A Floral and Faunal Biodiversity Assessment of Prey Long

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The work described in this report was conducted in May 2007 by Conservation International, Cambodia Program, Forest & Landscape, University of Copenhagen, and the Forestry Administration. The work focused on an assessment of the floral and faunal diversity of Prey Long Forest, located in Kratie and Stung Treng provinces, Cambodia.

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Front cover Photos:

Top: Grassland in lowland evergreen forest, Prey Long

Bottom, left: Banteng *Bos javanicus* captured on camera trap by CI in Prey Long in 2005.

Bottom, center: Asian leaf turtle *Cyclemys tcheponensis* recorded by the Cambodian Turtle Conservation Team in Prey Long in 2007.

Bottom, right: Malayan sun bear *Helarctos malayanus* captured on camera trap by CI in Prey Long in 2005.

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Introduction

Peov Somanak, Jake Brunner & Ida Theilade

BIOLOGICAL IMPORTANCE AND CONSERVATION STATUS

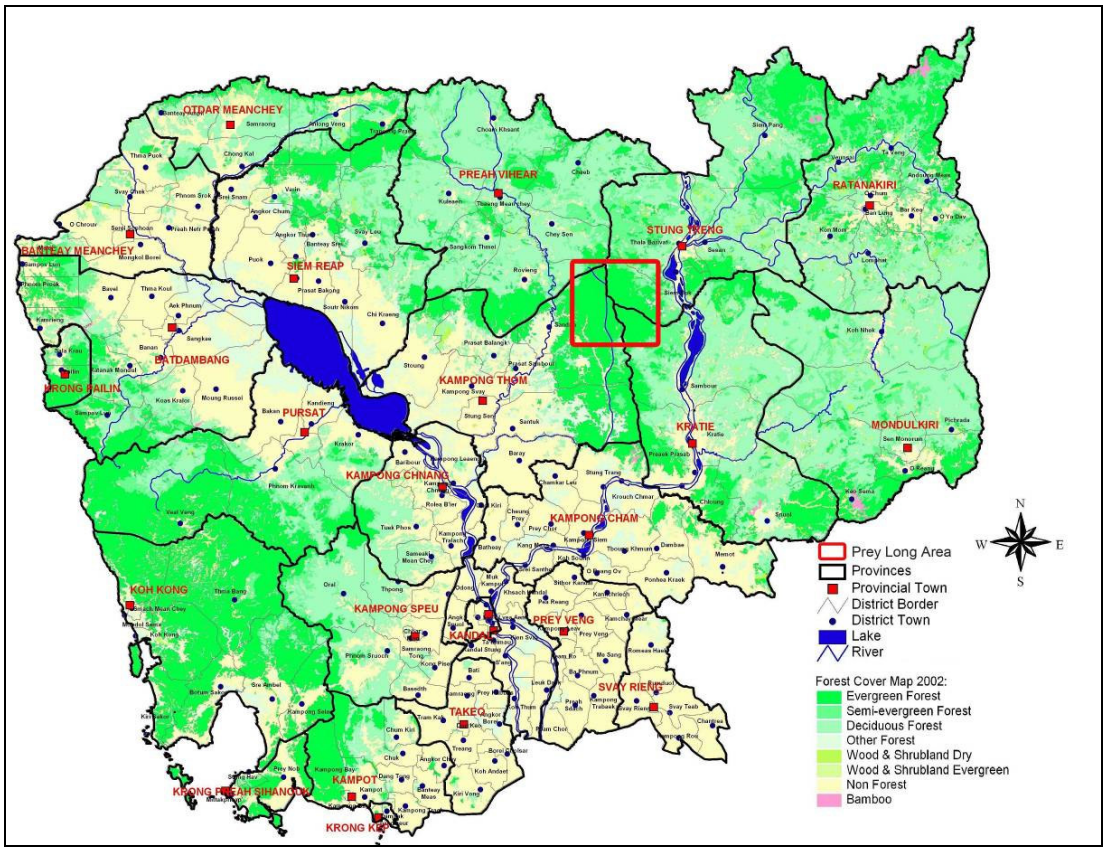
The Prey Long region contains the largest area of wet lowland evergreen forest in Cambodia, and probably in the Indo-Burma Hotspot (see Appendix 1 for satellite image of the forest estate). A rapid botanical survey of Prey long carried out in 2004 revealed a diverse and unique floral composition. Seven distinct types of vegetation were found, including rare primary evergreen forest and evergreen marsh forest (McDonald, 2004). The seven vegetation types can be classified as evergreen, semi-evergreen, or deciduous forests, but they differ significantly from each other on the basis of species composition, dominant trees, and plant community structure. The 2004 Independent Forest Sector Review highlighted the extremely high ecological significance of Prey Long. This assertion has been confirmed by other assessments: the National Forest Gene Conservation Strategy states that the Prey Long forests are home to 80% of the most valuable and endangered indigenous tree species of Cambodia. Of the twenty-one tree species identified as priorities for local livelihoods and the national economy, eighteen are found in Prey Long. The site is therefore valuable to the national reserve network due to its importance for floral conservation (CTSP/FA 2003, Strange et al. 2007).

According to McDonald (2004), even a cursory perusal of Cambodia's system of protected areas reveals a clear lack of protection for wet lowland evergreen forest. Almost all remaining undisturbed terrestrial landscapes are presently located in mountainous regions where floral and faunal species often differ markedly from lowland habitats. (The lack of representation of lowland evergreen forest in national protected area system is true across the hotspot.) Forest concessions and logging activities have historically been granted for lowland evergreen forests due to their ease of accessibility and their abundance of high value timber. Most lowland forest in Cambodia has been converted to agriculture. Lowland forest was once the most common vegetation type in Cambodia (McDonald 2004), but now it is poorly protected, highly threatened, and receives virtually no attention from researchers and conservationists.

Prey Long is situated to the west of Mekong River in the northern part of Cambodia and stretches over four provinces: Kratie, Kampong Thom, Steung Treng and Preah Vihear. *See map 1.* The forest estate is not officially demarcated and the Prey Long boundaries are therefore unclear. McDonald (2004) describes the greater Prey Long area as follows:

"Remnants of Cambodia's once vast lowland forests are now restricted to the northern reaches of Kampong Thom Province, the more significant pieces of which extend southward from the small village of Spong (13º 30' latitude; due West of Steung Treng on the Mekong River) in the Sandan and Mien Rith Districts (Map 2). People in this region refer to the uppermost portions of this forest as 'Prey Long', and those more than 20 km to the South of Spong as 'Prey Tlong.' As a matter of convenience, these forests will be referred to in the present report as the greater Prey Long region, so as to include forests that straddle various tributaries to the Mekong River, including (from North to South) the Siembok, Porong. O'Long, Chinit Rivers, and streams that feed the Steung Sen to the West, such as the O Kachong and O Ronul."

The broadest definition of the Prey Long landscape covers about 520,000ha (Ashwell *et al*., 2004). However, according to McDonald, the most biologically important and most intact portion of Prey Long covers about 80,000 ha.



Map 1. Prey Long region

Prey Long is under the jurisdiction of the Forestry Administration (FA) and forms part of the forest estate governed by the 2003 Forest Law under which it is classified as state private land. Three logging concessions are located in Prey Long belonging to Pheapimex Fuchan, Everbright CIG Wood Co. Ltd., and Colexim Forest Concession. The Everbright concession is located in Kratie and Steung Treng Provinces and covers an area of 136,376 ha. The Colexim concession is located in the western part of Prey Long in Kampong Thom Province. This concession covers an area of 139,610 ha. In 2002, all legal logging activities in Cambodia were suspended as part of a national logging ban. More than 250,000 people live in 340 villages in and around Prey Long, many of whom rely directly on the natural resources of the forest for their livelihoods. For those people, the forest provides their livelihood not only through resin tapping, but also via its provision of building materials, medicine, and food.

PROJECT OBJECTIVES

This project, which is a joint initiative of the FA, Conservation International (CI), and Forest & Landscape, Denmark (FLD), stemmed from FLD's interest in examining new models for concession management and specifically scope for the use of conservation concessions to balance development and conservation needs. These partners were also interested in utilising the potential for Prey Long to serve as a test case for a Reduced Emissions through Avoided Deforestation (READ) project that would allow Cambodia to capitalize financially on its stock of intact forest as part of an emissions reduction-based carbon trading scheme. READ projects were excluded from the Clean Development

Mechanism (CDM) of the 1997 Kyoto Protocol. However, there is renewed international discussion about including READ projects in a redesigned CDM since 20% of global carbon emissions are from deforestation. Because of its floral uniqueness, size and intactness, and the fact that it is outside the protected area system, slated for logging, and under the jurisdiction of a single authority, the FA, Prey Long meets criteria that should make it attractive to an internationally funded READ investment project.

The survey described in this report aimed to assess the importance of the Prey Long region for biological conservation, both nationally and globally. The objective was to assess whether, if the site was designated as a conservation concession with associated management and protection, it would also provide sufficient contributions to global conservation efforts to make the program worthwhile from a conservation perspective.

CONSERVATION CONCESSIONS

A conservation concession involves a long term-contract, typically 25-40 years, which provides periodic payments from an endowed fund in return for the conservation of a specified area. The payments partly reflect the opportunity cost of not exploiting the natural resources in the area. Payments can be negotiated to reflect other factors, such as government administration, decentralisation of funds to districts or communes, devolution of funds to affected communities, and the law enforcement costs. But the basis of any payment should be the economic value of exploitation forgone by conserving the area. Because financial flows do not incorporate environmental costs and benefits, the economic value does not simply equal profits from exploitation. Valuations may be adjusted for benefits preserved by the concession, such as watershed protection, as well as the risk-free nature of payments. Consequently, the level of compensation emerges as an output of a negotiation process that includes these considerations.

Cambodia's forests present an important economic resource and the sustainable use of its forests should be of considerable benefit to the country and contribute to national development. Cambodia's forests, which are among the least disturbed in the region and contain a wealth of globally threatened species, are also of global conservation importance. At present, if a country like Cambodia that contains large tracts of tropical forest wishes to benefit financially from the development of their forest, they have little choice but to turn to logging. A conservation concession is a simple way of removing or relaxing this constraint.

Conservation concessions can serve as complementary approaches to biodiversity conservation and income generation for some of Cambodia's important forest areas. In fact, a country like Cambodia may benefit more from conserving forest resources than from granting timber concessions. The principle is that conservation concession benefits will outweigh returns from alternative harmful uses of the target area. The conservation concession approach is particularly suitable for extensive areas controlled by a single entity, such as the government, which has the authority to cancel concessions or exclude areas out of pending concessions.

The payment structure of a conservation concession may be extremely attractive relative to other land uses. A conservation concession offers regularly scheduled, risk-free payments, denominated in stable foreign currency, for as long as the terms of the agreement are met. Ideally, the payments are guaranteed through the use of an endowed fund that covers the duration of the agreement. Negotiated elements of the agreement

include the size of payments, the duration of the payment, the investment portfolio to which annual payments will be directed, and norms and guidelines for monitoring and enforcing natural resource protection.

As Cambodia proceeds with efforts to rationalize the formal timber sector, a conservation concession strategy above offers several advantages:

- It conserves crucially important biodiversity resources of Cambodia while minimizing the displacement of economic activity.
- It directly responds to calls articulated in several policy documents (most notably the Forestry and Environment Action Plan 2007-2010) for innovative solutions to the tension between the country's economic needs and biological conservation needs.
- It contributes significantly to achievement of the Cambodian Millennium Development Goals (CMDG) adopted by the Royal Government of Cambodia, particularly those falling under CMDG 7, "Ensure Environment Sustainability," including targets relating to maintenance of forest coverage and surface under protection.
- It embodies pillars for sustainable forestry management emphasized under both the Rectangular Strategy for Growth, Employment, Equity and Efficiency 2003-2008 and the National Strategic Development Plan 2006-2010, particularly those of sustainable forest management policy, and protected areas system to protect biodiversity and endangered species.
- The enhanced management presence implied by the proposed strategy would greatly advance elements of the Governance Action Plan, especially those pertaining to efforts to combat illegal logging, transparency, and revenue collection in the forestry sector.
- It contributes to the execution of short-medium term actions identified in the Forestry and Environment Action Plan 2007-2010, notably the implementation of park management models and experimentation with a range of forest management models, among several others.

Thus, this model fits squarely within national policies and priorities relating to conservation and forest governance. In addition, given the presence of fairly high population levels around the forest, management efforts will necessarily incorporate co-management principles and explore various strategies to ensure benefits to local communities, including community forestry.

PROJECT DESIGN

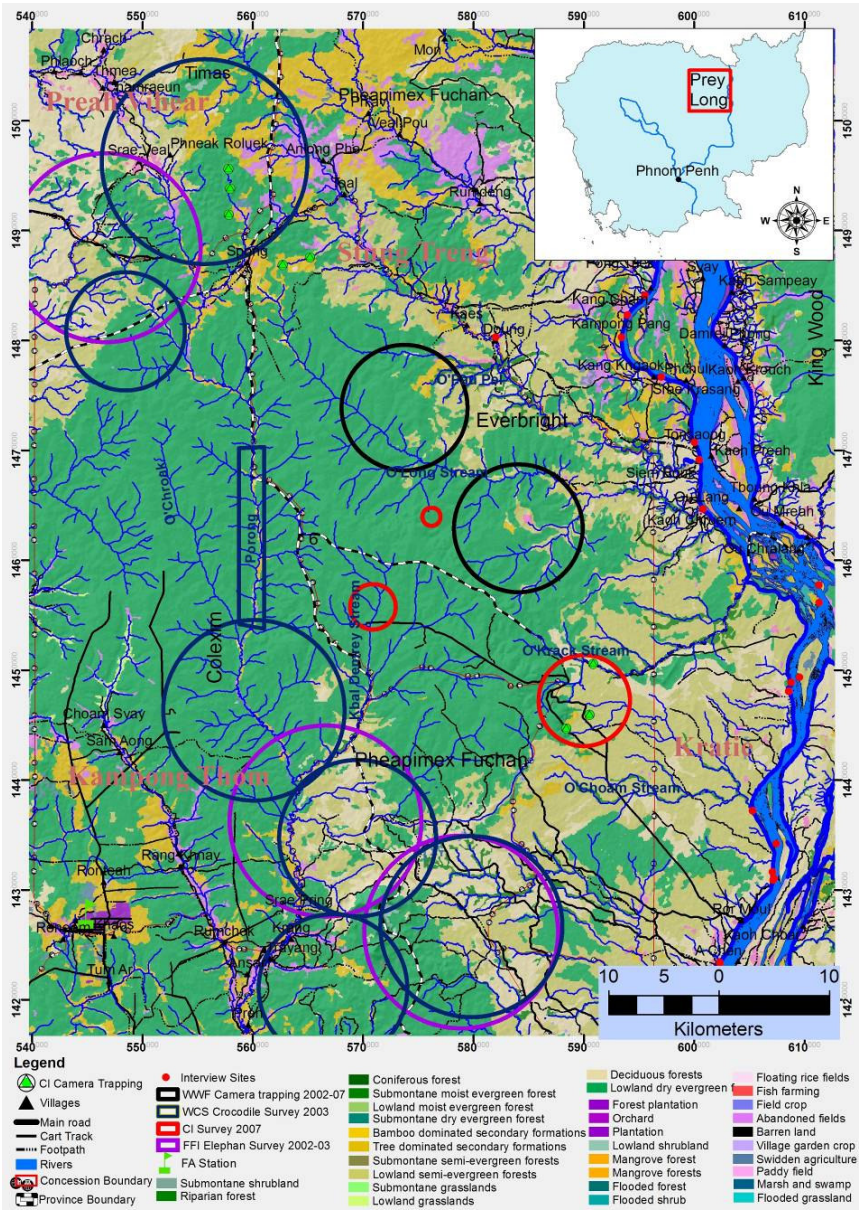
Next steps for developing the above mentioned model, upon agreement and approval from key stakeholders, include:

- Collection of background and mapping information required for zoning, including information on surrounding communities and resource use, commercial timber distribution, and distribution of biodiversity resources.
- Characterization of the opportunity cost of conservation for different candidate configurations of the buffer zone.
- Investigation of funding potential for the proposed management scheme.

With the information gathered through these steps, the collaborating partners would proceed to zoning and design of management structures and processes, as well as formulation of legal mechanisms to enact the proposed strategy. All of these activities would be pursued within a general approach that involves extensive consultation and participation from relevant stakeholders, particularly within the national policy arena.

BIOLOGICAL SURVEYS

In order to determine whether Prey Long would be a candidate area for a conservation concession, an essential next step is to collect more detailed information on the biological importance of Prey Long. Few previous surveys have been undertaken, and those that were conducted were mostly unsystematic and extremely limited in duration and taxonomic scope. They could not provide sufficient information to assess the distribution and status of biodiversity across Prey Long.



Map 2. Greater Prey Long area, showing sites of previous and present surveys

The longest running field project was a Japanese-funded and FA-implemented hydro-meteorological research project in the Colexim concession. However, the project generated few data that can be used for conservation purposes.

In 2002, Fauna & Flora International (FFI) conducted surveys for elephants in Prey Long; however, there are no available reports on the findings of these surveys.

In 2003, Wildlife Conservation Society (WCS) and FA conducted two brief surveys for crocodiles in the Colexim concession area along the Purong River. Interviewees reported the presence of crocodiles, but those anecdotal reports were not confirmed by field records.

In 2002, WWF initiated multi-taxa wildlife surveys and an elephant monitoring project in Siam Bok and Tholaborivath districts, Stung Treng Province. Camera trap surveys were carried out in 2002 and 2005. As part of elephant monitoring activities, WWF engage two local people from Khangcham and Siembok villages to spend two weeks every month in Prey Long recording wildlife signs, which they report to the WWF office in Stung Treng.

In 2005, a CI-led research team visited Prey Long and undertook preliminary field surveys and camera trapping near Spong village in the north, but with narrow focus on large mammals and turtles. See Appendix 2 for the list of species recorded from Prey Long.

FLD and FA have collaborated since 2000 on conservation of endangered indigenous tree species. The work has included collation of distribution maps and nation-wide identification of stands for conservation. CI supports teams of Cambodian scientists skilled in conducting systematic surveys of a wide range of globally threatened and under-studied taxa including highly trade-threatened mammals (bears, otters and pangolins), freshwater fish, amphibians, and turtles and tortoises. Over a 2-week period in May 2007, teams from the three institutions conducted a rapid assessment of Prey Long (see Map 2). The teams carried out field surveys for their selected taxa, and also collected information from local villagers on hunting and forest resource use. The results of each team constitute separate chapters in this report. We also review previous survey's data on priority species, and provide an overall summary of the current conservation status of the fauna and endangered forest types and tree species in Prey Long.

Evergreen trees of Prey Long

Ida Theilade, Lars Schmidt, Chhang Phourin, Chann Sophal, Sith Sam Nang, Hort Sothea & Mette Sinding Francke

INTRODUCTION

Categorized overall as lowland rain forest, Prey long covers a mosaic of many forest types with different degrees of deciduousness and species compositions. Forest types are presumably primarily determined by moisture which in turn is determined by topography and soil. Soil moisture thus varies with relative elevation, drainage pattern and groundwater table. The forest types range from swamp forest at permanent waterlogged sites to seasonal dry deciduous forest on higher elevations on sandy or rocky soil. There is a number of man-made forest types e.g. 1) secondary upgrowth after selective illegal felling of some of the key commercial species, 2) previous logged over forests with a relative enrichment of non-commercial species or species with lower commercial value (e.g. *Vatica* and *Lagerstroemia* species), and 3) various types of regeneration after shifting cultivation.

From Prey Long area McDonald (2005) recognized 7 well defined forest types:

1. Deciduous Forest. This type of forest is similar to the dry seasonal forest found in dryer climates Indochina. In Prey long it occurs in patches with sandy soil which dry out during the dry season and cannot support large canopies. Trees are relatively short (3-12 m) and consisting of drought tolerant species with small leaves and thick barks. Dry deciduous forests form a transition to natural grassland, which are found on the very dry sandy sites.
2. Semi-evergreen short forest. The forest is a transition type to tall evergreen forest, and often with similar species composition, yet trees are significantly smaller.
3. 'Sralao' (lagerstroemia) forest. Lagerstroemia stands are distinct by their white bark and high, erect, fluted stems. They often dominate patches of forests where they occur on 'wet and cool forest soil'.
4. Short riparian and melaleuca forest. This forest type occurs near rivers and streams, periodic inundated and remaining moist during the dry season.
5. Deciduous swamp forest. A quite unique forest type occurring around Pes Lake in the northern part of Prey Long. The soil is sandy but suspected overlying clay with poor drainage. Several very unique species and growth forms, normally associated with mangrove forest are found in this swamp forest.
6. Primary semi-evergreen dipterocarp forest. The forest type on the moist but not waterlogged areas. The forest consists of a large diversity of species with many large trees e.g. Dipterocarps with canopy closure at 30-50 m.
7. Evergreen swamp forest. This forest type occurs on very wet sites with permanent high water level. The forest consists of species adapted to permanent or long term inundation. The forest is reported to contain species characteristic of mangroves.

From a biodiversity point of view, the moist lowland rainforest (classes #2 and 6) is the most interesting. This forest type is by far the most species rich and, compared to the much more common dry deciduous forest, it is expected to contain a number of lesser known and endangered species. The swamp forest, as described by McDonald (2005) (classes #5 and 7 above) is a unique forest type for the area and presumably contains several rare, endemic and endangered species. However, compared to moist forests, swamp forests usually contain only few species (Richards 1996). The swamp forests are not accessible during the wet season and was not included in this survey. The present survey included different types of moist lowland evergreen forest types, namely secondary forests (logged once), primary forest and primary riverine forest. The objective of the survey was to assess the species diversity within and between different sub-types of moist forest from established transects.

METHODS

The survey was carried out in 7 transects within a radius of 15km from the base camp at O'Krack River (see map). We used a stratified sampling method to represent different forests types within evergreen lowland forest. Most plots (6) were situated in primary forest; one plot was in forest logged once 8 years ago. Two plots were in primary riverine forest. Within a given forest type plots were laid out randomly. We used the fixed area method of Gentry (1982) but modified it by widening transects and increasing diameter of trees included. Thus, our transects measured 50 x 12 meters. All trees > 8 cm diameter at breast height were identified and diameter recorded. Tree species recorded outside transects were registered on a checklist. Whenever possible, specimens were collected. Voucher specimens are deposited at the Forest Herbarium, Bangkok (BKF) with duplicates at the herbarium at the Forestry Administration, Phnom Penh.

RESULTS

A total of 63 tree species > 8 cm diameter at breast height were recorded. Fifty-four species were recorded from transects (Appendix 3). The number of species per plot was between 13 and 20 with slightly more species per plot in the riverine forest. The riverine forest also had more individual trees > 8 cm diameter at breast height per area than non-riverine forest. The species composition also differed between the two forest types. For example, fine stands of several *Diospyros* sp. were found along rivers while species of *Aglaia, Anisoptera, Dipterocarpus* and *Vatica* were more prevalent in non-riverine transects.

Thirty-one threatened tree species were recorded. Nine are registered in the IUCN red list (IUCN 2007) while an additional 22 are listed in the UNEP-WCMC Trees Database on threatened trees and other trees of conservation concern (UNEP-WCMC 2007). The conservation status of the species is shown in Appendix 3. *Diospyros bejaudii* was the only endemic tree species recorded in the present survey.

The number of species is plotted for the seven transects in fig. 1. The species-area curve for the seven transects shows no sign of leveling off. This demonstrates that the number of transects is disproportionate to the scale of the area and the heterogeneity of the vegetation. More transects are needed to estimate the total number of tree species (richness) in the evergreen forest.

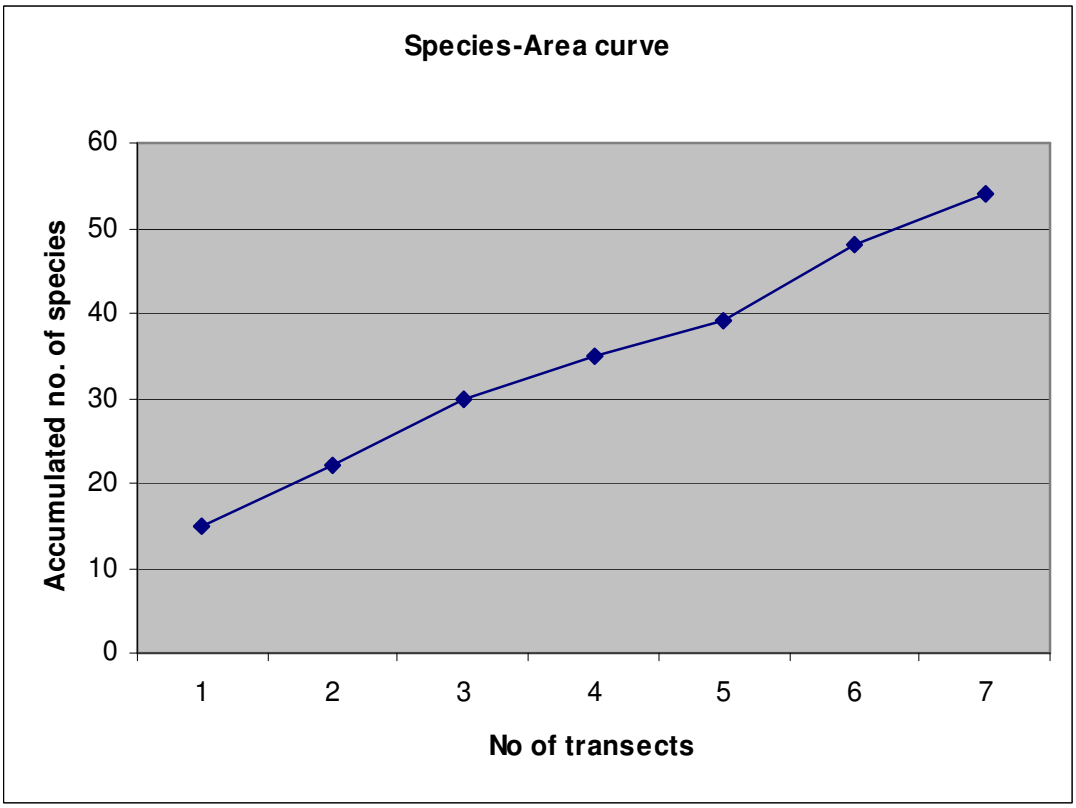


Fig.1. Species-area curve for the seven transects in lowland evergreen forest. Each transect covers 0.06 ha. Transect 1 = logged forest. Transect 2-4 = primary forest. Transect 5-7 = riverine forest.

Diversity and relative frequencies of species in the tree transects

The diversity and relative frequencies of species in each of the 7 transect plots are shown below (fig's 2-9 and tables 1-7). Very steep curves in the figures mean a high diversity with a high probability that a new encountered tree will also be a new tree species for the plot. The curve typically shows steepness in the beginning while there is a higher probability of meeting previously recorded species in the last part of the plot. Relative frequency of species in transects 1-7 is shown in fig. 9.

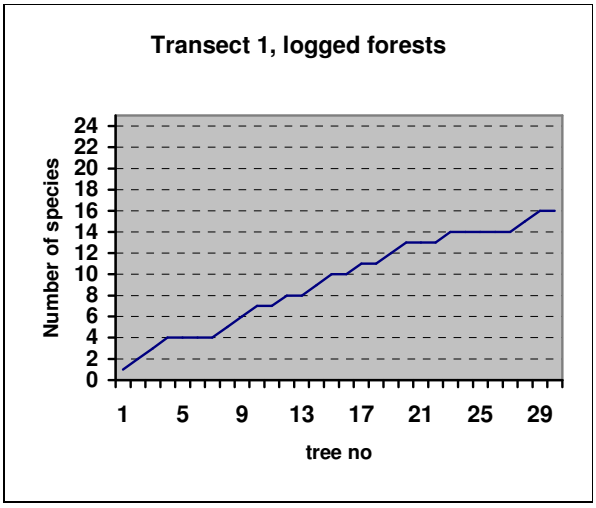
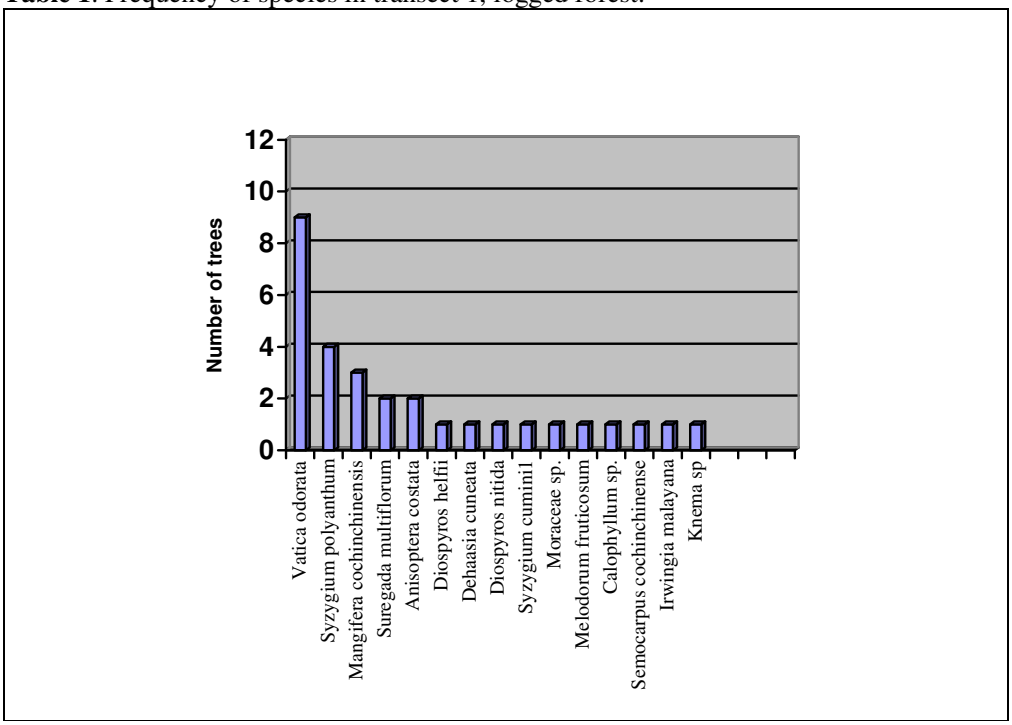


Fig.2. Tree diversity in transect 1, logged forest.

Table 1. Frequency of species in transect 1, logged forest.



Transect 1 in logged lowland forest. *Vatica* species are extremely abundant. Each species represented on average 30:16 = 1.9 times. The 5 most common species make up 66.7% of the trees in this plot.

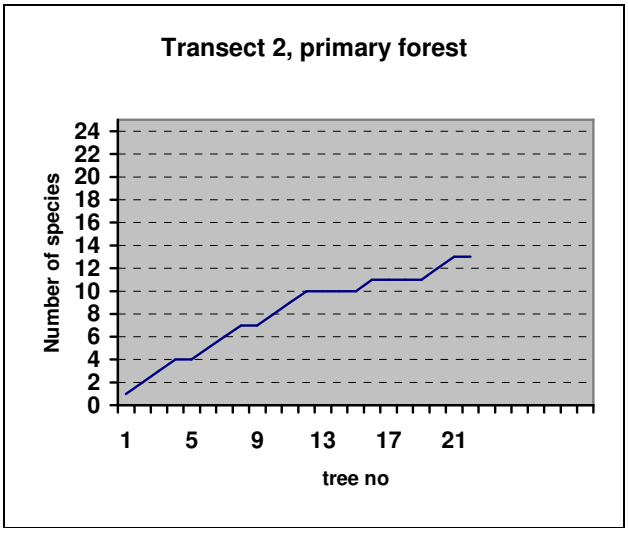
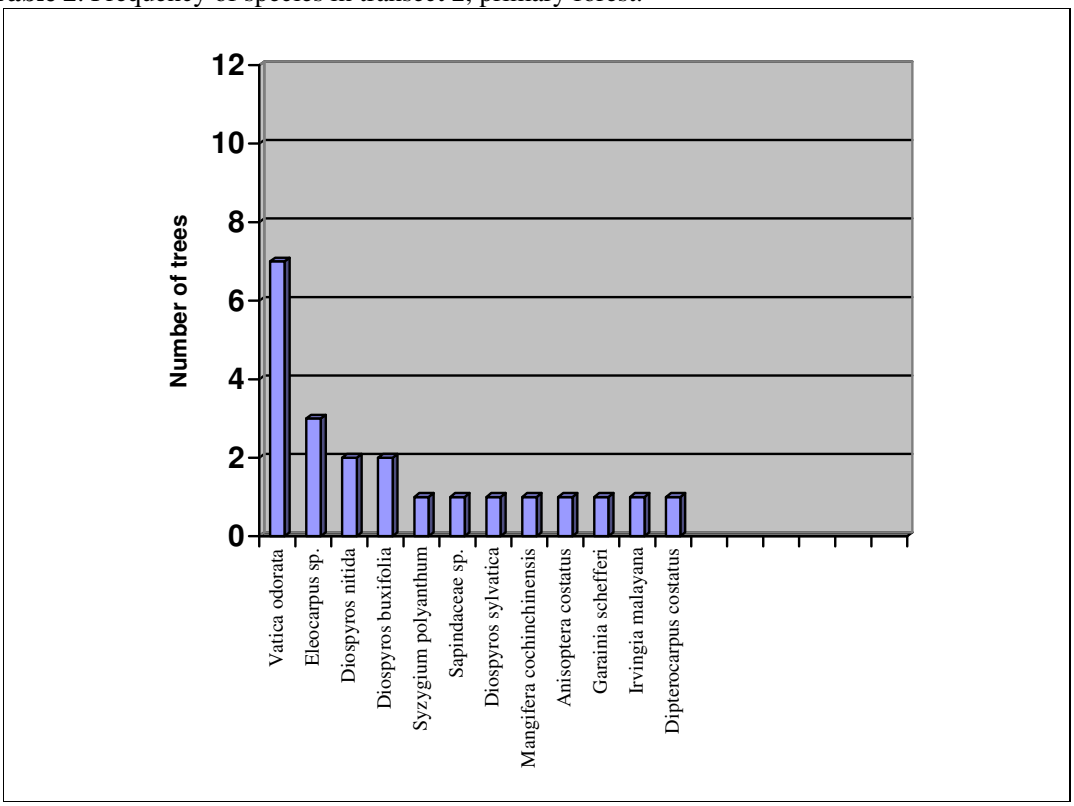


Fig. 3. Tree diversity in transect 2, primary forest.

Table 2. Frequency of species in transect 2, primary forest.



Transect 2 in primary lowland forest. The transect has few trees over chosen limiting diameter and a high diversity; each tree is represented on average 21:13 = 1.6 times. The 5 most common species make up 61.9% of the trees in this plot.

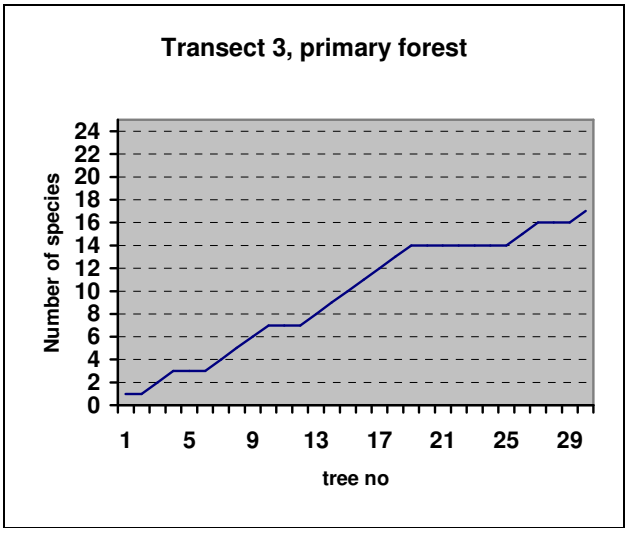
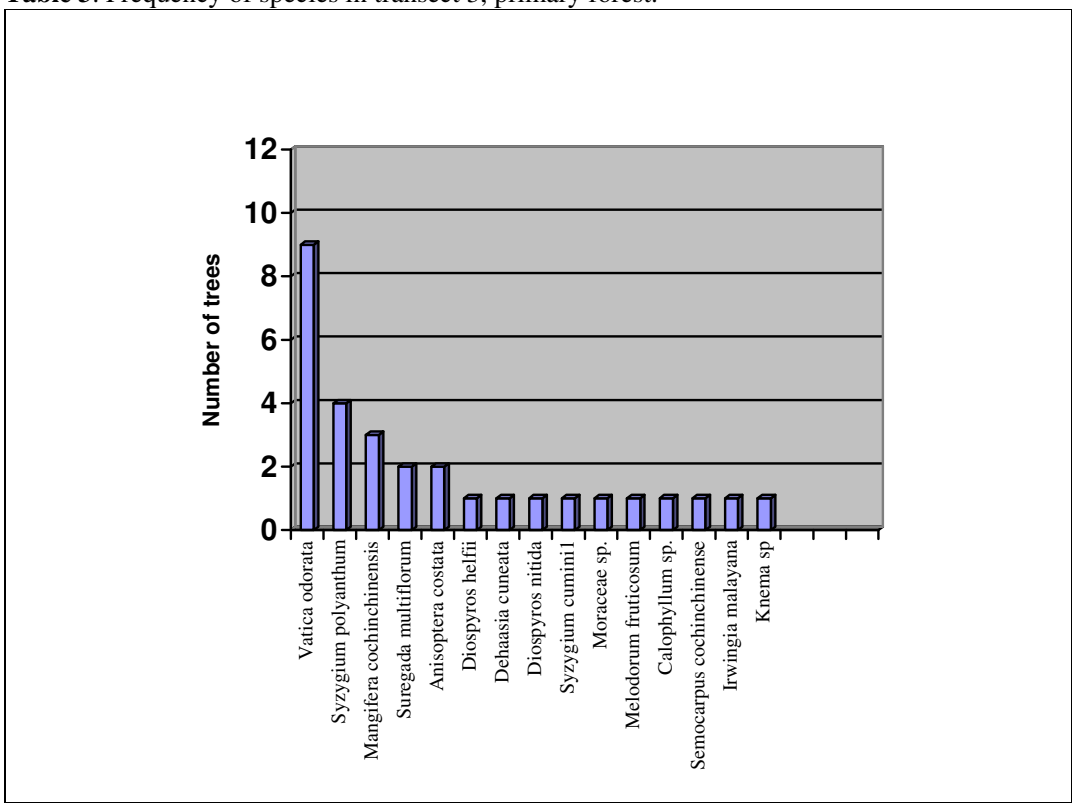


Fig. 4. Tree diversity in transect 3, primary forest.

Table 3. Frequency of species in transect 3, primary forest.



Transect 3 in primary lowland forest with high diversity. Each species is represented on average 29:17 = 1.7 times. The 5 most common species make up 51.7% of the trees in this plot.

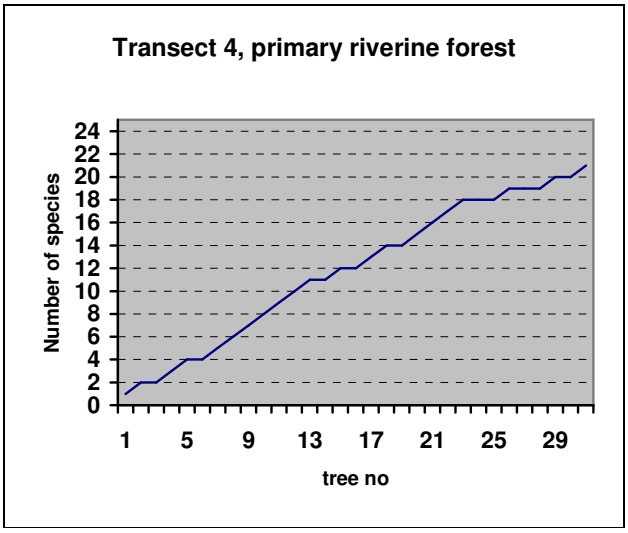
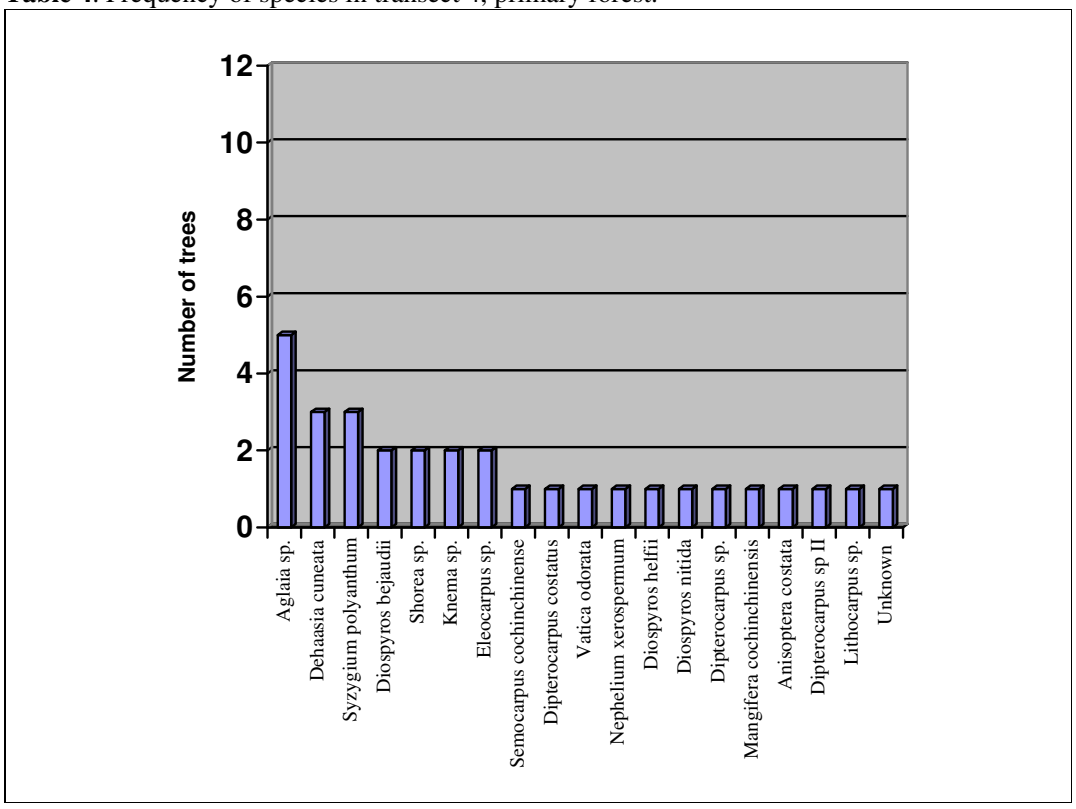


Fig. 5. Tree diversity in transect 4, primary forest.

Table 4. Frequency of species in transect 4, primary forest.



Transect 4 in primary lowland forest. An unknown *Aglaia* species is the most common tree. Several *Diospyros* and *Dipterocarpus* species were also found. Each species represented on average 31:21 = 1.5 times. The 5 most common species make up 48.4% of the trees in this plot.

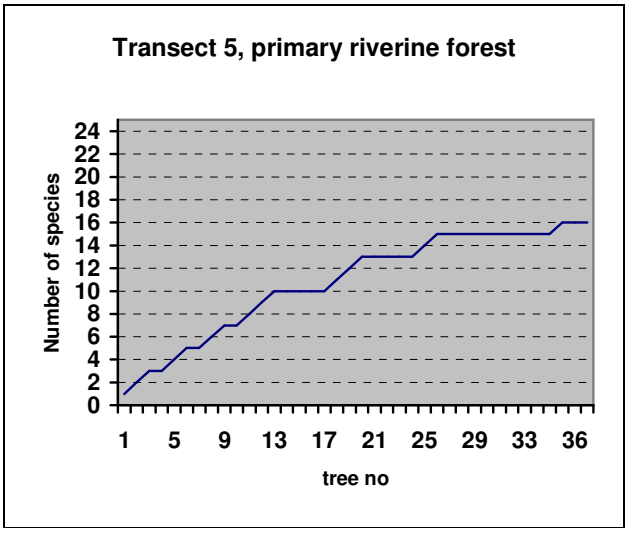
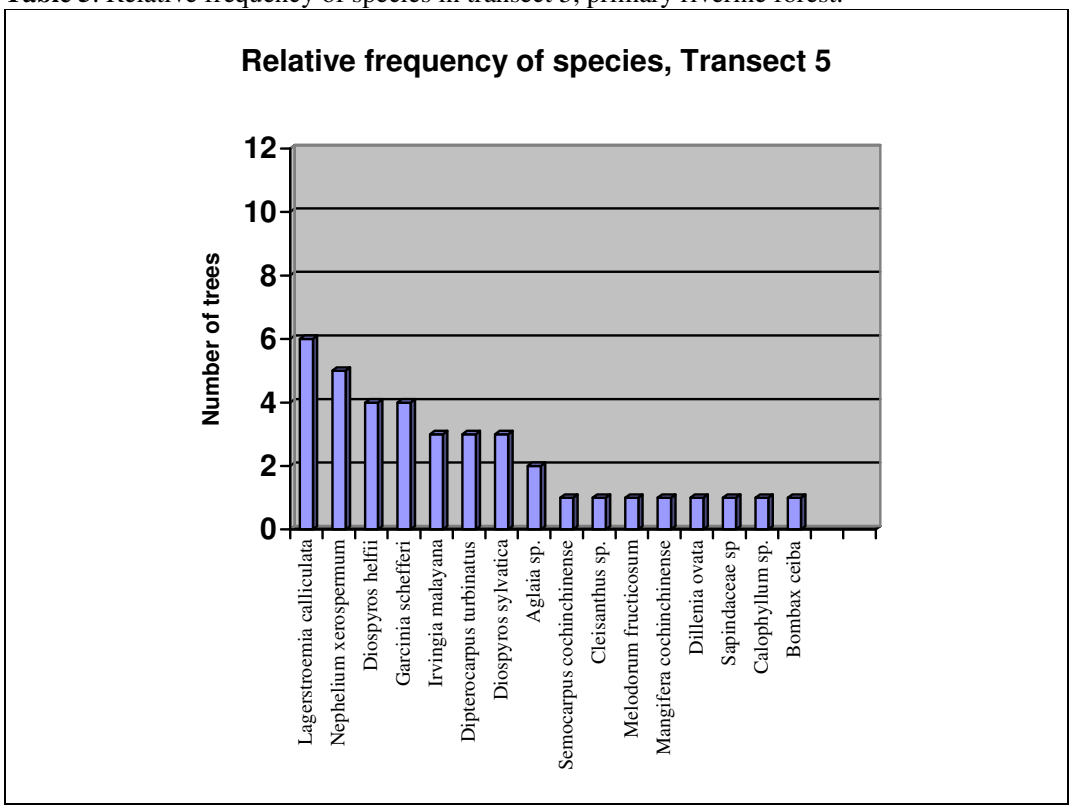


Fig. 6. Tree diversity in transect 5, primary riverine forest.

Table 5. Relative frequency of species in transect 5, primary riverine forest.



Transect 5 in primary, riverine forest. Many species with a pronounced grouping of species with several individuals was found in this transect. Each species represented on average 38:16 = 2.37 times. The 5 most common species make up 57.9% of the trees in this plot.

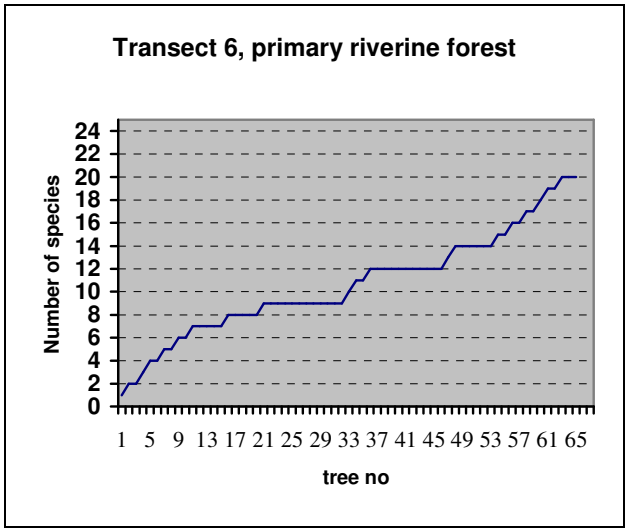
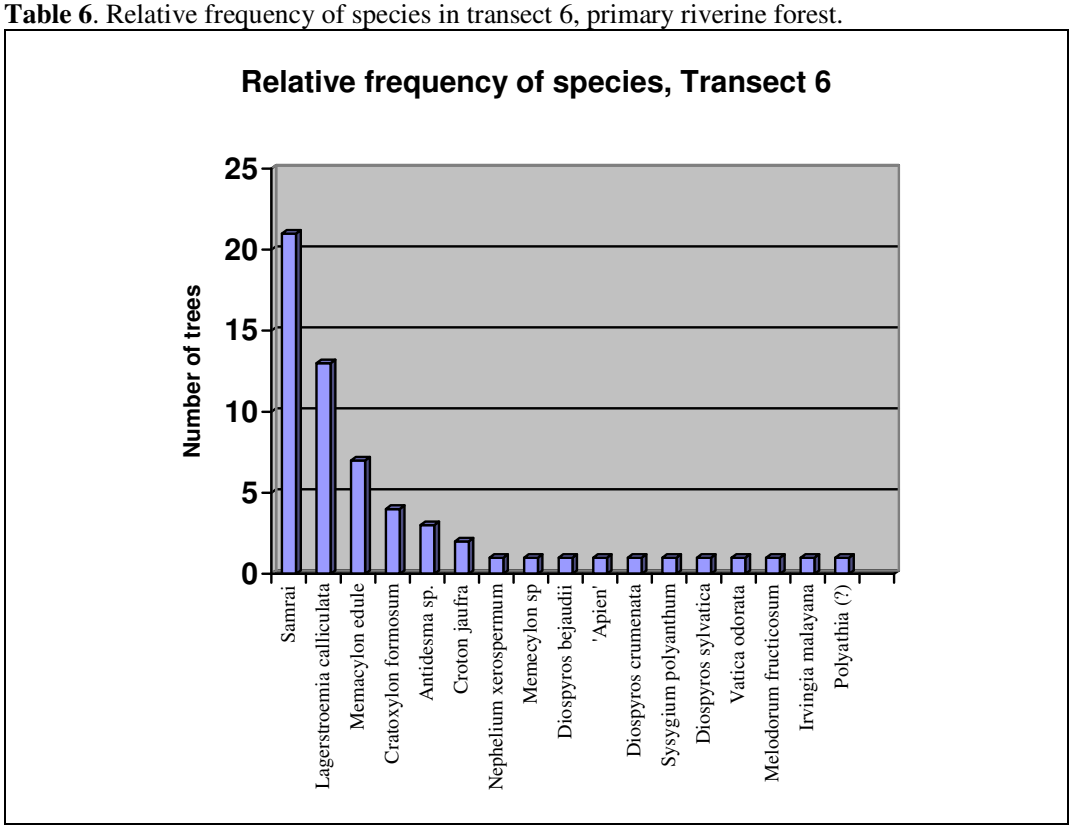


Fig. 7. Tree diversity in transect 6, primary riverine forest.

Table 6. Relative frequency of species in transect 6, primary riverine forest.



Transect 6 in primary, riverine forest. A very high number of trees and many species presented by several individuals was found within this transect. Each species is represented on average 65:20 = 3.3 times. The species with local name *Samrai* and *Lagerstroemia calliculata* are by far the most dominant. The 5 most common species make up 73.8% of the trees in the plot.

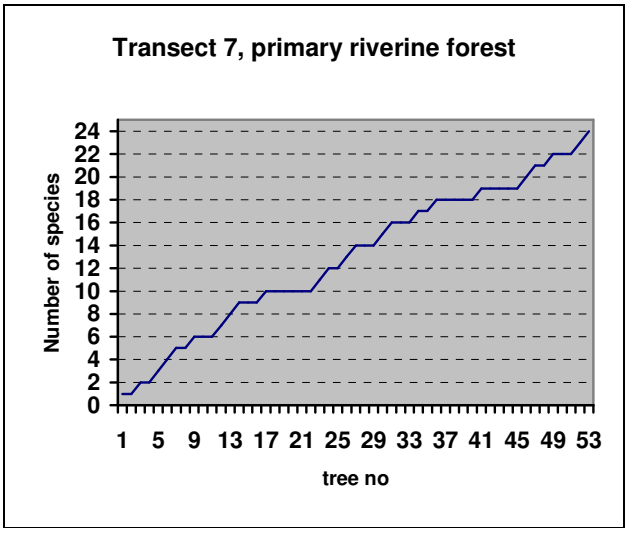
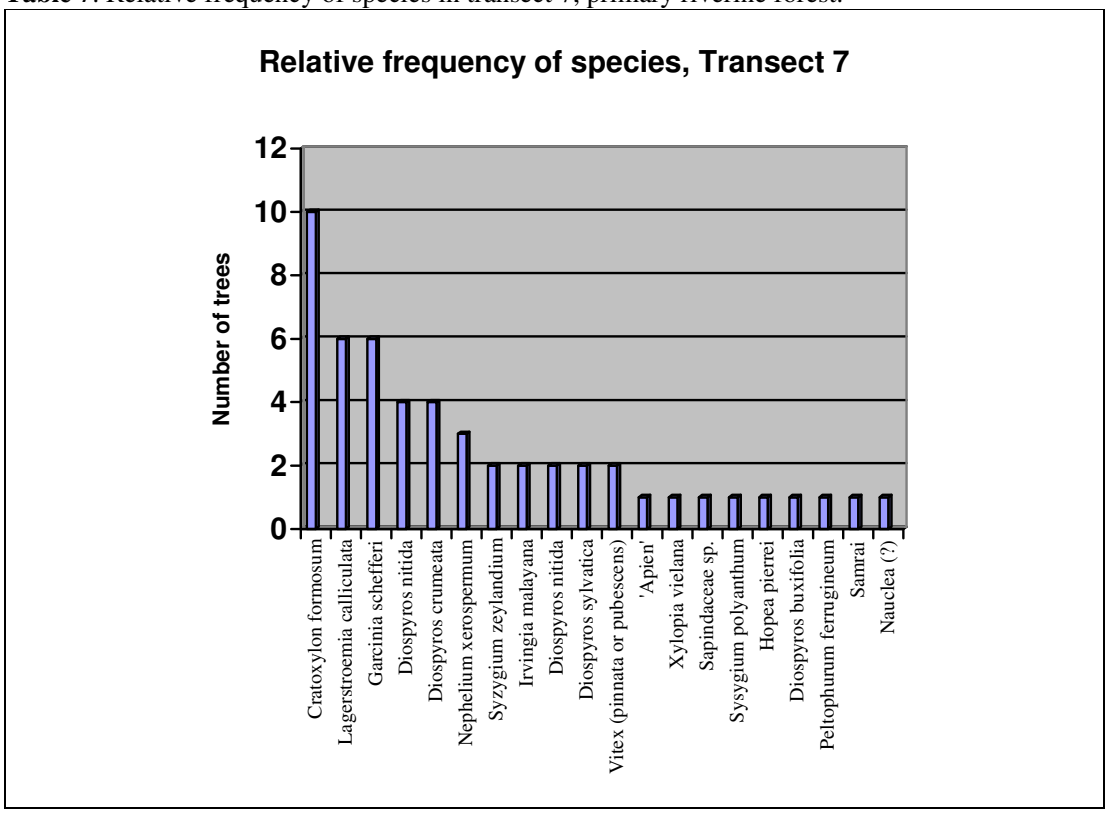


Fig. 8. Tree diversity in transect 7, primary riverine forest.

Table 7. Relative frequency of species in transect 7, primary riverine forest.



Transect 7 in primary, riverine forest. A very high number of trees and many species presented by several individuals was found within this transect. There is a relative high level of diversity. Each species represented on average 53:24 = 2.2 times. The 5 most common species make up 56.6% of the trees in the plot.

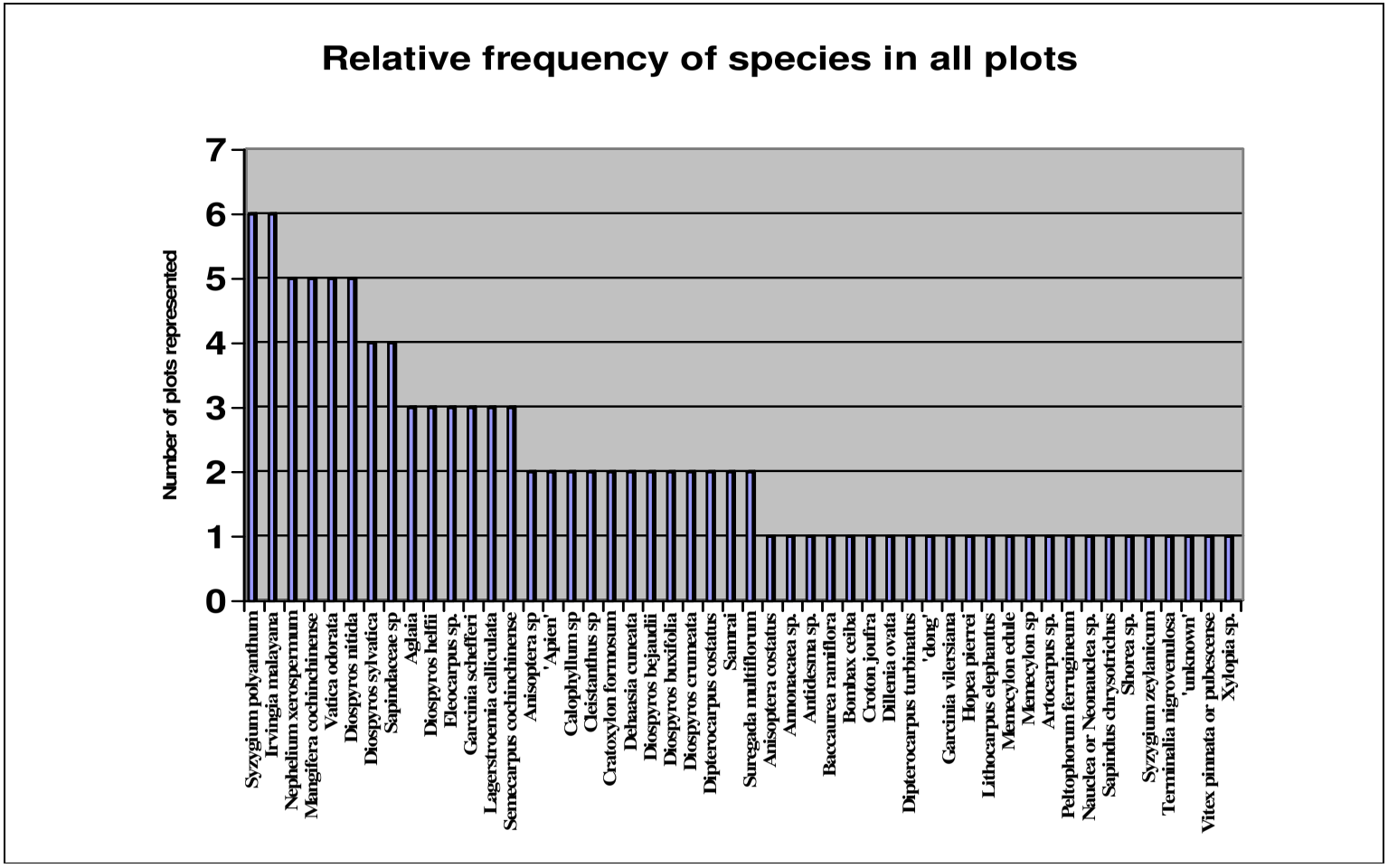


Fig. 9. Relative frequency of species in transects 1-7. No species are present in all transects. About half of the species were found in 1 transect only.

EVALUATION OF SPECIES DIVERSITY WITHIN TRANSECTS

Syzygium polyanthum and *Irvingia malayana* are the two most widespread species. *Syzygium polyanthum* are among the 5 species most abundant in transect 1-4, without, however, being dominant in either. *Irvingia malayana* occurs everywhere dispersed in very low density. *Mangifera cochinchinense* is occasionally common but never dominant. Species with sporadic high density are *Vatica odorata* (transect 1 and 2), *Lagerstroemia calliculata* (transect 5 and 7), *Aglaia* sp. (transect 4), 'Samrai' (transect 6) and *Cratoxylon formosum* (transect 7). Five *Diospyros* species are represented in all transects, *D. nitida* and *D. sylvatica* are represented in five of seven transects but none of them are common. All six species of *Diospyros* are represented in more than one transect. It should, however, be noticed that the *Diospyros* species are relatively small diameter trees and there are quite a few under-sized trees, which were not counted as we put our diameter limit >8cm.

It is remarkable that all transects, despite high species diversity, showed high level of dominance by few species. The five most common species typically make up more than 50% of the species, in transect 4 slightly less (48%), in transect 6 almost ¾ (73.8%). Transects with high dominance ratio should be expected to show a relatively low species diversity and fast species satiation. This holds for e.g. transect 1, 2, 3, and 5 but is less so in 6 where there is a high number of rare species despite the *Lagerstroemia* and *Samrai* dominance. Transect 4 and 7 have a few co-dominant species with low frequency and the area /species curve is steep.

DISCUSSION

The preliminary tree survey presented in this report is based on a stratified sampling method in a very limited area of evergreen forest in the greater Prey Long. More surveys are clearly needed to get a representative sampling of all forest types in the area. The unique swamp forest described from Prey Long has so far not been inventoried at all.

Primary evergreen forest was the focus of this survey. This forest type is threatened in all of S.E Asia. Most of the national priority tree species for conservation are expected to be found in this forest type and within Prey Long (CTSP/FA 2003). Almost 50% the tree species above 8 cm diameter recorded from Prey Long are of global conservation concern pointing to the ecological importance of the area. Furthermore, several of the tree species found are listed as national priority species for the forestry sector and local livelihoods in Cambodia. This highlights the importance of Prey Long for tree conservation on a national level.

In the sense of recording tree species richness, frequencies and relative dominance the present survey is insufficient. More surveys are needed to provide a complete checklist of the area and estimate populations of target species within Prey Long. However, the survey shows that Prey Long certainly has good stands of species like *Diospyros* sp. *Dipterocarpus* sp, *Aglaia* and *Afzelia*. Presence of several additional tree species of global and national conservation concern are expected to be found in Prey Long based on the management plan for Everbright logging concession (Everbright CIG Wood Co., Ltd. 2003), observations by staff of the Forestry Administration (Strange et al. 2007), and according to local guides. Additional tree species of conservation concern expected to be found in Prey Long include: *Albizia lebbeck, Aquilaria crassna, Cinnamomum cambodianum, Dalbergia oliveri, Dalbergia cochinchinensis, Dasymaschalon lamentaceum, Dysoxylon loureiri, Fragraea fragrans, Garcinia hanburyana, Gardenia*

angkorensis, Hopea helferi, Lasianthus kamputensis, Pinus merkusii, Pterocarpus macrocarpus, Shorea cochinchinensis. This makes Prey Long a national priority area for conservation of endangered tree species. Several other economically important species of conservation concern are recorded in the Everbright management plan. Further inventories are needed to confirm their presence and abundance.

Extraction of luxury woods was observed in the area near O'Krack. The practice of log-poaching is expected to have negatively affected presence and frequency of especially *Dalbergia spp*. and *Afzelia xylocarpa* in the otherwise un-logged forest.

Unfortunately most collected botanical material was sterile. A follow-up botanical inventory is planned for the flowering season in April 2008. The team will then bring tree climbing equipment in order to collect fertile specimens for verification and further taxonomic studies.

Bears

Roth Buntheun, Peov Somanak, Heng Namyi, Hay Dalino & Sett Sophak

INTRODUCTION

Two bear species are found in Cambodia: the Asiatic Black Bear *Ursus tibetanus*, and the Malayan Sun Bear *Helarctos malayanus*. Both species are highly threatened throughout their ranges due to habitat degradation and hunting, and both are classified as Vulnerable on the IUCN Red List of Threatened Species. Both bear species typically occur in forested habitats, particularly evergreen forest. Prey Long, with its large areas of lowland evergreen forest, has the potential to hold nationally or even globally important populations of *H. malayanus* because this bear mainly occurs in lowland tropical forests (Serveen *et al*. 1998). It is also possible that *Ursus tibetanus* occurs in Prey Long, though it is likely to be less abundant than *Helarctos malayanus* as its distribution in Cambodia is mostly limited to hill evergreen forest (Serveen *et al*. 1998, A. Olsson pers. comm.).

There are several historical reports of bears in Prey Long. In 2003, a WCS-led survey of Prey Long recorded bear scratch marks. In 2005, CI's research team set camera-traps in the northern part of Prey Long and recorded one photograph of an adult *H. malayanus*.

Bears are rarely observed in the field during surveys, but they leave signs that are easy to recognize and record. For more than a year, the CI-supported Cambodian bear research team has systematically surveyed sites throughout Cambodia to assess the presence and relative abundance of bears using methods and abundance analyses based on these signs. The same methods were used in this survey, wherein we aimed to survey Prey Long for the presence and abundance of *Ursus tibetanus* and *Helarctos malayanus*, and to compare the site with other forested areas across the country.

METHODS

Bears often leave scratch marks on trees when they climb to rest or to access food (see Figure 10). The two species of bears in Cambodia are significantly different in size (*Ursus tibetanus* is the larger species), and therefore the scratch marks also vary in size, with marks from adult *U. tibetanus* being larger than those of adult *Helarctos malayanus*. By measuring the distance between individual claw marks on a scratch-mark (see Figure 11), it is possible to determine which species has left the mark. This method follows Steinmetz (2007). See Appendix 4 for the reference table of scratch mark measurements.

Straight line 10m-wide belt transects were walked and bear signs and food sources were recorded in order to assess presence and relative abundance of bears, and habitat suitability. Transect start-points and directions were randomly selected at the study sites. A minimum of three people walked each transect; one in the middle to guide the direction using a compass and to record the data, with the other two people walking on either side of the mid-line. Their role was to zigzag through an area 5 m from the transect mid-line and to record all bear signs and potential food sources. The transect lengths varied according to topography, but each was a minimum of 200 m in length. The minimum distance between transects was 500 m.

The age of scratch marks can also be estimated. They are separated into four categories: *fresh* marks (less than two months old) are defined as having a sharp edge and containing

woody grit; *recent* marks (2-12 months) are defined as having an edge that has softened and no woody grit can be seen; *old* marks (1-3 years), when the edge is thickening and the bark is beginning to re-grow over the mark; and *very old* scratch marks (more than 3 years), when the bark edge has almost overgrown the mark. This is a rough but fairly consistent guideline, which varies slightly according to the species of tree and its corresponding growth rate (Steinmetz, 2007).

Two focal areas in Prey Long were surveyed for bear signs. The first site was located near O'Krack stream in the southeastern part of Prey Long, and consisted predominantly of evergreen forest with some scattered areas of deciduous forest. The second site was located near O'long stream in the northern part of Prey Long (UTM: 0578057N, 1468055E; approx. 80m asl). This survey site consisted of closed-canopy evergreen forest with many large trees, interspersed with permanent and temporary streams. See Map 2.

Six transects were conducted in evergreen and deciduous forest at the O'Krack survey site, and four transects were walked at the O'Long survey site, all in evergreen forest.

RESULTS

O'Krack Surveys

A total of 3 ha of forest were surveyed at this site. Table 8 shows a summary of the bear signs and potential food sources we recorded. Twenty-five scratch marks were recorded during the transect survey at this site, of which two (8%) were classified as *new*, twelve (48%) as *old*, and eleven (44%) as *very old*.

Table 8. Total numbers of bear signs and potential food sources at the O'Krack survey site, and the numbers of signs and food sources per hectare

	Surveyed Area	**Scratch marks**	**Broken termite mounds**	**Broken rotten logs**	**Termite mounds**	**Fruit trees***
Total signs/food sources	**3 ha**	25	4	1	193	95
Signs/food sources per ha.		8.3	1.3	0.3	64.3	31.6

* Tree species with edible fruits, upon which bear scratch-marks have been recorded elsewhere in Cambodia (A. Olsson, unpublished data)

Fig.10 (left). Old bear claw marks recorded in Prey Long

Fig.11 (right). Assessing a scratch mark

Three of the scratch marks were suitable for measuring to determine species (i.e. they were from the hind foot, and all claws were clearly identifiable). Two *new* scratch marks were determined to be from *Helarctos malayanus*, and one *old* scratch mark was determined to be from *Ursus tibetanus* (See table 9).

Table 9. Measurements of the three scratch marks which were used to identify the bear species

Date	4-claw width (cm)	5-claw width (cm)	3-claw width (cm)	Claw marks	Species ID
08/05/07	5.5	7.5	4	Hind foot	Sun bear
	8	11	4.5	Hind foot	Black bear
12/05/07	5	7	3.4	Hind foot	Sun bear

Additional observations recorded a further twenty scratch marks from bears in the O'Krack survey area. These scratch marks were all classified as *old* or *very old.*

O'Long Surveys

A total of 2ha of forest were surveyed at this site. Table 10 shows a summary of the bear signs and potential food sources we recorded.

Table 10. Total numbers of bear signs and potential food sources at the O'Long survey site, and the numbers of signs and food sources per hectare

	Area	Scratch marks	Broken bee nest	Termite mounds	Fruit trees
Total signs/food sources	**2 ha**	6	1	173	47
Signs/food sources per ha.		3	0.3	86.5	23.5

All of the scratch marks at this site were classified as *very old.* None of the marks were suitable for measuring to determine species.

Interviews

Interviews with local villagers in the northeastern part of Prey Long provided the following anecdotal information relating to bear hunting in Prey Long:

- According to a local guide from Doung village, five *Helarctos malayanus* were caught in 2006 by villagers from Sandan district, kampong Thom province, using steel snares placed in the O'Long area.
- In early 2007 near Khes and Doung villages, a young boy was injured by an adult female *H. malayanus* when he tried to catch her cub.
- Local guides who lived near the O'Krack surveys site claimed that in 2006 a bear cub was found in a hole in a tree, and sold at a market in Sambo district, Kratie province.
- Local villagers in Doung village said that they rarely see bears now, and that there are far fewer bears than in previous years.

DISCUSSION

The number of bear signs found in Prey Long is low when compared to other surveyed forest areas within Cambodia, such as the Central Cardamom Protected Forest and Bokor National Park (A. Olsson, unpublished data). Furthermore, the majority of scratch marks we recorded were classified as *old* or *very old*. This indicates that the present abundance of bears in the area is low and has been declining in recent years, possibly as a result of high hunting pressure.

The approximate abundance of fruit trees in the surveyed transects was very similar to other forest areas in Cambodia where bears have been recorded in higher abundance, suggesting that the food base for bear populations in Prey Long is good. This further indicates that the low abundance of bears we recorded in Prey Long is attributable to high hunting pressure.

Because Prey Long contains lowland forest, we predicted that *H. malayanus* would be the most dominant bear species. However, our scratch mark analysis indicates that *Ursus tibetanus* is also present. Due in part to their preference for hill forest habitats, *U. tibetanus* is less widespread in Cambodia than *Helarctos malayanus*, so its presence in Prey Long is interesting both from an ecological point of view and also from a conservation perspective. In an attempt to confirm the presence of *Ursus tibetanus* in Prey Long we will set camera-traps at sites where scratch marks indicate their presence. However, based on the results of this and previous surveys in Prey Long, it appears unlikely that the area holds nationally significant populations of *U. tibetanus.*

The results of this survey, when combined with previous survey results, confirms that *Helarctos malayanus* is present in Prey Long albeit in low numbers. The scarcity of this species can be attributed with reasonable certainty to high hunting pressure because the lowland evergreen forests of Prey Long provide sufficiently large areas of suitable habitat to support *H. malayanus* in much higher numbers. At the present time, it is unlikely that the populations of *H. malayanus* in Prey Long are nationally important for conservation. However, if the site is protected and the bear population is allowed to recover, Prey Long has the potential to become a key site for conservation of *H. malayanus* in Cambodia.

According to the National Wildlife Pracas which lists species that are protected under Cambodian law, *Ursus tibetanus* is listed as 'Endangered' - the highest category of legal protection, and *Helarctos malayanus* is listed as 'Rare' which still affords the species a high level of protection. If the wildlife law is enforced, it is possible that the populations of bears in Prey Long may recover. However, it is unlikely that this law will be sufficiently enforced to dissuade hunting of bears for many years, which may be too late for the bear populations in Prey Long.

Pangolins

Chann Sopheak & Chea Phallika

INTRODUCTION

One species of pangolin or scaly anteater is recorded in Cambodia, the Sunda Pangolin *Manis javanica*. This is a medium-sized nocturnal and secretive mammal, which can attain a maximum weight of about 12 kg. They feed exclusively on ants and termites. It is distributed throughout Southeast Asia to Malaysia and Indonesia (IUCN, 2007). Historically, *M. javanica* was widespread and abundant in Cambodia, but high and increasing levels of hunting for traditional Chinese medicine over the last decade has severely impacted these populations. It is now considered to be rare throughout most of its range, and has become locally extinct in many areas. Although *M. javanica* is only classified on the IUCN Red List of Threatened Species as Near Threatened, its global status has not been formally reviewed since 1996. It is now widely considered by experts to be vulnerable with extinction.

The CI-supported pangolin research team has conducted semi-structured interview surveys in and around protected areas throughout Cambodia over the last year, and all survey results indicate dramatic decreases in pangolin populations due to hunting. Several different methods are used to hunt pangolins, which are then transported alive to trade destinations in Vietnam and China. In many parts of the country such as the forests of Southwest Cambodia, the main method used to capture pangolins is to set nylon snares. In other areas in Cambodia, hunters use dogs to locate hiding pangolins. Some hunters from indigenous communities are also skilled at tracking pangolins in the forest without the use of dogs. Often, combinations of methods are used. The result is a precipitous decline in numbers of *M. javanica* throughout Cambodia.

Manis javanica typically occurs in evergreen forest. The forests of Prey Long could hold nationally or globally important populations of this rare species. Historical records indicate that *M. javanica* has not been found at this site, but specific survey methods and focused interviews are necessary to assess its presence and status with reasonable accuracy. Therefore, we aimed to assess the conservation importance of Prey Long for *M. javanica* conservation through semi-structured interviews in neighbouring villages.

METHODOLOGY

Pangolins are extremely secretive mammals, which makes them difficult to survey in the wild. Therefore, the most available source of information on the presence and status of pangolins in an area are from interviews with hunters in communities around the survey site. The pangolin research team conducted interviews in villages in Prey Long using prepared questionnaires that focused on assessing the status and threats to pangolins. The team interviewed hunters and wildlife traders.

In early 2007, the research team conducted interviews in villages to the west of Prey Long (Kampong Thom Province) so the geographic focus of this survey was on villages in the northeastern part of Prey Long, in Thalaborivat district (see Map 2 and Appendix 5 for the list of villages where interviews were conducted). Twenty interviews were conducted in five villages, with 3-5 interviews in each village.

RESULTS

Presence, status and threats

Interviewees stated that *M. javanica* is present both in evergreen and deciduous forest in Prey Long. Two main factors were given that interviewees claim are threatening pangolins in the area: high levels of hunting, and habitat destruction. All interviewees stated that due to their high value in trade, pangolins have been heavily hunted in Prey Long and their populations have rapidly declined. We were told that pangolins have been hunted in Prey Long for trade since the early 1990s, but that hunting seriously increased in 2000. Most interviewees stated that 2000-2002 were the years when people captured the most pangolins. They added that many people from local villages such as Dong, Kangcham, and Moum purposely went to the forest to hunt pangolins at that time because the trade price was high and the pangolins were still abundant. After this period the number of pangolins in Prey Long rapidly decreased. Apparently, the number of pangolin hunters has decreased because they no longer find many pangolins in the forest.

Many interviewees claimed that pangolins are locally extinct in the more accessible parts of Prey Long. For example, most villagers interviewed in Ron village (see Figures 12a and 12b) stated that pangolins have not been found in the forests within a few kilometers of that village since 2000, and villagers in Kangcham (a village along the Mekong River) stated that they have not seen pangolins in riparian forest or near the river in about a decade.

A hunter in Dong village summarised the impact of hunting on *M. javanica* in Prey Long when he said "In 2002, I should spend one or two weeks with a group of four or five people in the forest [in Prey Long] and we would catch three or more pangolins, but now we rarely catch even one". Another interviewee stated that pangolins are still present in the forests of Prey Long, although in very low numbers: "In the whole of last year my group of five people only got two pangolins from Prey Long" he said.

Figs.12a & 12b Interviewing villagers in Ron Village

Habitat destruction such as illegal logging and land encroachment was also stated as a current threat to pangolins in Prey Long, though not as severe a threat as hunting.

Local hunting methods

Mostly hunters in Prey Long stated that they caught pangolins without dogs or snares, simply by using their own tracking skills. They stated that, to catch pangolins, they

would find and track new scratch marks or prints, which are easily seen during the rainy season. A hunter in Moum village said that the best hunting season is between August and October. Most hunters stated that, in general, when they find a fresh mark left by *M. javanica*, they invariably find and capture the animal. They added, "When we go to hunt pangolins by our own skill, it is better not to bring the dog because we will confuse between the dog and pangolin marks on the ground, which makes it difficult to follow the pangolins". Some people do use dogs to hunt, but they rarely use snares to catch pangolins as they said it injures the animal and lowers its market price.

Trade and value

Interviewees stated that local people around Prey Long rarely use pangolins in traditional medicine. Instead, almost all of the captured pangolins are apparently sold to middlemen for eventually sale into Vietnam and China, where pangolins are highly valued for use in traditional medicine. The trade route for pangolins (and other wildlife) is apparently well established in the Prey Long area. Most villagers sell pangolins directly to middlemen in Stung Treng town, but some sell to middlemen in villages.

As was the case in other provinces where we conducted surveys, we found that the price of pangolins varies depending on the weight of the animal. The rule is that the larger the pangolin, the cheaper the price per kilogram. For example, we were told that small pangolins (up to 4.5 kg) are valued at $30/kg, whereas large pangolins (over 7 kg) only sell for about $15-20/kg.

DISCUSSION

Based both on known ecology and on interviewees, it is apparent that *Manis javanica* occurs both in evergreen and deciduous forest in Cambodia. It is therefore apparent that Prey Long contains large areas of suitable habitat for this species. However, as our interview information also indicates, many pangolins have been hunted from Prey Long and the species is now extremely rare and mostly now occurs in the more remote parts of the forest. In more accessible areas the species appears to have been functionally extirpated.

Until very recently, *Manis javanica* has received little conservation attention. However, the international trade in pangolins and pangolin parts for food and medicine has escalated dramatically and resulted in depleted populations of this species throughout most of its range. It now appears that *M. javanica* is severely threatened with extinction. *Manis javanica* is classified on the Cambodian National Red List as 'Rare', making it illegal to hunt or trade this species. Because of their specific diet and susceptibility to stress, pangolins are almost impossible to keep in captivity at present. Only a handful of captive pangolins exist in the world, so the only hope for conserving pangolins is to protect them in the wild. Prey Long provides suitable habitat for conservation of this rare and highly threatened species, but hunting pressures are high. The site is therefore unlikely to be able to support nationally important populations of *M. javanica* unless these pressures are reduced.

Otters

Hon Naven, Nop Navy & Heng Sokrith

INTRODUCTION

Up to four species of otter occur in Cambodia. The Small-clawed Otter *Aonyx cinerea*, Smooth-coated Otter *Lutragale perspicillata*, and Hairy-nosed Otter *Lutra sumatrana* have all been recorded from different parts of the country through field observations, camera trap photographs, tracks, captive individuals, and skins found in trade. The presence of the Eurasian Otter *Lutra lutra* has not yet been confirmed in Cambodia. Asian otters are apex predators in the freshwater realm. They were once widespread throughout a wide range of wetland ecosystems such as lakes, rivers, coastal zones, and marshes. However, with increasing human populations, otters now face many threats to their survival such as alteration of habitats, depletion of food sources due to over-fishing by man, extirpation as pest species, and hunting for trade (especially their skin). Most populations of otters in Southeast Asia have declined and some areas have seen local extirpations, bringing several of Asia's otter species to the brink of extinction. Following a recent re-assessment of otters for the IUCN Red List *Aonyx cinerea* and *Lutra perspicillata* have been proposed for re-classification as Endangered, and *L. sumatrana* as Critically Endangered.

Until recently, almost no information was available about the otters in Cambodia. In 2006, the CI-supported otter team visited wetland areas throughout Cambodia to undertake basic surveys to assess the presence and status of otters. The Hairy-nosed Otter *L. sumatrana* was the focal species as it was thought to be extinct until recently, when a few small and highly threatened populations were found in southern Vietnam and southern Thailand. Trade information suggested that it occurred in Cambodia, and the otter research team confirmed its presence in the wild in the flooded forests surrounding the Tonle Sap Lake. This species may also occur in other sites with flooded forest, and such findings are extremely important for the conservation of the species. Therefore, we aimed to assess the conservation importance of Prey Long for otter conservation, and to find out whether the flooded forests harbor *L. sumatrana.*

METHODS

We selected the forest and villages along the western side of the Mekong River in Stung Treng Province as the study site. This area contains a matrix of evergreen forest, swamp forest and deciduous forest with permanent streams. The survey sites were selected based on their suitability as otter habitats. There are five main permanent streams running through Prey Long and draining into the Mekong River, all of which have the potential to provide good habitat for otters. See Map 2 for location of survey site. See Appendix 6 for the full list of villages visited for interviews. In this area, most of the local people depend on farming (shifting cultivation and rice), fishing, collecting non-timber forest products (NTFPs), hunting, or a combination of these livelihoods.

Interviews were used to collect general information, but we also studied skins and other parts of otters found in villages to identify the species of otters present in the area. The interviewees were selected based on their livelihoods and likely knowledge of otters and their habitats. We interviewed fishermen, hunters, NTFP collectors and wildlife traders.

Thirty interviews were conducted during the survey. A questionnaire was used to provide a framework for questions and a casual conversation was established with the interviewee, during which the team took notes. To collect additional information, the team also looked for otter traps, snares and skins in the villages. See Figures 13 and 14.

Fig.13 (left). Interviewing in O'Dung village

Fig.14 (right). Interviews in O'Lung village

In addition to the interviews, three camera traps were set at suitable sites within Prey Long. Cameras of the brand Photo Scout were used. The cameras were set for 40 days. Table 11 describes the sites for camera traps.

Table 11. Descriptions of the three camera-trap locations

UTM	Location	Site Description
590881-1450554	O'Krak stream	O'krak is a permanent stream. The substrate is a mix of sand and rocks, and tall trees grow along the banks. The stream appears to have a high abundance of fish, amphibians and reptiles. However, there is evidence of hunting and fishing in this area.
590521-1445939	Salt lick	The camera traps were set near a salt-lick to target a wide variety of mammal species.
588437-1444683	O'choam stream	O'choam stream is a small permanent stream. The substrate is a mix of sand and rocks. Otters had allegedly been recently seen at this stream by local NTFP collectors.

Track and sign surveys were conducted in Kratie province near the O'krak stream. Paths and river-banks were walked to search for footprints, spraints, and other evidence such as partly eaten fish See map 1 for location of survey sites.

RESULTS

Presence and status

Most interviewees stated that they have recently seen otters. They stated that when they are in the forest to collect NTFPs or hunt they often see otters either swimming or on the riverbanks, typically in groups of 2-10. They stated that otters are most abundant near the streams of Olung, Ochoam, Osiembok, Stung Pongrong, and Okrak. They also stated that otters live in the flooded forest areas.

Interviewees stated that they see most otters during the dry season. Many interviewees said that there are two kinds of otters living along the streams in Prey Long, one grey and

one black. They stated that the tails of both species are flattened. They also stated that they see signs of otters along the streams such as tracks, spraints, and dens.

From interview results it appears that the populations of otters in the Prey Long area have decreased in the last 10-20 years. We were told that, previously, otters were frequently seen in and near the Mekong and large streams but that now the otters appear to avoid these places as many people visit those sites to fish. Now they favor smaller streams deep in the forest where there is less human activity. However, interviewees suggest that the expansion of human activities deeper into Prey Long puts further pressure on the already diminished otter populations.

Hunting and trade

In the past, local villagers used to trap otters along the Mekong River and large streams in Prey Long (see Figure 15). Now, the villagers claim that few otters are left in these areas, so not much effort is put into catching them any more. Otters are now mainly found in streams in the forest, where they are also becoming increasingly difficult to find and catch. In Moum, the interviewees said that when they go to collect resin deep in the forest they always bring snares with them so that they can catch wildlife as well. When they see otter signs along the streams, they set snares there (see Figure 16).

Fig.15 (left). Otter trap at Kangkangouk village

Fig.16 (right). Wildlife snares at Moum village

Otter pelts are very valuable so the species is targeted for hunting. For example, a villager from Moum stated that he caught one otter at Stung Pongrong in 2002 using a snare, sold the skin in Stung Treng for 300,000 Riel ($75) and kept the meat for food. A villager from Kangcham stated that he caught one otter at O'krak stream in 2005 with a hunting dog and sold the skin to a middleman in the village for $50. Other villagers stated that they have sold otter skins to traders in Stung Treng for $10 to $75 depending on the size and quality. Apparently, most otter skins were sold in Stung Treng, though middlemen from Kampong Thom and Stung Treng occasionally bought otter skins directly from the villages. Middlemen have also asked for otter sperm, as this is highly priced and used to improve sexual performance.

Otter cubs are popular as pets, and are often sold within local communities as such. When the cubs reach adulthood and are not easy to keep as a pet they are usually sold for their skin.

Most local people state that they do not know what otter skins are used for; they simply catch the otters, sell the skin, and keep the meat for food. The team managed to interview

two wildlife traders in Stung Treng. One of the traders sells otter skins to Vietnam via a trader in Phnom Penh. The other trader buys wildlife to produce traditional medicine. In the last few years she bought 4-6 otter skins/year. She cuts small pieces from the otter skins and sells them to people for medicine. She also prepares parts of the skins in a mixture with sesame seeds and honey, which is used by pregnant women to ease problems during labor.

The rainy season started early this year. This made track and sign surveys very difficult as the signs were washed away by rain, so no tracks or signs were recorded during the survey. No wildlife pictures were taken by the camera traps, as these malfunctioned due to the heavy rain. The team will return to conduct additional camera-trapping later in the year.

DISCUSSION

Otters, like pangolins, have been largely overlooked by biologists and conservationists in Southeast Asia. Throughout the region, the trade in otter skins has been significant yet it has gone mostly un-noticed because focus has been on other high-value species such as tigers. Because of the lack of species-focused conservation, otter populations have crashed in most range countries and many populations have been extirpated. Figure 17 shows 778 otter skins which were confiscated in Lhasa in 2003 as part of a mixed shipment of skins. This highlights the scale of the international trade in otter skins.

Fig.17 Animal skins from Seizure in Lhasa, 2003 (Courtesy of CI-China)

In spite of frightening status reports from other countries in the region, otters still appear to be relatively widespread in Cambodia, though surveys show that those populations are also threatened. The Hairy-nosed Otter is the world's rarest otter and very few small populations of this species have been found. It is classified on Cambodia's National Red List as 'Rare'. Previous surveys by the otter team indicate that this species prefers flooded forest and peat-swamp forest habitats. It is therefore possible that the otter species which villagers observe in the flooded forests of Prey Long may be this species. If it is found in Prey Long it will greatly increase the importance of the site for faunal conservation. The otter research team will return to Prey Long during the dry season to conduct camera trap surveys aiming to confirm the identity of the otters of Prey Long.

Tortoises & Freshwater Turtles

Som Sitha & Kheng Sokhorn

INTRODUCTION

Tortoises and turtles are the only reptiles in Cambodia that are globally threatened according to the IUCN Red List, and they are one of the most endangered groups of animals in Asia. Due to intense over-collection for local consumption and sale into the wildlife trade (which can amount to millions of turtles sold in China every year), most of Cambodia's turtles are highly threatened. Twelve species of tortoise and freshwater turtle were recorded for Cambodia prior to this report, of which one is classified as Critically Endangered, four are classified as Endangered, six are classified as Vulnerable and one is classified as Near Threatened. Due to their obvious conservation importance in Cambodia, we prioritised them for surveys to assess their status and threats in Prey Long.

Prey Long contains many streams which flow into the Mekong River, as well as permanent and temporary standing wetlands (ponds and marshes). In addition, there are large areas of flooded forest. These freshwater habitats provide ideal conditions for several of Asia's globally threatened freshwater turtles. In addition, the deciduous dipterocarp forests provide suitable habitat for one of Cambodia's most endangered tortoises, the Elongated Tortoise. There have been few surveys of tortoises and freshwater turtles (hereafter referred to as turtles) in the Prey Long area; subsequently there are few, if any, historic records of turtles. The only previous turtle survey for which records could be found is the 2005 survey in Prey Long by the BP-funded Cambodian Turtle Conservation Team (CTCT) in partnership with CI, which confirmed the presence of four turtle species: the Elongated Tortoise (*Indotestudo elongata*), the Asian Box Turtle (*Cuora amboinensis*), the Asian Leaf Turtle (*Cyclemys* sp.), and the Asiatic Softshell Turtle (*Amyda cartilaginea*). However, the results of interviews conducted during the 2005 survey, when reviewed against the ecology of all of Cambodia's turtle species, indicates that several other species potentially occur in the area. The interview results from 2005 also indicate that there are many threats to turtles in Prey Long, primarily as a result of people collecting them for sale into the wildlife trade, but also for local consumption. Our aim was therefore to assess the current species composition, distribution, relative abundance, and threats to tortoises and freshwater turtles in Prey Long, and to review the conservation importance of the area for turtles.

METHODS

Semi-structured interviews with local guides and hunters provided anecdotal information about the turtle species that are present in Prey Long and the threats that they face, but this information is not cited as stand-alone evidence for the confirmed presence of species. We used the Photographic Guide to the Turtles of Thailand, Laos, Vietnam and Cambodia (Stuart *et al*. 2001) to help the local people with their identifications and to relate their local names to scientific names. We recorded information on all turtles that hunters had captured, and photographed all live turtles and turtle shells we encountered. We also recorded details of collection techniques used by hunters and information on turtle trade.

We used two methods to survey for turtles - timed searches and live-trapping. Timed searches were carried out during the day and at night. During these timed searches we walked though areas of suitable habitat, looking for turtles in good locations (e.g., under vegetation, alongside streams, in marshes). We timed the search and recorded the number of observers so that we could work out the number of turtles found per person-hour. This allows us to compare between sites.

Live-capture traps were used to assess the composition of turtle populations. Nine traps measuring 70cm long, 50cm wide and 30cm high were used. Trapping was conducted for one night at a permanent stream called O'Krak, and for six nights at an ephemeral swamp called Boeng Meprey. Traps were placed in suitable microhabitats in shallow water with part of each trap above the water surface, allowing trapped turtles to breathe. Captured turtles were marked by notching a unique series of marginal scutes (see Cagle 1939). The sex and weight of all turtles captured or found in the possession of hunters was recorded, as was the straight-line carapace length and width (measured using calipers). No turtles were taken as voucher specimens, and all (except for those that had been captured by local hunters) were released at point of capture. We chose baits for the turtle traps that were strong smelling in order to attract turtles. We used both meat and fruit in order to attract turtle species with different diets. Bait used included chicken, fish, durian, prohok (a paste made from fermented fish), jackfruit, coconut, pineapple, and banana.

RESULTS

Information we collected from local guides and hunters indicated that seven species of turtle occur in Prey Long and that an eighth species, a deep-water river softshell turtle, occurs in the greater Prey Long area where it borders the Mekong River (see Table 12).

Table 12. Turtles reported from Prey Long from preliminary surveys in 2004 and more extensive interviews and surveys in 2007

Scientific name	Common Name	Conservation Status (IUCN)	Record			
			2004 Survey	2007		
				Interviews	Hunters	Survey
Amyda cartilaginea	Asiatic softshell turtle	Vulnerable	X	X	X	
Cyclemys cf. *tcheponensis*	Asian leaf turtle	Near Threatened	X	X	X	
Cuora amboinensis	Asian box turtle	Vulnerable	X	X		
Indotestudo elongata	Elongated tortoise	Endangered	X	X		
Heosemys grandis	Giant Asian pond turtle	Vulnerable		X	X	X
Hieremys annandalii	Yellow-headed temple turtle	Endangered		X		
Siebenrockiella crassicollis	Black marsh turtle	Vulnerable		X		
Pelochelys cantorii	Asian giant softshell turtle	Endangered		X*		

* Mekong River species

We captured three turtles during timed searches and observed seven turtles in the possession of local hunters during the course of this survey; no turtles were captured in traps. In total, the 2004 and 2007 surveys documented five of these species in the wild or in the possession of hunters within the forest. The presence of a sixth species, *Pelochelys cantorii*, was confirmed in the Mekong River by a joint CI-WWF river turtle study in February 2007. The last two species, the Black Marsh Turtle *Siebenrockiella crassicollis*

and the Yellow-headed Temple turtle *Hieremys annandalii* were only documented from anecdotal evidence, so their presence in Prey Long still needs to be confirmed. The wetland habitats within Prey Long are also ideal for the Malayan Snail-eating Turtle *Malayemys subtrijuga*, although this species was not recorded in our surveys or interviews.

Threats to Turtles

Interviews and observations made during this survey revealed that all species of freshwater turtles and tortoises in Prey Long were under threat from collection by local villagers for food and sale into the wildlife trade. The Elongated Tortoise *Indotestudo elongata* is also likely to be threatened by the clearing of deciduous forests.

Many people in this area catch turtles to sell to wildlife traders who reportedly live in Kratie province. Interviewees indicated that a significant proportion of the turtles collected in Prey Long are smuggled to Vietnam. This matches turtle trade information collected in other parts of Cambodia (Som *et al*. 2005). According to interviewees, many of the turtle collectors were reported to come from Sandan District in Kampong Thom province. During the survey, we met three turtle hunters with four hunting dogs and all were from Sandan district. These hunters reported that middle-men at their village would buy turtles from them. Depending on species and weight, the turtles they caught fetched between US$1-10/kg. The hunters had seven turtles in their baskets, consisting of one Giant Asian Pond Turtle (*Heosemys grandis*), three Asian Leaf Turtles (*Cyclemys* cf. *atripons*), and three Asiatic Softshell Turtles (*Amyda cartilaginea*).

Species Accounts

The Asian Leaf Turtle typically occurs in most aquatic habitats, from fast-flowing hill streams to slow-moving rivers and standing wetlands (Stuart *et al*, 2002). It is omnivorous and feeds on plants, fruit, fish, carrion, and invertebrates. The Asian Leaf Turtle which we found in Prey Long differs in many characteristics, especially colouration, from all other Leaf Turtles that have been recorded from Cambodia. Throughout the country the only species that has ever been recorded has been *Cyclemys atripons*, but the Leaf Turtle that occurs in Prey Long is clearly a different species. Species identification is difficult at this time as the genus is currently being revised (Stuart & Fritz, in press), but it appears to be *C. tcheponensis*. This species is only known from Vietnam, Laos, and Thailand. Therefore, this is the first record for Cambodia (increasing the number of turtles in Cambodia to thirteen species) and Prey Long is the only known site in Cambodia where it occurs, making this site crucial for the conservation of this turtle at the national level. Further examination of the data we collected for this turtle, combined with genetic analysis and return visits to the site, will confirm the species' identity.

Three Asian Giant Pond Turtles, *Heosemys grandis*, were found during the survey. This large turtle occurs in standing wetlands at low to mid-altitude, as well as slow-moving rivers and streams (Cox *et al*. 1998). It is omnivorous and feeds on plants, fruit, fish, and invertebrates. It occurs in Myanmar, peninsular Malaysia, Thailand, Cambodia, Laos, and southern Vietnam (Vetter & van Dijk 2006) and is classified as Vulnerable on the IUCN Red List. One individual was found on a dirt track during the late afternoon, and two were found at night, submerged in shallow water in a marsh called Boeing Meprey. Another was found on a hunter within Prey Long forest estate. All three of the turtles we found appeared to have recently emerged from the ground after the dry season following recent heavy rains, as a thick layer of clay was found on all their shells. This species has been found in lowland wetlands throughout Cambodia but it has not been recorded at such high

abundance (comparing timed search data across sites) as it was in Prey Long. The turtles in Prey Long also had a larger average size than at any other survey sites in Cambodia, indicating that the population has yet to be over-collected for trade (this turtle is targeted for collection due to its large size). The population in Prey Long is therefore likely to be nationally significant for conservation of this species.

The Asian Box Turtle *Cuora amboinensis* was captured in the wild in Prey Long during the 2004 survey, and interviewees during the 2007 survey stated that it was widespread throughout the wetlands of Prey Long. This small turtle occurs in aquatic habitats from sea-level to mid-elevation, particularly slow-moving rivers and shallow stillwaters (Cox *et al*. 1998). It is typically found in fairly undisturbed static or slow moving, well vegetated shallow wetlands, although it is also occasionally found in anthropogenically modified habitats such as flooded rice paddies. Though usually found in or near water, it is sometimes found in open or dense forest far from the nearest water source. It feeds on plants, fruit, fish, crustaceans, and other small prey. It is one of the most widespread turtles in tropical Asia, with a distribution extending from north-eastern India to Vietnam, through Malaysia and Indonesia, and into the Philippines (Rummler & Fritz 1991, Iverson 1992). It is classified on the IUUCN Red List as Vulnerable. This species is widespread throughout Cambodia (Som *et al*. 2005), but it is highly threatened due to collection for food and for trade. Prey Long contains large areas of suitable habitat for this species. Therefore, the populations of this turtle in Prey Long are likely to be of national significance for conservation of this species.

The Asiatic Softshell Turtle *Amyda cartilaginea* was recorded in the wild during the 2004 surveys, and three were found with hunters in Prey Long forest estate during the 2007 survey. This moderately common softshell turtle is almost entirely aquatic, occurring in a wide range of habitats from hill streams to deep rivers, lakes, and standing wetlands (Cox *et al*. 1998). It is an opportunistic feeder and eats fruit, fish, invertebrates, and carrion. It is distributed throughout most of Indochina and the Greater Sundas. The security afforded by its wide distribution and occurrence is offset by the demand for this species in wildlife trade (van Dijk *et al*. 2000). This species was collected during the 2004 survey and three were found in the possession of hunters during the 2007 survey. The hunters stated that they captured *A. cartilaginea* at night using torches, by spearing pointed sticks into sand or mud in O'chom stream. This method is commonly used throughout Southeast Asia to capture softshell turtles (D.Emmett, pers. comm.) because the turtle hides just beneath the riverbed where it ambushes fish and crabs. This turtle is classified on the IUCN Red List as Vulnerable. It is widespread and fairly common throughout Cambodia, so the population in Prey Long is not globally important, nor is it likely to be important for national conservation of this species.

The Elongated Tortoise *Indotestudo elongata* is classified on the IUCN Red List as Endangered. This terrestrial tortoise typically occurs in low to mid-elevation deciduous or pine forest and grasslands (Stuart *et al*. 2001). It does not occur in semi-evergreen or evergreen forest. It is essentially herbivorous, though it occasionally eats earthworms. It occurs in Nepal and north-east India, throughout mainland Indochina, and in peninsular Malaysia (Vetter & van Dijk 2006). This species was recorded in interviews during the 2007 survey, and one was found in the possession of a hunter within the forests of Prey Long during the 2004 survey. This tortoise is widespread in the dry forests of eastern Cambodia, so the populations of this species in the deciduous forests of Prey Long are unlikely to be nationally significant in conservation terms.

DISCUSSION

Prey Long forest estate contains at least five species of tortoise and freshwater turtle, and is the only site in Cambodia where the Asian Leaf Turtle *Cyclemys tcheponensis* is known to occur. The site appears to be nationally important for conservation of the following turtle species: the Asian Leaf Turtle *Cyclemys tcheponensis*, the Asian Giant Pond Turtle *Heosemys grandis*, and the Asian Box Turtle *Cuora amboinensis*. However, all of these species are threatened by uncontrolled collection for local consumption and trade.

Amphibians, Snakes & Lizards

Jodi Rowley

INTRODUCTION

Amphibians are one of the most highly threatened groups of animals, with one-third of all amphibian species listed as globally threatened and almost half known to be experiencing population declines. Globally this makes amphibians more highly threatened and declining faster than either birds or mammals.

Within Asia, Cambodia and its neighboring countries represent a region of high amphibian diversity, high human pressures, and relatively little information regarding the status of amphibian species or their conservation priorities. In Cambodia, amphibian surveys have been carried out in several protected areas, however the amphibian fauna over parts of the country is still relatively unknown. One of the gaps in knowledge for amphibians is the lowland forests of Prey Long. This survey aimed to fill this gap in knowledge, and provide an assessment of the amphibian species present and the threats they face. Although the survey focused predominantly on amphibians, it also included opportunistic collections of snakes and lizards because there is also a paucity of data for these taxa in the lowland forests of Cambodia.

METHODS

We conducted surveys at six sites in Prey Long from 5-10 May 2007 (see Map 2). Most sites included at least one wetland, as amphibians tend to congregate around water, especially during their breeding seasons. The sites of O'Aknamey, O'Krack and O'Prumcharey were small streams of approximately 3-5 m average width, lined with evergreen vegetation. The survey of O'Prumcharey also included a small pool adjacent to the main stream. O'Krack pond was a large (approx. 20 x 50 m), ephemeral pool of about 0.5 m depth, surrounded by evergreen forest. We also surveyed a section of dirt road with temporary pools along each side ('Road to O'Krack'). Phnom Krahorm was a large, flooded grassland (approx 100 x 500 m), with emerging grasses and trees and a water depth less than 0.5 m. Most sites were surveyed repeatedly throughout the survey period.

Surveys focused on amphibians, but also included snakes and lizards. Conditions were ideal for surveying amphibians, with the first heavy rains of the wet season occurring during the survey. The high rainfall allowed us to survey for amphibian species that breed in ephemeral pools, as well as stream breeding species. During drier parts of the year, it would be considerably more difficult to detect many of these species. We conducted nocturnal visual encounter surveys using headlamps. We also attempted to capture any frogs found moving across roads and through other habitats. Amphibians, snakes and lizards were captured by hand or using a hand-held dip-net.

Due to the cryptic nature of many Asian amphibians and reptiles, and the poor overall knowledge of Asian herpetofauna, photographs were taken of all species recorded and voucher specimens were collected for all but two snake species (*Xenopeltis unicolor* and *Cryptelytrops albolabris*). Voucher specimens were fixed in 10% formalin and stored in 70% alcohol until export for inclusion in international museums and formal identification.

Genetic material was collected from most specimens prior to fixation, and the calls of a number of amphibian species were also recorded.

RESULTS

At least 16 species of amphibians from three families were recorded at Prey Long (see Appendix 7). Six species of snake from two families, and two lizard species from a single family were also recorded (see Appendix 8). The most frequently observed amphibian species during this survey belonged to the Rhacophoridae family (tree frogs), with hundreds of individuals of each species observed in breeding aggregations at water-bodies. While most species were abundant at several sites, species were roughly divided into those that call and breed in and around temporary pools (e.g., the Rhacophoridae family), and those that call and breed in streams (e.g., *Rana nigrovittata).*

Monitor lizards (*Varanus* sp.) were observed in a local resin-collectors house, reportedly to be used as food.

DISCUSSION

The amphibians, snakes and lizards recorded from Prey Long belong to species that are relatively common, and most are distributed widely over Cambodia and even over South-east Asia. This is not surprising considering that amphibian and reptile endemism is highest in mountainous areas, with lowland sites tending to contain more widespread species. Despite this, the amphibian fauna in particular is relatively diverse for Cambodia, and the site was shown to provide breeding habitat for huge numbers of amphibians. In addition, due to the similarity of many species of amphibian and reptile, comparison of voucher specimens to other amphibians in museum collections and genetic analysis may reveal further, cryptic species among the collected amphibians, potentially with more restricted distributions. While the forests and wetlands of Prey Long remain intact, the site will continue to provide important habitat for amphibians, snakes and lizards. Hunting pressures are likely to be significant only for locally consumed or traded species such as monitor lizards and pythons. As a result, the largest threat to most of the amphibians, snakes and lizards of Prey Long is habitat destruction.

Freshwater Fishes

Voen Seila & Jodi Rowley

INTRODUCTION

Prey Long contains a vast lowland forested area that serves as a drainage basin, from whence it flows into the Mekong River and Tonle Sap Lake. An apparent lack of historical information suggests that the freshwater fish fauna of Prey Long's wetlands have not been studied but, due to its connections to the Mekong River, Prey Long is likely to contain an essentially similar though probably less diverse fish fauna to that of the Mekong River, which has been fairly well documented by Rainboth (1996). This survey aimed to provide a rapid assessment of the freshwater fishes of Prey Long and to assess the importance of the area for freshwater fish conservation.

METHODS

We surveyed three wetland sites in Prey Long. The first site was surveyed on May 08, 2007. This site was O' Krack stream (UTM: 0589642/1451262). The water depth was 0.1 – 1.5 m. This shallow stream had a substrate of sand with scattered rocks and consisted of small pools interconnected by riffles. There was a great deal of streamside vegetation, submerged vegetation, and water-plants. The second site was surveyed on May 10, 2007, and was a tributary stream to the O' Krack (Local name O' Anamey) (UTM: 0587945/1447404). The depth of the water at this second site ranged from 0.1 – 0.4 m. The third site was a small river (Stung Kbal Damrey), which was surveyed on May 12, 2007 (UTM: 0570244/1454638). The water depth at the third site was over 0.5m.

We used two different survey methods: gill nets and dip-nets. The gill nets had mesh diameters of 2.5cm and 4.5cm. They were placed across water-bodies during the day. Hand-held dip nets were used at night to collect fish which were inactive, especially those which rested near the surface of the water. Collection was hindered by recent heavy rain, as the water bodies were highly turbid and contained fallen vegetation and other debris, making visibility poor and reducing the effectiveness of both the gill nets and the dip-nets.

Voucher specimens were taken for all collected fish species because field identifications of Cambodia's freshwater fish are extremely difficult to make with any certainty. The fish were fixed in 10% formalin for several weeks, and then they were washed in water and placed into 70% alcohol for long-term preservation. Whenever possible, photographs were taken of each fish species prior to it being placed in formalin so that there is a record of the colouration and patterning, which often fades in formalin and can hinder subsequent identification to species. The voucher specimens will be sent to Michigan University for identification and deposition.

We also interviewed local guides to collect anecdotal information on previous and current threats to the freshwater fishes and their wetland habitats in Prey Long.

RESULTS

A total of at least sixteen fish species from seven families were caught at Prey Long during the 2007 survey (Appendices 9 & 10). Several could not be identified to species, and are awaiting formal identification. It is likely that the number of species we collected will

increase when the voucher specimens are formally identified, as there are many taxonomically very difficult genera of freshwater fish in the Mekong River (M. Smith, pers. comm.).

According to interviews with local guides and hunters, many fish used to be caught using destructive methods such as explosives and electro-fishing during past commercial logging activities. As a result, local guides reported that many places in Prey Long were over-fished to the point of local extinction of some species. Although commercial logging has now ceased, many hunters and illegal timber harvesters reportedly still use electro-fishing in conjunction with gill netting to collect fish while they are in the forest.

DISCUSSION

On the basis of our preliminary identifications, the freshwater fish fauna of Prey Long are homogeneous with those of the Mekong River and tributaries, although with considerably lower species diversity. This is probably due in part to a much narrower range of aquatic habitats and water conditions in Prey Long's wetlands than in the Cambodian section of the Mekong River. However, considering the exceptional diversity of fish species in the Mekong River and its tributaries (over 1,000 species recorded to date (Rainboth, 1996)), it is almost certain that Prey Long's wetlands will contain many more fish species than those found during this survey. More intensive surveys with additional survey methods in a wider variety of wetlands are necessary to produce a more complete inventory.

Because many of Prey Long's water systems are permanent, well-vegetated, and flood to form large inundated areas in the wet season, the site is likely to constitute important breeding and feeding grounds for many freshwater fish species from the Mekong River. In addition, the site may provide a refuge from the over-fishing that currently threatens many freshwater fishes in the Mekong River itself.

Records of other priority species

Priority species are defined here as species that are globally threatened according to the IUCN Red List of Threatened Species. In this chapter we review priority species reported during this and previous surveys, and outline their importance from a conservation perspective.

Elephas maximus Asian Elephant
Camera-trap records of Asian elephants were made during the WWF 2005 survey, and signs of a herd of elephants were recorded by WCS in 2003, by CI in 2005 and 2007, and by the WWF elephant monitoring team. The Asian elephant is classified as Endangered on the IUCN Red List. It is distributed from India throughout Southeast Asia, and into Malaysia and Indonesia. Few elephants still remain in Cambodia. The population of elephants in Prey Long is therefore likely to be nationally important for conservation.

Panthera tigris Tiger
A tiger track was recorded by WCS during their survey in 2003, and interviewees during the CI 2005 survey claimed that tigers still occur in very small numbers in Prey Long. However, there are no confirmed reports of tigers from Prey Long, and recent interviews suggested that few, if any, remain in Prey Long. The tiger is classified as Endangered on the IUCN Red List. The geographic distribution of the tiger once extended across Asia from eastern Turkey to the Sea of Okhotsk. However, its range has been greatly reduced in recent times. Tigers currently survive only in scattered populations from Bangladesh west to Myanmar, and in Sumatra, China, and the Russian Far East. There are very few recent records of tigers from Cambodia. It is unlikely that Prey Long contains a nationally significant population of tigers. Due to high and continuing levels of hunting, the most likely scenario is that none or only a few individuals remain, and that the population is functionally extinct.

Neofelis nebulosa Clouded Leopard
Camera-trap records of clouded leopards were recorded by WWF during their 2002 survey. This species is classified as Vulnerable on the IUCN Red List. The clouded leopard is found from eastern foothills of the Himalayas through most of Southeast Asia to the islands of Sumatra and Borneo. It has been recorded in forested areas throughout Cambodia in recent years. This secretive animal is rarely recorded, so it is possible that Prey Long holds a reasonable population of clouded leopards. However, high levels of hunting will impact this population both through direct capture of clouded leopards, as well as depletion of prey species. This species occurs in other protected areas in Cambodia (e.g., Central Cardamom Protected Forest, Preah Vihear, Mondulkiri Protected Forest, Virachey National Park), so it is unlikely that the population in Prey Long is a high priority investment for conservation of the species in Cambodia.

Cuon alpinus Dhole
WWF recorded dhole in camera-traps during their 2005 survey in Prey Long. This species of wild dog is classified as Endangered on the IUCN Red List. The dhole has a wide range

throughout Asia, but populations are highly fragmented and decreasing. It is estimated that fewer than 2,500 mature individuals remain in the wild. It has been recorded from forested areas throughout Cambodia. It is difficult to record from tracks, as they are easily confused with tracks of domestic dogs. As with the clouded leopard, the dhole occurs in other protected areas in Cambodia (e.g., Central Cardamom Protected Forest, Preah Vihear, the dry forest complex, and Mondulkiri Protected Forest), so it is unlikely that the population in Prey Long is a high priority investment for conservation of the species in Cambodia.

Bos javanicus Banteng
The banteng was recorded from tracks and observations during the WCS survey in 2003. It was also recorded in camera-traps set by WWF in 2005 and CI in 2005, and signs were recorded by CI in 2007. This species of wild cattle is classified as Endangered on the IUCN Red List. The banteng is found throughout Southeast Asia and into Malaysia and Indonesia. It has been recorded in dry deciduous forests and grasslands throughout Cambodia. Care must be taken when recording this species from signs as they can be confused with domestic cattle, but frequent records from camera-traps indicates an apparently high abundance of banteng in Prey Long. The populations of banteng in Prey Long are therefore almost certainly nationally important for conservation of the species.

Bos frontalis Gaur
The gaur was recorded from tracks during the WCS survey in 2003. It was also recorded in camera-traps set by WWF in 2005. This species of wild cattle is classified as Vulnerable on the IUCN Red List. The banteng is found from India throughout Southeast Asia and into Malaysia. It has been recorded in evergreen forest, dry deciduous forest, and grasslands throughout Cambodia. This species is more common and widespread in Cambodia than the banteng, so the populations in Prey Long do not represent a high conservation priority for conservation of the species.

Hylobates pileatus Pileated Gibbon
The distinctive call of the pileated gibbon was heard during the WCS survey in 2003 and during the CI survey in 2007. It was recorded both through observations and calls in 2005 by CI. This primate is classified as Vulnerable on the IUCN Red List. The pileated gibbon is found in Cambodia, southern Laos, and eastern Thailand. It has been recorded in evergreen forests throughout Cambodia. Its restricted global range and vulnerable global status means that any sizeable population of this gibbon is of conservation importance, so the population in Prey Long should be considered nationally important for conservation of the species.

Crocodylus siamensis Siamese Crocodile
The presence of crocodiles in Prey Long was indicated, but not confirmed, through interviews by WCS in 2003 and by CI in this 2007 survey. It is most likely that these crocodiles, if they occur in Prey Long, are Siamese crocodiles. It is classified as Critically Endangered on the IUCN Red List. The Siamese crocodile is found in Southeast Asia and Indonesia. It has been recorded as fragmented populations in wetlands throughout Cambodia. If the Siamese crocodile is confirmed to occur in Prey Long in significant numbers, the site will certainly be both nationally and globally important for conservation of this highly threatened species.

Summary

SITE SUMMARY

Prey Long is located in central lowland Cambodia. The forest is surrounded by large rivers, agricultural areas, villages and towns. The human population is the area is steadily increasing and access into the forests is relatively easy. Although part of the FA-managed forest estate it is not demarcated and does not have protected status. There are currently no forestry rangers based at the site, which means that there is effectively no law enforcement in Prey Long. All these factors have resulted in heavy forest resource exploitation. According to local residents, many species of wildlife have shown dramatic declines in their population over the last two decades.

Access into to the site for logging and hunting is a serious issue. Much of the area is criss-crossed with logging roads, ox-cart tracks and footpaths. Few, if any, areas of forest in Prey Long are completely undisturbed, although there still remain large areas of lowland evergreen forest with relatively minimal disturbance. Another issue is land encroachment. Small temporary villages are being built inside the forest estate for the purposes of housing loggers and slash-and-burn farmers, and villages on the edge of the forest are also increasing both in numbers and in size. The local communities are poor and they rely on the forest for a wide range of resources for their subsistence such as timber for housing, firewood, non-timber forest products, fish and bushmeat. This often has minimal conservation impacts if managed correctly. More serious is the high level of logging and hunting by local villagers for trade, as this typically targets high-value rare animal and tree species.

Prey Long encompasses a very large tract of lowland tropical evergreen forest that in its natural state supports an extremely high diversity of wildlife. However, the populations of many species have declined dramatically due to high and sustained hunting pressure. The site still contains a wealth of globally threatened animal species but for many of those species that occur in better protected areas in Cambodia, Prey Long is not currently a priority site for investment in conservation of those species. However, the forested area is still easily large enough to harbor viable populations of many threatened species, even those with large home ranges such as clouded leopards, dhole and bears. If the site is placed under enforced protection and wildlife populations are allowed to recover, the national and global conservation importance of Prey Long would increase dramatically. In addition, protection of Prey Long would allow the recovery of an extremely rare example of lowland evergreen tropical forest, meaning that the protected site would represent the best example of a globally threatened ecosystem and it would contain an abundance of globally threatened species.

SPECIES SUMMARY

Even in their current state, the forests of Prey Long still appear to harbor nationally important populations of several globally threatened animals. Based on current knowledge, the most important of these species appear to be Asian elephant, banteng, and pileated gibbon.

The banteng is still widespread in Prey Long, probably because it is not a high value species in the wildlife trade and is not specifically targeted by hunting (though some are occasionally caught in snares set for others species). However, a serious threat to banteng and other wild ungulates is the risk of disease transfer by domestic cattle and buffaloes within the forest area.

The recent outbreak of a fatal disease of cattle in villages in the northern part of Prey Long highlights the severity and immediacy of this threat.

Pileated gibbons were frequently heard throughout Prey Long, indicating that the species is widespread in the area. As with the Banteng, the pileated gibbon is not highly valued in the wildlife trade. Therefore, it is not very economically viable to hunt gibbons (though they are shot opportunistically for subsistence consumption or to catch juveniles for pets). The species is wary of humans and hard to capture as they almost never go onto the ground, so it is likely that the population in Prey Long will remain secure even with current threat levels.

Surveys show that a herd of Asian elephants still exist in Prey Long. Due to their need for large areas of suitable habitat, a country-wide decrease in such habitats, and targeted hunting for the ivory trade, Asian elephants are highly threatened throughout their range. Very few herds of elephants still exist in the wild in Cambodia, and any site that sustains a herd is extremely important for the survival of this species in Cambodia. Therefore, specific attention should be paid to conservation of the Asian elephants in Prey Long, both to ensure the landscape connectivity and to reduce threats to this species.

If Prey Long is effectively protected and wildlife populations recover to levels comparable to other protected sites in Cambodia, the site will likely become nationally important for several threatened animals whose presence has been confirmed but only in low numbers. Based on current knowledge, the most important of these species are the Malayan sun bear, Asian giant pond turtle, Malayan box turtle, clouded leopard, and the dhole.

Interview and survey data indicated the presence of several species in Prey Long that, if their presence in significant numbers is confirmed, would considerably elevate the conservation importance of the site. Based on current data, the three most important such species are the Hairy-nosed otter, the Siamese crocodile, and the tiger.

Due to the presence of large areas of flooded evergreen forest in Prey Long, the site has the potential to contain globally significant populations of the Hairy-nosed otter, which is only recorded from flooded forest and only occurs in three known sites in the world. Interviews suggest its presence in Prey Long, but this needs to be confirmed.

The tiger is solitary with large home ranges, resulting in low densities wherever they occur naturally. Large areas of suitable habitat are therefore needed to sustain healthy, viable populations of tigers. Prey Long probably contains sufficient habitat to sustain a population of tigers, and the prey base is probably sufficient (camera-traps recorded an abundance of ungulates). However, hunting has probably depleted the tiger population in Prey Long to such low levels that the species is functionally extinct. If a significant population of tigers is found in Prey Long, it will considerably elevate the conservation importance of the site.

The Siamese crocodile has been recorded in fragmented populations throughout Cambodia, and it is plausible that a population remains in Prey Long. If a sizeable or breeding population of this critically endangered species is found, it would constitute a very significant increase in the global conservation importance of the site.

Additional Information on Threats

WILDLIFE TRADE

There is an organized system of illegal hunting and trade in Prey Long. Wildlife is apparently transported to Stung Treng, Kratie, and Kampong Thom towns for sale. See Appendix 11 for a list of wildlife found in villages around Prey Long while conducting interviews, and Appendix 12 for a list of prices for different wildlife traded from Prey Long. This information indicates that, in addition to the globally threatened species listed in this report, more common species such as cobras, monitor lizards, civets, wild pig, red muntjac deer, sambar deer, slow lorises, and a wide variety of birds (e.g., Hill mynas) are hunted by local villagers for local consumption and trade.

The international demand for monkeys to use as test animals for medicinal industry has led to an increase in the hunting of wild long-tailed macaques in Cambodia, which are then 'laundered' through registered breeding facilities. Local people capture live wild macaques and sell them to these farms. This practice is widespread in Prey Long. The method used to capture long-tailed macaques is not only severely harmful to the macaque populations, but it is also very damaging to the forest habitats. When a troupe of macaques is observed, they are chased into an easily accessible tree. The surrounding trees are then cut down so the macaques cannot jump to safety, leaving them trapped in one tree. One or two hunters then climb the tree and scare the monkeys into jumping down from the tree, where other hunters capture them in large nets. One long-tailed macaque can be sold for $25-$50.

DISEASE TRANSMISSION TO WILDLIFE

During the surveys, the research teams learned that an infectious disease was spreading through the northern part of Prey Long. This disease affected ungulates (hoofed animals), and large numbers of domestic buffaloes and cattle had recently died, see Figure 18. Local villagers stated that they had observed dead wild pigs, deer and banteng in the forest recently, which had apparently also died from this disease.

Fig.18 A dead buffalo, killed by a fatal disease spreading through the northern part of Prey Long

Domestic cattle are often taken into Prey Long's forests for grazing, and it is easy for their diseases to transfer to wild animals. This is a severe threat to wild ungulates in Prey Long.

Furthermore, the lack of buffaloes to use for plowing the rice field means that many villagers now have no way of sowing their rice crops, which is absolutely necessary for their livelihoods. If there is a shortfall of rice, many families may have to increase their hunting and collecting from the forest in order to earn money to buy rice.

TIMBER, NON-TIMBER FOREST PRODUCTS, AND LAND CLEARANCE

As indicated during interviews and through field observations, Prey Long is heavily impacted by local people who collect resin in the forest. About 90 percent of interviewees stated that they depend to some extent on resin collection. Each family 'own' a number of resin trees in the forest, sometimes as many as 500, some of these far away from the village. Normally, they have to spend one to three weeks in the forest to collect the resin from all the trees, and most hunt for their food while in the forest.

Many people illegally cut luxury timber (see Figure 19). Middlemen from other areas come to Kangcham village to buy wood for the production of boats to sell to Vietnam. Vietnamese business people come to Kangcham village to buy land and build houses, to have a base from which to log timber in Prey Long for building boats.

Fig.19 Illegal logging of luxury timber in Prey Long

Some areas of forest in this area have been cleared for agricultural purposes. Several of these areas have been illegally sold to wealthy businessmen. As an example, interviewees stated that a businessman from Kampong Thom province cut hundreds of hectares of forest to make a farm.

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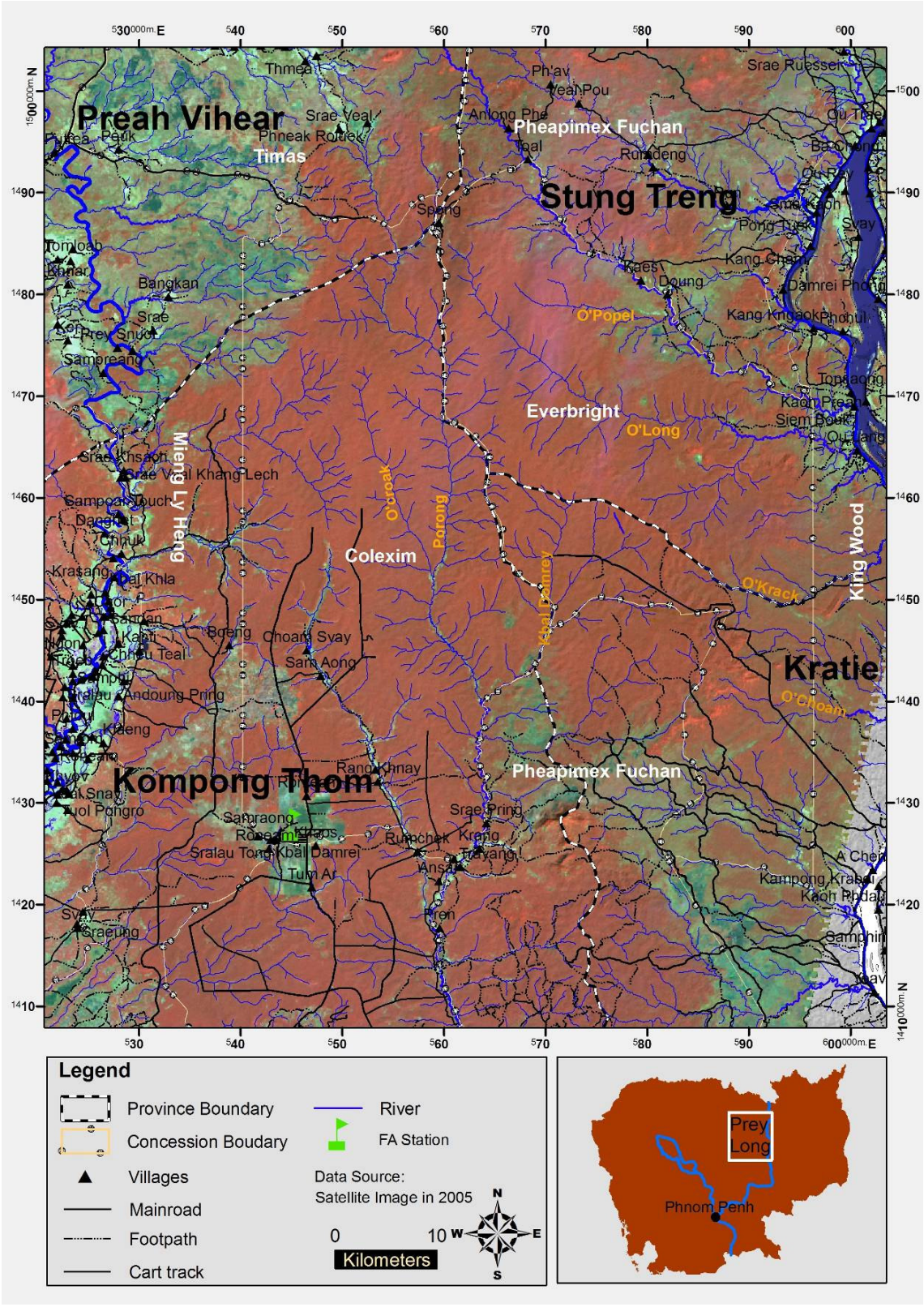
Appendix 1. Satellite image of Prey Long



Acquired Jan 2005. Red colour is dense evergreen forest. Deciduous and open or degraded forest is red/green. Cleared and cropped land appears as shades of green.

Appendix 2. Checklist of faunal species recorded in Prey Long

Scientific name	Common Name	International Conservation Status (IUCN)	National conservation Status	WWF 2002/2005 survey	WCS 2003 survey	CI 2005/2007 survey***
Mammals						
Elephas maximus	Asian elephant	EN	Endangered	-/CT	T	T, F/I
Helarctos malayanus	Malayan sun bear	VU	Rare		T	CT, I/ S
Ursus thibetanus	Asiatic black bear	VU	Endangered			I/S
Panthera pardus	Leopard		Rare		T	
Panthera tigris	Tiger	EN	Endangered		T	I/-
Neofelis nebulosa	Clouded leopard	VU	Endangered	CT/-		
Prionailurus bengalensis	Leopard cat		Common	CT/-		CT/-
Cuon alpinus	Dhole	EN	Rare	-/CT	T, F	I/-
Canis aureus	Asiatic jackal		Common		F	
Viverra zibetha	Large Indian civet		Common	CT/-		
Viverricula indica	Small Indian civet		Common	-/CT		CT/-
Paradoxurus hermaphroditus	Common palm civet		Common	CT/-	F, T	CT/-
Viverra megaspila	Large-spotted civet		Common	-/CT		
Arctictis binturong	Binturong		Common	-/CT		
Arctonys collaris	Hog badger		Rare	CT/-		
Lutra/Lutragale/Aonyx	Otter sp.		Rare		I	-/I
Sus scrofa	Wild pig		Common	CT/-	O	CT, T/ S, T, F
Muntiacus muntjac	Red muntjac		Common	CT/-	O, T	CT/O, F, T
Cervus unicolour	Sambar		Common	-/CT	T	T/T, F
Tragulus napu	Greater mouse deer		Common	CT/-		
Bos javanicus	Banteng	EN	Rare	-/CT	T, F, O	CT, I/T, I
Bos gaurus	Gaur	VU	Rare	-/CT	T	I, S/-
Macaca fascicularis	Long-tailed macaque		Common	-/CT		-/HU
Macaca nemestrina	Pig-tailed macaque	VU	Common			I/-
Hylobates pileatus	Pileated gibbon	VU	Rare		H	O,H/H
Nycticebus coucang	Slow loris		Rare			-/I
Manis javanica	Sunda pangolin		Rare			I/I
Hystrix brachyura	Malayan porcupine		Common	CT/-		O
Reptiles						
Amyda cartilaginea	Asiatic softshell turtle	VU	n/a*			TR/I, HU
Cyclemys atripons/tcheponensis	Asian leaf turtle		n/a			TR/I, HU
Cuora amboinensis	Asian box turtle	VU	n/a			TR/I
Indotestudo elongata	Elongated tortoise	EN	n/a			HU/I
Heosemys grandis	Giant Asian pond turtle	VU	n/a			-/TR, HU, I
Hieremys annandalii	Yellow-headed temple turtle	EN	n/a			-/I
Siebenrockiella crassicollis	Black marsh turtle	VU	n/a			-/I

Pelochelys cantorii	Asian giant softshell turtle	EN	n/a		-/TR, I**
Boiga ocellata	Grey cat snake		Common		-/TR
Enydris longicauda			Common		-/TR
Homalopsis buccata	Puff-faced water snake		Common		-/TR
Xenochrophis piscator	Chequered keelback		Common		-/TR
Xenopeltis unicolor	Sunbeam snake		Common		-/TR
Cryptelytrops albolabris	White-lipped pit viper		Common		-/TR
Calloselasma rhodostoma	Malayan pit viper		Common		-/O
Dixonius siamensis			Common		-/TR
Gekko gecko	Tokay gecko		Common		-/TR
Varanus bengalensis	Bengal monitor lizard		Common		-/HU
Varanus salvator	Water monitor lizard		Common		-/I
Physignathus cocincinus	Water dragon		Common		-/HU
Crocodylus sp.	Crocodile		n/a*	I	-/I
Naja sp.	Cobra		Common		-/I
Python sp.	Python		Common		-/I
Amphibians					
Kalophrynus interlineatus	Striped sticky frog		n/a*		-/TR
Kaloula pulchra	Painted bullfrog		n/a		-/TR
Microhyla butleri	Noisy frog		n/a		-/TR
Microhyla heymonsi	Dark-sided chorus frog		n/a		-/TR
Microhyla ornata	Ornate chorus frog		n/a		-/TR
Microhyla pulchra	Painted chorus frog		n/a		-/TR
Micryletta inornata	Inornate froglet		n/a		-/TR
Fejervarya limnocharis	Rice field frog		n/a		-/TR
Hoplobatrachus rugulosus	Rugose frog		n/a		-/TR
Occidozyga lima	Common puddle frog		n/a		-/TR
Occidozyga martensi	Marten's puddle frog		n/a		-/TR
Rana lateralis	Yellow frog		n/a		-/TR
Rana nigrovittata	Dark-sided frog		n/a		-/TR
Chirixalus nongkhorensis	Nong Khor bushfrog		n/a		-/TR
Chirixalus vittatus	Burmese bushfrog		n/a		-/TR
Polypedates leucomystax	Common treefrog		n/a		-/TR
Birds					
Ciconia episcopus	Wooly necked stork		Common	O	CT/-
Leptoptilos javanicus	Lesser adjutant		Rare	O	
Lophura diardi	Siamese fireback		Rare	O	
Fancolinus pintadeanus	Chinese francolin		Common		I/-
Spilornis cheela	Crested serpent eagle		Common		CT/-
Psittacula finschii	Grey-headed parakeet		Common		CT/-
Pseudibis gigantea	Giant ibis		Endangered	H	

	Thick-billed pigeon		Common	HU
Lophura nycthemera	Silver pheasant		Common	O
Pavo muticus	Green peafowl	VU	Rare	I/-
Gracula religiosa	Hill myna		Common	-/I
Fish				
Xenentodon sp.			n/a*	-/TR
Dangila sp. 1			n/a	-/TR
Dangila sp. 2			n/a	-/TR
Hampala macrolepidota			n/a	-/TR
Neolissochilus blanci			n/a	-/TR
Osteochilus hasselti			n/a	-/TR
Poropuntius deauratus			n/a	-/TR
Raiamas guttatus			n/a	-/TR
Rasbora paviei			n/a	-/TR
Rasbora spilocerca			n/a	-/TR
Systomus sp.			n/a	-/TR
Channa sp.			n/a	-/TR
Leiocassis siamensis			n/a	-/TR
Clarias meladerma			n/a	-/TR
Silurichthys phaiosoma			n/a	-/TR
Mastacembelus armatus			n/a	-/TR

CT=camera trap photo, TR=trapped/caught, O=observation, H=heard, T=tracks, F=faeces, S=signs, I=interview information, HU=individuals found with hunters.

* Turtles, tortoises, crocodiles, amphibians and fishes are under the jurisdiction of the Fisheries Administration (FiA) and are therefore not included in the FA wildlife prakas. A separate wildlife praces for these species will be produced in the near future.

** Species found in the Mekong River bordering Prey Long.

*** This includes surveys carried out by the Cambodian Turtle Conservation Program both in 2005 and 2007.

Appendix 3. Species recorded in May 2007 survey and their conservation status.

Tree species	IUCN category and evaluation criteria IUCN Red List 1994	UNEP-WCMC Trees Database on threatened trees	National priority species for conservation
Afzelia xylocarpa *	EN A1cd	+	+
Aglaia sp.			
Anisoptera sp.			
Anisoptera costatus	EN A1cd+2cd	+	+
Annonaceae sp. (cf. Polyalthia)			
Antidesma sp.			
Baccaurea ramiflora			
Bombax ceiba		+	
Cananga latifolia *		+	+
Calophyllum sp.			
Cleistanthus sp.			
Cratoxylon formosum		+	
Croton joufra		+	
Dehaasia cuneata		+	
Dialium cochinchinense *		+	
Dillenia ovata		+	
Diospyros bejaudii			+
Diospyros buxifolia		+	
Diospyros crumenata	EN B1+2c	+	+
Diospyros helferi			
Diospyros nitida		+	+
Diospyros sylvatica			
Dipterocarpus alatus *	EN A1cd+2cd, B1+2c	+	+
Dipterocarpus cf. costatus	EN A1cd+2cd	+	
Dipterocarpus sp.		+	
Dipterocarpus turbinatus	CR A1cd+2cd	+	
Eleaocarpus sp.			
Garcinia schefferi			
Garcinia vilersiana			
Heritiera javanica *		+	
Hopea odorata *	VU A1cd+2cd	+	+
Hopea pierrei	EN A1c+2c, B1+2c, C1, D	+	
Irvingia malayana	LR/lc	+	
Knema sp.			
Lagerstroemia calliculata			
Lithocarpus elephantus			
Mangifera cochinchinensis		+	
Melodorum fruticosum			
Memecylon edule		+	
Memecylon sp.			
Moraceae sp. (Artocarpus)			
Nephelium xerospermum			
Peltophorum ferruginum			
Pterocarpus pedatus *			
Rubiaceae sp. (Nauclea or Neonauclea)			
Sandoricum indicum *		+	
Sapindaceae sp.			
Sapindus chrysotrichus			
Semecarpus cochinchinense		+	
Shorea sp.			

Suregada multiflorum			
Syzygium cumini		+	
Syzygium polyanthum		+	
Syzygium zeylanicum		+	
Terminalia nigrovenulosa		+	
Unknown sp. 3 (local name ”apien”)			
Unknown sp. 1 (local name ”dong”)			
Unknown sp. 2 (local name ”samrai”)			
Unknown sp. 3			
Vatica odorata			
Vitex sp. (pinnata or pubescense)		+	
Xylia xylocarpa		+	+
Xylopia cf. vielana		+	

Species marked with an asterix were found outside transects.
IUCN category and evaluation criteria are according to IUCN (2007).
+ indicates that species is listed in the UNEP-WCMC Trees Database on threatened trees and other trees of conservation concern (UNEP-WCMC 2007).
National priority species for conservation are according to the Forest Gene Conservation Strategy (CTSP/FA 2003).

Appendix 4. Reference table to determine bear species based on scratch marks

Table to distinguish Asiatic black bear and Malayan sun bear by their claw marks on climbed trees			
	STEP 1	**STEP 2**	**STEP 3**
	4-claw width	**5-claw width**	**3-claw width**
Black bear	>6.6	>9.0	>4.1
Sun bear	<6.0	<8.2	<4.0
Indeterminate	6.0-6.6	8.2-9.0	4.0-4.1

Source: Steinmetz, R. Table to distinguish Asiatic black bears and Malayan sun bears by their claw-marks on climbed trees. Working document, WWF-Thailand, PO Box 4, Asian Institute of Technology, Klong Luang, Patumthani, 12120, Thailand, Email: roberts@wwfgreatermekong.org

Appendix 5. List of villages where pangolin interviews were conducted

- Kangcham Commune, Thalaborivat District, Stung Treng Province
  - Dong Village (UTM: 582031/1480302)
  - Kangcham Village (UTM: 595583/1484085)
  - Moum Village (UTM: 593764/1483009)
- Chamkalue Commune, Thalaborivat District, Stung Treng Province
  - Ron Village (UTM: 587167/1488982)

Appendix 6. List of villages where otter interviews were conducted

-Dung village : UTM 582031/1480302
-Kangcham village : UTM 595583/1484085
-Moum : UTM 593983/1482316
-Kampongpang : UTM 593442/1480288
-Kangkangouk : UTM 597033/1476668
-Osoum : UTM 600039/1470714
-Siembok : UTM 600493/1469139
-Olung : UTM 600826/1464642
-Koh Preah : UTM 602612/1475141
-Stung Treng town : UTM 602271/1495440

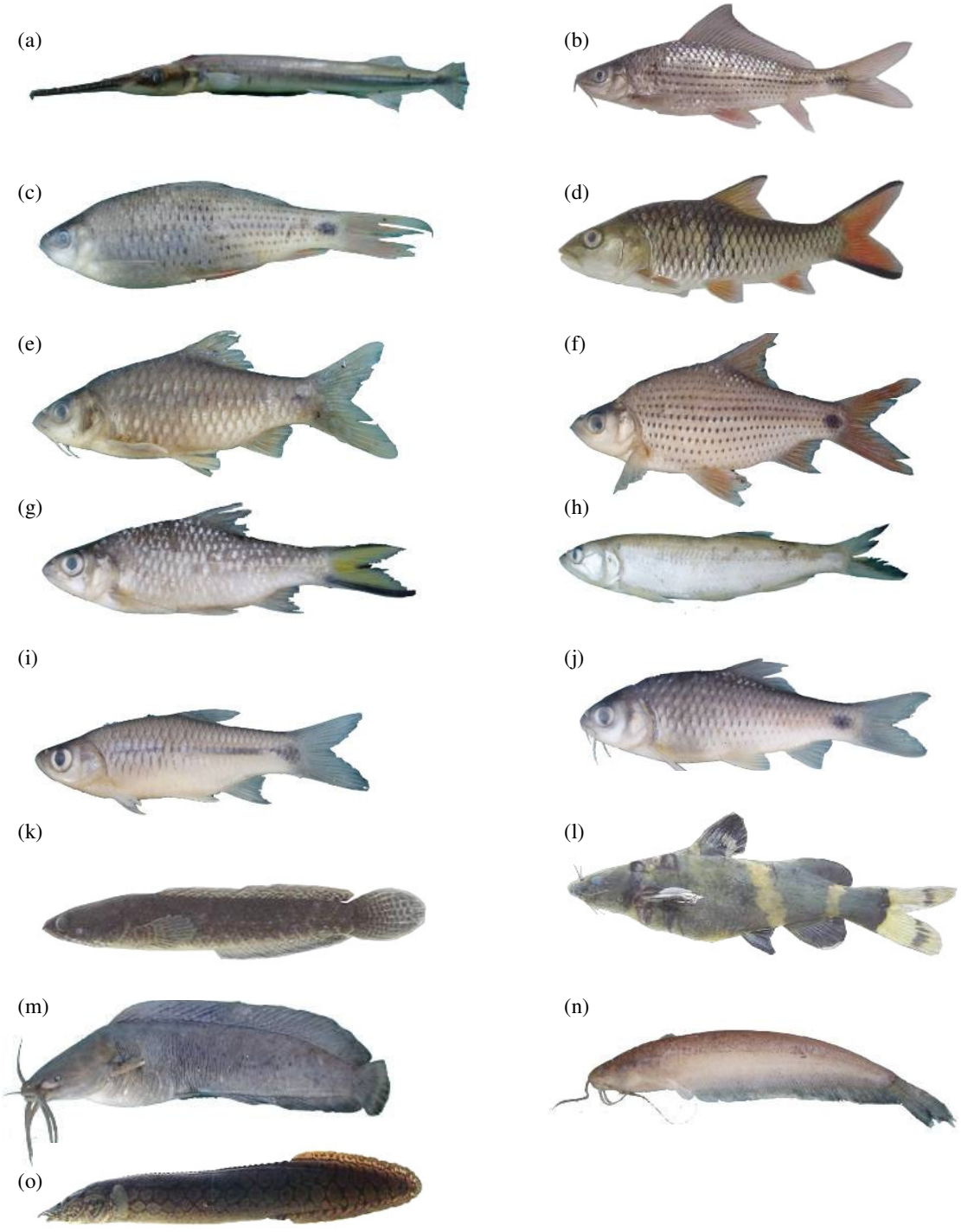
Appendix 7. Amphibian species recorded from Prey Long during surveys in 2007

Family	Species	O'Aknamey	O'Krack	O'Prumcharey	O'Krack Pond	Road to O'Krack	Phnom Krahorm
Microhylidae	*Kalophrynus interlineatus*	X					
	Kaloula pulchra	X					
	Microhyla butleri		X				X
	Microhyla heymonsi	X	X				
	Microhyla ornata	X	X	X		X	
	Microhyla pulchra		X				
	Micryletta inornata	X					
Ranidae	*Fejervarya limnocharis*	X				X	X
	Hoplobatrachus rugulosus	X					X
	Occidozyga lima						X
	Occidozyga martensi	X		X		X	
	Rana lateralis						X
	Rana nigrovittata	X		X		X	
Rhacophoridae	*Chirixalus nongkhorensis*			X	X		X
	Chirixalus vittatus				X		X
	Polypedates leucomystax	X		X	X		X

Appendix 8. Snake and lizard species recorded from Prey Long during surveys in 2007

Family	Genus	O'Aknamey	O'Krack	O'Prumcharey	O'Krack Pond	Road to O'Krack	Phnom Krahorm
Colubridae	*Boiga ocellata*	X					
	Enydris longicauda	X		X			
	Homalopsis buccata	X					
	Xenochrophis piscator	X					
	Xenopeltis unicolor				X		
Elapidae	*Cryptelytrops albolabris*				X		
Gekkonidae	*Dixonius siamensis*		X				
	Gekko gecko						X

Appendix 9. Freshwater fishes captured during survey at Prey Long



(a) *Xenentodon sp.,* (b) *Danglia* sp. 1, (c) *Danglia* sp. 2*,* (d) *Hampala macrolepidota* (e) *Neolissochilus blanci*, (f) *Osteochilus hasselti* (g) *Poropuntius deauratus.* (h) *Raiamas guttatus*, (i) *Rasbora paviei,* (j) *Systomus* sp. (k) *Channa* sp. (l) *Leiocassis siamensis,* (m) *Clarias melanderma* (n) *Silurichthys phaiosoma*, (o) *Mastacembelus armatus.* Not to scale.

The *Rasbora spilocerca* specimen was not photographed.

Appendix 10. Freshwater fish species recorded from Prey Long during surveys in 2007

Order	Family	Scientific name	Local Name	Site 1	Site 2	Site 3
Beloniformes	Belonidae	*Xenentodon* sp.				X
Cipriniformes	Cyprinidae	*Dangila* sp. 1	Khnanwng veng	X		
	Cyprinidae	*Dangila* sp. 2	Trey kros	X		
	Cyprinidae	*Hampala macrolepidota*	Trey khmann	X		
	Cyprinidae	*Neolissochilus blanci*	Blanci		X	X
	Cyprinidae	*Osteochilus hasselti*				X
	Cyprinidae	*Poropuntius deauratus*	Kros phnom	X		
	Cyprinidae	*Raiamas guttatus*	Saka keo	X		
	Cyprinidae	*Rasbora paviei*	Changwa chhnoht	X	X	X
	Cyprinidae	*Rasbora spilocerca*		X		
	Cyprinidae	*Systomus* sp.				X
Perciformes	Chanidae	*Channa* sp.	Trey ksan	X	X	X
Siluriformes	Bagridae	*Leiocassis siamensis*	Trey kanchos thmor	X		X
	Clariidae	*Clarias meladerma*	Andaing toun	X	X	
	Siluridae	*Silurichthys phaiosoma*	Phaiosoma			X
Sybranchiformes	Mastacembelidae	*Mastacembelus armatus*	Trey kchoeung	X		

Appendix 11. List of wildlife found at Siambok and Thalaboryvat district Stung Treng Province

English name	Scientific name	Location	Observation type	Other
Log-tailed macaque	*Macaca fascicularis*	Olung	Direct/Photo See figure 7	-There are two log-tailed macaques which local people keep as pets in their house.
Southern serow	*Naemorhedus sumatraensis*	Stung Treng	Direct/horn	-The owner of the guest house used them for decoration and keeps them for selling.
Grey-headed parakeet	*Psittacula finschii*	Kangcham and Olung	Direct/Photo See figure 8	-The local people keep them as their pet. The team found three at Kangcham and one at Olung.
Bengal monitor	*Varanus bengalensis*	Siembok	Direct/photo See figure 9	-The local people used dogs to hunt monitors for food.
Thick-billed pigeon	*Trero curvirostra*	Dung	Direct/Photo See figure 10	-The local people use it for food.

Appendix 12. List of prices for wildlife traded in Prey Long area

Species	Unit	Price
Otter	1 = 6kg	$ 100.0
Water Monitor	1 kg	$ 5.0
Chelonian sp.	1	$ 6.3
Wild Pig	1 kg	$ 2.0
Red Muntjac	1	$ 12.5
Python sp.	1 kg	$ 5.0
Cobra sp.	1 kg	$ 15.0
Pangolin	1 kg (Number 1)	$ 50.0
Macaque sp.	> 1kg	$ 62.5
Loris	1	$ 2.5

Appendix 13. Survey photographs

Discussing and preparing for the field work

Difficulties getting motorbikes across streams

An old bridge originally used for logging

Camping in the forest

Deciduous forest in Prey Long

Temporary wetland in Prey Long

Long-tailed Macaque in captivity

Grey-headed Parakeet in captivity

Bengal Monitor in captivity

Thick-billed Pigeon in captivity

Elongated Tortoise *Indotestudo elongata*

Asian Leaf Turtle *Cyclemys tcheponensis*

Common Treefrog *Polypedates leucomystax*

White-lipped Pit Viper *Cryptelytrops albolabris*

Surveying for fish and turtles in Prey Long

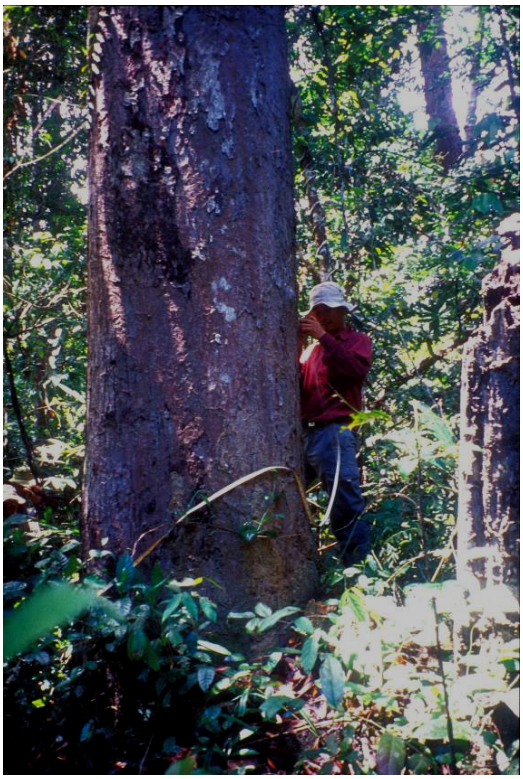
O'Krack stream, a survey site for freshwater fish

Measuring an Asian Giant Pond Turtle *Heosemys grandis*

Conducting interviews in local communities

Illegal land clearance in Prey Long

Resin-tapping in Prey Long



Left: Dipterocarps of considerable diameter are still found in Prey Long. Resin tapping from these giants is important for local livelihoods. The stands are important seed sources for future reforestation and on-farm tree planting activities.

Right: Many forest types with different degrees of deciduousness and species compositions are represented in Prey Long. Transect in evergreen lowland forest.

Appendix 14. Deciduous trees of Prey Long

Deciduous Trees of Prey Long

Mette Sinding Francke, Ith Saveng, Ida Theilade & Lars Schmidt

INTRODUCTION

As part of a BSc/MSc study, we went on a short 4 day trip to the North Eastern part of Prey Long, Stung Treng province. Mr. Ith Saveng from the MSc course in environmental development, Royal University of Phnom Penh, was so kind to assist me in the field taking time from his own studies. I am a Biology student at the University of Copenhagen, Denmark.

Since we are students with only little field experience, we chose to assess the more species poor deciduous forest type. The study site was approximately 25 km west into the forest from the Mekong River in the proximity of Doung Village. Se map in Apendix 1.

The primary aim of the field study was to compare two different survey methods, Fixed area and fixed count. In this chapter we publish the results achieved in Prey Long, using these two methods.

When travelling from the Mekong towards the survey area, we observed that two different forest types alternated most of the way between the Mekong and Doung. One was a dry, open canopy, deciduous forest dominated by short big leafed Dipterocarps, such as *Shorea sp.*. Shrubs, grasses and *Cycas* covered the forest bed. *Lagerstroemia floribunda Jack* (Sralao) and two other species dominated the other forest type. The humidity rose as we got deeper into the forest and the two forest types seemed, at some point, to shift in accordance to the altitude where the open deciduous forest was on dry rocky hill tops and the taller, humid Sralao forest in the low-lying areas with sandy soil . In some areas the Sralao forest was characterised by many big lianas and strangler figs.

The villagers in Doung were very dependent on the forest and supplemented their rice cultivation with hunting and gathering of non timber forest products. The people from villages by the Mekong River also supplemented their income by selective logging in the forest. It is not accessible by truck or 4WD, but still we found timber and saw mills in Kang Cham and two more villages along the Mekong. Timber was primarily cut for private use, but a considerable amount of timber was also shipped and sold locally. All areas in this part of the forest were degraded to some extend. No high quality timber species were left[1] and the natural dry season fires occur more often as a result of the slash and burn practise by the villagers. We encountered many families who were moving their

[1] Interview with Mr. Dong

farms from the river banks and further into the forest, clearing new land. Increase in population is certainly putting pressure on this forest.

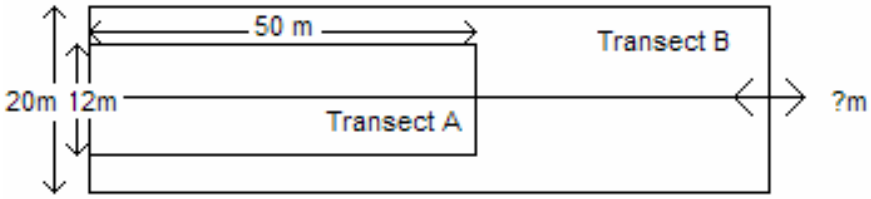
METHODS

The study site was 40 minutes walk from Doung village and was covered by a mosaic of open grassland, open deciduous forest, mixed deciduous-evergreen forest and transitions between the three.

The methods used for sampling was fixed area (method A) and fixed count (method B) (Gordon & Newton 2006) . All trees more than 5 cm in diameter at breast height were identified by local name and diameter recorded.

The last day of surveying, specimens were collected and later identified by Mr. Eang Hourth, WWF, Phnom Penh and Mr. Rachan Pooma and employees at the Royal Forestry Herbarium, Bangkok (BKF). Voucher specimens are deposited in BKF.

Both transect A and B have the same starting point and transect A is embedded in transect B, as it takes a larger area to sample the 100 trees decided upon as a fixed sample number, in this particular forest type. Transect A has a fixed area(12*50m=600m^2), transect B has a variable transect length but the with is set to 20m. The length is determined by the distance it takes to sample 100 trees.



Both methods were applied for 6 transects, for the 7th transect only method A was applied.

Some transects stretch over transition zones between dry and mixed deciduous forest (transect 5) and between dry deciduous forest and grassland (transect 6 and 7).

We conducted short interviews with our local guides. Their statements are not claimed to be facts, only indices.

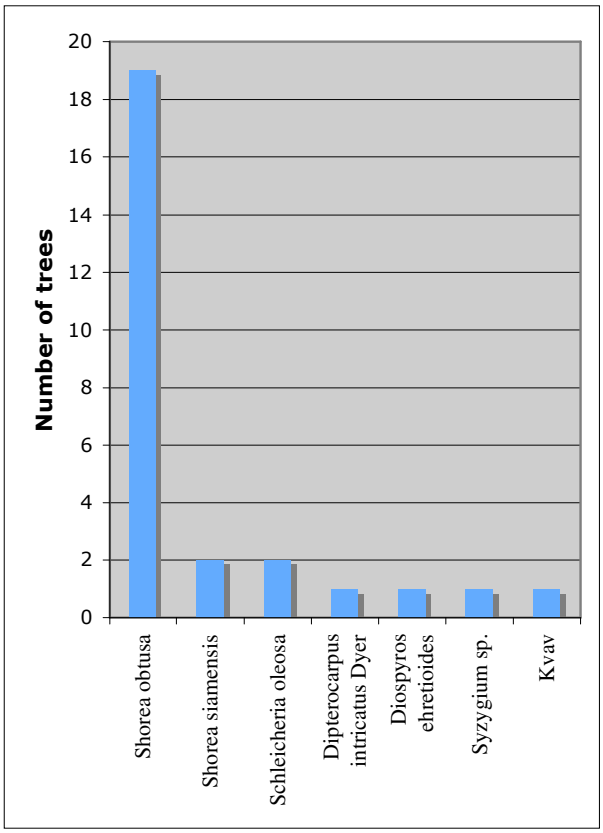
We have compiled a species list of our results and the species found by Dr. J. Anderw McDonald in 2004 in the forest surrounding Spong village. To evaluate the relative importance of the species in regards to conservation, we used the International Union for the Conservation of Nature, category and evaluation criteria IUCN Red List 2007 (IUCN Red List), the United Nations Environment Program - World Conservation and Monitoring Centre, Trees Database on Threatened Trees (UNEP-WCMC) and the list of priority species for conservation by Cambodian Tree Seed Centre (CTSP 2003).

RESULTS

In 7 transects covering 12710 m^2, we found 50 tree species.

In all of the 7 transects, different species dominated. Two different transects that appear very similar, can hold different dominant species. A species dominant in one transect can be completely absent in the other (ex transect 1 and 3). The rough division of plant communities into dry deciduous, mixed and evergreen forests is too broad scaled. Only transect 1 appeared somewhat homogenous. Termite mounds in all transects, influenced the species composition and abundance, as some species only occurred on top of these and often the density of trees was higher on termite mounds.

fig. 1. Relative frequency of species in transect 1 A, dry deciduous forest.



Transect 1 A (600m^2) and 1 B (2018m^2) was sampled in an area with short dry deciduous forest, dry sand and gravel soil and approximately 400 metre from the bordering open grassland. The open canopy allowed much light through to the forest bed, which was covered in grass and short herbs, similar to the species in the open grassland. The most dominant species was **Shorea obtusa, Shorea siamensis** and an unsampled and therefore unidentified **Diospyros** species. 19 different species was found in the transects.

In transect 1 A, the growth was very uniform. In the larger transect 1 B a few termite mounds and the different species of trees they sustain, elevated the species number from 7 to 19. Transect 1 A holds the fewest species in this survey.

fig 2. Relative frequency of species in transect 1 B, dry deciduous forest.

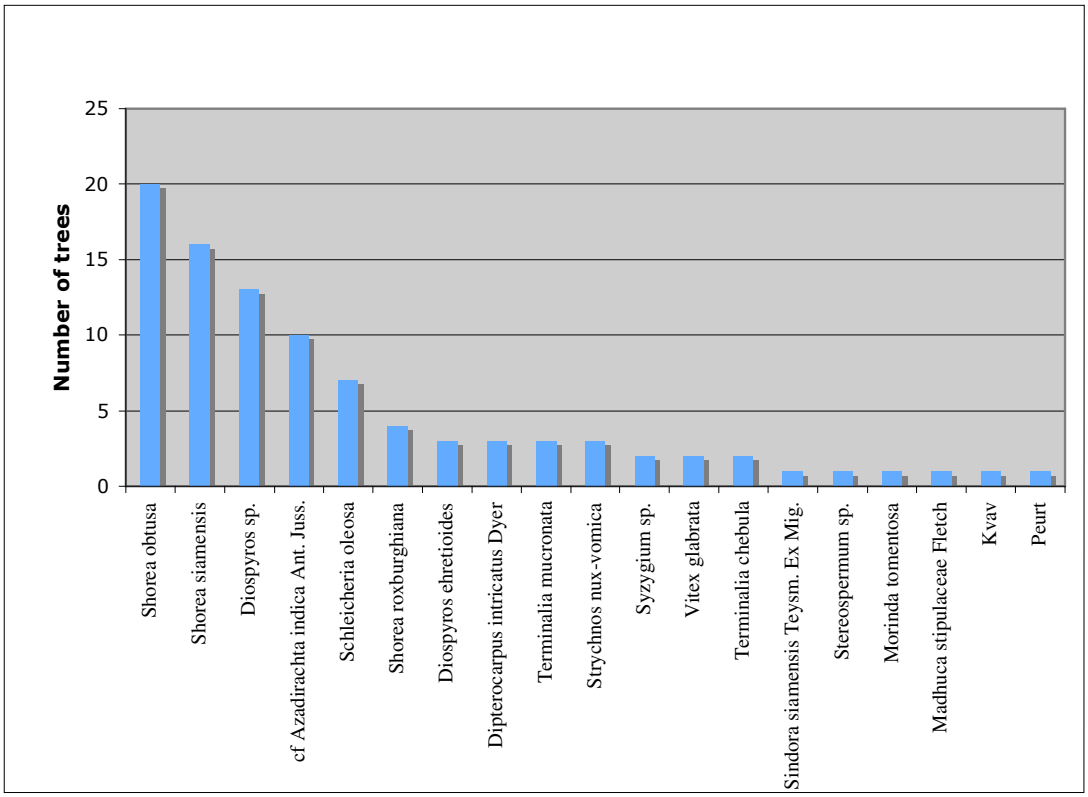
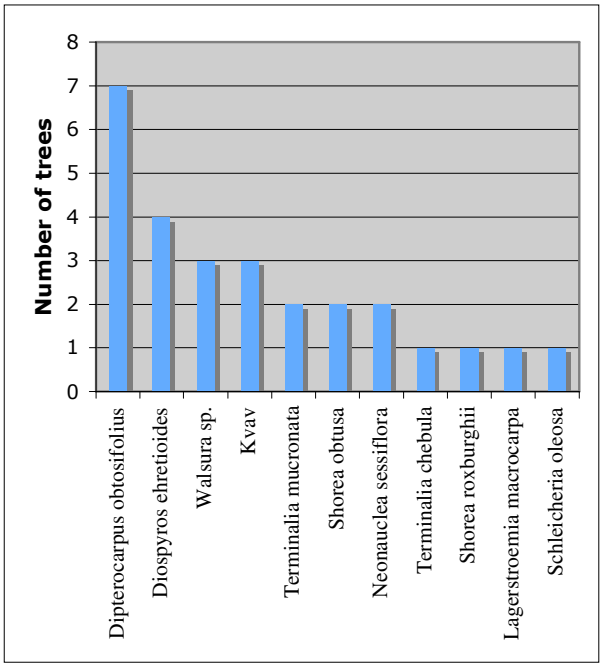


fig 3. Relative frequency of species in transect 2 A, dry deciduous forest.



Ttransect 2 A (600m^2), and B (2446 m^2) was closer to a stream, further away from the grassland. Trees here were taller and the forest bed was covered with grass and herbs, with a different species composition as in the grassland.

The most abundant species in 2B was *Dipterocarpus obtosifolius* and "Kvav", probably ***Rubiaceae* sp.**[2]

Species numbers rise from 11(2A) to 25 (2B) as we enlarge the transect. The transects 2A,B add 8 new species to the list.

fig 4. Relative frequency of species in transect 2 B, dry deciduous forest.

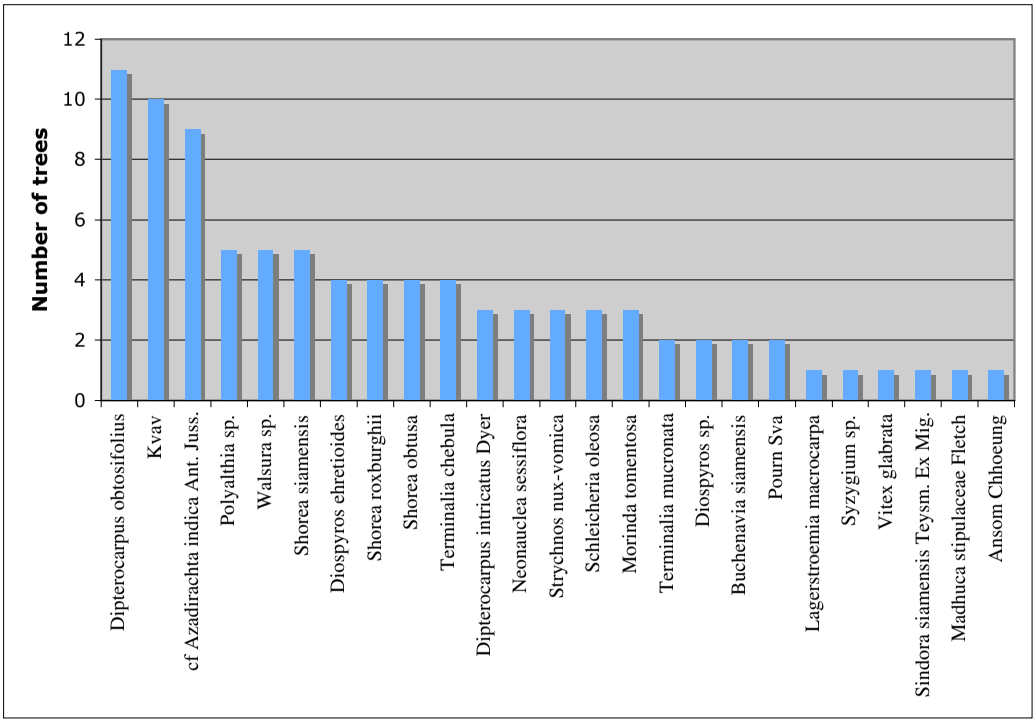
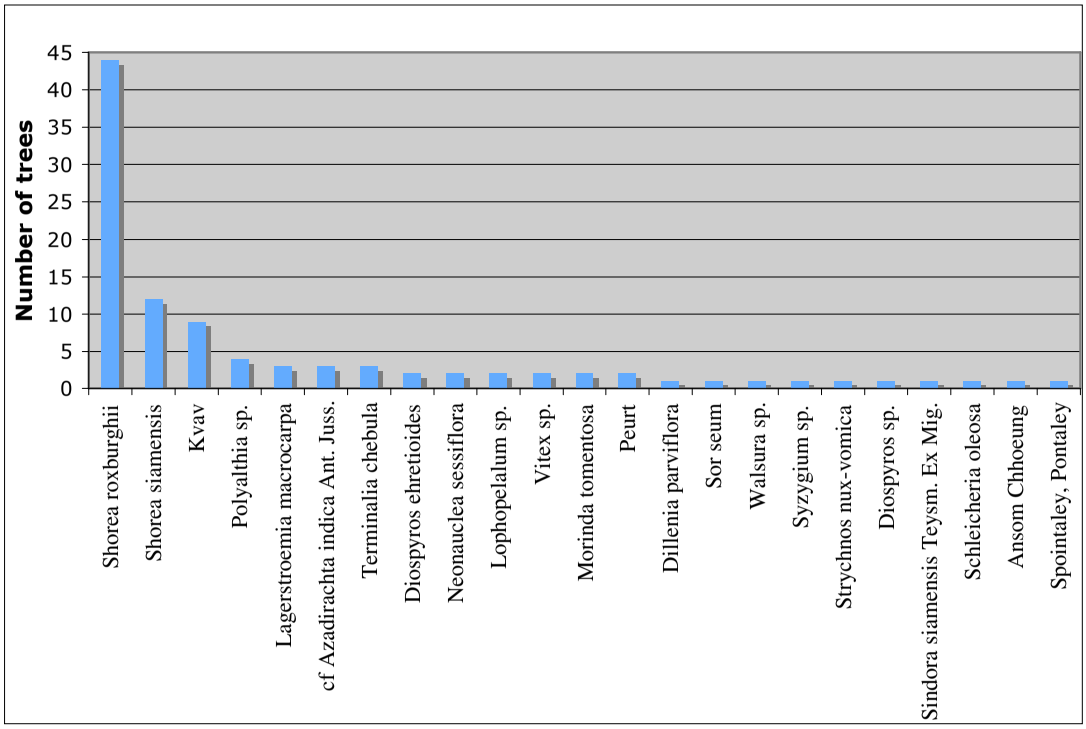
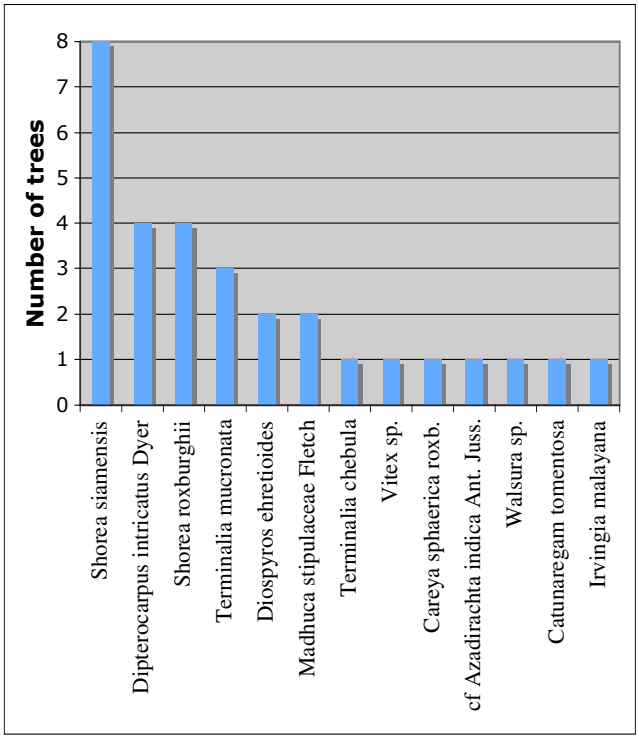


fig 5. Relative frequency of species in transect 3 B, dry deciduous forest.



Transect 3B covered 1006m^2 and held 23 species. The vegetation was relatively dense. We found only a few old trees but many young ones with similar diameter. (Possibly a recent colonisation of grassland or a recolonisation after fire). The most dominant species was ***Shorea roxburghii*** which makes up 44% of the trees in the transects. The tree with the largest diameter (91cm dbh) was also *Shorea roxburghii*. Possibly a mother tree. Transect A and B was very similar. 6 new species was added with this transect.

fig 6. Relative frequency of species in transect 4 A, dry deciduous forest.



The transects covered, 4 A (600m^2), 4 B (1776m^2). Species numbers rise from 13 (4A) to 24 (4B) and 5 new species were added to the list.
Species dominance change as transect is enlarged. The third most dominant species in transect 4B, "Kvav" is not even registered in transect 4A. But *Shorea siamensis* is the most dominant species in both transects making up c 25% of the trees in the transect.

fig 7. Relative frequency of species in transect 4 B, dry deciduous forest.

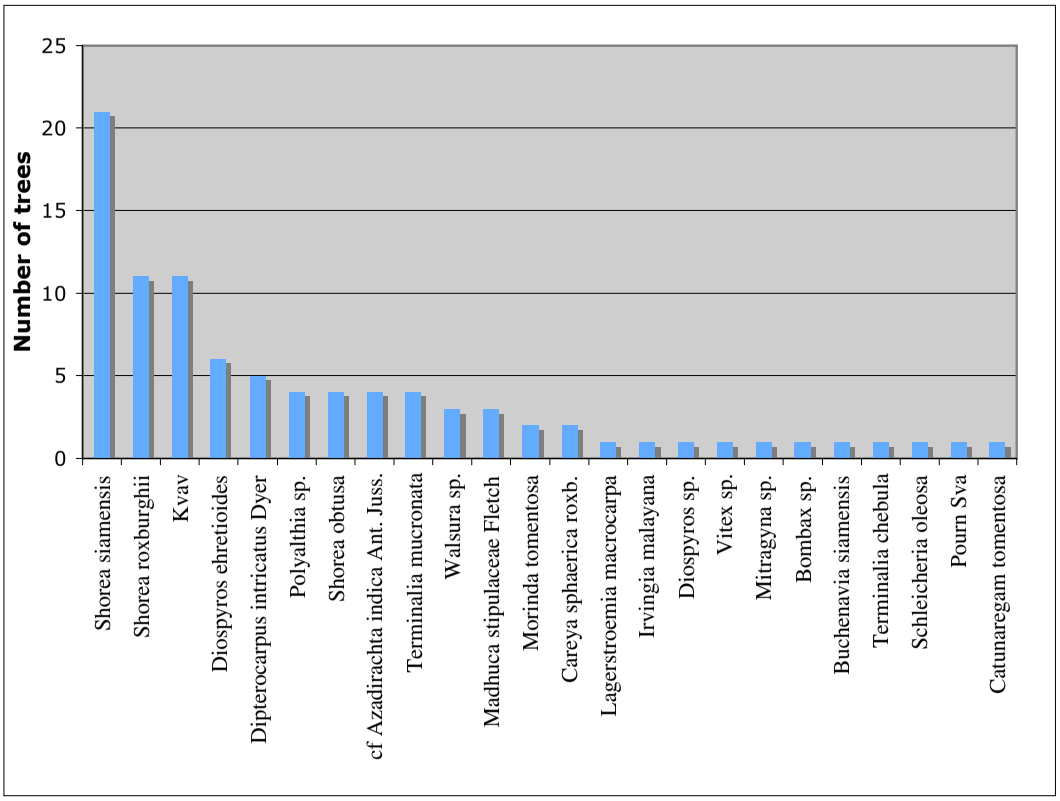
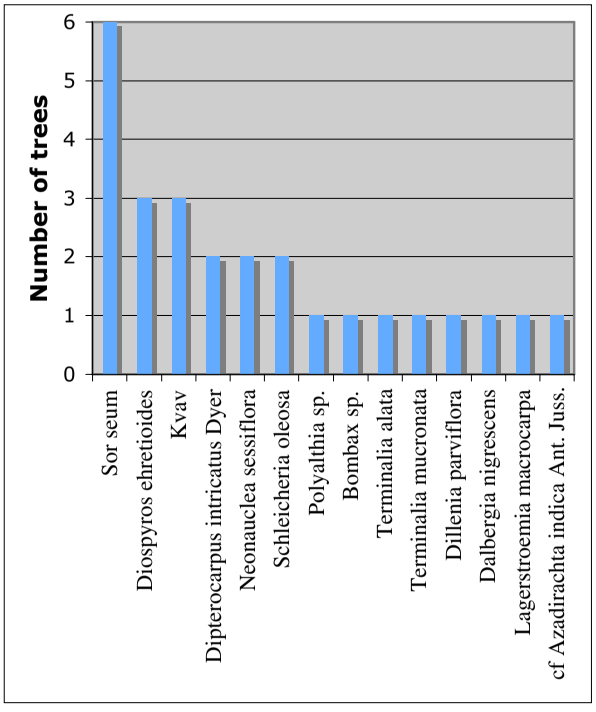


fig 8. Relative frequency of species in transect 5 A, dry deciduous forest.



The transects 5 A and B, were sampled in the transition zone between deciduous and evergreen forest. The forest bed was covered by a ginger species and the soil was dark silt. A higher humidity and the *L. floribunda* Jack, indicated the mixed deciduous and evergreen forest type.

There are 14 species in transect 5 A (600m^2) and 26 in 5 B (2008m^2).

This makes 5 B the most species rich transect of the survey, even though it is not the biggest.

As seen from the graphs, great variation in species composition occurs within these two transects. The dominant species in 5A are different from 5B. The dominant species, Sor seum in transect A is number 4th in transect B.
5 A and B adds 7 new species to the list.

fig 9. Relative frequency of species in transect 5 B, dry deciduous forest.

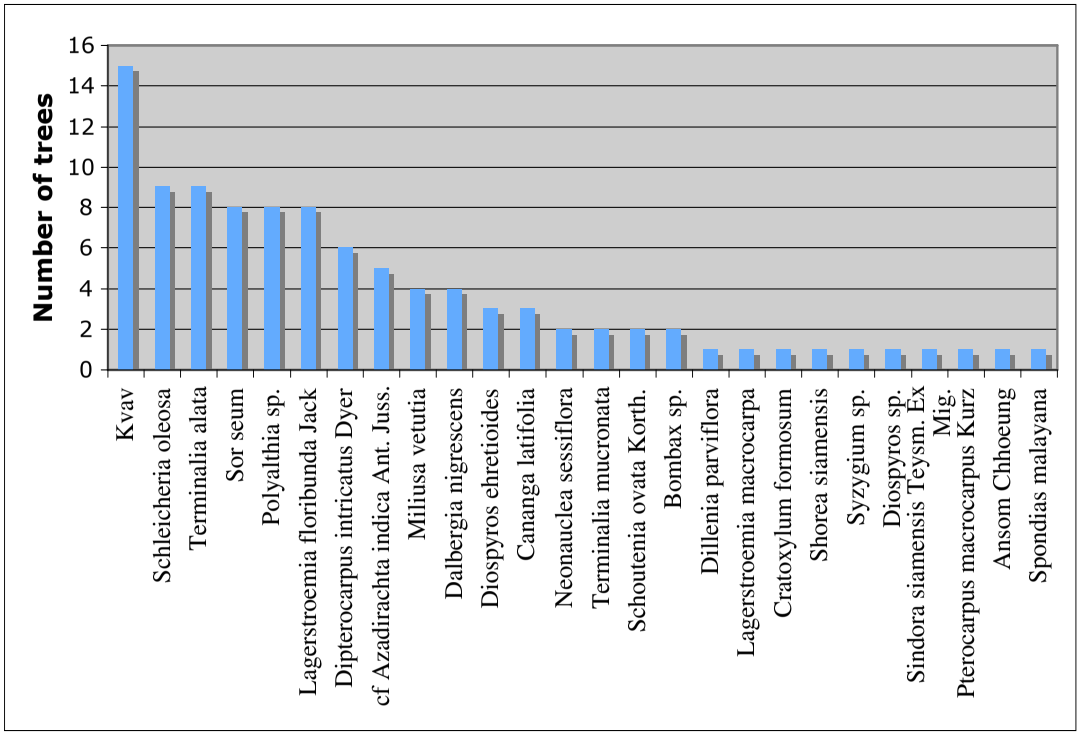
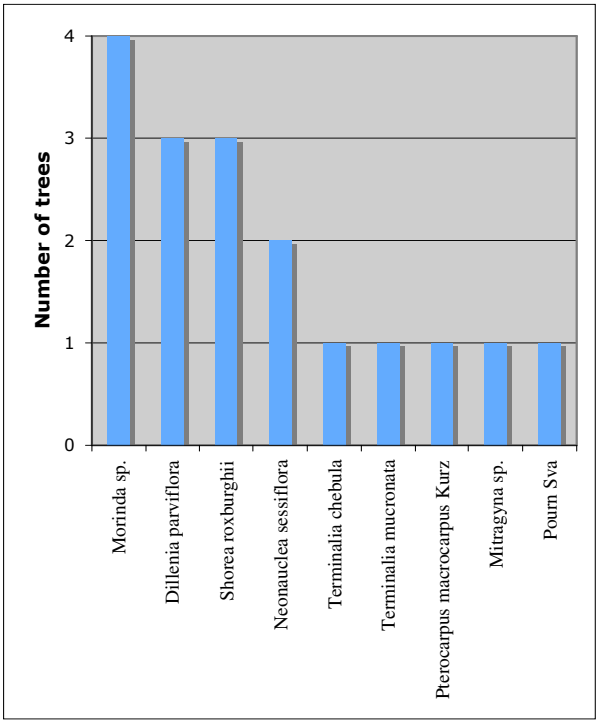


fig 10. Relative frequency of species in transect 6 A, dry deciduous forest.



Transect 6 A (600m^2) holds 9 species, 6 B (2856m^2), 15.
6 B is the largest transect, but not the most species rich.
A species not encountered before (*Morinda* sp.), dominates the species poor transect, 6 A.
Transect 6 A and B, adds 2 new species to the species list.

fig 11. Relative frequency of species in transect 6 B, dry deciduous forest.

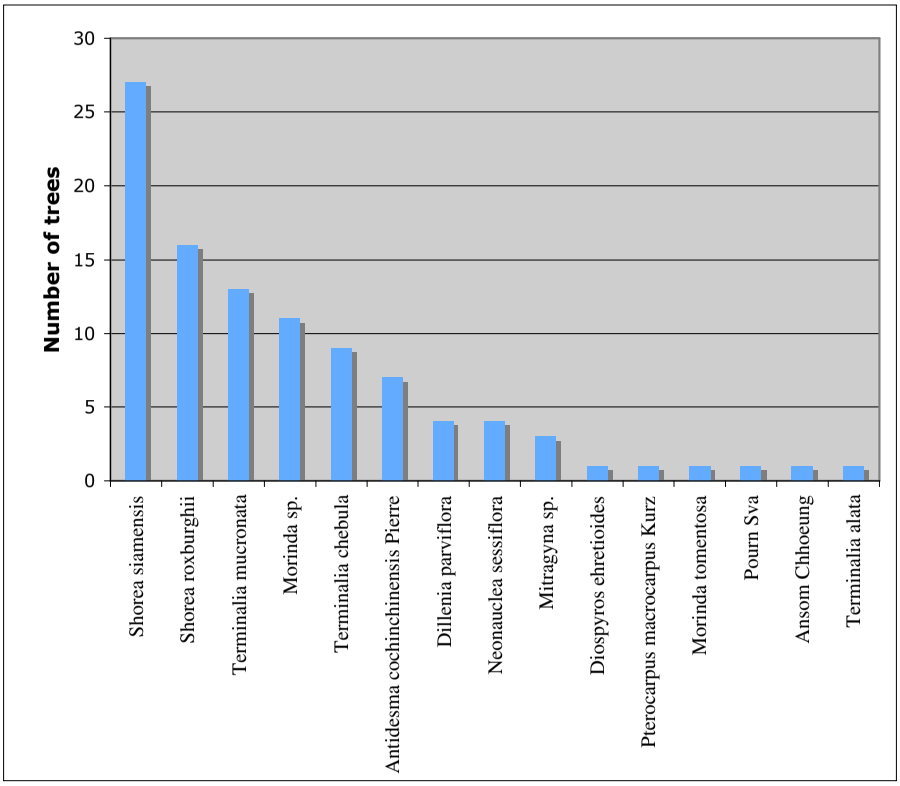
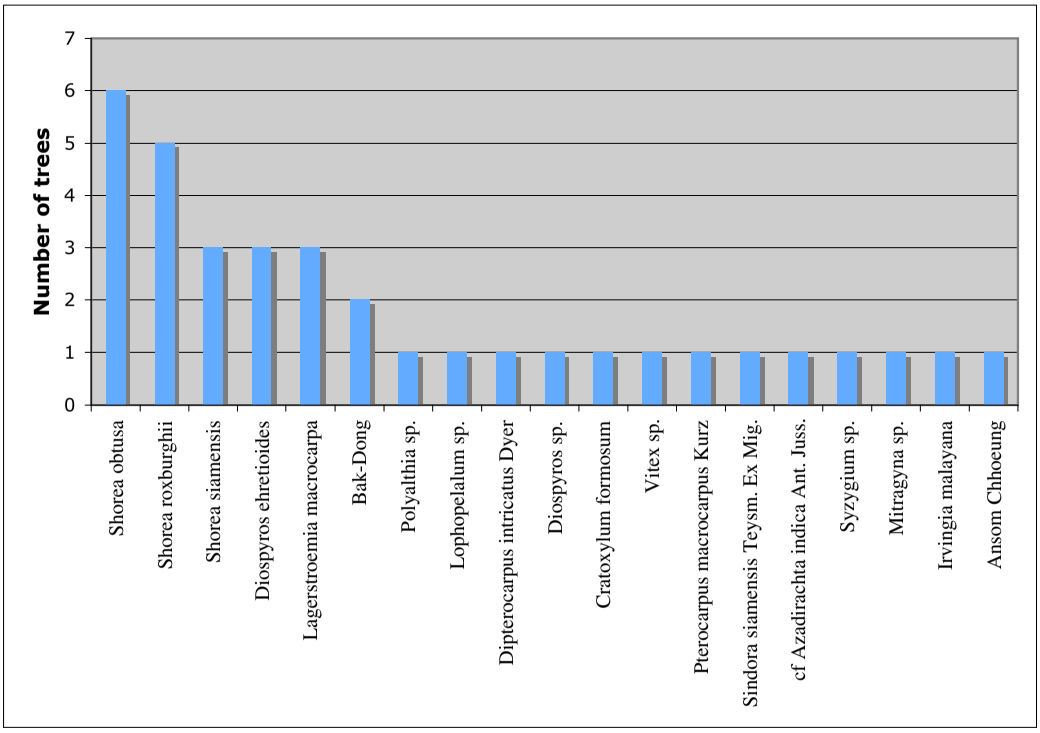
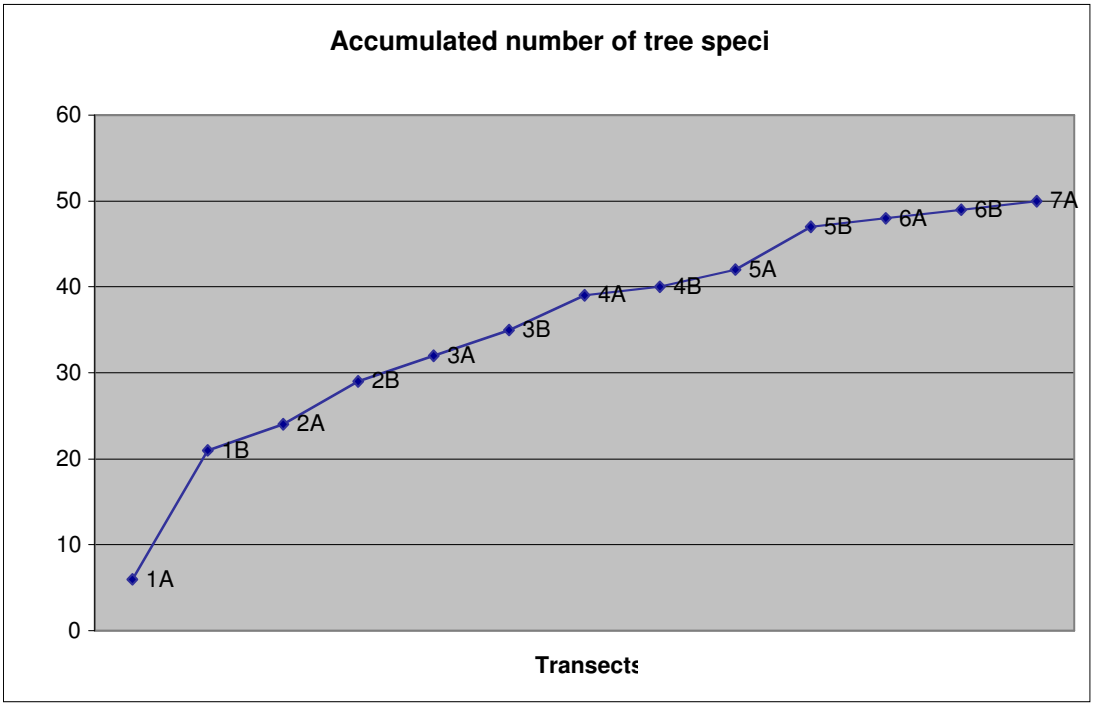


fig 12. Relative frequency of species in transect 7 A, dry deciduous forest.



The most dominant species are *S. obtusa* and *S. roxburghii*, Transect 7 A is the most species rich of the A transects, with 19 species in 600m^2. This transect covered both grassland, dry deciduous and a transition zone to mixed forest. Despite the species richness, this transect contributed with only one more species to the total of 50 different species within the transects. All but 7 specimens are collected in and close to this transect.

fig 13. Species-area curve for the 13 transects in deciduous forest, Prey Long.



DISCUSSION

Prey Long resides on an old riverbed. Sand, silt and gravel are the main components of the soil and are believed to determine the vegetation types. This has resulted in a mosaic of different forest types within greater Prey Long. There is great variation in forest types even within restricted areas.

A total of 50 tree species were recorded in our survey. An additional 12 species were recorded from dry deciduous forest in Prey Long by McDonald (2004). Some of the species recorded in this study were recorded in the evergreen forest as well. The number of species is likely to increase as we survey larger areas in Prey Long.

All high quality timber was said to have been cleared from the forest years ago. The local guide interviewed during the surveys in evergreen forest specifically mentioned that no *Afzelia xylocarpa* and *Dalbergia cochinchinensis* Pierre, was left in North Eastern Prey Long. And expectedly, we didn't encounter the two species otherwise associated with deciduous forests in South East Asia.

The deciduous forest type is quite common in Cambodia and northern Thailand. However, deciduous forest in Prey Long is cleared for agriculture and plantation schemes. Two species found in the present survey are listed on the IUCN red List (*Shorea roxburghii* G. Don and *Anisoptera costata* Korth.), while 56% of all species recorded are found on the UNEP-WCMC Trees Database on threatened trees. Furthermore, 3 species are listed as national priority species for conservation by Cambodia Tree Seed Project (2003). Thus, deciduous forest in Prey Long harbours many tree species of national and global conservation concern. Prey Long is one of very few forests in Cambodia where extensive and intact areas of both evergreen and deciduous forest is found including a range of vegetation types forming transition zones between the two forest types. More studies will help determine which areas overlap in species abundance and ecosystem types. An overview of the whole area and habitat types is needed to prioritise areas for conservation, rehabilitation, and production. Planning should aim to maintain species diversity, benefit the national economy as well as the people relying on forest products from Prey Long.

REFERENCES

Gordon, James E. and Newton, Adrian C. : Efficient floristic inventory for the assessment of tropical tree diversity: A comparative test of four alternative approaches. Forest Ecology and Management 237 (2006) 564-573, ELSEVIER (Gordon & Newton 2006)

Interview with local guide Mr. Khean Dong from Ror Moul at the Mekong River, Kratie province, May 2007 . Same guide used in evergreen survey. (interview with Mr. Dong)

Information and assistance from the local guides, Mr. Kess, Kang Cham Village and Mr. Mett, Doung Village. June 2007

Appendix A. Photos

Grassland bordering to dry deciduous forest. *Buchenavia siamensis*

Local guide, Mr. Kess in grassland bordering to dry deciduous forest.

Dry deciduous forest bed, after recent burning. *Cycas sp*., *Shorea obtusa*.

Crossing roads on the way to Doung Village. Dry deciduous forest.

Appendix B. List of species recorded in June 2007 survey and their conservation status.

Guttiferae	Cratoxylon formosum (Jack) Dyer	ល្ងៀង	Lo ngieng		X	
Labiateae	Vitex glabrata R.Br.	ពពូល	Por-pul		X	
Labiateae	cf Vitex pinnata	[illegible]	Khmoeul*		X	
Lecythidaceae	Careya sphaerica Roxb. (C. arborea McDonald)	[illegible]	Kandol		X	
Leguminoaseae	Dalbergia nigrescens	[illegible]	Snuol			
Leguminosae	Pterocarpus macrocarpus Kurz	[illegible]	Thnong		X	X
Leguminosae	Sindora siamensis Teijsm. ex Miq.	[illegible]	Ro koh		X	
Loganiaceae	Strychnos nux-blanda or nux-vomica	ល្វាក	La veak		X	
Lythraceae	Lagerstroemia floribunda Jack	ស្រឡៅ	Sra-lau		X	
Lythraceae	Lagerstroemia macrocarpa Wall.	ឥន្ទ្រនេល	Entrenel		X	
Meliaceae	cf Azadirachta indica Ant. Juss.	ស្ដៅ	Sdao, sdout		X	
Meliaceae	Walsura sp.	ឥសីផ្សំស្រេច	Eysei psam srach			
Myrtaceae	cf Syzygium cumini (L.) Skeels	ព្រីង	Pring		X	
Rubiaceae	Catunaregam tomentosa	ល្វៀង	Lveang			
Rubiaceae	cf Mitragyna rotundifolia and M. hirsuta	ខ្ទុម	Khatum, ktum			
Rubiaceae	cf Morinda citrifolia Hunter	លំពុក	Am Pok, lompok		X	
Rubiaceae	Morinda tomentosa	ញរព្រៃ	Nho prey, Gnor			
Rubiaceae	Neonauclea sessiflora or N. Pallida	រលៀយ	Ro-leay		X	
Rubiaceae		ខ្វាវ	Kvav			
Sapindaceae	Schleichera oleosa	ពង្រ	Pong-ro		X	
Sapotaceae	Madhuca stipulaceae Fletcher	ស្គុំ	Skum		X	

Family	species	khmer	khmer-eng	IUCN Red List	UNEP-WCMC	CTSP 2003
Anacardiaceae	Buchenavia siamensis	[illegible]	Leang chey, Mchey			
Anacardiaceae	Spondias malayana	ម្កាក់ព្រៃ	Mokak Prey			
Annonaceae	Cananga latifolia Finet & Gagnep.	[illegible]	Chhkai sreing		X	X
Annonaceae	Miliusa velutina Hook.f. & Thoms.	ស្មារក្របី	Sma krobey		X	
Annonaceae	Polyalthia sp.	ពង់វៀក, ស្វាយដៃល	Pong veak, Snay der			
Bignoniaceae	cf Stereospermum cylindricum Pierre	សង្កតធ្មាត	Sangkout tmat			
Bombacaceae	cf Bombax anceps Pierre	រកា	Ro-ka		X	
Celastraceae	Lophopelalum sp.	សុភី	Sophi			
Combretaceae	Terminalia alata Heyne ex Roth	ឈើក	Chheek		X	
Combretaceae	Terminalia chebula Kurz	ស្វ	Smor		X	
Combretaceae	Terminalia mucronata (T. coticosa McDonald)	ប្រាំដំឡឹង	Pram dom leang		X	
Dilleinaceae	Dillenia parviflora	នេ	Lo-ve, rrve			
Dipterocarpaceae	Antidesma cochinchinensis Pierre	ដង្កៀបក្ដាម	Dang keap kdam			
Dipterocarpaceae	Dipterocarpus intricatus Dyer	ត្រាច	Trach		X	
Dipterocarpaceae	Dipterocarpus obtosifolius Teysm.	ត្បែង	Tbeng		X	
Dipterocarpaceae	Shorea obtusa Wall	ផ្ចឹក	Phchoek		X	
Dipterocarpaceae	Shorea roxburghii G. Don	ពពេល	Popel	EN A1cd	X	X
Dipterocarpaceae	Shorea siamensis Miq.	រាំងភ្នំ	Reang (Phnom)		X	
Ebenaceae	Diospyros ehretioides Wall.	មមាំង	Mor maing		X	
Ebenaceae	Diospyros sp.	ក្រុំ	Krum			

Simaroubaceae/ Irvingiaceae	Irvingia malayana	ចំបក់	Cham bak		X	
Tiliacea	Schoutenia ovata Korth.	អាចម័សត្វ	Arch satt		X	
		ពីត	Peurt			
		ពយនស្វា	Pourn Sva			
		អន្សមឆ្មឹង	Ansom Chhoeung			
		ស្ពាន់តាឡឺ	Spointaley, Pontaley			
		បាក់ដង	Bak-Dong			
		សសើម	Sor seum			

*Khnoeul and Khnoeul Prey have been treated as one species on this list. Unfortunately we have no specimen of the species called Khnoeul Prey and therefore no way of comparing the two.

Appendix C. Species recorded in dry deciduous forest, Prey Long by McDonald, (2004)

Family	Species	Khmer	IUCN category and evaluation criteria IUCN Red List 2007	UNEP-WCMC Trees database on threatened trees	National priority species for conservation CTSP 2003
Myrtaceae	Melaleuca quinquenervia (Cav.) S.T. Blake	Smach		X	
Chrysobalanaceae	Parinari annamensis (Hance)J.E. Vidal	Tlok		X	
Rhizophoaceae	Carallia brachiata (Lour.) Merr.	Tromeng		X	
Myrtaceae	Rhodomyrtus sp.	Puich			
Fabaceae	Cassia siamensis Lem.*	Ankan			
Annonaceae	Xylopia sp.	Krey			
Sapotaceae	Madhuca elleptica** (Pierre & Dub.)H.J.Lam	Srakom		X	
Dilleinaceae	Dillenia sp.	Pluh			
Fagaceae	Lithocarpus sp.	Krang			
Leguminosae	Xylia xylocarpa (Roxb.) Taub.	Sokram		X	
Dipterocarpaceae	Anisoptera costata Korth.	Pdieck	EN A1cd+2cd	X	
Ebenaceae	Diospyros sp.***	Cheu kmau			

* Probably synonym for *Senna siamea* (Lam.) H.S. Irwin & Barneby

** Probably the same species found in our survey. "Srakom" = "Skum", identified as a different species, *Madhuca stipulaceae* Fletcher. See species list above

*** Identified as *Diospyros crumenata* = Cheu Kmau, by Mr. Chhan Phourin, Prey Long 2007.

Appendix D. Species recorded outside transect, Prey Long 2007

Family	Species	Khmer	IUCN category and evaluation criteria IUCN Red List 2007	UNEP-WCMC Trees database on threatened trees	National priority species for conservation CTSP 2003
Burseraceae	cf Canarium subulatum and C. strictum	Ploeuch			
Euphorbiaceae	Phyllanthus emblica L.	Kantuot prey		X	