.7cm, resulting in an estimated total length for the crocodile of ca. 2.5+m.

**Table 1:** Summary of crocodile survey effort and results in Ha Lam Lake, June 2005

| Date (2005) | Survey area | Time (hrs) | Total distance | Survey result |
|---|---|---|---|---|
| Daytime surveys | | | | |
| 13/6 | Walking surveys along the lake north and south banks | 4 | 5.7 km | A fresh track of a big crocodile found, belly width 48cm (WP 9).<br>The villager guide heard the sound possibly of a crocodile sliding into the lake (WP10) |
| 15/6 | Walking survey in upper area of Ha Lam lake | 3 | 1.5 km | No croc evidence found |
| Nocturnal spotlight surveys | | | | |
| 12/6 | Spotlight foot surveys along the lake south bank | 2 | 2.0 km | No croc evidence found |
| 13/6 | Spotlight canoe surveys in Ha Lam lake | 3 | 4.5km | Sound of animal running, likely of a crocodile heard |
| No date | Spotlight surveys from two observation sites | 3 | n/a (stationary) | No croc evidence found |
| 15/6 | Spotlight canoe surveys in Ha Lam lake | 3.5 | 8.0 km | One adult crocodile seen (WP33) |

### 3.1.2 Interviews

Interviews were conducted over a period of four days from 12-16 June 2005 with local villagers who worked in and around the lake. Locals report more crocodiles are seen in Bau

Chao section than in any other sections of the lake (Table 2). Some older villagers report that crocodiles used to be common in the lake but now there are not many left. Reports from some interviewees indicate that hunting had occurred in the past (and may still be occurring on an opportunistic basis).

**Table 2:** Interview-based crocodile information in Ha Lam Lake, June 2005

| Informant - village | Crocodile information |
|---|---|
| Many villagers | A cow was lost, and later found dead and half eaten in the lake in February 2004. The owner in Buon Bai claimed it was killed by crocodile and asked Commune PC for compensation. The PC confirmed the information and did not know how to solve since no policy for such case has existed. |
| Village elder | Crocodiles used to be common many years ago (1970s ?) but now there are not many in the lake. |
| Post office worker | There has been some crocodile hunting in the past but people don't like to talk about it as they will get into trouble with the authorities (or the survey team) |
| Y Bức - Buon Bung B | June 8, 2005, saw a crocodile and used a sling shot to shoot a stone at the crocodile in Bau Chao area. |
| Ma H'Dem - Buon Bai | March 2003, trapped a crocodile measuring 2.2m in length and weighed about 100kg in a snare at WP 9 (photo 61). The crocodile was returned to the lake. The release was made at the demand of local authority and district forest ranger |
| Ma H'Dem - Buon Bai | June 10, 2005, as walking to his farm, he and his daughter saw an adult crocodile basking on lake bank at Lotus lake section at 8am from a distance of 10m. He used a stick to chase the croc into the water. (WP 18, photos 18). |
| Y Leo (age 25) from Krong Hnang, married and has lived in Buon Bung A since 1998 | May 2005, he often observed large crocodile at three different locations. He said it was likely to see crocodile in the lake when sunny and early morning. |
| Ma H'Danh - Buon Bai | June 6, 2005 when fishing, he saw a crocodile surface. |
| Ma Dui - Buon Bai | Often hears crocodile calls in daytime. Some other villagers said often hear crocodile sound in July and August each year. |
| Ma Truong-Buon Bai | Saw a crocodile with no tail in Bau Chao section in 2004. |
| Ma Phai - B. Bung A | Saw a crocodile with no tail in Bau Chao in May 2005. |

## 3.2. Song Hinh Reservoir

### 3.2.1 Surveys

In the Song Hinh reservoir, spotlight surveys were conducted by two small motored boats over three nights from 16-18 June 2005. Shallow areas and embayment of former streams or rivers with many submerged tree stumps and standing trunks of the pre-reservoir forests made the nighttime search along the shoreline difficult. Navigation in some legs of survey routes was possible only by rowing. A total of 182km survey route was traversed,

but no crocodiles were encountered (Table 3). Most of the 45-50km shoreline was surveyed at least twice. Numerous gill nets were seen in the reservoir and also many fishermen using illegal electro-fishing gear.

Two major tributary rivers flowing into the reservoir from the mountainous terrain nearby, namely Thay Nghe 1 and Thay Nghe 2 were surveyed by foot on 16 June 2005. No crocodile sightings and/or signs were found over the 14km surveyed (Table 3). Despite having very clear water (thanks to good forested watershed under the management of the Production and Forest Protection Unit[8] of the Phu Yen Province Army Headquarters) it seems these small and shallow rivers do not provide suitable habitat for crocodiles.

**Table 3**: Summary of survey effort and results in Song Hinh Reservoir, June 2005

| Date(2005) | Survey area | Time (hrs) | Total distance | Survey results |
|---|---|---|---|---|
| Daytime surveys | | | | |
| 17/6 | Reservoir reconnaissance by boat (return route) | 4 | 16km | Visit two fishing camps on the route. No croc information |
| 19/6 | Foot survey along two main tributary rivers near the camp | 9 | 14km | No croc evidence found |
| Nocturnal spotlight surveys | | | | |
| 16/6 | Focus in upstream and middle parts of the reservoir (return route) | 4 | 65km | No croc evidence found |
| 17/8 | Similar to 16/6 with more search effort in unchecked stream estuaries and embayment areas (return route) | 4 | 70km | No croc evidence found |
| 18/6 | More focus in the downstream half of the reservoir (one way route) | 3.5 | 47km | No croc evidence found |

### 3.2.2 Interviews

According to some older villagers living in the area, crocodiles were once common in the Hinh River (Song Hinh) and its tributaries in the 1970's but hunting in the late 1970s and 1980s reduced their numbers. Crocodile were still known to exist in these rivers and small tributaries even up until the dam was built in 1999 (Table 4). It is likely that these remaining crocodiles were forced out of their preferred habitat by the raising waters as the reservoir filled, and now remain trapped in a hostile environment of poor habitat, intensive fishing and hunting.

Despite the large number of fishermen and others working in and around the reservoir, very few crocodiles have been seen since the reservoir was built (over the last five years). Most

[8] The Unit manages and protects a forested mountainous area of 3000ha upstream of Song Hinh Reservoir, the former H'Roi revolutionary base. Five patrols are conducted a month. No present observation of crocodiles has been seen in their managed area (Source: Mr Dzung - Unit Head).

people we spoke to had heard the same well-known stories of crocodiles being seen or captured in the reservoir. According to interviews, crocodiles have been seen in the reservoir as recently as April 2005 (see Table 4), although interviewees also reveal that three crocodiles were killed or captured in 2004. Two large crocodiles were intentionally hunted (one a female with eggs) and killed with electro fishing gear, while a smaller (estimated 10kg, [1.5m long]) crocodile was found dead on the shore [possibly after drowning in a fishing net].

**Table 4:** Interview-based crocodile information in Song Hinh Reservoir

| People interviewed near the main dam area (reservoir north end, Ea Trol commune) |
|---|
| *Mr Ty - head of the guard team of SHFMB*<br>• In an early morning of April005 (about 7am), he saw a big crocodile of over 100kg surfacing near the main dam (near a submerged rock). |
| *Mr Tiến - Thung Village*<br>• He heard that in 2004 some fishermen saw a crocodile big as a boat in the fuse dam area (near the main dam). |
| *Several fishers and villagers told*<br>• In 2004, Mr Tu Sang[9], a professional fisher, caught two crocodiles using electro-fishing gear, one ca. 85kg with eggs and one smaller, ca. 40kg, after actively pursuing them. Both were sold – one dead and one alive. |
| *Ma Dé - Duc Village*<br>• In June 2004, when going angling in the reservoir, he and his son saw a young dead crocodile stranded on shore. He described the crocodile weigh of ca. 10kg, snout length ca. 20cm, tail length 50cm, body size about adult leg calf [Estimated at 1.5-1.7m long] |
| *Mr Tao - Owner of a shop near Song Hinh Reservoir Eco-tourism Area* (main dam)<br>• In 1975, he saw crocodiles in Dong Cam Irrigation Dam (downstream of Ba River). In 1976 people from Dong Nai came and hunted many crocodiles in Dong Cam area.<br>• In 1999 the dam was under construction, when sifting for gold near the Mud Stream he saw crocodiles in the tall reed wetland. |
| *Ma H'Ri - Thung Village*<br>• Many fishers told him there were lots of crocodiles in Ea Sau Stream in 1997-98 before dam construction |
| *Oi Ri (Age 70) - Traditional village leader of Thung Village* told:<br>• In 1985 Ma Trung (Oi Bích) shot dead a crocodile in Ea Sau Stream because this one often got on land to catch his cows.<br>• Crocodile is abundant in Hinh River (Song Hinh) during the Anti-French Resistance War (the 1930 - 40's), then fewer during Anti-American Resistance War (the 1950s - 70s). In 1975, crocodiles were still seen in Song Hinh. |
| *Kpă é (Ma B'Rách) (Age 45) - Head of Thung Village*<br>• In 1975 it was told that there were many crocodiles in the streams of Ea Sau, Mud and Bamboo[10]. At the moment, no one talked about crocodiles any more. |

[9] During a visit to a fisher camp in the middle part of the reservoir on 17/6, by chance we meet Mr Tu Sang, an elusive fisher. He was very wary of the team thus we could not get any crocodile information from him.

[10] These streams were submerged when the reservoir impoundment

People interviewed in the reservoir south end (upper part, Song Hinh commune)

*Mr Tam No (Age 77) - Village 2A*

- A ethnic minority, former revolutionary soldier/leader, lived all his life in Song Hinh.
- He said Son-Thanh brothers of Duc Binh Dong commune have intensively fished by electricity and caught all the fish and crocodile.
- He estimates 3 crocodiles remaining in the upper part of Song Hinh Reservoir (one big and two small)
- He is sad because wildlife like deer and wild boar has disappeared. Before soldiers and indigenous villagers hunted just few animals for subsistence purpose. After 1975 people have hunted in a genocidal manner.

## 3.3. Other Sites Surveyed

Quick PRAs were conducted to some extended sites where local verbal reports indicated crocodile were present. Results suggest a number of scattered deep river pools in Song Hinh, Gia Lai and Dak Lak Provinces may still harbour freshwater crocodiles.

### 3.3.1 Ba River

A daytime survey was conducted on foot along a six kilometre reach of Ba River, along the northern border of Ea Lam commune on 14 June, 2005 (see Map 2). This river stretch was quite shallow during the survey and human and cattle footprints were encountered on any sand bars even in the middle of the river. Crocodiles are unlikely to exist in this river reach given unsuitable conditions of shallow flowing water and intensive human disturbance.

Information Box 1: Crocodile information in Ba river

On 15 June, Mr Binh, chairman of Song Hinh District Farmer Association while working in Ea Lam commune told the team of crocodile information from the Ba river. His brother-in-law, Mr Thanh, a professional eel fisherman boats for several weeks each trip along the Ba River. In a recent visit to his family in Hai Rieng Town, Mr Thanh told he them he saw two crocodiles big like a small boat at a long deep pool in Ba River, between Bau Kho Village and Ba Village in December 2004. He also revealed there is no crocodile farm establishment in Song Hinh River or the surrounding area.

Based on the information in Box 1, a rapid survey was conducted to the Ba River and the nearby Bau Kho village, an E De culture-titled village. Habitats at the site appear to provide a suitable refuge for crocodiles with good forests on both banks, deep water (local estimate ca. 10m in dry season), some rocks and sandy beaches (Photos 8 and 9). The village head (Mr Thanh) told the team that although many crocodiles existed in the Ba River in the 1960s, they have entirely disappeared by 2000. It is possible that a few crocodiles may persist in such scattered, undisturbed deep pools of the upstream Ba River.

### 3.3.2 Krong Hnang River

While working at Ha Lam Lake, the survey team received information of crocodiles in Krong Hnang River. On 15 June, 2005, a rapid assessment was conducted to remote E De minority villages (Tan, Toi, and Toi B villages) along Krong Hnang River in nearby Gia Lai province. We obtained secondhand information that several local fishermen from Pan Village (opposite Toi village) reportedly encountered crocodiles in some deep pools in the Krong Hnang River (Table 5). We were not able to meet these fishermen at the time of our visit, however the level of detailed information suggests some crocodiles may remain in

some deep sections of Krong Hnang River near the Ea So Nature Reserve[11] in Dak Lak province (Map 4). Map 4 shows a sketch of prospective crocodile sites in Krong Hnang River.

**Table 5:** Local verbal report of crocodiles in Krong Hnang River

| Interviewee | Information reported |
|---|---|
| Y Ngoi – Toi Village | Few months ago fishermen of Pan village saw a crocodile at a deep pool in the river. |
| Y Truyen (Ma Hang) – Tan Village | Ma Ra, a fisher of Pan village, recently saw a crocodile in Ton Var Xeh 'Lake', whose water depth was told of 6-7m in dry season.<br>More crocodiles remain in Klay 'Lake', where is ca. 6km upstream of Tơn Var Xeh, with deep water, rocks and good surrounding forests. |
| Ma Ph ng - Toi B Village | His father, Ma Thu (Oi H'Diep), recently saw a crocodile in H'Rung 'Lake', where is between the Tơn Var Xeh 'Lake' and Klay 'Lake'. |
| Y Lan - Toi B Village | He described two crocodiles live in a burrow in the bank of Ton Var Xeh 'Lake'.<br>Ma Blao of Toi B Village saw crocodile swimming three months ago in KSô 'Lake', which is upstream of and near the Tơn Var Xeh 'Lake'. |

### 3.3.3 Dak Lak Province

A quick survey was made to the upstream area of Hinh River (upstream of the Song Hinh Reservoir) in the neighboring Dak Lak Province on 18 June 2005. Interviewees did not know of any crocodiles or reports in this upstream part of the Hinh River (much of the riverbanks have been extensively farmed for many years). The only other information was obtained in reference to crocodiles being present in the Krong Hnang River (see Appendix 4).

[11] Villagers we interviewed call the Ea So Nature Reserve as Krong Hnang Nature Reserve.

# 4. Discussion

## 4.1. A Question of Origin

The origin of the Song Hinh district crocodiles was assessed to determine if these crocodiles were farm escapees or native to the area. This was achieved by examining the crocodile history and crocodile farm development in the area. The freshwater crocodile has inhabited the area for as long as the E De elderly can remember. The local folklore (Box 2) implies that the crocodile has existed for a long time in E De minority culture. Most villagers and fishermen we interviewed also stated that crocodiles in Song Hinh district have a local origin and were reported as far back as the 1930 -1940s (Tables 3, 4). Cuc (1994) also states that the freshwater crocodile was formerly common throughout the freshwater habitats of southern Viet Nam (including Song Hinh area).

Although crocodile farms are numerous in Ho Chi Minh City and the southern provinces, the central region of Viet Nam has very few. Only one newly established farm in coastal Phu Yen province and two farms in Khanh Hoa (a province south of Phu Yen) were reported by locals. There have not been any farms established in Song Hinh district or in the vicinity. Hence crocodile farms are not a source of the Song Hinh crocodiles.

Information box 2: Local E De crocodile folklore

Once upon a time, the crocodile used to ferry people across the river. One day, a man and his dog asked the crocodile for a ride on its back to the other side of the river. The crocodile was very pleased to carry the man but left the dog behind. After that, the dog said to the crocodile: "You carried my boss across the river. You should not leave me here. I have to follow my boss". The dog then tried to persuade the crocodile and finally the crocodile agreed to help. When on the other side, the dog informed the crocodile that he had defecated on his head. The crocodile was very upset and vowed to hunt the dog. From that moment, crocodiles have not carried people across the river, and the piles of the dog faeces on the head of the crocodile have formed the bumps we can see today.

## 4.2. The Status of Crocodiles in Song Hinh District

### 4.2.1. Ha Lam Lake

Survey findings suggest there may be a small group of wild freshwater crocodiles inhabiting the Ha Lam Lake. Two adult individuals were encountered at two different sections in the lake approximate 1.5km apart. It is probable that there are more than two crocodiles remaining in the lake as they will have adapted to the hunting threat and become extremely wary of light and noise. Some local villagers estimate about five to six crocodiles in the lake. Given the wary nature of the crocodiles in frequently disturbed habitats, an optimistic estimate may be greater. However, no hatchings or small crocodiles were encountered or reported during the surveys, leading us to suspect the group may not be a breeding population. Further study is required if a better estimation is to be obtained.

Given short time in the field, no contact with Krong Trai Nature Reserve was made to verify if the local name of 'Ha Lam Lake' is indeed the same lake as 'Tay Son Lake' which is mentioned as having previously haboured hundreds of crocodiles in this nature reserve (Cuc

1994, Cao and Jenkins 1998, Platt and Tri, 2000). It is likely that the two lake names refer to the same lake within the Reserve (see section 2.1.1 Ha Lam Lake).

Although the Tay Son Lake was considered to harbour about 200 crocodiles in 1981 (Cuc 1994), by 1994 Cuc (1994) considered crocodiles to be rare in the wild and stated that only a small number remained. Cuc (1994) described habitat destruction and the intensive hunting for meat, eggs and skins to be the primary factors for the decline, and more recently the extensive illegal trade in the international skin trade (Cuc 1994). Platt and Tri (2000) were denied access to Tay Son Lake during surveys in 1999 but reported that crocodiles in the lake were now rare and subjected to continual exploitation. [We consider the report of Cao and Jenkins (1998) to be erroneous when describing Tay Son Lake as containing 200 crocodiles in 1998, and that the species was said to be "common" and "abundant in Viet Nam" at that time. We feel they were stating out of date information].

Despite the freshwater crocodile being listed for priority protection and the development programme for rare and endangered species in Krong Trai Nature Reserve (SubFIPI III, 2004), law enforcement in Ha Lam Lake is rather weak. Although separated from the main reserve by the Ba River, no staffed guard station exists in the lake area. Lake management is designated to the local authority. Each month, forest rangers from the reserve come to Ea Lam commune to inspect the Ha Lam Lake and meet with local authorities to get an update of the lake protection situation. Ea Lam People's Committee has only one staff in charge of forestry land management in the commune. The publicised news of wild crocodile presence in the Ha Lam Lake may draw more crocodile hunters to the lake.

Ha Lam Lake offers a variety of relevant habitats for the remaining crocodiles like forested fringing vegetation, flooded forest, lotus swamp and floating vegetation mat, open water with fish and other fauna, although there is also a considerable amount of agricultural land fringing the lake. Some protection is also afforded from hunting pressure, by local forestry staff, even if not always effective. In its present state, the lake can provide a good refuge for wild crocodiles and other wildlife like waterfowl and reptiles.

Unfortunately, at present, the greatest threat to Ha Lam Lake crocodiles is from the on-going Lower Ba River Hydropower Project which aims to flood part of the Ba River including the Ha Lam Lake (see section 4.3.2 for detailed discussion). The remaining crocodiles of Ha Lam Lake urgently need effective protection from the negative impacts of the dam construction project and illegal hunting.

### 4.2.2. Song Hinh Reservoir

Although we did not find any crocodiles in the Song Hinh Reservoir, interview results suggest that a number of individuals may still be present in this large reservoir. However, the Song Hinh Reservoir is currently not a suitable habitat for crocodiles to survive, particularly in dry season, given high fishing intensity and no riparian habitats relevant for crocodiles such as fringing forests and vegetation. Due to high water level fluctuation (8-10m) every year in the reservoir and human-induced disturbances like cultivation and cattle grazing activities, edge habitats of the reservoir mainly are barren, short grassy or agriculture lands.

The crocodiles of Song Hinh reservoir have most likely originated from the now flooded Hinh River and its tributaries. Raising water levels have flooded these rivers, restricting crocodiles to the intensively fished reservoir. If there are a few crocodiles existing in the reservoir, they are in a hopeless situation as they face unsuitable habitat, direct hunting and the extensive use of fishing nets and electro-fishing gear (three crocodiles have already been killed or captured in 2004). Any remaining individuals are struggling to survive in Song Hinh Reservoir. They have received poor attention from managers of the resources for protection.

Key limiting factors in reservoir management include:

- inadequate awareness by local managers, reservoir authorities and local people about the laws, regulations and conservation significance of crocodile and other wildlife; and
- institutional gap in reservoir management.

There is obviously an institutional gap in terms of reservoir management. In reality, the fishery is not managed and wildlife not protected in the reservoir. Illegal method of fishing by electricity is commonly used in the reservoir and several crocodiles were reportedly caught by this method. The water area in the reservoir is designed and managed just for human use, but not for the wildlife. There are two key management entities, the MBHP (Management Board of Song Hinh Hydropower Plant) managing the reservoir for the purpose of electricity generation, and the SHFMB managing and tapping the fishery and tourism potential of the reservoir. The crocodile is not listed in the protection list of any entities here. Authorities do not know about conservation status of the freshwater crocodile and can not control the hunting situation of this rare animal protected by Vietnamese law.

## 4.3 Awareness Raising

To some extent, the surveys have already generated awareness of the importance of wild crocodile protection among local agencies including authorities of the Ea Lam Commune, Song Hinh District and provincial departments in charge of natural resources and forestry. In the briefing meeting at Song Hinh District PC on 20 June 2005 (at the end of the field survey), local authorities pledged to strengthen protection in Ha Lam Swamp and called for external assistance for long-term conservation measures. Further structured awareness-raising programmemes are essential for the future conservation of the freshwater crocodiles of Song Hinh district (see 5. Recommendations).

## 4.4. Threats to the Wild Crocodiles of Song Hinh District

Current major threats in order of severity that crocodiles are facing in Ha Lam Lake and Song Hinh Reservoir are listed in Table 6. The greatest threat to the Ha Lam Lake crocodiles is habitat loss due to construction of Lower Ba River Hydropower reservoir. Any crocodiles remaining in Song Hinh Hydropower Reservoir face the constant menace of being hunted or drowning in a multitude of fishing nets of the established reservoir fishery.

**Table 6:** Threats to the wild crocodiles ranked in order of severity

| Rank order | Ha Lam Lake | Song Hinh Reservoir |
|---|---|---|
| 1 | Habitat loss due to Lower Ba River Hydropower Reservoir Project | Hunting |
| 2 | Hunting by outsider hunters when the news publicised | Killed by electro-fishing. Highly destructive impact on natural resources. |
| 3 | Disturbance due to villagers farming happening around the lake and fishing in the lake | Drowning in fishing nets; Intensive fishing activities happening all over the reservoir. |

### 4.4.1. Hunting

Locals report some professional fishers in Song Hinh reservoir have actively hunted crocodiles and sold them to local fish traders. A chain of crocodile trade was uncovered by chance when the survey team was visiting the main dam of the reservoir on 18 June 2005. A local fish trader approached and at first mistook the team's purpose for seeking crocodiles to buy. He told us that a crocodile was sold alive to Ho Chi Minh City last year (2004). The buyer was phoned, who then drove all the way from Ho Chi Minh City (8 hours) to the reservoir to buy the crocodile. Crocodiles have also been hunted at the Ha Lam Lake, although not recently (as far as we know), although one large crocodile was recently caught in a snare but later released (see 3.1.2 Interviews).

Wild crocodiles are hunted to supply farming trade, even ending up in Thailand (Mr Thang, pers. comm.). Crocodile farming could be considered as a means to alleviate hunting pressure on wild crocodiles if laws and regulations are followed. However, much of the founder stock come from the wild (Cao and Jenkins 1998) and farms have been augmented from wild populations to improve the farm efficiency through enhancing genetic diversity. There is an urgent need to stop the collection of wild crocodiles for crocodile farms by strengthening enforcement and raising awareness among crocodile farm owners, local authorities, fishermen, traders, forest rangers and other relevant stakeholders.

### 4.4.2. Proposed Hydropower Dam Development Projects

The Electricity of Viet Nam (EVN) has proposed building a chain of hydroelectric dams in the basin of Ba River and its tributaries (see Map 4, 5), among which, two dam construction projects are on-going and posing a great threat to any crocodiles remaining in the region (PECC-1 2002a, PECC-1 2002b, PECC-1 2002c and PECC-4 2002).

- **The Lower Ba River Hydropower Dam (250 MW) is scheduled to be built in January 2006.** At a high water level of 107m amsl the 7,994ha future reservoir will submerge ca. 986 ha of Ea Lam Commune, including the Ha Lam Lake (at 94m amsl), in the rainy season of 2006 (from September to December). About 150 E De minority households farming around the lake will be affected by the future reservoir and were recently assessed for compensation. Big wood trees around the lake were marked for harvest and clearance before the impoundment. Habitat loss due to the reservoir development is currently the greatest threat to the critically endangered freshwater crocodile and this was not discussed in the project EIA document (PECC-1 2002c).

- The Krong Hnang River Hydroelectric Project (66 MW) was initiated in May 2005. Located in the districts of M'Drak and Ea Kar of Dak Lak province and Song Hinh district of Phu Yen province, the future reservoir of 2.300 ha area will have a high water level of 265m amsl and will submerge part (ca. 750ha) of the Ea So Nature Reserve. The project is likely to negatively impact on any remaining downstream crocodiles and their habitats in the Krong Hnang River by increasing accessibility to the crocodile sites and disrupting river flow rates with a cascading effect of consequences. The Krong Hnang River was reported as a crocodile site during interviews in Ha Lam Lake (see 3.3.2 Krong Hnang River).

At present, the Song Hinh Hydropower Reservoir (established in 1999) is not suitable for crocodile survival, primarily due to the degraded (or non-existent) riparian habitat and the intensive fishery.

Man-made reservoirs can produce multiple economic benefits, but also pose greater threats to wildlife and local indigenous people. When reservoirs are established, in-migrants are attracted to the new reservoirs due to improved road access, availability of water, new land for settlement and fish stock established in the new reservoirs. Outsiders come and compete with locals including wildlife and indigenous ethnic people. Consequently, this can threaten local wildlife and indigenous people, and cause unsustainable development, a decrease in biodiversity and social resentment from indigenous people (see Table 7). There needs to be a more effective management arrangement to address the conflict between immigrants and local indigenous people and wildlife. In order to ensure equity in development, certain areas of land and water surface should be set aside for indigenous use and as a wildlife reserve in any reservoir development plans.

**Table 7:** Comparison Between Ha Lam Lake and Song Hinh Reservoir

| Ha Lam Lake | Song Hinh Reservoir |
|---|---|
| • remote area<br>• relatively inaccessible to outsiders<br>• inhabited mainly by ethnics minority people in low density<br>• exploit natural resources mostly for subsistent purposes<br>• less impact on crocodiles and other wildlife | • better road and accessibility<br>• immigrants dominant the area and compete with local people and wildlife<br>• immigrants with more skills and power, using destructive method to exploit natural resources<br>• severe impact on crocodiles and other wildlife |

By nature, man-made reservoirs may not be a suitable habitat for crocodile. Given the high water level fluctuation of and modified hydrological regime in reservoirs, which do not follow natural rhythm and often lag in phase, it may be difficult for the crocodiles to find suitable nesting habitat in the new, abruptly changing environment. Large areas of the Song Hinh reservoir are exposed in the dry season, where they are colonised by short-term crops, grass, bushy plants, or completely no vegetation. Very little riparian vegetation surrounds the reservoir, particularly during low water level period, which allows hunters easily to spot crocodiles in open water surface and hunt them. This has been the case for the crocodiles in the Song Hinh Reservoir. There is no area within the reservoir which is protected for wildlife (like crocodiles or waterfowl) to live and breed, whereas intensive human activities

(fishing) occur throughout the reservoir. Therefore, some area in the reservoir and surrounding land should be designated for wildlife and indigenous use only.

Uncertainties always exist in any EIA study. Song Hinh Dam Construction Project has been viewed as a successful project with considerable investment for the assessment of environmental and social impacts with international funding and technical support. The environmental evaluation of the Song Hinh Hydropower Project stated the protected freshwater crocodiles were suspected to exist in the early 1980s, but had not been seen since (CITEC & IEM 1996). In fact, the wild crocodiles have been there throughout the construction and establishment of the reservoir. Environmental monitoring should be used as a management tool to supplement any weakness and overcome unknown factors in the EIA of dam development projects by informing the adaptive management. If there had been a functioning environmental and biodiversity monitoring programme existing in the Song Hinh reservoir, the wild crocodiles in Song Hinh could have been saved. Currently there is no agency responsible for environment and biodiversity monitoring/management in Song Hinh reservoir. See section 4.2.2 for more discussion regarding institutional limitation in reservoir management.

### 4.4.3. Intensive Fishery

Since the impoundment of the Hind River to form the Song Hinh reservoir (1999), numerous people from other areas have come to the reservoir to make a living from fishing. The fishing industry is actively encouraged, and fishing happens throughout the reservoir, year round, except in three flood months (from October - December). Numerous fishing techniques are used: fish weir, electricity shock, three-layer net, gill net, traps, angling, blanket nets, and hand catching. It is estimated about 500 fishers use the reservoir, among them only 50 registered with the SHFMB who pay a monthly fishing fee. Electric-shock fishing method, which is an illegal and destructive fishing practice, is rampant in Song Hinh reservoir. Many of these fishing practices are incompatible with crocodile survival.

Information box 3: Song Hinh Reservoir Fishery Management Board (SHFMB)

Source: Mr Tinh - The Board Head and Mr Ty - Head of the guard team

- Belonging to Phu Yen Youth Union, the entity was established at the end of 1999, when the reservoir impoundment to manage fishery in the reservoir.
- In 2000, 2001 and 2002: Stocked the reservoir with 200 million fingerlings of common carp, grass eater carp and silver carp.
- Fishing is permitted from January-September, and not from October-December.

### 4.4.4. Other Human-induced Disturbances

Remaining crocodiles in Ha Lam Lake are often disturbed, since frequent human activities happen in and around the lake, for example, cultivation and cattle grazing in the surrounding land, burning in dry season (March - April) to prepare field for agriculture, and fishing in the lake. Crocodiles are also persecuted and attacked with sling shots and sticks. Snares are also set around the lake which can catch even large crocodiles (see section 3.1.2). It has also been suggested that crocodiles have been killed for food and because they are perceived as a threat to humans and livestock (Platt and Tri 2000).

# 5. Recommendations

## 5.1. Immediate Actions to Protect the Ha Lam Lake Crocodiles

The following activities are recommended for immediate implementation in the remaining period of 2005 in order to protect the Ha Lam Lake crocodiles from any further loss until next year (2006) when effective measures addressing threats of the dam construction and hunting problems will be available and implemented.

- Awareness-raising: hold community meetings in Ea Lam Commune with participation of minority villages currently using the lake and surrounding land. The purpose is to present the findings, raise awareness of the importance of the wild crocodile conservation in Ha Lam Lake and develop community-based protection measures and action plan (currently underway by ITB).
- Increased protection: facilitate arrangement of local participation in policing the crocodile protection in the field to ensure that the Ha Lam Lake crocodiles and their habitat become more effectively protected in the short term. Facilitate the participatory development of community-based regulations to protect the crocodiles through the establishment of local guardian group (wardens) conducting regular patrols of the crocodile habitats in the lake area. External support is needed for this effort.
- Increased protection: liaise with Krong Trai Nature Reserve and local relevant government authorities to ensure that the authorities strengthen crocodile protection in Ha Lam Lake and to discuss crocodile conservation action plans.
- Lobby Electricity of Viet Nam (EVN): discussions are urgently needed with the management board of the Lower Ba River Hydropower Project to propose options for appropriate conservation actions.

## 5.2. Long-term Conservation of Ha Lam Lake Crocodiles

### Rationale for the Action

Several reports suggest that crocodiles can also be found in other rivers and lakes in Song Hinh district, most likely the Central Highlands. It is critical that action must take place now to assess the situation otherwise the remaining wild crocodiles, one after another, sooner or later, will being tracked down, hunted and eventually eliminated from the wild of Viet Nam. The situation is already happening in Song Hinh Reservoir and else where in Viet Nam.

It is crucial to conserve any wild crocodiles remaining in Song Hinh district[12] and other potential areas of Viet Nam. These may be the last crocodiles and are Viet Nam's living heritage, pride and contribution to biodiversity conservation of crocodiles in the world.

### Establish and Implement a Management Plan for Ha Lam Lake

The survey findings in Ha Lam Lake have immediately raised a question. Is it possible to stop or postpone implementation of the Lower Ba River Hydropower project in order to facilitate options to save the wild freshwater crocodiles in Ha Lam Lake? Given time

[12] Song Hinh means "Hinh River" in Vietnamese.

limitations (about five months remain before the damming of the Ba River channel, and the country's increasing demand for electricity, there is obviously little room for alternatives. However, the Electricity of Viet Nam (EVN) needs to be engaged in a dialogue regarding the impacts of the dam on the Ha Lam Lake crocodiles. A delay in damming of the Ba River could allow appropriate conservation actions to be implemented.

A comprehensive study of three possible options is urgently needed, which will be used to inform dam project management, higher level decision-makers in provincial and national stakeholder workshops (proposed in section 5.4) regarding solutions to protect the Ha Lam Lake crocodiles.

### Option 1: In-situ Conservation - No Damming Scenario

- Alternative solution of livelihood for minority farmer cultivating around the lake.
- Facilitate local people's participation in crocodile protection.
- Stop the degrading natural forests and vegetation in areas surrounding the lake.
- Initiate riparian vegetation rehabilitation.
- Strengthen the enforcement protection of Ha Lam Lake crocodiles.

### Option 2: In-situ Conservation - Damming Senario

Submerging a large area of 7,996 ha, the future reservoir will enable the connection and wide distribution of any crocodiles currently remaining in Ha Lam Lake, the Krong Hnang River, or even upper reaches of the Ba River. Possible study steps are as the follows.

- Collect information including maps of ground elevation, land cover/land use, management plans in the future reservoir area.
- Assess the possible environmental impacts of the dam project.
- Study and intelligently predict potential suitable crocodile habitats, distribution pattern, and threats under this scenario.
- Develop protection measures and management plans for the most suitable habitats to be established after the damming, through a participatory process. The plan must propose areas with sufficient size in the reservoir and surrounding land set aside for wildlife and indigenous use only.
- Any sustainable management plans must promote co-management models involving local people to prevent inevitable migration waves of outsiders to the area and associated threats arise after reservoir formation. Seek and advocate the designation of resource utilisation and management rights, in and around these crocodile wetland habitats, to the local people.

### Option 3: Relocation - Damming Scenario

This option is an ex-situ conservation measure or a study of the possibility to relocate the remaining wild crocodiles to a well protected habitat. It should be made clear that this is the last resort to be sought when assessing any final conservation decisions. If there are no any feasible solutions for in-situ conservation, the Ha Lam Lake wild crocodiles would need to be re-located.

This option is to research and propose the most relevant natural habitat in another area, based on solid understanding of habitat requirement of the species in the wild. Ideally, prospective sites should be located in or near an existing protected area for conservation management advantages, preferably in wilderness area of Phu Yen, Gia Lai or Dak Lak Provinces. Suitable sites for relocation may exist in Krong Trai Nature Reserve (Ba river), Ea So Nature Reserve (upstream of Krong Hnang river) or other protected areas in the central highlands, offer some degree of protection as the relocation site.

If there are no suitable habitats found at the time, individuals can be temporarily held in a captive facility to be identified through further research. Captured individuals will be tagged for monitoring and record tracking purposes before being released to a more suitable environment in the future, preferably a well-protected natural habitat.

## 5.3. Conduct Extended Crocodile Surveys

Some undisturbed upstream sections and tributaries of the Ba River remain un-surveyed. Interview findings suggest that there are prospective sites for future crocodile surveys in the Central Highland. Population surveys involving interviews and active searches should be conducted as soon as possible at the following sites. See Map 4 for site location and interview-based information in Section 3.3.

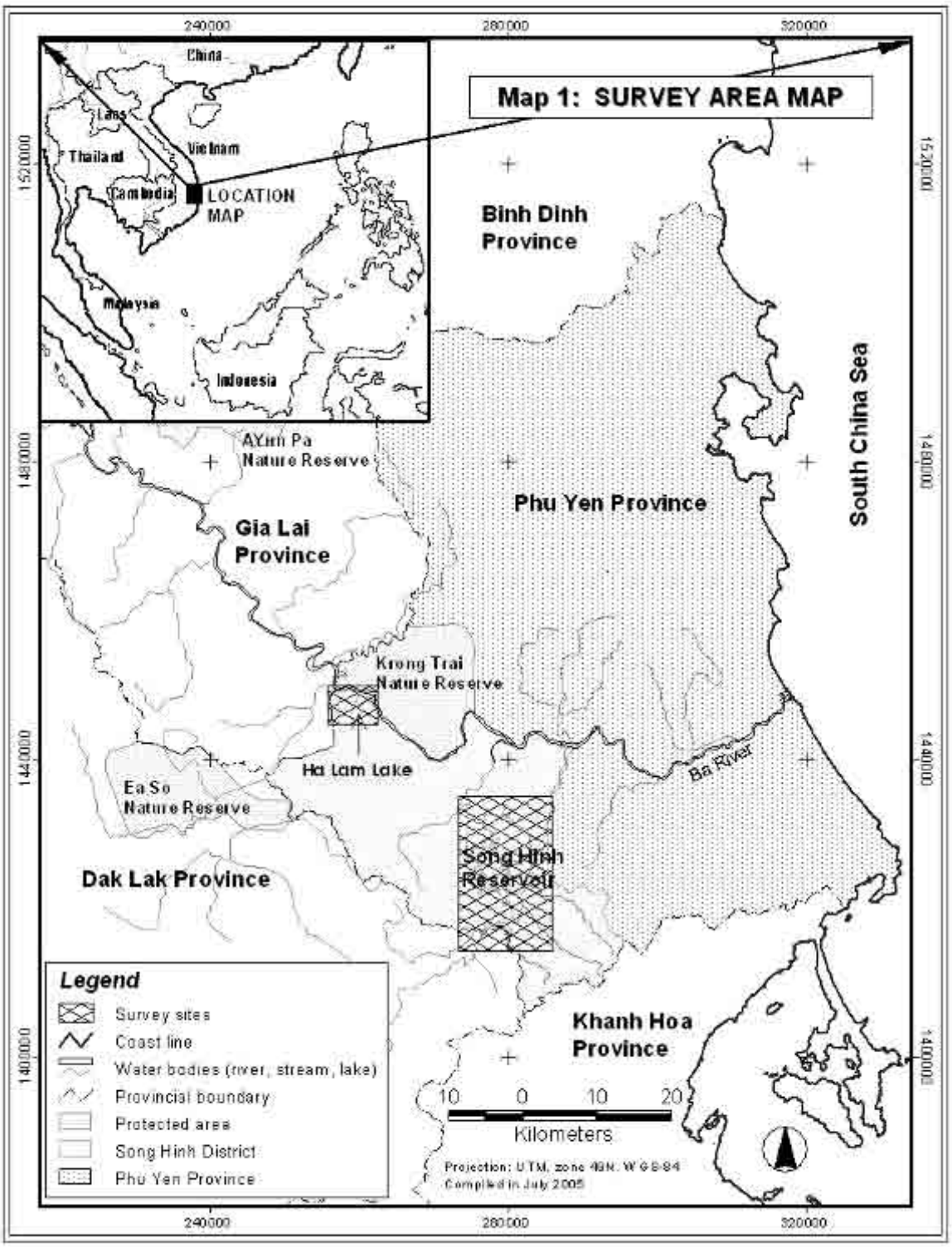
- Deep pool sections in Krong Nang river in Dak Lak and Gia Lai Province (Map 4).
- Undisturbed upper reaches of the Ba river in Gia Lai Province.
- Sere Pok River. Platt and Tri (2000) proposed a small population may exist in Sere Pok River and verification of this claim should receive the highest priority especially as crocodile known to exist across the border in Cambodia. This area could be a significant discovery.
- Re-evaluate areas upstream areas of Song Hinh River in Dak Lak Province.

## 5.4. Other Priority Activities

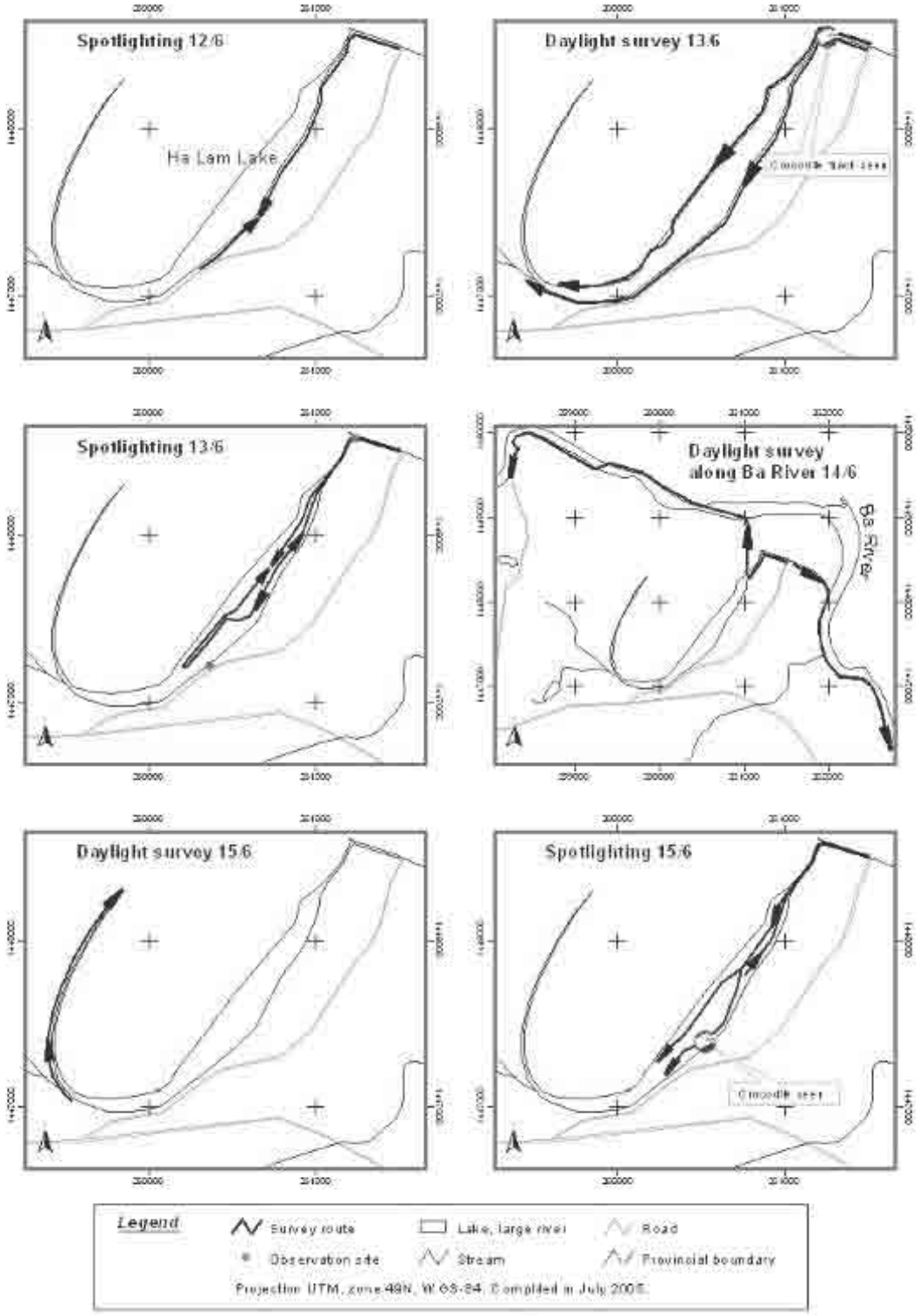
- Awareness raising: conduct a comprehensive campaign to raise awareness and understanding of the importance of conserving the wild freshwater crocodiles in other areas. The awareness campaign will cover geographic areas like the Song Hinh Reservoir and protected areas of Krong Trai, Ea So and Yok Don, and target groups like the fishers.
- Stakeholder workshop: hold stakeholder workshops at district, provincial and national levels with participation of relevant stakeholders to present the survey findings, draw attention to the crocodiles and discuss conservation action plan and priority activities.
- Capacity building: an increase in the knowledge and capacity especially for local staff in charge of forest protection and natural resources management is required.
- Investigate trade: the investigation and monitoring of the reported wildlife trade chain in Song Hinh district is urgently needed. Local Forest Protection Department should be involved in the process and strengthened in the law enforcement capability in order to be able to control any infractions. Findings from the investigation should be provided to relevant wildlife protection entities for appropriate enforcement action.

- Fund raising: all conservation efforts require resources and funds. Proposals need to develop quickly to seek funding for the implementation of the above-mentioned priority actions. Support of crocodile conservation programmes in Cambodia and Lao PDR should be encouraged and international conservation agencies and donors sought.

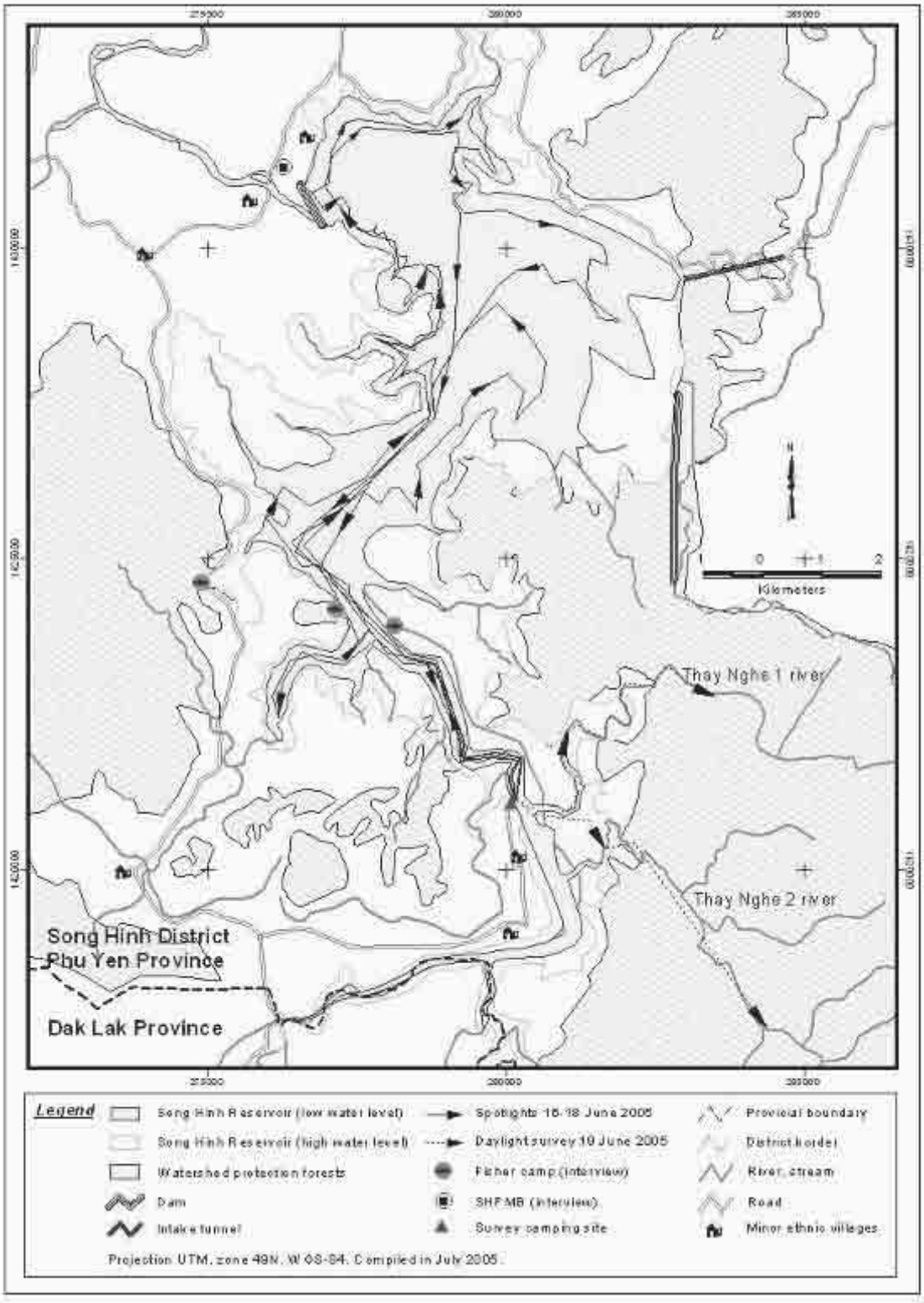
# 6. Maps


Map 1: SURVEY AREA MAP
China
Laos
Vietnam
Thailand
Cambodia
LOCATION MAP
Malaysia
Indonesia
Binh Dinh Province
South China Sea
A Yun Pa Nature Reserve
Phu Yen Province
Gia Lai Province
Krong Trai Nature Reserve
Ha Lam Lake
Ba River
Ea So Nature Reserve
Song Hinh Reservoir
Dak Lak Province
Khanh Hoa Province
Legend
Survey sites
Coast line
Water bodies (river, stream, lake)
Provincial boundary
Protected area
Song Hinh District
Phu Yen Province
10 0 10 20
Kilometers
Projection: UTM, zone 49N, WGS-84
Compiled in July 2005
240000
280000
320000
1520000
1480000
1440000
1400000

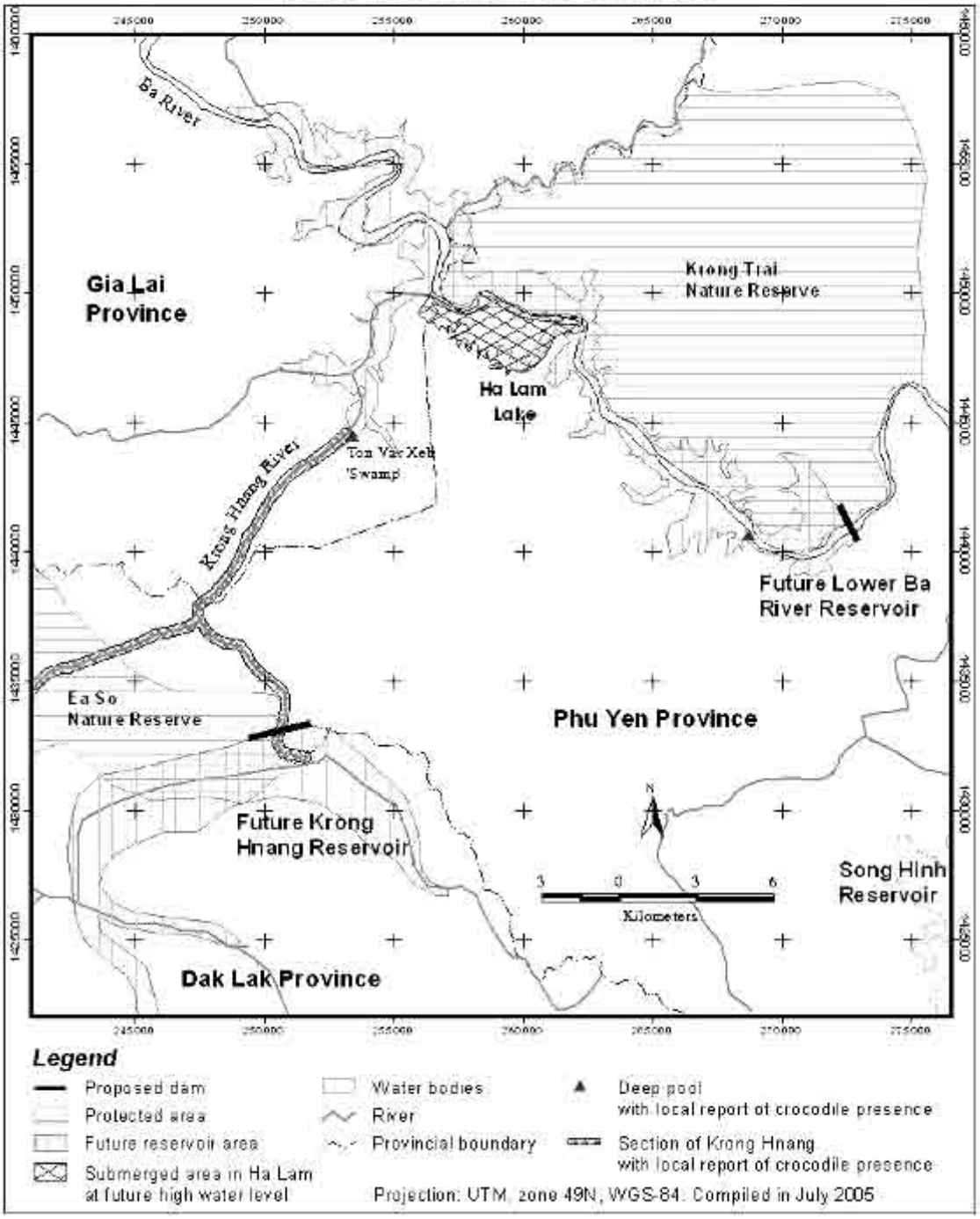
**Map 2: Survey routes followed in Ha Lam Lake and vicinity**

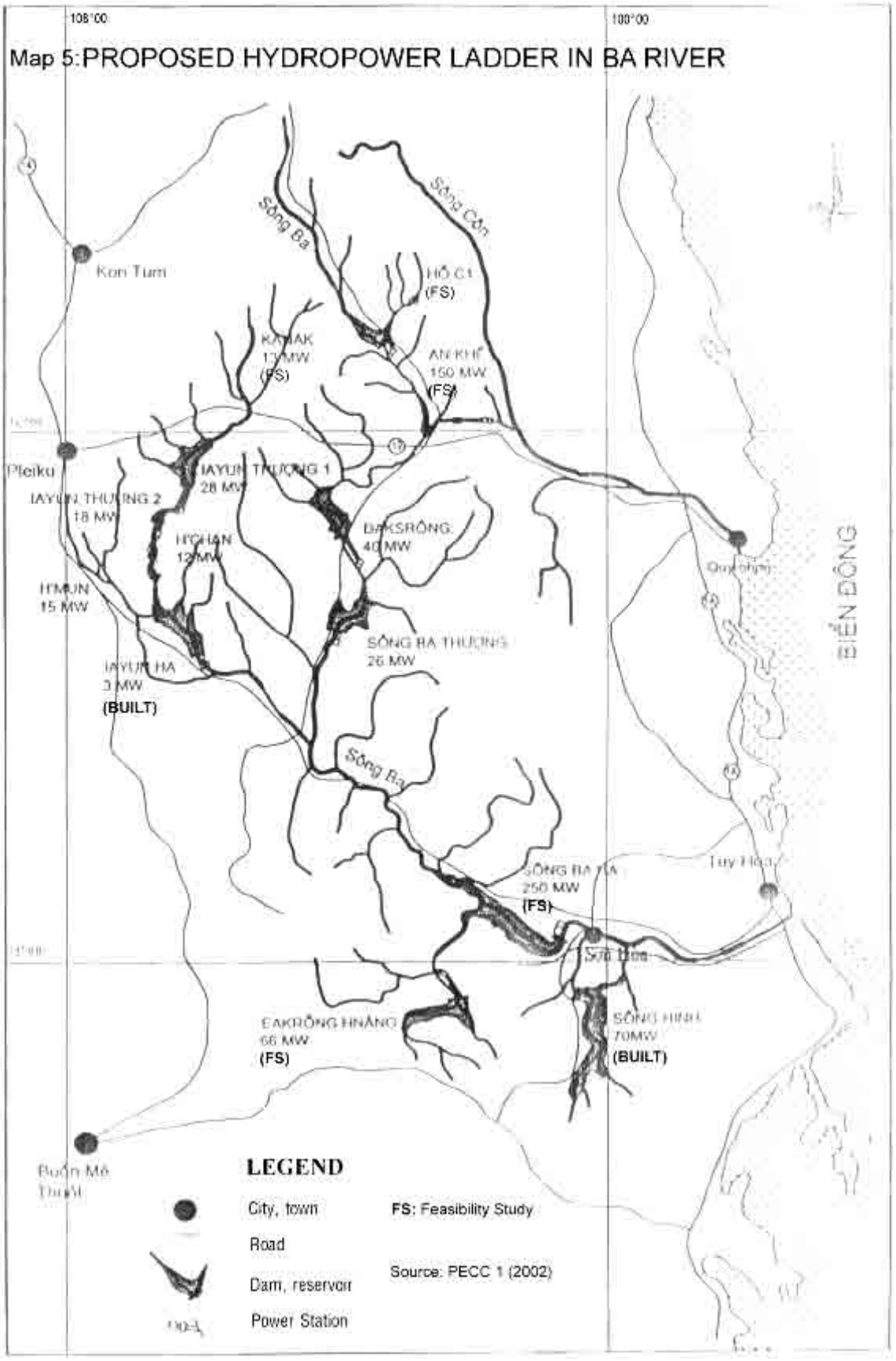


**Map 3: Survey routes followed in Song Hinh Reservoir and vicinity**



**Map 4: Possible habitat loss due to Lower Ba River Hydropower Project and Krong Hnang Hydropower Project**




108°00
100°00
Map 5:PROPOSED HYDROPOWER LADDER IN BA RIVER
Sông Ba
Sông Côn
Kon Tum
HỐ C1
(FS)
KANAK
(FS)
AN KHÊ
150 MW
(FS)
Pleiku
IAYUN THƯỢNG 1
28 MW
IAYUN THƯỢNG 2
18 MW
BÁKSRÔNG
40 MW
HMUN
15 MW
SÔNG BA THƯỢNG
26 MW
IAYUN HA
3 MW
(BUILT)
Sông Ba
SÔNG BA HẠ
250 MW
(FS)
Tuy Hòa
EAKRÔNG HNÂNG
66 MW
(FS)
SÔNG HINH
70MW
(BUILT)
BIỂN ĐÔNG
Buôn Mê Thuột
LEGEND
City, town
Road
Dam, reservoir
Power Station
FS: Feasibility Study
Source: PECC 1 (2002)

# Literature cited

BirdLife International and FIPI (2004). Sourcebook of existing and proposed protected areas in Viet Nam (Second edition). Krong Trai Nature Reserve. Website: http://www.birdlifeindochina.org/source_book/. Accessed 5 July 2005.

CITEC[13] and IEM[14] (1996). Song Hinh Multi-Purpose Project: Assessment/monitoring of environmental impact and mitigation measures. Report prepared for SIDA. 43pp.

Cao, V. S. and R. W. G. Jenkins (1998). Crocodile conservation and development in Viet Nam. In Crocodiles: Proceedings of the 14th working meeting of the Crocodile Specialist Group, pp 135-140. IUCN Gland.

Cuc, H.T. (1994). Status and conservation of crocodiles in Viet Nam. In Crocodiles: Proceedings of the 12th Working Meeting of the Crocodile Specialist Group, pp 28-34. IUCN Publications, Gland.

Daltry, J.C., Chheang D., Em P., Poeung M., Sam H., Sorn P., Tan T. & Simpson, B.K. (2003). Status of the Siamese Crocodile in the Central Cardamom Mountains, Southwest Cambodia. Cambodian Crocodile Conservation Programmeme: Fauna & Flora International: Cambodia Programmeme, and Department of Forestry and Wildlife, Phnom Penh.

ITB (2004). Song Hinh biodiversity survey report.

IUCN/SSC Crocodile Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. viii + 167 pp. Accessed 30 June 2005.

IUCN (2004). 2004 IUCN Red List of Threatened Species. (www.redlist.org). Accessed August 5, 2005.

IUCN (2005). IUCN Asia Newsletter. Issue in May 2005.

Murphy, D.J., Phan Duy Thuc and Nguyen Thanh Long. (2004). The Siamese crocodile re-establishment programmeme in Cat Tien National Park, Viet Nam. 1999-2004. Technical Report No. 48. Cat Tien National Park Conservation Project..

PECC 1 (2002a). Planning for a chain of hydropower plants in Ba River. Summary document.

PECC 1 (2002b). Lower Ba River Hydroelectricity: Feasible study. Vol. 1: Main report. In Vietnamese.

PECC 1 (2002c). Lower Ba River Hydroelectricity: Feasibility study. Vol. 2: Appendices. Environment Impact Assessment report. In Vietnamese.

[13] Center for International Technical and Education Cooperation - Royal Institute of Technology, Sweden

[14] International Environmental Management Co. Ltd, Thailand

PECC 4 (2002). Ea Krong Hnang Hydroelectricity: Pre-feasibility study. Summary document. In Vietnamese.

Platt, Steven G. (1999). Investigation into the Status of Crocodiles and Turtles in Viet Nam and Cambodia – Unpublished Trip Report, Wildlife Conservation Society, New York.

Platt, S.G. and N.V. Tri (2000). Status of the Siamese crocodile in Viet Nam. Oryx 34(3):217-221.

Ross, J.P. (ed.). (1998). Crocodiles. Status Survey and Conservation Action Plan [online]. http://www.flmnh.ufl.edu/natsci/herpetology/act-plan/plan1998a.htm [6 July 1998].

Simpson, B.K. and Han, S. 2004. Siamese crocodile (Crocodylus siamensis) surveys in Cambodia. Pp 110-120. In: Crocodiles. Proceedings of the 17th Working Meeting of the Crocodile Specialist Group, IUCN - The World Conservation Union, Gland, Switzerland and Cambridge UK.

SubFIPI III (2004). Detailed planning of Krong Trai Nature Reserve, Son Hoa District, Phu Yen Province. 63pp.

Thorbjarnarson, J. (2003).Conservation of Siamese Crocodiles in Lao PDR. Unpublished Report, Wildlife Conservation Society, New York.

# Appendices

## Appendix 1: Survey Itinerary and Description (10 - 20 June 2005)

| Date | Itineraries and Activities |
|---|---|
| 10/6 | 1315: Boyd Simpson arrives in HCMC from Cambodia<br>1400 - 1700: Survey team meeting at ITB to review and discuss:<br>• Survey objectives, methodology, plan<br>• Data and information to be collected during the survey<br>• Format of survey forms and report<br>• Task assignment |
| 11/6 | 500-2100: Travel from HCMC to Song Hinh, pick up two provincial officials of DARD and DoNRE in Tuy Hoa City, stay night at district guest house |
| 12/6 | 730 - 830: *Meet with district authority* (Mr Toại - PC vice chairman, Ms Yến - Office manager, Mr Lân - Land management official) to review survey plan.<br>830 - 900: Drive to Ea Lam commune to start the survey in Ha Lam lake<br>900 - 1230: Meet Mr Ksor YLê - Chairman of the commune PC; Conduct reconnaissance of Ha Lam Lake and interview villagers met on the way.<br>1400 - 1700: Boyd provides a brief training on crocodile information and survey methods; Plan detailed survey routes and schedule. |
| | 1930 - 2130: *Spotlight foot survey along South bank of the lake*<br>The teams use dim light for finding walking route and quitely walk along the water egde, stop for every 100m interval distance for spotlight. Two times of spotlight at each station with 5 minutes break.<br>Team 1: Boyd, Dung, Quan, Ma H'Dem, from WP1 to WP5. Distance: 0.5 km<br>Team 2: devided into two groups (G1: Tri, Quang; G2: Vinh, Y Blưng). G2 after G1 15', walk from the east end (WP2) upstream, meet team 1 and finish the survey at WP5. Appr. distance: 1.5 km |
| 13/6 | 800 - 1200: *Daytime foot survey along the shoreline of Ha Lam lake*<br>The teams walk and look for croc signs and sighting, plus interview local people met along the survey routes.<br>• Team 1: South bank (Boyd, Quan), from WP6 (east end) to WP7 (finish). Approximate distance: 3.0 km.<br>• Team 2: North bank (Vinh, Tri, Dung, Quang and a villager). From WP 6 (east end), the team survey through a wetland forest and a small island (WP12), reaches the abandoned pump station, wade across the lake (WP13) to go back camp. A fresh crocodile track found on a steep sand slope at WP9. The villager guide heard a sound possibly of a crocodile sliding into the water from a bamboo grove (WP10). Distance: 2.7 km |
| | 1930 - 2230: *Spotlight survey Ha Lam lake using two paddling canoes and from two ambush sites selected on the lake bank*<br>• Spotlight boat survey done by two small paddling canoes, each can load max. 2 persons. Team 1 (Boyd and a villager) and team 2 (Tri and a villager), both start at WP14 (mid of the lake), go eastward to the east end and westward to WP15 (Lotus 'lake') respectively, break then return and finish the survey route at WP14. Appr. distance: 2.5 km (team 1) and 2.0 km (team 2).<br>• At some innavigable sections due to floating vegatation mats, team 1 lifted the canoe over land to continue |

| | |
|---|---|
| | the route. Two guards accompanying Boyd by walking along the south bank made noise that may disturb survey results.<br>• Team 2 made a zigzag route at the Lotus 'lake', where its width is much larger (ca. 200m) with dense lotus cover and flooded forest in the north edge. At 21:45, sound of a running animal, possibly crocodile, heard in the Lotus 'lake', but spotlight impossible due to bush blocking. The villager was scared of crocodile and stopped paddling for a moment.<br>• Ambush spotlight conducted from two observation locations WP15 and WP16 by team 3 (Vinh and Dung) and team 4 (Quan and Quang) respectively. Spotlight the surrounding area for 10' then 20' quite break and repeat the process. |
| 14/6 | 800 - 1200: *Daytime foot survey along Ba river.* Teams 1 and 2 survey from near the confluence of Ha Lam Lake and Ba River, up and downstream respectively, to rapidly assess habitats and interview people that we met along the Ba river.<br>• Team 1: Boyd, Vinh, Dung, Y Leo. From WP17 - WP18. Distance: 3.6 km<br>• Team 2: Tri, Quang, Quan. From WP20 - WP22. Distance covered 2.4 km<br>1400 - 1700: Documenting |
| | Early farewell dinner |
| 15/6 | 730 - 1100: Team 1 (Boyd, Tri). *Foot survey in the upper area of Ha Lam lake.* From WP23 to WP24 (north end of the lake). Appr. distance: 1.5 km<br>Team 2: *Rapid assessment to extended sites with verbal reports of crocodile*<br>• 700 - 1300: Short car visit to remote ethnic minority (E De) villages along Krong Hnang river in Gia Lai Province: Toi (WP25), Tang (WP26) and Toi B village (WP28) and quick assessment of Ton Var Xeh 'lake' in Krong Hnang river (Vinh, Quan, Quang, Dung, Y Le).<br>• 1430 - 1700: Visit to Bầu Khô Village and a deep pool reach of the Ba river (WP31) next to Krong Trai Nature Reserve (Vinh, Quang, Dung) |
| | 1930 - 2300: *Spotlight survey Ha Lam lake using paddling canoes*<br>Team 1 (Boyd and a villager) and team 2 (Tri and a villager) start in the middle of the lake (WP32), boating eastward to Bau Chao. Team 1 begins first, then team 2 follows after 15 minutes. Both teams meet at the east end and return to the starting site at 2100. Continue the survey to the west of the lake, here the lake gets wider, each team spotlight along each bank. Team 1 searches the south bank and team 2 searches the north bank. One adult crocodile seen by team 1 at WP33 (in lotus 'lake' area). Each team covers an appr. distance of 4 km. |
| 16/6 | Start the survey in Song Hinh reservoir and vicinity<br>830: Drive to Song Hinh Commune with a stop at Hai Rieng town to get supply<br>1000: Set up survey camp<br>1400: Meeting with People's Committee of Song Hinh commune. |
| | 1900 - 2300: *Spotlight boat survey in Song Hinh reservoir.* Begin at the camp, survey to downstream area (north) and return to the camp. More search efforts made in the upper (south) and middle parts of the reservoir<br>• Team 1 (Boyd, Dung) follow along the left (east) shoreline, from WP36 to WP46 and return. Distance covered: 38km<br>• Team 2 (Tri, Vinh, Thanh) follow the right (west) shoreline, from WP 47 to WP56. Distance covered: 27km |
| 17/6 | 730 - 1130: *Daytime survey reservoir and interview fishers*<br>All team conduct daylight reconnaissance of the reservoir by boat, visit to two fishing camps and conduct |

| | |
|---|---|
| | interview with Mr Hùng at Đồi Tranh camp (WP57) and Mr Tư Sang (WP58). |
| | 1900 - 2300: ***Spotlight boat survey in Song Hinh reservoir.*** Begin at the camp, survey to downstream area of the reservoir and return to the camp. Repeat the route of the previous day, with more search efforts in areas like unchecked embayments and stream estuaries along the reservoir shore.<br>• Team 1 (Boyd, Quan) follow the left shoreline, appr. distance: 40km<br>• Team 2 (Tri, Vinh, Thanh) follow the right shoreline, appr. distance: 30km |
| 18/6 | 730 - 1230: Drive to Dac Lac Province to ***survey upstream area of Song Hinh River/Reservoir.*** Visit and interview Agriculture State Farm 715C (Mr Truong) and Production and Forest Protection Unit of Phu Yen Province Army Headquarters (Mr Dung), Vong Phu Mountain Forest Ranger Station (Mr Quang) and local people.<br>1430 - 1800: Drive to the main dam area<br>• Visit and interview Song Hinh Reservoir Fishery Management Board and Forest Ranger Station in Đức Village (Vinh, Boyd, Tri, Quang)<br>• Conduct interviews at a fishing camp by the road (Quan, Dung) |
| | 1945 - 2400: ***Spotlight boat survey in Song Hinh reservoir.*** Begin at the main dam and survey southward back the camp. Focus in the downstream (north) half of the reservoir (one way route).<br>• Team 1 (Boyd, Vinh): search along the right shoreline of the reservoir, from WP61 (main dam) - WP76 (camp), total distance: 28km<br>• Team 2 (Tri, Quang, Thanh): search along the left shoreline of the reservoir, fom WP77 to WP92. Total distance: 19km. |
| 19/6 | 730 - 1700: ***Foot survey along two main rivers flowing into Song Hinh reservoir***<br>• Team 1 (Boyd, Vinh, Thanh) follow Thầy Nghè 1 river (or Thach Thao 1), from WP93 to WP100 (last waypoint before returning to the camp). One way distance: 7km<br>• Team 2 (Tri, Quang) follow Thầy Nghè 2 river (or Thach Thao 2), from WP101 to WP107 (last waypoint before returning to the camp). One way distance: 7km<br>900 - 1400: Drive to the main dam area to conduct ***interview with ethnic minority villagers.*** Team 3 (Quan, Dung). |
| | Farewell dinner |
| 20/6 | 830: Complete survey in Song Hinh reservoir, drive to Hai Rieng Townlet.<br>1030: Briefing meeting at Song Hinh District PC<br>1430: Drive to HCMC |
| 21/6 | 1330: Survey team meeting at ITB to discuss findings and reporting |

Notes: Shaded rows are nighttime activities

Members of the Survey Team

| Team members | Organisation | Role |
|---|---|---|
| Mr Vu Ngọc Long | ITB | Project supervisor and advisor |
| Mr Nguyen Xuan Vinh | ITB | Team leader |
| Mr Boyd Simpson | FFI Cambodia | Crocodile specialist and technical advisor |
| Mr Ngo Van Tri | ITB | Crocodile specialist |
| Mr Lai Tung Quan | ITB | PRA specialist |
| Mr Vo Van Dung | Phu Yen DoNRE | Local specialist |
| Mr Huynh Xuan Quang | Phu Yen DARD | Local specialist |
| Local staff and guides | | |

# Appendix 2: Survey Route GPS Coordinates

| DATE | WP | CODE | UTM_X | UTM_Y | NOTES |
|---|---|---|---|---|---|
| 12/6 | 1 | B133 | 260450 | 1446607 | Team 1: start foot spotlight |
| | 2 | V8 | 261667 | 1447926 | Team 2: start foot spotlight (the east end of Ha Lam lake) |
| | 3 | V9 | 261176 | 1447670 | location Ma H'Dem trapped the crocodile |
| | 4 | V11 | 261166 | 1447601 | large/wide water body area where likely to see croc in daytime |
| | 5 | B134 | 260795 | 1446909 | location two teams met and finish spotlight |
| 13/6 | 6 | B131 | 261667 | 1447928 | Team 1: start walking survey South bank of Ha Lam lake (from the east end) |
| | 7 | B138 | 259604 | 1446530 | Finish walking survey |
| | 8 | V8 | 261667 | 1447926 | Team 2: start walking survey North bank of Ha Lam lake (from the east end) |
| | 9 | V12 | 261385 | 1448043 | a crocodile track found |
| | 10 | V14 | 261299 | 1447905 | likely sound of croc sliding into water heard in bamboo grove |
| | 11 | V15 | 261041 | 1447704 | lotus lake with floating water hyacinth (photos 3 & 4) |
| | 12 | V16 | 260220 | 1446537 | wetland forest (photo 1) |
| | 13 | A1 | 259722 | 1446528 | Finish walking survey |
| | 14 | B139 | 260938 | 1447202 | Team 1+2: start / finish spotlight canoe survey |
| | 15 | V18 | 260520 | 1446650 | Lotus 'lake'. Team 3: observation position on the South bank, where Ma H'Dem saw a crocodile in 10/6 |
| | 16 | B135 | 261385 | 1448005 | Team 4: observation position, where croc track found |
| 14/6 | 17 | B141 | 261215 | 1448337 | Team 1: Ba river foot survey start |
| | 18 | B142 | 258374 | 1448912 | Ba river survey finish at a ferry boat station |
| | 19 | T1 | 261670 | 1447925 | Team 2 follows Ea Tsai, a small stream connecting Ha Lam lake to Ba river (agriculture land) |
| | 20 | T3 | 262179 | 1447419 | Ba river foot survey start |
| | 21 | T4 | 262080 | 1447195 | sesame field w scatter forest along river bank. A common barking deer seen |
| | 22 | T5 | 262886 | 1445696 | Ba river survey finish |
| 15/6 | 23 | B143 | 259692 | 1446472 | Team 1: survey upper part of Ha Lam lake - start foot survey (west end) |
| | 24 | B144 | 259999 | 1447740 | North end of Ha Lam lake |
| | 25 | V23 | 254490 | 1445002 | Team 2: short visit to Krong Hnang river (Toi Village) |
| | 26 | V24 | 254655 | 1444808 | Tang Village |

| | | | | | |
|---|---|---|---|---|---|
| | 27 | V25 | 254114 | 1444569 | Ea Ly stream, a small tributary of Krong Hnang. |
| | 28 | V26 | 253831 | 1443802 | Toi B Village. |
| | 29 | V28 | 253573 | 1443904 | Ton Var Xeh 'lake'. Photos 10 |
| | 30 | V31 | 254764 | 1447059 | Krong Hnang bridge |
| | 31 | V32 | 268885 | 1440046 | Deep pool in Ba river w verbal report of croc. Photo 8 & 9 |
| | 32 | T87 | 260943 | 1447197 | start spotlight canoe survey (Team 1+2) |
| | 33 | B145 | 260674 | 1446833 | croc seen here spotlight survey (Team 1) |
| | 34 | B146 | 260542 | 1446782 | Small island |
| 16/6 | 35 | B147 | 280245 | 1420290 | Song Hinh survey camp. |
| | 36 | B148 | 280326 | 1420403 | Team 1: start spotlight boat survey from the camp |
| | 37 | B152 | 277867 | 1423239 | survey route |
| | 38 | B160 | 277767 | 1425772 | survey route |
| | 39 | B164 | 278261 | 1427431 | survey route |
| | 40 | B172 | 278286 | 1429307 | survey route |
| | 41 | B176 | 277850 | 1429876 | survey route |
| | 42 | B177 | 277678 | 1429963 | survey route (West end, near dam wall) |
| | 43 | B178 | 277129 | 1430685 | survey route |
| | 44 | B182 | 278609 | 1431594 | survey route |
| | 45 | B186 | 279251 | 1431176 | survey route |
| | 46 | B192 | 279374 | 1430253 | last waypoint, spotlight survey on the way return to the camp |
| | 47 | V33 | 280276 | 1420534 | Team 2: start spotlight boat survey from the camp |
| | 48 | V39 | 279094 | 1422153 | survey route |
| | 49 | V45 | 277514 | 1423978 | survey route (embayment area) |
| | 50 | V51 | 278097 | 1425437 | survey route (submerged stream) |
| | 51 | V53 | 278353 | 1425622 | survey route (large embayment area) |
| | 52 | V55 | 278644 | 1425222 | survey route (stream) |
| | 53 | V59 | 279330 | 1426680 | survey route |
| | 54 | V63 | 279581 | 1427198 | survey route |
| | 55 | V67 | 280306 | 1426724 | survey route |
| | 56 | V73 | 279484 | 1428189 | last waypoint, spotlight on the way return to the camp |
| 17/6 | 57 | V74 | 278196 | 1423183 | fishing camp at Doi Tranh (interview). |
| | 58 | A2 | 277305 | 1423577 | Tu Sang fishing camp at Bamboo stream (interview) |

| | | | | | |
|---|---|---|---|---|---|
| | 59 | B194 | 276333 | 1421779 | Bamboo stream. spotlight boat survey (Team 1) |
| 18/6 | 60 | V75 | 274926 | 1415296 | Ma Doal bridge, Dac Lac province. Collect control point by GPS averaging for 15 minutes |
| | 61 | V77 | 277181 | 1430654 | Team 1: start spotlight boat survey from the main dam, follow the east bank |
| | 62 | V79 | 277469 | 1431743 | survey route |
| | 63 | V82 | 278712 | 1431622 | survey route |
| | 64 | V86 | 279541 | 1432078 | survey route |
| | 65 | V91 | 279573 | 1431877 | survey route |
| | 66 | V99 | 279980 | 1430890 | survey route |
| | 67 | V103 | 279219 | 1430906 | survey route |
| | 68 | V107 | 280099 | 1430280 | survey route |
| | 69 | V112 | 281763 | 1429707 | survey route |
| | 70 | V114 | 281842 | 1429376 | survey route (near tunnel) |
| | 71 | V118 | 281582 | 1428773 | survey route |
| | 72 | V123 | 280941 | 1429059 | survey route |
| | 73 | V128 | 279437 | 1428272 | survey route |
| | 74 | V133 | 278044 | 1425945 | survey route |
| | 75 | V137 | 277419 | 1423835 | survey route |
| | 76 | V139 | 280315 | 1420389 | Finish spotlighting survey near the camp |
| | 77 | T14 | 276874 | 1430599 | Team 2: start spotlight survey from the main dam, follow the west bank |
| | 78 | T15 | 277075 | 1430323 | survey route |
| | 79 | T17 | 277389 | 1430517 | survey route |
| | 80 | T22 | 277933 | 1429952 | survey route |
| | 81 | T27 | 278144 | 1429820 | survey route |
| | 82 | T32 | 278478 | 1429511 | survey route |
| | 83 | T38 | 278258 | 1429242 | survey route |
| | 84 | T44 | 278496 | 1428843 | survey route |
| | 85 | T50 | 279004 | 1429328 | survey route |
| | 86 | T55 | 279057 | 1428691 | survey route |
| | 87 | T60 | 278818 | 1428182 | survey route |
| | 88 | T65 | 278240 | 1428017 | survey route |
| | 89 | T70 | 278898 | 1427536 | survey route |

| | | | | | |
|---|---|---|---|---|---|
| | 90 | T75 | 277414 | 1423835 | survey route |
| | 91 | T80 | 279346 | 1421122 | survey route |
| | 92 | T85 | 280254 | 1420290 | end at camp site |
| 19/6 | 93 | B202 | 281333 | 1421601 | Team 1: foot survey along Thay Nghe 1 river. Location of high water level |
| | 94 | B203 | 281850 | 1421607 | survey route |
| | 95 | B204 | 282259 | 1421669 | survey route |
| | 96 | B205 | 282134 | 1422319 | survey route (long deep water pool) |
| | 97 | V140 | 282482 | 1422268 | survey route (middle deep water pool) |
| | 98 | B206 | 282736 | 1422435 | survey route (end deep water pool) |
| | 99 | B207 | 283324 | 1422269 | Lunch place |
| | 100 | B208 | 283670 | 1422111 | end survey route |
| | 101 | T7 | 280291 | 1420462 | Team 2: foot survey along Thay Nghe 2 river |
| | 102 | T8 | 280321 | 1420373 | survey route (agricultural land) |
| | 103 | T9 | 280591 | 1420124 | survey route (agricultural land) |
| | 104 | T10 | 281813 | 1419561 | survey route (agricultural land) |
| | 105 | T11 | 281563 | 1420002 | survey route (agricultural land) |
| | 106 | T12 | 282310 | 1419631 | survey route (agricultural land both side of stream) |
| | 107 | T13 | 284476 | 1416604 | Mang stream - end route and return to the camp |

Notes:
Team member composition is different for each survey. Refer to Appendix 1 - Survey Itinerary for participants of each specific activity and survey details
WP: Waypoint; Code: GIS Waypoint ID; Projection: UTM Zone 49N WGS84

# Appendix 3: Semi-structured Interview Guidance Questions

## Questions about crocodile presence

1. Have you seen a crocodile in the lake?

2. Have you heard stories or reports of someone else seeing a crocodile in the lake?

3. Have you heard stories or reports of someone catching/selling a crocodile in the lake?

## Questions for more detail information (what, when, where and how)

1. How was the croc seen? caught? sold or eaten? price?

2. What area / village did the report come from?

3. What year/ month? Wet or dry season?

4. How big was croc? [small crocs will indicate breeding in area]

5. Other information related to the caught ones? [e.g. female with eggs]

## Other information

1. Do traditional people have any beliefs or folklores relating to crocodiles?

2. Have you heard reports of crocodiles from other areas?

3. Have you known any crocodile farms that once existed or exist in Song Hinh and adjacent area?

# Appendix 4: Additional Information in Dak Lak Province

On 18/6, a rapid assessment was conducted to the (ca. 8km) upstream of Hinh river/Song Hinh reservoir in Dak Lak province. Several local people we interviewed report no information of crocodile presence in this upper reach of Hinh river, but in Krong Hnang and Krong Na rivers in the 80s.

Interview-based information from a short survey to upstream area of Song Hinh river/reservoir in Dak Lak province

*Mr Nguyen Dinh Truong, director of Agriculture State Farm 715C*

- Mr Trường used to be a former soldier who had fought and has lived in the area for about 20 years, currently manages the farm with 3700 inhabitants
- He observed that before wildlife is abundant (e.g. eel, yellow turtle, soft-shell turtle, tiger, wolf, bear, mountain goat, monitor lizard). There is a small pass near the state farm named 'Tiger pass'. Since more immigrants from the North moved to live in the area (esp. in 1984-1985 period), and there were more fishing and hunting pressure and consequently wildlife resources had gradually been depleted.

*Ma Tân (Age 55) - Village 9, M'Doal commune, MaDrac district, Dac Lac province*

- In the 80's, saw crocodiles basking at sand and gravel shores in Song Hinh River while fishing
- More crocodiles in Krong Hnang River than in Song Hinh River.

*Ma Dung (Age 46) - Village 4, MaDrak district, Dac Lac Province*

- His former village is Hí Village in Khanh Dương Townlet, about 20km away, a former strategic village established in 1966 during the war.
- Used to be former soldier until 1980.
- In 1977, shot dead one crocodile of 50kg at Krong Chinh Reservoir (near the Minor Ethnic Boarding School) in Dac Village, Chư M'Tam Commune, MaDrak District. Krong Chinh is a small tributary of Krong Hnang.
- 1985, heard about a croc burrow and basking in upstream area of Song Hinh, at a sand beach in the state farm 715C.
- In 1987-1988, fished in Krong Hnang and knew crocodiles living in the river.
- In the 80's, there were crocs in Krong Na and someone tried to trap the croc with duck bait but failed. Krong Na flows to Cambodia, probably a tributary of the Sere Pok River.

Forest rangers - Vong Phu Mountain Forest Guard Station

- Several said about three years ago they heard news of crocodile presence at a small reservoir (namely Tax Dam) in Khanh Duong Town, MaDrac District, Dak Lak province.

# Appendix 5: Selected Survey Photos

*Photo 1:* Wetland forest in Ha Lam Lake

*Photo 2:* A portion of Ha Lam lake with dense vegetated banks

*Photo 3:* Ha Lam Lake with floating grass mat and inundated forest in the background

*Photo 4:* The east end of Ha Lam lake (narrow portion)

*Photo 5:* A fresh crocodile track found on a bank of Ha Lam Lake

*Photo 6:* Local E De (minor ethnic) on the way back home by the end of a working day. They farm in the field surrounding Ha Lam Lake.

*Photo 7:* Panoramic view of the Ba River, the reach near Ha Lam Swamp with a large sand bar in middle of the river

*Photo 8:* A deep pool in Ba River near Bau Kho Village with local verbal report of crocodile. Krong Trai Nature Reserve is just on the other site of the river

*Photo 9:* Another view of a deep pool in Ba River with rocky and sandy beaches

*Photo 10:* A deep pool in Krong Hnang River (Ton Var Xeh 'Swamp') with local report of crocodile

*Photo 11:* Sustainable/low impact fishing method by local E De in the Ba River

*Photo 12:* Survey team at the east end of Ha Lam Lake

*Photo 13:* Typical view of littoral area of Song Hinh reservoir at low water level

*Photo 14:* Remain of the pre-reservoir forests. Typical habitat in shallow, embayment areas of Song Hinh Reservoir

*Photo 15:* Fish raising cages in the upper part of Song Hinh Reservoir

*Photo 16:* Small boats with electric-fishing equipment

*Photo 17:* Daylight survey along Thay Nghe 1 river, upstream of Song Hinh Reservoir. Clear, shallow river in dry season with good watershed protection forests.

*Photo 18:* A long deep pool (Vuc Dai) in Thay Nghe 1 river

# Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme

The Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme (MWBP) is a joint programme of the four riparian governments of the Lower Mekong Basin – Cambodia, Lao PDR, Thailand and Viet Nam – managed by the United Nations Development Programme (UNDP), the World Conservation Union (IUCN) and the Mekong River Commission (MRC), in collaboration with other key stakeholders. With funding from the Global Environment Facility (GEF), UNDP, the Royal Netherlands Government, MRCS, the Water and Nature Initiative (WANI) and other donors, the programme addresses the most critical issues for the conservation and sustainable use of natural resources in the Mekong wetlands. MWBP aims to strengthen the capacity of organisations and people to develop sustainable livelihoods and manage wetland biodiversity resources wisely. It is a five-year (2004-2009) intervention at three levels – regional, national and local – with demonstration wetland areas in each of the four countries: in the Songkhram river basin, Thailand; in Attapeu province in southern Lao PDR; in Stung Treng, Cambodia; and in the Plain of Reeds in the Mekong Delta, Viet Nam. The programme aims to:

- Improve coordination for wetland planning from regional to local levels
- Strengthen policy and economic environments for wetland conservation
- Generate and share information
- Train and build capacity for the wise use of wetlands
- Create alternative options for sustainable natural resource use and improve livelihoods

MWBP is a partnership between governments, aid agencies and NGOs, and provides a framework for complementary work for wetland conservation and sustainable livelihoods in the Lower Mekong Basin.

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