

Biodiversity Assessment of the REDD Community Forest Project in Oddar Meanchey Cambodia



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Front cover photos: Wildlife species in Oddar Meanchey. From top row, Green Peafowl©Jonathan C. Eames, Siamese Fireback©Wildlife Conservation Society (WCS), Greater Adjutant©Sun Visan, Lesser Adjutant©Koulang Chey. From second row far left, White-Rumped Vulture©Allan Michaud and WCS, Oriental Pied Hornbill©Koulang Chey, White-rumped falcon©Hugh Wright, Lesser Adjutant Stork and Woolley-necked stork©Jonathan Eames. From third row, Elds Deer©Jonathan Eames, Red Muntjac©WCS, Sambar©WWF. Golden Jackal©Jonathan Eames. From fourth row far left, Flying Fox©Joe Walston, Silver Langur©Koulang Chey, far right Eld's Deer©WCS and World Wildlife Fund (WWF). From bottom row, second photo from left, Siamese Crocodile©Koulang Chey, Python©WCS, Water Monitor©Koulang Chey. All other photos from public sources.

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EXECUTIVE SUMMARY

The following report details the results of field surveys that were carried out in November 2010 to provide information on the distribution and status of birds and mammals within a proposed REDD project site. The site comprises thirteen Community Forests (CFs) that vary in size from 383ha to 18,261ha and are spread across the province of Oddar Meanchey, Cambodia.

Bird and mammal surveys were carried out in order to:

- Provide necessary biodiversity baseline data to satisfy the Climate, Community and Biodiversity Alliance's requirements for validation with regards to biodiversity assessment and monitoring;
- Identify species and habitats of High Conservation Value for prioritization in future conservation efforts;
- Design a biodiversity monitoring plan for the REDD Project site for the lifespan of the project (30 years)

Taking into account the size of individual CF areas, their geographical position in relation to other forested or protected areas, the forest type and the percentage of forest cover, six CFs were identified as target sites for biodiversity surveys. These areas were: Andong Bor; Sorng Rokavorn; Prey Srong; Sangkrou Preychheu; Romdoul Veasna and Rolus Thom. Targeted community interviews focusing on wildlife were conducted at all six CFs, whilst bird and mammal surveys were conducted in the first four; taken together, the four² CFs that were surveyed represented approximately 50% of the combined total area of all 13 CFs.

Oddar Meanchey Province is one of the driest regions of Cambodia with a dry season lasting more than four months. Three predominant forest types, Deciduous Dipterocarp, Mixed/Semi-evergreen and Evergreen are found in this landscape. Of the four CFs surveyed, Sorng Rokavorn and Andong Bor are dominated by Deciduous Dipterocarp Forest whilst Sangkrou Preychheu and Prey Srong are dominated by Semi-evergreen and Evergreen Forests.

Community interviews provided generally reliable information on mammals, but in the case of birds, the information was usually considered tentative at best. Whilst villagers could identify commercially valuable species, such as bovines, Sunda Pangolin and Green Peafowl, their knowledge of other species was considered much poorer.

The field surveys targeted particular species that are listed on the IUCN Red List of Threatened Species. Birds were surveyed by direct observation and recognition of their vocalizations, whilst mammals were identified by direct observation and by sign surveys (primarily tracks and faeces). Surveys for mammals were conducted both during the day and at night and targeted areas of highest potential that had been identified from detailed maps and through the knowledge of local community members.

Altogether, the survey recorded a total of 174 bird species in the CFs visited with the largest number of species (110) being recorded in the largest CF, Sorng Rokavorn. In addition, 26 mammal species were putatively identified to occur across the four CFs. All four CFs surveyed supported

² Due to mine risks and security concerns Romdoul Veasna and Rolus Thom had to be dropped from the list for biodiversity survey work.

breeding populations of at least one globally threatened bird species and at least one globally-threatened mammal and as such are species of High Conservation Value (HCV).

Whilst most of the threatened species that were detected are probably scarce within the REDD Project site, the Endangered Green Peafowl is present in small numbers in two of the CFs. In addition Sorng Rokavorn, the largest of the CFs, probably supports a viable population of this species. This CF also has populations of important mammals such as Banteng, large deer, and probably, Dhole and an unidentified large cat (either Leopard or Tiger). Apart from being significantly larger than the other CFs (>18,000ha) Sorng Rokavorn has a number of year-round water resources – a key element in determining the presence and distribution of Green Peafowl, large waterbirds and many species of mammal, which likely contribute to its importance for these various species.

Aside from Green Peafowl, threatened bird species that were recorded included Greater and Lesser Adjutant, and Great Slaty Woodpecker (the only globally threatened bird found at all four sites). In addition, the Near-threatened bird species encountered were Black-necked Stork, White-rumped Falcon and Siamese Fireback. Nine of the mammals recorded are globally threatened; five of these were confirmed to be present within at least one CF, including three Endangered species: Banteng, Pileated Gibbon (a viable population in Sangkrou Preycheu) and Sunda Pangolin (scarce throughout). Two other threatened species were confirmed from at least one CF, Sun Bear and Northern-Pig-tailed Macaque, whilst an additional four were putatively recorded Dhole, Gaur, Eld's Deer and Sambar in at least one location. Based on reports obtained during interviews, three other threatened or near-threatened species were thought to potentially still occur within some CFs; Hog Deer, Tiger and Leopard.

Small populations of some of the threatened species discovered are known to occur in or near Kulem Promtep Wildlife Sanctuary, approximately 40km to the east of Sorng Rokavorn and even closer to Prey Sorng and Sangkrou Preycheu. There is therefore a possibility that some of these species, such as Banteng, Greater Adjutant and Black-necked Stork, form an extension of these same populations rather than representing isolated remnant populations, and as a consequence some of the CFs could provide important components to the overall 'protected area' system in the region. Within a global context, the conservation of a viable population of Banteng and Green Peafowl within Sorng Rokavorn are probably the most important contributions that the REDD Project can make to species conservation efforts in the region.

In the absence of the REDD Project, it has been predicted that forest habitat in the project area will be reduced by 20% in the next 10 years through land clearing, illegal logging and fires. The Project is designed to reverse this trend of forest loss and degradation through patrolling to deter logging and other illegal activities and careful harvesting of NTFPs within the project area, and through the use of silvicultural treatments designed to enhance and restore native forest habitat. Sustainable use of existing and new NTFPs could encourage and promote forest protection efforts by local stakeholders. If implemented successfully and promptly, such activities are anticipated to deliver net positive benefits to biodiversity. Appropriate, timely interventions and outreach have the potential to reduce the pressure on species of High Conservation Values (namely, globally threatened species) within the CFs.

Although there is a possibility that the project may temporarily increase illegal activities in other locations outside the CFs, it was felt that pressures from these activities are inevitable. More importantly, the REDD Project has the potential to provide a paradigm that other members of the community may follow and therefore the project would have an overall positive impact.

It is essential that biodiversity monitoring forms a part of the management strategy of any protected area, even in instances where the primary objective is to maintain the maximum forest cover, as in the case of REDD projects. The particular character of the Community Forest system of the proposed Oddar Meanchey REDD Project poses some important considerations for designing and implementing a successful strategy. The non-continuous nature of the 13 CFs and the differences in size and habitat type means that careful consideration is necessary to maximize the efficacy and efficiency of resource allocation to the project. Recommendations are made for implementation of monitoring activities at those sites with the greatest potential for long-term benefit to the biodiversity.

Informed by the results of surveys, the biodiversity monitoring strategy aims to build on the existing skills base of the local community members in the short-term whilst recommending additional components that can be implemented with training, following the provision of financial and logistic resources over the 30-year period of the project.

The monitoring strategy includes both a list of key species (e.g. Banteng, Pileated Gibbon and Green Peafowl) found to occur within the CFs that would be not only beneficial but also possible for local non-scientific personnel to monitor; and considerations for the data management protocols and their development over the course of the REDD Project lifespan. In addition to the on-going community-based monitoring recommended, the REDD Project Implementing Agency is strongly advised to both expand upon this preliminary survey period and involve professional scientific and conservation agencies/individuals on an annual basis, throughout the Project period.

The long-term monitoring strategy described herein provides details of the level of contribution of the stake-holders, allocation of resources and the distribution of responsibilities. This includes for example, an initial 12-month mapping exercise; transect walks and opportunistic data collection by local villagers; provision of additional training; and supplementary professional surveys to augment the quantity and quality of baseline data.

Additional activities that would increase the impact of monitoring activities that are strongly recommended include the employment of a dedicated data collation person, the recruitment of a Khmer scientific advisor, appropriate actions that address current skills-based and equipment needs (e.g. field training and camera traps), and employment of higher-skill-based monitoring approaches in consultation with appropriate specialists (e.g. for molecular or modeling-based techniques).

This document outlines suggestions and recommendations that are believed to provide the most potential for suitable implementation of a biodiversity monitoring strategy within the confines of the resources and expertise available. All biodiversity monitoring strategies are subject to limitations and difficulties and whether the suggested course of action will be successful will be very much dependent on the gain of supplementary information and the nature of the future of this REDD Project.

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Conventions

Mammal names (common and scientific) follow those in the IUCN Red List (2010). Bird names (common and scientific) follow the updated 2010 version of Inskipp *et al.* (1996) available at the Oriental Bird Club website <http://www.orientalbirdclub.org>. Scientific names of birds are given in Table 3.1.

The Projected Coordinate System used was UTM UPS, Map Datum: Indian Thailand, Zone 48P

Abbreviations

asl above sea level

dbh diameter at breast height

ha hectare

km kilometres

m metres

Acronyms

CCBA The Climate, Community and Biodiversity Alliance

CDM Clean Development Mechanism

CITES Convention on International Trade in Endangered Species of Wild Fauna and Flora

CF Community Forest

FA Forestry Administration, Ministry of Agriculture, Forestry and Fisheries, Royal Government of Cambodia

GPS Global Positioning System

IBA (globally) Important Bird Area

ICF International Crane Foundation

IUCN World Conservation Union

NTPF Non-timber Forest Product

REDD Reducing Emissions from Deforestation and Degradation

WWF Worldwide Fund for Nature

WCS Wildlife Conservation Society

Explanation of Some Terms Used in this Report

Trapeang: a seasonal or permanent non-flowing water body situated within dipterocarp forest or grassland, frequently less than 1ha in total area. *Trapeangs* are a critical landscape feature in the dry season because they provide water and feeding habitat for a host of different mammal and large bird species during this drought-prone time of year.

Deciduous Dipterocarp Forest: DDF is the predominant vegetation in the province of Oddar Meanchey, where in 2006 there were about 240,000 ha of this habitat, compared to about 150,000 ha of Evergreen Forest and 55,000 ha of Semi-evergreen Forest (Bradley 2009). DDF is also sometimes called Dry Deciduous Forest and occasionally Dry Dipterocarp Forest.

Threatened Species: Three main IUCN global threat levels are recognised: CR – Critically Endangered, (being the highest level of threat), EN – Endangered and VU – Vulnerable. Details of the IUCN threat categories and criteria are to be found at <http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria>. Species in these three categories are considered threatened and are listed on the IUCN Red List of Threatened Species. Additionally there

are species that have been classified as Near-threatened (nTh) that may become threatened in the short-term.

CITES: The Convention on International Trade in Endangered Species of Wild Fauna and Flora works by subjecting international trade in specimens of selected species to certain controls. All import, export, re-export and introduction from the species covered by the Convention has to be authorized through a licensing system. Each Party to the Convention³ must designate one or more Management Authorities in charge of administering that licensing system and one or more Scientific Authorities to advise them on the effects of trade on the status of the species. The species covered by CITES are listed in three Appendices, according to the degree of protection they need. For additional information on the number and type of species covered by the Convention see <http://www.cites.org/eng/disc/how.shtml>.

Appendix I includes species threatened with extinction. Trade in specimens of these species is permitted only in exceptional circumstances.

Appendix II includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival. \

Appendix III contains species that are protected in at least one country that has asked other CITES Parties for assistance in controlling the trade. Changes to Appendix III follow a distinct procedure from changes to Appendices I and II, as each Party's is entitled to make unilateral amendments to it.

High Conservation Value (HCV): a biological, ecological, social or cultural value of outstanding significance or critical importance at the national, regional or global scale. Areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endemism, endangered species, refugia) or globally, regionally or nationally significant large landscapes where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance are defined as HCV Areas⁴. For more detailed definitions refer to the High Conservation Value (HCV) Resource Network <http://hcvnetwork.org/>.

Non-timber Forest Product (NTFP): any commodity obtained from the forest that does not necessitate harvesting of trees. Examples include medicinal plants, fish, mammals and birds that are eaten, honey, mushrooms and fuelwood.



Fish are one of the important NTFPs that are harvested in Sorng Rokavorn Community Forest (Frank Lambert)

³ Cambodia is a Party to CITES

⁴ There are also two non-biological definitions of HCV Areas, which are (a) Areas fundamental to meeting basic needs of local communities (e.g. subsistence, health), and (b) Areas critical to local communities' traditional cultural identity (areas of cultural, ecological, economic or religious significance identified in cooperation with such local communities).

1 INTRODUCTION

1.1. Biodiversity Surveys in the Context of REDD

This report details the results of surveys that were carried out in November 2010⁵ to provide information on the biodiversity of a proposed REDD project site. REDD (Reducing Emissions from Deforestation and Degradation) is a global climate change initiative under which developed countries and private companies are encouraged to provide payments to compensate developing nations for forests that are sustainably managed. REDD is a new approach to climate mitigation, which gives greater recognition to the importance of protecting and sustainably managing tropical forest resources in developing countries (Anon. 2009). It is estimated that around one fifth of global Carbon-dioxide emissions originate from the loss of forests associated with land use and land cover changes. Currently, these payments are only available through voluntary emissions reduction markets, but after 2012, it is anticipated that a post-Kyoto agreement may see the inclusion of a REDD mechanism in the official Clean Development Mechanism (CDM) market as well.

In order to sell carbon credits on the market and thereby achieve the objectives of the REDD scheme, the project will be validated by the Climate, Community and Biodiversity Alliance (CCBA). As part of this process, biodiversity surveys are required to demonstrate the presence or absence of HCVs such as globally threatened species and to establish the likely comparative effects of the with or “without project” scenario. In addition, the surveys provide a starting point from which it should be possible to establish a biodiversity monitoring plan to assess the impacts of REDD activities during the lifetime of the project.

1.2. Project Sites

The REDD Project is located in the Cambodian province of Oddar Meanchey (Figure 1.1 and 1.2). The province is 6,158 km² in size and shares a 224 km border with Thailand, whilst within Cambodia it borders the provinces of Siem Reap, Banteay Meanchey and Preah Vihear.



Figure 1.1. Location of Oddar Meanchey Province

⁵ Appendix 1 outlines the field schedule

1.3. Biodiversity Assessment Objectives

The biodiversity surveys were carried out in order to:

- Provide necessary biodiversity baseline data to satisfy CCBA's requirements for validation with regards to biodiversity assessment and monitoring;
- Identify species and habitats of High Conservation Value for prioritization in future conservation efforts;
- Design a biodiversity monitoring plan for the REDD site for the lifespan of the project (30 years)⁶

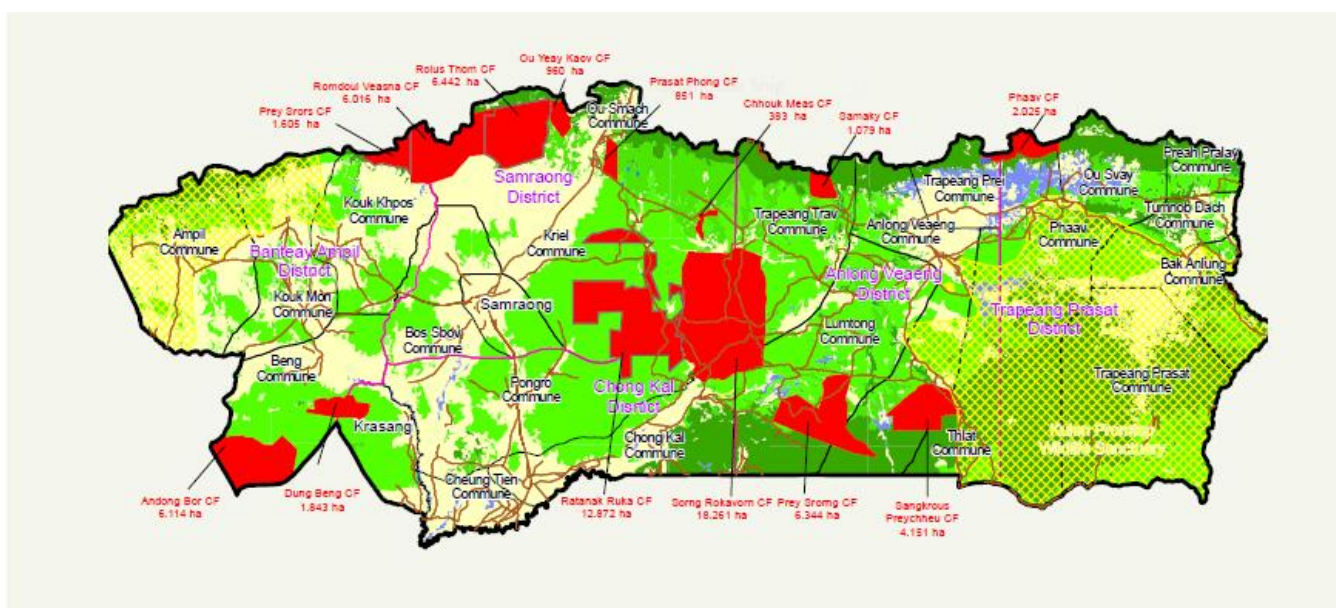


Figure 1.2 Location of the 13 Community Forestry areas that comprise the REDD Project Site in Oddar Meanchey Province. Community Forests are shaded red. Source Bradley (2009).

1.4. Biodiversity Survey Constraints

1.4.1. Landmine risk

The province of Oddar Meanchey was one of the final strongholds of the post-1979 Khmer Rouge army, and was only finally established as a province in 1999 following the capture of senior Khmer Rouge guerillas. In part because of long-standing security concerns, there have been fewer international agencies working in the province than elsewhere in the country, and this is largely due to the localized presence of landmines and other unexploded ordinance (UXO), and in recent years, due to an on-going (but minor) border dispute with Thailand. A 2003 study found that almost 10% of all mine casualties in Cambodia occurred in Oddar Meanchey, whilst a UNICEF survey in the period 1989-2000 in the eastern districts found that 85% of respondents suspected the presence of landmines or UXO in their settlements (Bradley 2009).

⁶ Members of the biodiversity survey team also provided capacity building and field training to relevant personnel on monitoring and analysis techniques

In view of these concerns, the biodiversity survey team visited the main office of the Halo Trust in Siem Reap and its local office in Anlong Veng in an attempt to assess the risk of landmines in the six target Community Forests. After the briefing, the team leader decided that it was inadvisable to undertake field surveys in the two target CFs along the Thai border, namely Rolus Thom and Romdoul Veasna, because of the presence of landmines and on-going tensions along the border. It was also decided that the north-central part of Sorng Rokavorn should be avoided as a large scale mining initiative through the central area and around a former military base was known to have occurred in this area and thus represented an area at high risk of current landmine presence. Although local villagers are aware of mines in these areas they consider them to pose a low risk as they are believed to be mainly anti-tank mines and as such locals regularly walk off trail (even in areas marked as mine fields) in the belief that such mines cannot be detonated by walking over them. Discussions with the Halo Trust indicated, however that it was commonplace for anti-personnel mines to be placed on top of anti-tank mines thus making it possible for them to be detonated by walking over them.

Whilst landmines could also potentially exist in other areas of the REDD site, information from locals suggested that mines were not placed out in these areas and an absence of former military bases would suggest that this information was accurate. Within the majority of CFs surveys concentrated around very well-used tractor tracks and off trail areas indicated as not mined by local informants. In particular, the mine risk in Andong Bor, Sangkrou Preychheu and Prey Srorng was perceived as low, though certain access roads to the surrounding villages (not to the CFs) are known to have been mined.

In view of the real risk of mines in some of the areas, it is strongly recommended that future visitors to these areas seek advice from the HALO Trust, the Cambodian Mine Action Centre (CMAC) and other de-mining organizations before using tracks or conducting any work off-track within any of the CFs. The tracks that the biodiversity team used during the November 2010 surveys are shown in Appendix 2. Whilst these tracks were walked by survey team members, it would be inadvisable to use a tractor along any track within Sorng Rokavorn that has not been de-mined. Tracks that have been de-mined are usually well marked as such in the field with red and white markings on trees.

1.4.2. Length of survey period

Comprehensive biodiversity surveys take a considerable amount of time, particularly in areas with mosaics of different habitats, such as those found in the community forests of Oddar Meanchey. With only thirty days fieldwork (including time to access sites, set up camps etc.), and thirteen Community Forests, it was necessary to decide on a strategy that would maximize the potential to identify the most important threatened wildlife and overall species diversity. The main criteria used to choose the target CFs were size of the community forest area, their geographical position in relation to other areas of forest and existing protected areas, the forest type and the percentage of forest cover. Using these criteria, six CFs were identified as target sites for biodiversity surveys. These areas⁷ were: Andong Bor; Romdoul Veasna; Rolus Thom; Sorng Rokavorn; Prey Srorng and Sangkrou Preychheu. Community interviews focusing on wildlife were conducted at all six CFs.

The habitat within the six CFs was representative of that found across the 13 CFs (Table 1.1). Due to the risk from UXOs in Romdoul Veasna and Rolus Thom, which were heavily mined so that local villagers were not willing to stray from a few well used tracks, surveys in these areas were not conducted. Nevertheless, the four remaining CFs that were surveyed encompassed approximately half the total area of the 13 CFs that comprise the Oddar Meanchey REDD Site (Table 1.1, Figure 1.2,

⁷ Due to mine risks and security concerns two of these target CFs had to be dropped from the list for biodiversity survey work.

Figure 1.3). The coverage of the ground surveys within these four CFs is illustrated by the maps in Appendix 2.

Time and budget limitations placed constraints on the range of fauna that could be effectively sampled. The biodiversity surveys outlined in this report were therefore limited to bird and mammal surveys. These two groups are more easily sampled in short time frames than, for example, the herpetofauna, particularly since there was a perceived mine risk associated with many water bodies and riverine areas and of straying from well marked pathways.

Table 1.1. Habitat types and sizes of the 13 Community Forests in the REDD Site. Sites highlighted in yellow were those where biodiversity surveys were carried out in November 2010. *Source: Anon. 2009.*

Community Forest Group Name		Size (ha)	Evergreen Forest	Mixed/Deciduous Forest	Non-forest
1	Angdong Bor	6,114	0%	97%	3%
2	Chhouk Meas	383	79%	19%	1%
3	Dung Beng	1,843	40%	53%	7%
4	Ou Yeay Kaov	960	91%	0%	9%
5	Phaav	2,025	95%	1%	4%
6	Prey Srorng	6,344	72%	19%	9%
7	Prey Srors	1,605	94%	0%	6%
8	Ratanak Ruka	12,733	4%	90%	5%
9	Rolus Thom	6,443	62%	3%	35%
10	Romdoul Veasna	6,009	59%	1%	40%
11	Samaky	1,079	92%	6%	1%
12	Sangkrou Preychheu	4,151	89%	6%	5%
13	Sorng Rokavorn	18,164	9%	85%	6%
Total/Average		67,853	36%	53%	11%
Biodiversity Survey Area:		34,773			

1.4.3. Timing (seasonality)

During the dry season in Cambodia, as water resources dry up, both mammals and birds dependent on water (including the majority of threatened bird and large mammal species in Cambodia) tend to congregate near permanent water sources. This is the best time to carry out surveys because many animals are relatively easy to find and document. The imposed timing of the Oddar Meanchey biodiversity surveys was therefore not optimal, since the landscape was dotted with non-permanent water resources and wildlife remained somewhat scattered during November, this being the very beginning of the dry season. The late timing of the rains further exacerbated the effect of the early timing of the surveys. In addition, long grass in Dry Deciduous Forest areas made it substantially more difficult to look for mammals and, in some cases due to the potential mine risk, to find safe trails for survey work. The surveys also coincided with the rice harvest which meant that some key informants (ex-hunters, for example) were not available for the village interviews or for assisting with field work.

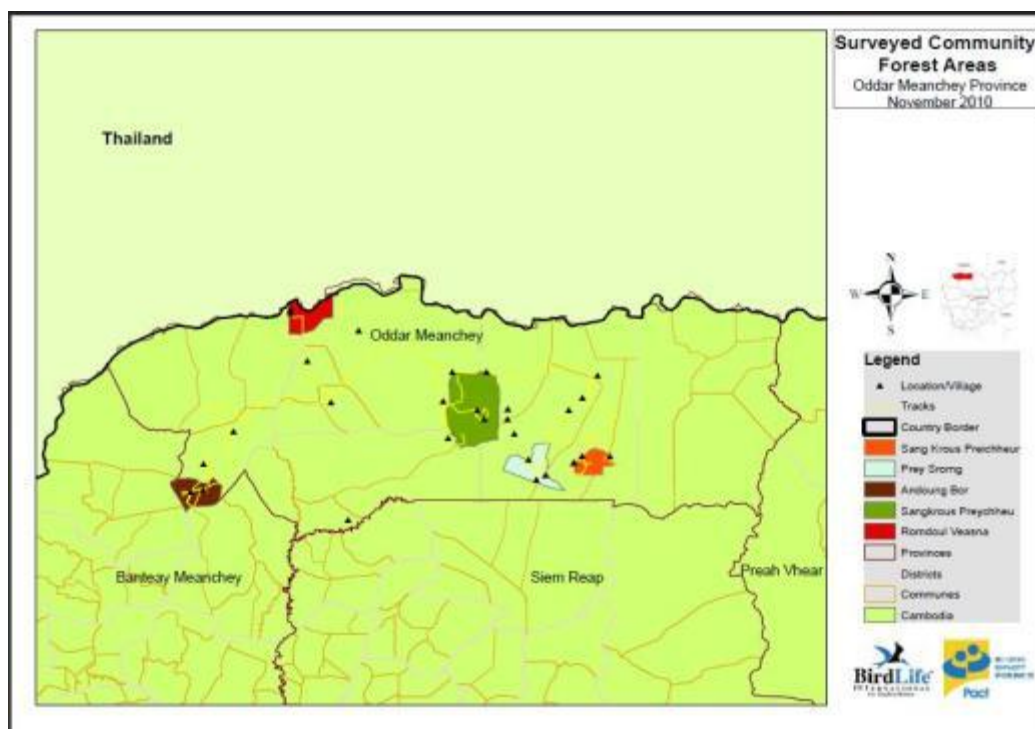


Figure 1.3. Location of the Community Forests that were surveyed in November 2010.



Figure 1.4. Long grass in DDF areas often made it more difficult to undertake biodiversity surveys.

The timing of this survey that specifically impacted the bird surveys was that the majority of bird species were not particularly vocal and not responsive to playback (of their vocalizations) due to seasonality, making it more difficult to detect them. For example, Green Peafowl, which was

observed in one CF and reported to be fairly widespread there, was never heard. Had the surveys been further into the dry season the abundance of such species could have potentially been determined using well-tested methods that rely on vocalizations (e.g. Brickley *et al.* (1998) in the case of Green Peafowl).

1.5. Vegetation Types in the Community Forests

The majority of forests in the plains of the Northern provinces are non-aquatic ecosystems, and Oddar Meanchey Province is no exception, being one of the driest regions of Cambodia: it receives on average only about 1,300 mm of rainfall per year and the dry season lasts for more than four months (Anon. 2009). Classifications of the forest types were taken from the Project Design Document (PDD) (Anon *et al.*, 2009), which were based on the case study by Kim Phat *et al.* (2002). In the study Kim Phat *et al.* (2002) distinguished three predominant forest types on these plains: Deciduous, Mixed/Semi-evergreen, and Evergreen. Deciduous forests contain almost exclusively deciduous tree species (>90%) and are referred to as Deciduous Dipterocarp Forests (DDF) in this report. Mixed forests contain both deciduous and evergreen tree species where deciduous species represent more than 50 % of the stand – this habitat is referred to as Semi-evergreen Forest in this report. Evergreen Forests are dominated by evergreen tree species and often merge into Semi-evergreen Forest. In the field therefore, it is often difficult to distinguish between Semi-evergreen and Evergreen Forest types because Semi-evergreen forests contain 30-70% of evergreen trees, and often appears to be evergreen even during the dry season when many of the deciduous trees lack their leaves.

In the context of the CFs that were surveyed, DDF was dominant in Sorng Rokavorn and Andong Bor, and represented significant portions of some of the areas surveyed in Prey Sorng. In contrast Sangkrou Preycheu and Prey Sorng are dominated by Semi-evergreen and Evergreen Forest, though due to logging much of this habitat is now rather open and heavily disturbed. Within all the CFs visited there was a distinctive habitat mosaic, with Semi-evergreen in some locations and Evergreen forest patches appearing along river courses and areas with the wettest characteristics. Table 1.1 (taken from Anon. 2009) provides estimates of the extent of these forest types in the 13 CFs based on interpretation of satellite images.

Although no study of the vegetation was made by the biodiversity team, Anon. (2009) provided a description of the vegetation and status of habitat in the CFs, produced during the calculation of Carbon stock. The following descriptions are therefore based primarily on Anon (2009):

Semi-evergreen Forest are relatively open, and have low crown covers, only exhibiting a closed canopy structure during the wet season, whilst DDF is even more open and usually has an open canopy structure. The single-tree stratum of these forests generally feature tree diameters of less than 40cm and are relatively species poor, dominated by dipterocarp trees and a few gregarious tree species such as *Lagerstroemia* spp. and *Xylia dolabriformis* as well as numerous scattered associated species such as *Azizium xylocarpus*, *Pterocarpus pedatus*, *Ceibapentandra*, and *Irvingiaoliveri*. Important indigenous tree species include *Albizia lebbek* (locally known as *chres*), *Fagraea fragrans* (ta trao), *Diospyros cruenata*, *Thwaites (cheu kmao)*, *Gardenia ankorensis (dai khala)*, *Dalbergia oliveri*, *Pterocarpus macrocarpus*, *Dipterocarpus tubinatus*, and *Azizium xylocarpa (beng)*, a high-value deciduous, broad-leaved tree. A number of bamboo species are also present in Semi-evergreen Forests.

In the dry season, DDF and to a lesser extent SEF is subject to frequent fires. Although fire is a natural phenomenon in these systems, human intervention has exacerbated the incidence of fire due to the extremely dry conditions during the dry season. Due to fires, the under-story is nearly

always sparse and dominated by grasses. During the wet season and the beginning of the dry season, before any burning has occurred, these grasses are typically 0.5-2m tall (Figure 1.4).

Human impacts, such as degradation from fire, typically occurs with more frequency in DDF compared to other forest types. In contrast to the denser crown closure found in older growth Evergreen Forests, DDF naturally has a very open canopy leaving them more susceptible to drying out and hence more prone to fire. Even in undisturbed DDF, crown cover may only have a 40% closure. Approximately 20% of the forest in the project area is degraded, containing less than 20% canopy closure, especially in areas with DDF. This forest degradation is thought to have occurred mainly over the past 15 years, and has accelerated in the last 5 years. Annual human-caused ground fires contribute to this degradation, as they are common occurrences in the DDF (Anon *et al.*, 2009).

Evergreen Forests in Oddar Meanchey Province are mainly dry-land evergreen forests (in contrast to highland forests or tropical rainforests) and are predominant in the hilly parts of the CFs along the border with Thailand. They are multi-storey forests with more than 80% trees of evergreen species, and a canopy cover of 80-90%. These floristically and structurally heterogeneous forests occur in areas where the rainfall exceeds 1,200 mm per year and the dry season lasts three to five months. In primary Evergreen Forest areas, emergent trees such as *Dipterocarpus alatus*, *Shorea vulgaris*, *Anisoptera cochinchinnensis*, *Tetrameles nudiflora* and figs *Ficus* may exceed 40m high, although such areas are now very rare within the CFs. They possess cylindrical boles up to 20m high and as such some species are much sought after for timber. The diverse continuous tree stratum is between 20-30m high and has no family clearly dominating. *Guttifera*, *Irvingia malayana*, *Sindora cochinchinnensis*, *Pterocarpus pedatus*, and *Pahudia cochinchinensis* are commonly found.

2. METHODS

2.1. Field Survey Period and Scope

Very brief reconnaissance visits to most of the sites were made in June 2010 to facilitate planning for the biodiversity surveys (Carr *et al.* 2010). Subsequently, all of the community interviews and biodiversity field work was carried out during November 2010. Appendix 1 outlines the schedule for interviews and biodiversity field surveys that were carried out in November.

Due to the very limited time available to visit the different sites, it was not possible to conduct surveys that would provide a complete list of birds or mammals occurring within any of the CFs, or to ascertain densities or population sizes for any species in any of the areas. In particular, it needs to be emphasized that threatened species often occur at low densities and can be overlooked on a short survey undertaken at a sub-optimal time of year. It can therefore, be assumed that there are other species of bird and mammal within these CFs that were not recorded during the November 2010 surveys and that any future longer-term survey work in these areas will likely add to the site-specific species lists. In addition, the long-term monitoring program outlined in this report is anticipated to not only assist in providing verification of the presence of particular species of mammals or, perhaps, large waterbirds, but also to add to the list of species known from the CFs. In this respect, the deployment of digital camera traps within the CFs for monitoring purposes would almost certainly be beneficial to on-going monitoring strategies.

2.2. Interviews at the Community Level

Brief interviews were carried out in June 2010 with community members of the following Community Forests: Andong Bor, Dung Beng, Romdoul Veasna, Ratanak Ruka, Sorng Rokavorn, and Sangkrous Preychheu. In November 2010, additional, more rigorous interviews were conducted in villages close to Andong Bor, Romdoul Veasna, Rolus Thom, Sorng Rokavorn, Sangkrous Preychheu and Prey Srong. Wherever possible, these interviews targeted members of the local community who used the forest regularly, including ex-hunters and in some instances, members of the military.

Interviews were structured and guided by data sheets that were filled in during the interview process. All questions were asked in Khmer by FA⁸ and Pact staff⁹ with guidance from the survey team biologists¹⁰. Appendix 3 provides a sample data sheet used during the interviews.

Since local people do not have binoculars or other field equipment to assist them in seeing birds or distant mammals, and/or a general understanding of the potential for species to occur in a given habitat type, they are often unable to provide conclusive, unambiguous evidence for the occurrence of the majority of species. During interviews there was often confusion amongst hunters as to the correct identification of a bird or mammal species that they had seen. In the case of mammals, those that are traditionally hunted for meat or medicinal use were more likely to be correctly identified and described as they are well-known to the communities. The local names for such species, however, were often inconsistent with those found in Khmer-language field guides and/or additional local names were assigned to the species (e.g. *kjong* locally used for Lesser Mousedeer in addition to

⁸ Touch Phalla and Hort Sothea – senior officers of the Forestry Administration and have 5+ years field experience with a particular emphasis on mammals

⁹ Samnang Khiev – a member of Pact staff with extensive experience of working with the Community Forest Groups of Oddar Meanchey.

¹⁰ Dr. Frank Lambert – Bird specialist of 25+ years; Dr. Vittoria Elliott – Mammal specialist of 10+ years

Kdann nyayn toit). Verification of the species that the participants were referring to, using photographs, was therefore an essential element of the interview process.

In the case of birds, which local people clearly knew very poorly, questions were generally limited to the more conspicuous (larger) species of conservation concern. These included Green Peafowl, Giant Ibis, White-shouldered Ibis, adjutant storks, Bengal Florican, Sarus Crane, White-winged Duck, and vultures.

During the interviews, participants were first asked to provide a list of animals that they knew to occur within the CF using the local name. In some cases they were also asked to describe the features that they used to identify the species to ascertain their level of identification skills and verify the correct name assignment. They were subsequently asked to provide various details about the species (relating to size, colouration, behaviour, habitat, seasonality, etc.) as a means to identify potential or definite misidentifications since behavioral traits can often be diagnostic in distinguishing two similar species. For example, Pig-tailed Macaques spend much time on the forest floor in comparison to similar primate species.

The final part of the interview process was to show the participants a collection of photographs of individual threatened species and, where it was necessary, to show them illustrations of possible confusion species in books such as Suon Phalla (2002), Tan Seta & Poole (2003), Walston (2008), and Robson (2009) to verify their misidentification. For example, White-winged Duck and Comb Duck were usually thought to be the same species when pictures of the latter were also shown. . These photographs were examined and discussed one-by-one and it was during this process that it was usually possible to clarify with certainty which species the villagers had been talking about and to focus discussion on the particular species of interest. At this point additional information with regard to timings and locations of sightings were obtained for the species of interest, in order to inform and direct field surveys.

The interviews generally provided a wealth of information on mammals, but in the case of birds, the information was usually considered tentative at best. Villagers could identify Green Peafowl, a commercially valuable species, but almost no other species. Although sightings of certain species were often claimed it became clear once similar species were considered that they were most likely misidentifications. For example, whilst villagers would indicate that White-winged Duck was present, they then re-identified these birds as being Comb Duck when shown illustrations of these, or even Lesser Whistling Duck, a species that looks and behaves nothing like a White-winged Duck. Claims of White-shouldered Ibis from Sorng Rokavorn almost certainly referred to Woolley-necked Stork.

Despite the various constraints and short-comings of the interview process, the interviews helped the biodiversity team to identify potential species of conservation concern that occurred within the sites, the local names used by the villagers, the likely areas where they were to be found, the frequency and seasonality of observation and the last time that each species had been encountered. The interview process also gathered information on the location of water resources used by animals and areas where animals were considered more likely to be found, and in some cases the extent of various threats to the CFs (e.g. military activities).

2.3. Methods – Birds

2.3.1. Bird species of particular concern

The bird surveys targeted in particular the species of highest conservation concern, these being those considered threatened by IUCN that might potentially occur in the CFs of Oddar Meanchey (Table 2.1); those known to be DDF biome-restricted (Seng Kim Hout *et al.* 2003) because this biome

is under threat; and, particularly in areas dominated by DDF, the assemblage of woodpecker species. The survey team's knowledge of bird distribution and habitat preferences and the geographical features of the area were thus used to form a target list of bird species for the surveys.

Woodpecker diversity was included as a means to compare sites dominated by DDF (the main vegetation at Andong Bor and Sorng Rokavorn and predominant in parts of Prey Srorng) and can potentially be used to evaluate the health of the forest during monitoring activities spanning the next 30 years (i.e. the length of the REDD project). Aside from Great Slaty Woodpecker, some of the sites appeared unlikely to support threatened bird species on a regular basis, so that overall assessment of woodpecker diversity provided an alternative means to evaluate and monitor the richness of the avifauna.

Table 2.1. Threatened bird species occurring in DDF landscapes in Cambodia.

**Migrant visitors. Source: BirdLife International (2010) with modifications.*

Scientific Name	Common Name
Critically Endangered Species	
<i>Thaumatibis gigantean</i>	Giant Ibis
<i>Pseudibis davisoni</i>	White-shouldered Ibis
<i>Sarcogyps calvus</i>	Red-headed Vulture
<i>Gyps bengalensis</i>	White-rumped Vulture
<i>Gyps tenuirostris</i>	Slender-billed Vulture
<i>Houbaropsis bengalensis</i>	Bengal Florican
Endangered Species	
<i>Pavo muticus</i>	Green Peafowl
<i>Cairina scutulata</i>	White-winged Duck
<i>Leptoptilos dubius</i>	Greater Adjutant
<i>Heliopais personatus</i>	Masked Finfoot*
Vulnerable Species	
<i>Leptoptilos javanicus</i>	Lesser Adjutant
<i>Grus antigone</i>	Sarus Crane
<i>Aquila heliaca</i>	Eastern Imperial Eagle
<i>Aquila clanga</i> *	Greater Spotted Eagle
<i>Aquila hastata</i>	Indian Spotted Eagle
<i>Mulleripicus pulverulentus</i>	Great Slaty Woodpecker
<i>Acrocephalus tangorum</i> *	Manchurian Reed Warbler
<i>Emberiza aureola</i> *	Yellow-breasted Bunting
Near-Threatend Species	
<i>Lophura diardi</i>	Siamese Fireback
<i>Ephippiorhynchus asiaticus</i> *	Black-necked Stork
<i>Ichthyophaga humilis</i>	Lesser Fish-eagle
<i>Ichthyophaga ichthyaetus</i>	Grey-headed Fish-eagle
<i>Aegypius monachus</i>	Cinereous Vulture
<i>Polihierax insignis</i>	White-rumped Falcon
<i>Ploceus hypoxanthus</i>	Asian Golden Weaver

Woodpeckers represent the best group in these particular forests for such evaluation because (1) there are at least 13 resident species that occur in DDF and associated habitats – more species than in any other family that occurs, (2) most woodpecker species are probably fairly specialized in their feeding or breeding requirements, (3) woodpeckers are relatively conspicuous and relatively easy to identify by voice alone and in many instances respond to playback (and hence can be potentially found by “trawling” with playback of their song), and (4) several of the more conspicuous species have unusually distinctive and far-carrying voices (including the one threatened woodpecker species – Great Slaty Woodpecker) and therefore represent ideal species for a monitoring program that local villagers could carry out without the need for expensive or delicate equipment such as binoculars. In addition one species, Black-headed Woodpecker is biome-restricted, being found only in DDF and occasionally in pine savannas (R. Timmins *in litt.* 2010). In Cambodia, Great Slaty Woodpecker also appears to favour this habitat among others.

2.3.2. Bird surveys: general records

Birds were generally observed using Swarovski 10x42 and Leica 8x20 binoculars and occasionally these were supplemented with a Swarovski 25-50 x 65mm telescope (Figure 1.4). Locations of all sightings of key species and tracks that were followed were recorded using a hand-held Lowrance iFinder H2OC and a Garmin GPSmap 60CSx. Bird vocalizations were recorded using a digital Edirol R-09 recorder combined with a Sennheiser ME66 microphone. Vocalizations that were used to assist in identification or in playback were obtained from a number of sources but most notably from the Xeno-canto website <http://www.xeno-canto.org/asia>. When necessary, Robson (2009) was used as a reference for bird identification.



Figure 2.1. Male White-rumped Falcon, a near-Threatened species confined to DDF that is often most easily found by “trawling” (photo Hugh Wright). This species was recorded in 3 CFs: Sorn Rokavorn, Prey Srorng and AndongBor.

In addition to the transect counts described below, birds were surveyed by opportunistic observation and identification of their vocalizations whenever unknown calls or songs were heard. Occasional nocturnal forays were also made. In general, trails within the CF boundaries were walked slowly and deliberately, with frequent stops to observe mixed feeding flocks or to monitor birds

feeding at fruiting trees. During the heat of the day, efforts were made to find soaring birds such as large waterbirds and raptors. In addition to the potential for landmines, tall grasses in some areas of DDF limited the potential for following birds off-trail. Playback of voice recordings was used to try to attract and therefore identify the occasional species for which the voice was unknown to the bird survey team. Voice recordings were also made as a means to document the presence of particular birds at specific sites. Recordings of the vocalizations of a few target species were occasionally used as an aid to finding them, such as White-rumped Falcon (Figure 2.1), Streak-throated Woodpecker and Rufous-bellied Woodpecker, by “trawling” – the random use of playback in suitable habitats. Recordings of unknown vocalizations were also made, in order to potentially identify the species, by subsequent comparison with known vocalizations.

2.3.3. Bird surveys – timed transects

At each of the four CFs where birds were surveyed, three different transects were walked within the CF boundaries in representative habitat types. Usually the mammal survey team would deploy on a different trail during the bird transect walks to reduce the incidence of disturbance. Birds were surveyed along existing main (tractor) trails starting just after dawn and lasted until bird activity became notably subdued, usually around or after 9am. This was largely dependent on cloud cover with birds becoming less evident earlier on cloudless days than on cloudy ones. Transect start and finish times, GPS coordinates and route data were recorded in order to calculate the transect length and total time. During transects, all birds seen or heard were documented, including the number of individuals in a particular group (for gregarious species), where possible (Appendix 4). For heard only records, the number of individuals remains unknown; but in the case of gregarious species this would usually be expected to be more than one.

Transect time and length varied for a variety of reasons, including the period of time spent studying any mixed flocks that were encountered, the time spent identifying birds seen, the occasional use of playback and occasional disturbance from passers-by. The transect length and total time of transect were therefore used to calculate the encounter rates for the species of particular interest. For gregarious species, encounter rate refers to the number of groups encountered, not the number of individuals. For non-gregarious species, the assumption was made that any heard-only record refers to one individual.

Based on the transect data and general bird survey data, a bird list was compiled for each CF surveyed (Table 3.1). Whilst absolute abundance could not be determined using the survey methods employed, due to a lack of time which precluded the collection of sufficient data, an attempt was made to provide an estimate of relative abundance of a particular species at a particular site by using a scoring system. In Table 3.1, for each bird species, a score has been assigned to indicate the likelihood of a particular species being detected by a competent observer (by voice or sight) in a single day (score 1), in two days (score 2) or in more than two days (score 3) at the same time of year (November/ towards the end of the rainy season) and in the appropriate habitat type. Hence species with a score of 1 are more abundant (or at least more conspicuous) and should be detected within a day of survey work by a competent observer, but a bird with score 3 might potentially take 3 or more days to detect (such species were those that were detected only once during the survey period). Note that since a significant proportion of birds present at the sites are winter visitors; these species would not be detected at all outside of the normal wintering or migration period: most migrants would be absent from May-August, but this varies with species, some of which may not arrive before October and some of which may leave in March or April.

The encounter rates that were calculated from the transect data for a selection of bird species are very provisional since they are based on only three transects at each site, but the rates could inform

a future high-budget monitoring system implemented by professional biologists. In order for these encounter rates to form the basis of a long-term monitoring strategy it will be necessary to build on this data set by undertaking additional, longer-term surveys which may provide either more robust encounter rates, or population density estimates for key species, and to more clearly identify, map and mark the most appropriate transect locations. Encounter rates are shown in Appendix 4c.

2.4. Methods - Mammals

Mammals were surveyed by direct observations and sign surveys and through interviews in four Community Forest sites. Surveys for signs of animal presence were conducted both during the day and at night during forest walks along trails and adjacent to water sources. Direct observations, faeces, tracks and other signs of animal presence were recorded. Where possible samples of faeces and photographs of tracks were taken and conserved for potential subsequent confirmatory analysis. Due to the time limitations for the surveys, attempts were made to maximize collation of evidence of the important mammal species. Survey effort was therefore directed according to likelihood of incidence in the CFs based on information obtained from a variety of sources that indicated their habitat preferences and expected distributions, and according to local information.

Initial attempts to accumulate a relative rate of encounter were abandoned as the time available for surveys, number of observations and the targeted survey structure meant that any rate obtained would be meaningless for all but Northern Red Muntjac, Eurasian Wild Pig and Burmese Hare, which are of less conservation concern.

2.4.1 Map information

Satellite imagery and map information provided by Pact, which incorporated JICA information of road and waterways and the results from a community mapping exercise that identified water sources and areas of wild animal sightings, was examined before the survey. This helped to determine the locations of sites with greatest promise and to inform surveys from the outset. The main process of site selection relied on studying these maps, which included the details of the identifiable habitat types (based on both the carbon ground-truthed sites and informed by the local mapping exercise) and identification of the principal areas of human activity, including villages, cultivation, roads, cart tracks and paths.

2.4.2. Survey strategy

Due to the time limitations, it was necessary to impose some level of triage during the process of site selection, which resulted in six sites being initially selected for surveys. A strategy that attempted to maximize the chances of obtaining information on the most important mammal species was also implemented. As such, surveys were focused on those species of conservation concern that were considered most likely to be present in the community forests based on previous evidence and habitat preferences. Surveys also targeted water sources, which are more likely to provide evidence of species, and salt licks.

Whilst efforts were made to collect data systematically it is not possible to quantitatively assess differences in species abundance based on the methods employed and a relative rate of encounter was used to establish a basic understanding of comparative levels of animal presence across the CFs. Presence of the more abundant, less important species (e.g. Eurasian Wild Pig) was recorded when encountered but no attempt was made to quantify their abundance as the survey design did not allow for this. Although visits were made to five of the CFs only four were considered to have been surveyed. A one half day visit was made to Romdoul Veasna CF as this was a pre-selected site for

survey. It was selected as a site for survey as it represented a potentially different habitat, however, it was subsequently discovered that only one pathway was deemed as 'safe' from unexploded ordinances. At least three survey days were spent in each of the other four sites (Andong Bor, Sangkrous Preychheu, Prey Srong and Srong Rokavorn). Attempts were made to survey all relevant target areas within each of the CFs (i.e. substantial water sources and/or areas of reported high animal presence). However, this coverage was not possible in Srong Rokavorn due to the risk from unexploded ordinances, particularly through the central region of the site. Time and effort in the four community forest sites surveyed is reported in Appendix 5.

An extension of the targeted species approach included the adoption of a strategy that maximized the encounter rate by taking into account the forest type within each of the four sites surveyed. Surveys were therefore targeted towards the large ungulates in the mainly open DDF of Andong Bor and Srong Rokavorn, whereas surveys were targeted to maximize encounter of the important primate species in the Semi-evergreen and Evergreen Forests of Sangkrous Preychheu and Prey Srong.

Interviews were carried out with six community forest committees and respective local former hunters. Where possible, interviews were conducted prior to field surveys to identify potential areas to target. The subsequent field surveys focused in the areas identified through the interviews as providing a high potential for mammal sightings. In particular, areas where knowledgeable interviewees reported recent sightings of bovids, large deer, bear or large cats; or identified as 'resting' sites, or having high mammal density either through description as such or through repeated designation of an area, were targeted for field surveys. Interviews were conducted according to the following format: knowledgeable members of the local villages who had recently visited the forest and former hunters were asked to name animal species that they were aware of being *recently* present in the community forests, as a result of direct observations, track, vocalizations or other indicators of their presence. Emphasis was placed on recent records and attempts were made to obtain month and year information for all reports. Verification of species names was subsequently carried out using picture cards at which point details regarding temporal and geographic information were also sought.

During field surveys, evidence of important mammal species such as large cats, large deer, wild cattle, pangolin, bears and wild dogs was recorded systematically for all encounters. In order to provide a general overview of mammal presence within the CFs, evidence of, Eurasian Wild Pig, mouse deer, Leopard Cat, civet and small mammal species presence was recorded; instead of individual records, however, an assessment of general distribution and abundance was made based on a relative likelihood of encounter according to the quantity of signs observed in each of the CFs.

Following accepted practices, all track and other signs found are considered to be provisional records, however, they were identified to their most likely species of origin based on diagnostic features of the track and faeces including size, morphology, shape and character (see Timmins *et al.* 2003 and Owens 2009 for discussion)

2.4.3. Camera-trapping

At each of the CF's surveyed, between three and five film-loaded, flash camera-traps were placed out for one or two nights at locations informed by the sign searches to represent potential for capture. The limited time spent at each of the CFs, the logistic difficulties of moving between several sites within a limited time-frame, in addition to the risk of theft with leaving camera-traps unattended meant that it was not possible to utilize the camera-traps to their full potential and therefore the expected success rate was not high.

2.4.4 Expected globally threatened focal species

The following globally threatened species are key species that were thought to be potentially present within the project area and therefore formed the basis of focused surveys.

Sambar *Rusa unicolor* (Vulnerable) and **Eld's Deer** *Rucervus eldii* (Vulnerable)

Eld's Deer are known to be associated with DDF including the lowlands of northern Cambodia (Timmins & Duckworth 2008). Recent records demonstrate their continued presence in the Ang Trapeang Thmor Conservation Area to the north of Banteay Meanchey (Owens, 2009), just south of the Community forest of Andong Bor and in the Kulen Promtep Wildlife Sanctuary in Preah Vihear, just south east of Sangkrou Preycheuu.

Sambar are associated with various habitats across their range, including areas with high level of human disturbance in some parts of Southeast Asia. Sambar have been recorded from several locations within Cambodia, although their numbers appear to be limited in some areas that would otherwise be expected to sustain healthy numbers, potentially as a result of targeted hunting. The project area includes suitable habitat and if hunting pressures have been avoided due to low human populations in the area since the Khmer Rouge occupancy, there is potential for the CFs to maintain an important population of this species.

Banteng *Bos javanicus* (Endangered)

Banteng have previously been reported from the open DDF of Sorng Rokavorn (Chamnan 2004), with more recent evidence being produced during the reconnaissance visits in June 2010 (Carr *et al.* 2010) of the confiscation of a kill in the Kork Kdann region of the CF.



Figure 2.2. Banteng killed and confiscated from hunters in Sorng Rokavorn, 2008 (Bun Saluth)

Banteng are found in a variety of habitat types but like many large ungulates are restricted in their distribution by the requirement for access to permanent water sources. They are known to visit mineral sources, such as salt licks, which provided a focus for survey efforts. Although historically

herds would be substantial, due to recent and persistent hunting pressures, the majority of current Banteng populations persist in small isolated populations with the exception of the eastern plains of Cambodia. Once found throughout much of Southeast Asia their distribution has diminished, also as a result of over-exploitation, such that small remnant groups are becoming increasingly important for the global survival of the species.

Northern Pig-tailed Macaque *Macaca leonina* (Vulnerable)

The Northern Pig-tailed Macaque is found in Semi-evergreen Forest habitat from Bangladesh to Indochina. Although listed as globally Vulnerable due to persecution in other parts of its range, populations of this species are fairly stable within Cambodia (Boonratana *et al.*, 2008). Nevertheless, it is anticipated that increased habitat loss and hunting will inevitably exert pressure on this species at some point in the future. Its preference for Semi-evergreen Forest and fairly common status suggest that it is a species of global importance that has a high likelihood of being present within the project area.

Pileated Gibbon *Hylobates pileatus* (Endangered)

Pileated Gibbons is restricted in its range to western Cambodia, Laos and Thailand, and is generally found in seasonal evergreen and mixed deciduous-evergreen forests (Brockelman *et al.*, 2008). Several of the CF sites targeted for survey therefore represent potential locations of expected presence of this globally Endangered species.

Dhole *Cuon alpinus* (Vulnerable)

The current distribution of Dhole within Indochina (Durbin *et al.* 2008) would suggest potential for their presence within the Oddar Meanchey project site. Dhole range is not generally limited by habitat preferences or vegetation but by prey availability and access to water; as a result, historically their distribution was extensive throughout the Asian continent with remnant populations continuing to be present throughout. However, due to high levels of persecution, low prey availability and incidental by-catch in snares, particularly in Indochina, Dhole now occur at reduced density in fragmented populations across many parts of its current range (Durbin *et al.* 2008). Given their current status as Endangered, even a small fragmented population of Dhole within the project site could represent an important record.

Although there is low likelihood of finding large packs of Dhole in Oddar Meanchey, given their expected distribution and habitat preferences it is possible that Dhole could be present at low numbers within the larger CFs, provided there is sufficient prey availability and water sources. The reported low 'pack' sizes of Dhole (1-2 animals), in Cambodia (T. Evans *in litt.* 2010) would suggest that it may be possible to sustain a Dhole 'pack' with smaller sized and reduced prey availability than would be expected for their usual reported pack size of 5 to 12 individuals, which would require larger more frequently available prey items.

Sunda Pangolin *Manis javanica* (Endangered)

The Sunda Pangolin has a fairly wide distribution across much of mainland Southeast Asia and the northern islands of the archipelago. Although historically common throughout its range, recent and persistent hunting has caused a rapid decline in its numbers. The recent increase in trade in this species and the proximity of the Thai border, where much of the wildlife trade from Cambodia is lost, suggests that the species may be present at low numbers in the survey area.

Sun Bear *Helarctos malayanus* (Vulnerable) and Asiatic Black Bear *Ursus thibetanus* (Vulnerable)

Both bear species have a distribution that includes Cambodia with evidence of both species being found from nearby provinces suggesting that there is potential for both to be found within the project site.

Tiger *Panthera tigris* (Endangered)

The Tiger is a globally threatened species of conservation interest. , The most recent confirmed records of Tiger in Cambodia are from a camera-trap photograph taken in 2007. Although unlikely to be present, the forest type and prey potential of the project area are consistent with the potential presence of Tiger and therefore surveys did not exclude it as a potential focal species.

2.4.5 Survey areas and level of effort

Four community forest areas were surveyed for signs of mammals for between three and five days. Interviews with former hunters were also conducted at all four sites and two additional sites (Romdoul Veasna and Rolus Thom) near the Thai border where it was not possible to carry out systematic surveys for signs due to the level of threat posed by unexploded ordnance in the area. At one of the interview sites (Romdoul Veasna) following interviews with the local village and military, the field team was accompanied by the military to conduct a 'snap-shot' survey along the path to the border post in order to obtain an indication of the habitat and potential for animal presence. Reports suggested that the area was, however, heavily logged and hunted; see results section.

3. RESULTS and DISCUSSION

3.1. Bird Diversity

Table 3.1 lists all the bird species that were recorded during surveys within the four CFs, which represent confirmed observations. An additional three species (Asian Openbill, Woolley-necked Stork and a Vulture species) that were reliably reported by local people to be present but were not observed during surveys in any of the CFs, are also indicated by square brackets [] in the table. The list for Romdoul Veasna only relates to walking a single trail within the CF on one morning (map in Appendix 2) and is hence very provisional. For species listed by local people, only Green Peafowl records are considered to be completely reliable because this is a conspicuous, easily identifiable bird of commercial importance and hence likely to be correctly identified. Other bird species listed on the basis of information from local people were only included in Table 3.1 when the locals provided credible descriptions of the species and their habits and correctly identified the species from illustrations.

Altogether, the survey recorded a total of 174 bird species in the CFs visited (including three stork species that were credibly reported during interviews only) with the largest number of species (110) being recorded in Sorng Rokavorn. As anticipated, the CFs supported important communities of woodpeckers as well as good populations of passerine migrants (Table 3.2). Indeed, 15% of the bird species recorded within the CF boundaries were migrant species, of which 22 species were passerines (12.8% of the species total). It is likely that with additional effort, more migrant species would have been detected in some of the areas that were surveyed. More species of woodpecker and passerine migrant were encountered in the largest CF, Sorng Rokavorn, than in any other, although more time was spent in this particular CF.



Figure 3.1. Lesser Adjutant Storks (with a Woolley-necked Stork) in northern Cambodia (Jonathan C. Eames)

Table 3.1. Birds observed or reliably reported to occur within Community Forests that were surveyed showing habitats in which they were found

Species occurring only as winter visitors or on migration are denoted by a superscript ¹ e. Species with resident & migrant populations are marked with ²
 1 - expected to see on a single days survey in appropriate habitats; 2 - expected to see within a 2 day survey in appropriate habitats; 3 – expected to be seen in a 3 or more day, seen once only in 3 days by survey team

[] - reported to be present at times by local people but not encountered by field team. [s] = seasonally present. V - observed during short visit

IUCN Red List: nTh - near Threatened; V - Vulnerable; EN - Endangered. CITES - II = Appendix II

Habitat Types (found in during surveys) - DDF - Deciduous Dipterocarp; SEF - Semi-Evergreen Forest; EF - Evergreen Forest; * - near water

Bird Species Present within Community Forest Areas			Red List Category	CITES Appendix	Habitat Type	Andong Bor	Sangkrou Preychheu	Prey Srorn	Sorng Rokavorn	Romdoul Veasna
Total Area of CF (ha):						6,114	4,151	6,344	18,164	6,009
English Name	Scientific Name	Khmer name								
Phasianidae										
Chinese Francolin	<i>Francolinus pintadeanus</i>	ទា			DDF	1	3	[]	2	
Scaly-breasted Partridge	<i>Arborophila charltonii</i>	ទាជើងបៃតង			EF		3	3		V
Red Junglefowl	<i>Gallus gallus</i>	មាន់ព្រៃ			EF-SEF	2	2	2	2	
Siamese Fireback	<i>Lophura diardi</i>	ស្តេចក្នុងព័ត	nTh	II	EF		2	3		
Green Peafowl	<i>Pavo muticus</i>	ក្រោក	EN	II	DDF-SEF*		[s]		3	[]
Ciconiidae										
Painted Stork	<i>Mycteria leucocephala</i>	រនាសពណ៌				[?]				
Asian Openbill	<i>Anastomus oscitans</i>	ចង្កៀសខ្នង							[]	
Woolly-necked Stork	<i>Ciconia episcopus</i>	សត្វកស ឬត្រី						[]	[]	
Black-necked Stork	<i>Ephippiorhynchus asiaticus</i>	អង្កត់ខ្មៅ	nTh		DDF*				3	
Lesser Adjutant	<i>Leptoptilos javanicus</i>	ត្រីដក់តូច	VU		DDF-SEF*		3		3	
Greater Adjutant	<i>Leptoptilos dubius</i>	ត្រីដក់ធំ	EN		DDF-SEF*			3	[]	
Ardeidae										
Javan Pond Heron	<i>Ardeola speciosa</i>	កុកក្រកក្បាលឆ្មោតខ្ចី			SEF*			3	2	

Bird Species Present within Community Forest Areas			Red List Category	CITES Appendix	Habitat Type	Andong Bor	Sangkrou Preychheu	Prey Srorn	Sorng Rokavorn	Romdoul Veasna
Falconidae			nTh	II	DDF	2		2	2	
White-rumped Falcon	<i>Polihierax insignis</i>	ស្វាំងស្លាបស្រួចចុងខ្នងស								
Collared Falconet	<i>Microhierax caerulescens</i>	ស្វាំងតូចស្លាបស្រួច		II	DDF				1	
Accipitridae										
Jerdon's Baza	<i>Aviceda jerdoni</i>	ស្វាំងត្នោតស្លាបដែកកំប៉ោយ		II	EF					v
Black Baza ²	<i>Aviceda leuphotes</i>	ស្វាំងខ្មៅ-សស្លាបដែក		II	DDF			2		
Oriental Honey Buzzard	<i>Pernis ptilorhynchus</i>	រអាតឃ្មុំ		II	EF				3	v
Gyps Vulture	<i>Gyps sp.</i>	ត្នាត		II					[]	
Crested Serpent Eagle	<i>Spilornis cheela</i>	អកពស់ព្រៃ		II	DDF-SEF	3			1	v
Crested Goshawk	<i>Accipiter trivirgatus</i>	ស្វាំងស្លាបដែកកំប៉ោយខ្លី		II	DDF-SEF	3			2	v
Shikra	<i>Accipiter badius</i>	ស្វាំងស្លាបដែក		II	DDF-SEF		3	3	3	
Rufous-winged Buzzard	<i>Butastur liventer</i>	រអាតត្នោត		II	DDF	3		3	1	
Grey-faced Buzzard ¹	<i>Butastur indicus</i>	រអាតត្រចៀកប្រផេះ		II	DDF	3				
Rufous-bellied Hawk-Eagle	<i>Hieraaetus kienerii</i>	ស្វាំងពោះត្នោត		II	DDF	3				
Changeable Hawk-Eagle	<i>Spizaetus cirrhatus</i>	អកព្រៃច្រើនពណ៌		II	DDF-EF		2	2	2	
Turnicidae										
Barred Buttonquail	<i>Turnix suscitator</i>	ក្រូចអ៊ុត			DDF				3	
Charadriidae										
Red-wattled Lapwing	<i>Vanellus indicus</i>	ត្រងើវិចទូល			DDF	2			3	
Scolopacidae										
Green Sandpiper ¹	<i>Tringa ochropus</i>	ទឹកលីតស្លាបក្រោមត្នោតចាស់			DDF*				3	
Glareolidae										
Oriental Pratincole ¹	<i>Glareola maldivarum</i>	ទន្រ្ទីតធំ			DDF			3		
Columbidae										

Bird Species Present within Community Forest Areas			Red List Category	CITES Appendix	Habitat Type	Andong Bor	Sangkrou Preychheu	Prey Srorn	Sorng Rokavorn	Romdoul Veasna
Red Turtle Dove	<i>Streptopelia tranquebarica</i>	សណក់ទ្រាំង			DDF	1		3	3	
Spotted Dove	<i>Streptopelia chinensis</i>	សណក់បាយ			DDF-SEF	1	1	1	1	✓
Emerald Dove	<i>Chalcophaps indica</i>	សណក់ស្លាបបៃតង			SEF		3			
Zebra Dove	<i>Geopelia striata</i>	សណក់តូច			DDF				2	
Orange-breasted Green Pigeon	<i>Treron bicinctus</i>	ពពួលក្បាលបៃតង			DDF				3	
Thick-billed Green Pigeon	<i>Treron curvirostra</i>	ពពួលចំពុះធំលឿង			DDF-EV		1	1		✓
Yellow-legged Green Pigeon	<i>Treron phoenicopterus</i>	ពពួលជើងលឿង			DDF	3			3	
Green Imperial Pigeon	<i>Ducula aenea</i>	ព្រាបព្រៃ			DDF-EF		1		2	
Psittacidae										
Vernal Hanging Parrot	<i>Loriculus vernalis</i>	សេកក្រិច		II	DDF-SEF		2	2	1	✓
Blossom-headed Parakeet	<i>Psittacula roseate</i>	សេកអ្នាត់		II	DDF	1	2	1	1	
Red-breasted Parakeet	<i>Psittacula alexandri</i>	សេកសក់		II	DDF-SEF	1	1	1	1	✓
Cuculidae										
Banded Bay Cuckoo	<i>Cacomantis sonneratii</i>	តាវ៉ាខ្លួនអង្គុន់ត្នោត			SEF				3	
Violet Cuckoo	<i>Chrysococcyx xanthorhynchus</i>	តាវ៉ាស្វាយ			EF					✓
Green-billed Malkoha	<i>Rhopodytes tristis</i>	តុកកាតូ			DDF-SEF		2	2	2	✓
Greater Coucal	<i>Centropus sinensis</i>	លូតធំ			DDF-SEF	2	2	3	1	✓
Strigidae										
Collared Scops Owl	<i>Otus bakkamoena</i>	ឪឡឡឹក		II	SEF-EF	2	2	2	3	
Brown Fish Owl	<i>Ketupa zeylonensis</i>	ឪទុយត្រីថ្នាសត្នោត		II	DDF				3	
Brown Wood Owl	<i>Strix leptogrammica</i>	ម្សៅធំគូក		II	SEF-EF		3	2	2	
Collared Owlet	<i>Glaucidium brodiei</i>	ម្សៅតូចភ្នែកបួន		II	DDF			1		
Asian Barred Owlet	<i>Glaucidium cuculoides</i>	ម្សៅតូចព្រៃ		II	DDF	2	2	1	1	✓
Brown Hawk-Owl ²	<i>Ninox scutulata</i>	ម្សៅមន្ទីរ		II	DDF-SEF		2		2	

Bird Species Present within Community Forest Areas			Red List Category	CITES Appendix	Habitat Type	Andong Bor	Sangkrou Preychheu	Prey Srorn	Sorng Rokavorn	Romdoul Veasna
Caprimulgidae										
Great Eared Nightjar	<i>Eurostopodus macrotis</i>	ពពួកកំធំ			DDF				2	
Large-tailed Nightjar	<i>Caprimulgus macrurus</i>	ពពួកកំធំ			DDF	3	2	3		
Apodidae										
Brown-backed Needletail	<i>Hirundapus giganteus</i>	ត្រចៀកកំធំខ្នងត្នោត			SEF-EF		3	3		
Asian Palm Swift	<i>Cypsiurus balasiensis</i>	ត្រចៀកកំដើមត្នោត			DDF				3	
Hemiprocidae										
Crested Treeswift	<i>Hemiprocne coronata</i>	ត្រចៀកកំព្រៃ			DDF	1		2	1	
Trogonidae										
Orange-breasted Trogon	<i>Harpactes oreskios</i>	ចាបច្រៀបពោះលឿង			SEF-EF		1	1		
Coraciidae										
Indian Roller	<i>Coracias benghalensis</i>	ឡឺវខៀវ			DDF	1	2	1	1	v
Alcedinidae										
Banded Kingfisher	<i>Lacedo pulchella</i>	កងប្រៃ			SEF-EF		2	2		
Common Kingfisher	<i>Alcedo atthis</i>	ចមាតត្រីម			SEF-EF*		3		2	
Meropidae										
Blue-bearded Bee-eater	<i>Nyctyornis athertoni</i>	ត្រងេវព្រៃ			EF		3			
Green Bee-eater	<i>Merops orientalis</i>	ត្រងេវតូច			DDF				3	
Chestnut-headed Bee-eater	<i>Merops leschenaultia</i>	ត្រងេវក្បាលត្នោតខ្ចី			DDF			3	2	
Upupidae										
Common Hoopoe	<i>Upupa epops</i>	បាតូ			DDF	3		3	3	
Bucerotidae										
Oriental Pied Hornbill	<i>Anthraceroceros albirostris</i>	កេងកងតូច		II	DDF-EF	3	1	1	1	
Ramphastidae										

Bird Species Present within Community Forest Areas			Red List Category	CITES Appendix	Habitat Type	Andong Bor	Sangkrou Preychheu	Prey Sorn	Sorng Rokavorn	Romdoul Veasna
Lineated Barbet	<i>Megalaima lineate</i>	ប៉េលេតាកក្បាលត្រែត			DDF-SEF	2	1	1	1	✓
Green-eared Barbet	<i>Megalaima faiostricta</i>	ប៉េលេតាកត្រឡប់ក្រហម			DEF-EF	2	3	1	3	✓
Blue-eared Barbet	<i>Megalaima australis</i>	ប៉េលេតាកថ្លាសខ្មៅ			EF		3	2		
Picidae										
Rufous-bellied Woodpecker	<i>Hypopicus hyperythrus</i>	ត្រសេះពោះត្នោត			DDF				3	
Grey-capped Pygmy Woodpecker	<i>Dendrocopos canicapillus</i>	ត្រសេះតូចខ្មៅស			DDF	1	2	2	1	
Fulvous-breasted Woodpecker	<i>Dendrocopos macei</i>	ត្រសេះមឡូមខ្មៅស			DDF	1				
White-bellied Woodpecker	<i>Dryocopus javensis</i>	ត្រសេះពោះស			DDF-EF	1	2	3	2	
Lesser Yellow-naped Woodpecker	<i>Picus chlorolophus</i>	ត្រសេះតូចកំប៉ោយលឿង			SEF-EF	2	2			
Greater Yellow-naped Woodpecker	<i>Picus flavinucha</i>	ត្រសេះធំកំប៉ោយលឿង			DDF-EF		3	3	2	
Laced Woodpecker	<i>Picus vittatus</i>	ត្រសេះតូចក្បាលក្រហម			EF		1		?	✓
Streak-throated Woodpecker	<i>Picus xanthopygaeus</i>	ត្រសេះបៃតងទ្រូងពណ៌ក្រហម			DDF	2			3	
Black-headed Woodpecker	<i>Picus erythropygius</i>	ត្រសេះបៃតងក្បាលខ្មៅ			DDF	2	2	1	1	
Grey-headed Woodpecker	<i>Picus canus</i>	ត្រសេះបៃតងក្បាលប្រផេះ			DDF-SEF			3	3	
Common Flameback	<i>Dinopium javanense</i>	ត្រសេះតូចខ្នងក្រហម			DDF-SEF	1	1	1	1	✓
Greater Flameback	<i>Chrysocolaptes lucidus</i>	ត្រសេះធំខ្នងក្រហម			DDF-EF		2	2	2	✓
Heart-spotted Woodpecker	<i>Hemicircus canente</i>	ត្រសេះពពាសបំពង់កស			SEF-EF			3	2	
Great Slaty Woodpecker	<i>Mulleripicus pulverulentus</i>	ត្រសេះដី	VU		DDF-SEF	1	2	2	1	
Eurylaimidae										
Banded Broadbill	<i>Eurylaimus javanicus</i>	សត្វចំពុះធំ			EF		3	2		
Pittidae										
Hooded Pitta	<i>Pitta sordid</i>	ប៉ាក់ខ្មៅវិបន្តក្បាលត្នោត			EF		3			
Genera Incertae sedis										

Bird Species Present within Community Forest Areas			Red List Category	CITES Appendix	Habitat Type	Andong Bor	Sangkrou Preychheu	Prey Srorn	Sorng Rokavorn	Romdoul Veasna
Large Woodshrike	<i>Tephrodornis virgatus</i>	អល់អែកមធូរ			SEF		3			
Common Woodshrike	<i>Tephrodornis pondicerianus</i>	អល់អែកតូច			DDF	1			1	
Aegithinidae										
Common lora	<i>Aegithina tiphia</i>	ចេកចៅស្លាបខ្មៅស			DDF-SEF	2	2	3	3	
Great lora	<i>Aegithina lafresnaye</i>	ចេកចៅស្លាបខ្មៅ			SEF		2	3		
Campephagidae										
Large Cuckoo-shrike	<i>Coracina macei</i>	អល់អែកធំ			DDF-SEF	1	1	2	1	
Indochinese Cuckoo-shrike	<i>Coracina polioptera</i>	អល់អែកសក្រោមកន្ទុយ			SEF		3		3	
Rosy Minivet ¹	<i>Pericrocotus roseus</i>	ចេកទេសកុលាប			DDF				3	
Swinhoe's Minivet	<i>Pericrocotus cantonensis</i>	ចេកទេសផ្កាឈូក			DDF				?	
Ashy Minivet ¹	<i>Pericrocotus divaricatus</i>	ចេកទេសខ្មៅស			DDF	2	3	2	2	
Small Minivet	<i>Pericrocotus cinnamomeus</i>	ចេកទេសតូច			DDF	1		1	1	v
Scarlet Minivet	<i>Pericrocotus flammeus</i>	ចេកទេសធំ			SEF-EF	2	3	2	3	
Bar-winged Flycatcher-shrike	<i>Hemipus picatus</i>	អល់អែកស្លាបខ្មៅផ្លែឆ័ស			SEF-EF	3	2	1	3	
Laniidae										
Brown Shrike ¹	<i>Lanius cristatus</i>	ចាបដូនតាខ្មៅត្រចៀកខ្មៅ			DDF	3				
Burmese Shrike	<i>Lanius collurioides</i>	ចាបដូនតាខ្មៅត្រចៀកពោស			DDF		3	2		
Oriolidae										
Black-naped Oriole ²	<i>Oriolus chinensis</i>	ចេកទុំ			SEF-EF		1	1	3	v
Black-hooded Oriole	<i>Oriolus xanthornus</i>	ចេកទុំក្បាលខ្មៅ			DDF	1		2	2	
Dicruridae										
Black Drongo	<i>Dicrurus macrocercus</i>	អន្លេបខ្មៅ			DDF	2			3	v
Ashy Drongo	<i>Dicrurus leucophaeus</i>	អន្លេបប្រផេះ			DDF-SEF	1	1	1	1	v
Bronzed Drongo	<i>Dicrurus aeneus</i>	អន្លេបខ្មៅរលើប			SEF-EF	2	2	2	2	

Bird Species Present within Community Forest Areas			Red List Category	CITES Appendix	Habitat Type	Andong Bor	Sangkrou Preychheu	Prey Srorn	Sorng Rokavorn	Romdoul Veasna
Hair-crested Drongo	<i>Dicrurus hottentottus</i>	អន្ទេបកំប៉ើយខ្សែ			SEF-EF		2	3	2	
Greater Racket-tailed Drongo	<i>Dicrurus paradiseus</i>	អន្ទេបទងកន្ត្រៃ			DDF-SEF	1	1	1	1	v
Rhipiduridae										
White-browed Fantail	<i>Rhipidura aureola</i>	កញ្ចាក់ស្លាចិញ្ចើមស			DDF	1	3	2	2	
Monarchidae										
Black-naped Monarch	<i>Hypothymis azurea</i>	ពពិតបន្ទូលក្បាលខ្មៅ			SEF-EF	1	1	1	3	v
Asian Paradise-flycatcher	<i>Terpsiphone paradisi</i>	ចាបស៊ីរុយខ្នងត្នោត			SEF-EF		2	2		
Corvidae										
Red-billed Blue Magpie	<i>Urocissa erythrorhyncha</i>	ឆ្កែឆ្កែខ្មៅ			SEF			3	?	
Rufous Treepie	<i>Dendrocitta vagabunda</i>	ឆ្កែឆ្កែលឿង			DDF-SEF	3	2	3	2	
Racquet-tailed Treepie	<i>Crypsirina temia</i>	ទ្រមាក់ខ្លា			SEF-EF				2	
Southern Jungle Crow	<i>Corvus macrorhynchos</i>	ក្អែក			DDF-EF					v
Hirundinidae										
Barn Swallow ¹	<i>Hirundo rustica</i>	ត្រចៀកកាំ			DDF*	2	2	2	2	
Alaudidae										
Indochinese Bushlark	<i>Mirafr erythrocephala</i>	ក្រូចអិន			DDF	3		3	3	
Cisticolidae										
Brown Prinia	<i>Prinia polychroa</i>	ចាបដង្កូវធំ			DDF	1		2	1	
Rufescent Prinia	<i>Prinia rufescens</i>	ចាបដង្កូវស្លាបច្រេះ			DDF	1	3	1	1	
Grey-breasted Prinia	<i>Prinia hodgsonii</i>	ចាបដង្កូវទ្រូងប្រផេះ			DDF	1	3	1	2	
Yellow-bellied Prinia	<i>Prinia flaviventris</i>	ចាបដង្កូវលឿង			DDF*				2	
Genera Incertae Sedis										
Dark-necked Tailorbird	<i>Orthotomus atrogularis</i>	ចាបតេតព្រៃ			SEF-EF	2	1	1	2	v
Pycnonotidae										

Bird Species Present within Community Forest Areas			Red List Category	CITES Appendix	Habitat Type	Andong Bor	Sangkroun Preychheu	Prey Sroon	Sorng Rokavorn	Romdoul Veasna
Black-headed Bulbul	<i>Pycnonotus atriceps</i>	ពពិតក្បាលខ្មៅ			SEF-EF				3	
Black-crested Bulbul	<i>Pycnonotus melanicterus</i>	ពពិតក្បាលខ្មៅកំប៉ោយ			SEF-EF	3	1	1	2	✓
Sooty-headed Bulbul	<i>Pycnonotus aurigaster</i>	ពពិតក្បាលខ្មៅចុងខ្នងស			DDF	1			1	
Stripe-throated Bulbul	<i>Pycnonotus finlaysoni</i>	ពពិតពុកមាត់លឿង			SEF-EF		2	2	3	
Streak-eared Bulbul	<i>Pycnonotus blanfordi</i>	ពពិតត្រចៀកត្នោត			DDF-SEF	3	2	2		
Puff-throated Bulbul	<i>Criniger pallidus</i>	ពពិតបំពង់កស្រង្វលឿងចាស់			SEF-EF			3		✓
Sylviidae										
Asian Stubtail ^{1?}	<i>Urosphena squameiceps</i>	ចាបដូនតាកន្ទុយកុត			EF		3			
Lanceolated Warbler ¹	<i>Locustella lanceolata</i>	ចាបដូនតាឆ្មុតចុងខ្នង			DDF	3				
Oriental Reed Warbler ¹	<i>Acrocephalus orientalis</i>	ចាបដូនតា			DDF*				3	
Black-browed Reed Warbler ¹	<i>Acrocephalus bistrigiceps</i>	ចាបដូនតាចិញ្ចើមខ្មៅស			DDF*				2	
Dusky Warbler ¹	<i>Phylloscopus fuscatus</i>	ចាបដូនតាខ្នងត្នោត			SEF*				2	✓
Radde's Warbler ¹	<i>Phylloscopus schwarzi</i>	ចាបដូនតាគំរូបក្រោមកន្ទុយក្រាស់			SEF		3	2	3	
Yellow-browed Warbler ¹	<i>Phylloscopus inornatus</i>	ចាបដូនតាចិញ្ចើមលឿង			DDF	1	1	1	1	✓
Two-barred Greenish Warbler ¹	<i>Phylloscopus plumbeitarsus</i>	ចាបដូនតាស្លាបឆ្មុតពីរ			DDF-EF	1	1	1	3	✓
Pale-legged Leaf Warbler ¹	<i>Phylloscopus tenellipes</i>	ចាបដូនតាក្បាលប្រផេះ			SEF-EF	check	1	1		✓
Eastern Crowned Warbler ¹	<i>Phylloscopus coronatus</i>	ចាបដូនតាឆ្មុតក្បាលលឿងព្រលែត			SEF-EF			3		
Blyth's Leaf Warbler ¹	<i>Phylloscopus reguloides</i>	ចាបដូនតា.....			SEF-EF		3			
Buff-throated Warbler ¹	<i>Phylloscopus subaffinis</i>	ចាបដូនតា.....			DDF/SEF				3	
Timaliidae										
Puff-throated Babbler	<i>Pellorneum ruficeps</i>	ចាបដូនតាបំពង់កប៉ោង			SEF-EF	3	2	1	1	✓
Abbott's Babbler	<i>Malacocincla abbotti</i>	ចាបដូនតាចំពុះធំ			EF		2	2		✓
Scaly-crowned Babbler	<i>Malacopteron cinereum</i>	ចាបដូនតាបន្ទូលក្បាលស្រកា			EF		2			
Striped Tit-Babbler	<i>Macronous gularis</i>	ចាបដូនតាទ្វារស័ព្ទ			SEF-EF	2	1	1	1	✓

Bird Species Present within Community Forest Areas			Red List Category	CITES Appendix	Habitat Type	Andong Bor	Sangkrou Preychheu	Prey Srorn	Sorng Rokavorn	Romdoul Veasna
Chestnut-capped Babbler	<i>Timalia pileata</i>	ចាប់ផ្តើមតាមន្ទូលក្បាលត្នោតខ្ចី			DDF	1		1	1	
White-crested Laughingthrush	<i>Garrulax leucolophus</i>	ចក់រីកកំប៉ោយស			SEF-EF	2	1	1	1	✓
Lesser Necklaced Laughingthrush	<i>Garrulax monileger</i>	ចក់រីកវិល្លៀងខ្មៅ			SEF-EF				?	✓
White-bellied Yuhina	<i>Erpornis zantholeuca</i>	ចាប់ផ្តើមតាកំប៉ោយគូចលឿង			SEF			3		
Zosteropidae										
Oriental White-eye	<i>Zosterops palpebrosus</i>	ចាប់កន្លងភ្នែកស			SEF	3	?sp			
Irenidae										
Asian Fairy-bluebird	<i>Irena puella</i>	ចេកខ្ចីខ្សែវី			SEF-EF		3	3		✓
Sittidae										
Chestnut-bellied Nuthatch	<i>Sitta castanea</i>	ត្រសេះតូចពោះត្នោតខ្ចី			DDF	3		3	3	
Velvet-fronted Nuthatch	<i>Sitta frontalis</i>	ត្រសេះតូចចំពុះក្រហម			SEF	3	2			
Sturnidae										
Hill Myna	<i>Gracula religiosa</i>	សារិកាកែវវង់		II	DDF-EF	?	2		1	
Black-collared Starling	<i>Sturnus nigricollis</i>	ត្រលីងត្រលោង			DDF			3	2	
Muscicapidae										
Siberian Rubythroat ¹	<i>Luscinia calliope</i>	ចាប់វាលស្រែកក្រហម			DDF			3	3	
Siberian Blue Robin ¹	<i>Luscinia cyane</i>	ល្វាចេកខ្មៅលឿង			EF		3			
Oriental Magpie-Robin	<i>Copsychus saularis</i>	ល្វាចេក			DDF	2			3	
White-rumped Shama	<i>Copsychus malabaricus</i>	ល្វាចេកព្រៃ			SEF-EF	2	1	1		✓
Common Stonechat ¹	<i>Saxicola torquatus</i>	ពពិចថ្មត្នោត			DDF				3	
Pied Bushchat	<i>Saxicola caprata</i>	ពពិចថ្មខ្មៅម្តងខ្នងស			DDF	1	2	2	1	
White-throated Rock Thrush ¹	<i>Monticola gularis</i>	ពពិចថ្មកស			SEF-EF		3	3	3	✓
Dark-sided Flycatcher ¹	<i>Muscicapa sibirica</i>	ចាប់ស៊ីរុយម្តងកស			DDF	2			3	
Asian Brown Flycatcher ¹	<i>Muscicapa dauurica</i>	ចាប់ស៊ីរុយខ្នងត្នោត			DDF	2	2	2	3	✓

Bird Species Present within Community Forest Areas			Red List Category	CITES Appendix	Habitat Type	Andong Bor	Sangkrou Preychheu	Prey Sorn	Sorng Rokavorn	Romdoul Veasna
Brown-streaked Flycatcher	<i>Muscicapa williamsoni</i>	ចាប់ស៊ីវល្លាទ្រូងផ្កាត			DDF				3	v
Red-breasted Flycatcher ¹	<i>Ficedula parva</i>	ចាប់ស៊ីវល្លាក្រហម			DDF	1	1	1	2	
Hainan Blue Flycatcher	<i>Cyornis hainanus</i>	ចាប់ស៊ីវល្លាខ្មៅត្រចៀកខ្មៅ			SEF-EF	3	1	1	3	v
Tickell's Blue Flycatcher	<i>Cyornis tickelliae</i>	ចាប់ស៊ីវល្លា.....			EF	3	?			
Grey-headed Canary-Flycatcher	<i>Culicicapa ceylonensis</i>	ចាប់ស៊ីវល្លាក្បាលប្រផេះ			SEF-EF	2	1	1		
Chloropseidae										
Blue-winged Leafbird	<i>Chloropsis cochinchinensis</i>	ចាប់ស៊ីវល្លាខ្មៅ			DDF-SEF	3	2	2		
Golden-fronted Leafbird	<i>Chloropsis aurifrons</i>	ចាប់ស៊ីវល្លាស្បែក			SEF-EF		3		2	
Dicaeidae										
Plain Flowerpecker	<i>Dicaeum concolor</i>	ចាប់កន្លង់កក់			DDF	2		2	1	v
Fire-breasted Flowerpecker	<i>Dicaeum ignipectus</i>	ចាប់កន្លង់ទ្រូងក្រហម			DDF-SEF		?			
Nectariniidae										
Ruby-cheeked Sunbird	<i>Chalcoparia singalensis</i>	ចាប់កន្លង់បំពង់កត្នោតខ្ចី			SEF			3		
Brown-throated Sunbird	<i>Anthreptes malacensis</i>	ចាប់កន្លង់បំពង់កត្នោតចាស់			SEF		3			
Purple Sunbird	<i>Cinnyris asiaticus</i>	ចាប់កន្លង់ខ្មៅ			DDF	1	3	3	2	
Olive-backed Sunbird	<i>Cinnyris jugularis</i>	ចាប់កន្លង់			DDF-SEF		2	1	2	v
Estrildidae										
White-rumped Munia	<i>Lonchura striata</i>	ចាប់ចង្កៀងចុងខ្នងស			DDF			3	3	
Black-headed Munia	<i>Lonchura Malacca</i>	ចាប់ចង្កៀងក្បាលខ្មៅ			DDF				3	
Motacillidae										
Olive-backed Pipit ¹	<i>Anthus hodgsoni</i>	ក្រូចអិនទ្រូងផ្កាខ្មៅ			DDF	3		3		v

3.1.1. Migrant bird species

As the extent of forested habitats in the region dwindle, remaining areas will become more important for the millions of birds that winter in Southeast Asia. Whilst not yet flagged as a high conservation concern, the extent of forest available for forest-dependent migrants will surely become an issue in the future. In particular, there are several migrant species in the region that require wetter forests with a good under-story during their winter visits. These species include Pale-legged/Sakhalin Leaf Warbler (the criteria required to separate these two taxa on the wintering grounds are still unclear), White-throated Rock-thrush and Siberian Blue Robin. Of these, Pale-legged/Sakhalin Leaf Warblers were abundant in the Evergreen and more evergreen parts of Semi-evergreen Forests within the CFs, whilst the number of observations (>10) of the rather skulking White-throated Rock-thrush made during general observations also suggests that it must be common in the same areas.

Table 3.2 indicates the number of passerine migrant species recorded in the four CFs that were surveyed (the actual species are listed in Table 3.1). As might be anticipated, the largest area (Sornng Rokavorn) had the largest number of migrant species. This can probably be attributed to the greater diversity of habitats in this particular CF, including permanent wetlands.

Table 3.2. Number of bird species, woodpecker species and passerine migrant species encountered in the four CFs surveyed. The forested area and type is based on data in the Project Design Document - Anon (2009). Habitat Types – Mixed-DDF/Mixed Deciduous Dipterocarp, EF Evergreen Forest. (*Mixed Deciduous Forest is equivalent to Semi-evergreen Forest*).

Community Forest Name	Forested Area (ha)	Habitat Types	Birds	Wood-peckers	Passerine Migrants
Sangkrouk Preychheu	3,943	Mixed-DDF (6%), EF (94%)	95	9	11
Prey Srong	5,773	Mixed-DDF (21%), EF (79%)	104	9	10
Andong Bor	5,930	Mixed-DDF (100%)	80	8	9
Sornng Rokavorn	17,074	Mixed-DDF (90%), EF (10%)	107	11	15

All four CFs surveyed supported breeding populations of at least one globally threatened species and can therefore be classified as globally Important Bird Areas based on IBA criteria Category A1 “Globally threatened species” (Seng Kim Hout *et al.* 2003). Sornng Rokavorn can also be recognized as an IBA based on Category A3 “Biome-restricted Assemblages”. Although BirdLife International recognized 40 IBAs in Cambodia, none of these are in Oddar Meanchey Province, as surveys of the area had not been carried out at the time the IBA Directory was compiled in 2003.

3.1.2. Globally threatened and near-threatened birds

The seven globally threatened species of High Conservation Value found within the CFs were:

Green Peafowl (*Endangered*). Green Peafowl was once widespread in the region, but is now declining and has a severely fragmented population, primarily owing to intense habitat conversion and high hunting and trapping levels. This beautiful pheasant was once described as the “*commonest game bird in Indochina*” (Delacour & Jabouille 1925), and it has therefore been inferred that the species was widespread and common in Cambodia during the first half of the 20th Century

(Goes 2009). Today, Cambodia and Laos are the most important countries in the region for this Endangered species; it is extinct in Malaysia and peninsular Thailand and is probably extinct in north-east India and Bangladesh. The main population in Laos is in Xe Pian NBCA and nearby areas in the south of that country. In Cambodia, various wildlife surveys in the northeastern provinces have found a stronghold in Mondolkiri, where the Green Peafowl is still widespread and locally common. It is found in the DDF and lowland SEF in Seima Biodiversity Conservation Area and Snoul Wildlife Sanctuary, Phnom Prich Wildlife Sanctuary and Phnom Kus. In contrast, surveys in Ratanakiri and Stung Treng have generally produced few records (Goes 2009)

Whilst this species is easy to detect during the breeding season, when males call daily, they were not vocal during the survey period and only one individual was seen, in Sorng Rokavorn. However, this is such a distinctive species that villagers knew the bird even in areas where it is already extinct, such as Andong Bor CF.

The results of interviews suggest that small numbers persist at scattered locations in Romdoul Veasna and in Sangkrou Preychheu. One villager from the former CF had seen a small group of about five birds near the southern border of the CF (somewhere near E333000 N1583000) in Jan-Feb 2009. One bird was also reported to be regularly observed near the school at Romdoul Veasna in early November 2010, indicating that the species occurs in at least two locations within this CF. The only birds that villagers knew to occur within Sangkrou Preychheu, was a group of five peafowl that are regularly seen coming to a pond near the border of the CF during the dry season. This pond was located at E95517 N1552526. During the wet season and early dry season these birds apparently feed and drink to the north of the CF where there are still ample water supplies. Whilst only one individual male Green Peafowl was observed in Sorng Rokavorn (at c. E373550 N1564990), local people indicated that this species was present in small numbers at scattered localities in the east and south of the CF and there may therefore be a significant population within the boundaries of the CF. One reason for this is that Sorng Rokavorn has a number of year-round water resources – a key element in determining the presence of Green Peafowl.

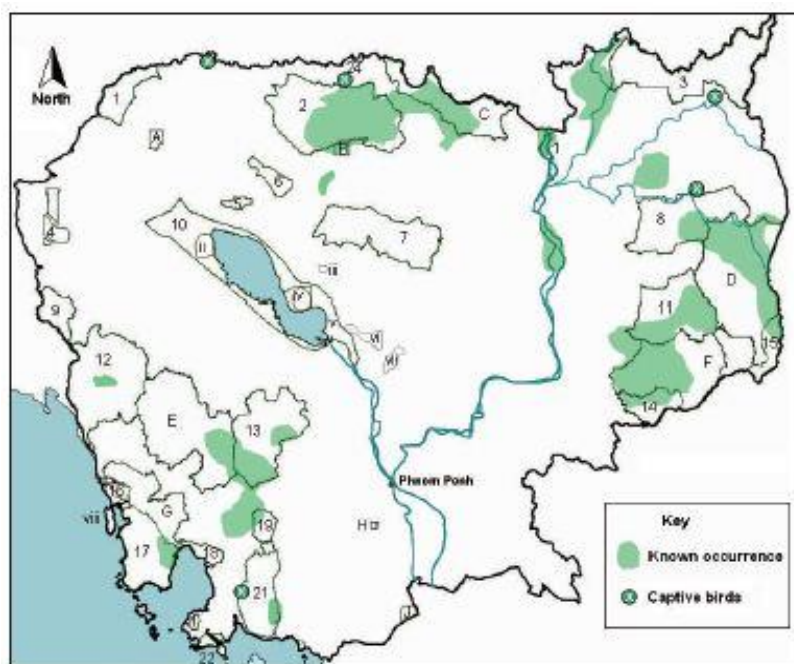


Figure 3.2. Distribution of Green Peafowl in Cambodia. Source: Goes 2009. Note that Oddar Meanchey Province lies outside of the reported current distribution. (NB -Numbers and letters refer to classifications used in the original study that are not relevant here).

The records of Green Peafowl in Oddar Meanchey are significant in global terms since they represent an extension of the confirmed present range of the species (Figure 3.1, Goes 2009). Maps in Appendix 2 include the locations where Green Peafowl were reported or observed during the 2010 survey.

Greater Adjutant (*Endangered*). Although it is possible that this species sometimes visits several of the CFs during the wet and early dry season, we were only able to verify its occurrence in Prey Srorng where one was observed at 10m distance and locals reported regularly seeing up to three adjutants with paler grey wing patches together at one particular pond, located at E388241 N1555217. Maps in Appendix 2 indicate these locations. It was not clear if this species occurs within the CF year-round or is only a visitor: the breeding season on the Tonle Sap is January to June, although birds start to return in November. In the northern plains, it breeds from November to April (F. Goes *in litt.* 2010). During aerial surveys conducted across northern Cambodia in September 2001 no Greater Adjutants were recorded in Oddar Meanchey (Barzen 2004) so it is presumably a fairly rare species in the province, although there is a small breeding population in Kulem Promtep Wildlife Sanctuary (T. Evans *in litt.* 2010) which is only about 25km to the east of Prey Srorng. Local people were generally unable to clearly distinguish between the various storks that could potentially occur at the sites and reports of this species within Sorng Rokavorn could not be verified.

Lesser Adjutant (*Vulnerable*). Two birds were photographed in a close tree in Sangkrous Preychheu and a number of sightings of close perched birds, possibly involving up to 10 birds, were made in Sorng Rokavorn. Maps in Appendix 2 indicate where these sightings were made. As with the previous species it is impossible to ascertain whether or not the species is present year-round or is just a visitor during the wetter months. ICF reported a few scattered individuals in the province of Oddar Meanchey during aerial surveys in September 2001 (Barzen 2004).

Great Slaty Woodpecker (*Vulnerable*). This species was found in all CFs visited except Romdoul Veasna (visited for only a morning). This is a very vocal species that is easily detected even when 500-1,000m away. It is a widespread bird in Cambodia with large area requirements and is declining throughout its range (India to Borneo). Results of the surveys suggest that whilst there are only small numbers in Andong Bor and Sangkrous Preychheu there is a very robust population within Sorng Rokavorn, where groups of up to five birds were encountered on several days.

Black-necked Stork (*Near-threatened*). Although there are probably as many as 10,000 Black-necked Storks in Australia, the mainland Asia population had declined to only about 1,000 individuals by 2006 and its conservation status in the region is therefore of very high concern. Cambodia may now have the most important population for the species in Southeast Asia since it is probably already extinct in Indonesia, Thailand and Vietnam and is now probably extinct as a breeding species in southern Laos (R. Timmins *in litt.* 2010) and Myanmar (BirdLife 2010). One was seen at a pond within Sorng Rokavorn at E373554 N1564199. Local people did not recognize this species from photos or illustrations in books suggesting that it is not common and perhaps only a visitor. During aerial surveys conducted by ICF in 2001, only 1-2 Black-necked Storks were seen in Oddar Meanchey (Barzen 2004). This species breeds regularly in the vicinity of Kulem Promtep Wildlife Sanctuary (T. Evans *in litt.*), approximately 40km east of Sorng Rokavorn. It should be noted that it is possible that some of the adjutant storks that local people say that they occasionally see are in fact this species.

White-rumped Falcon (*Near-threatened*). This is a biome-restricted species (Table 3.3) that is now considered Near-threatened and as DDF becomes a rarer habitat may be upgraded to VU. It was found in DDF in Sorng Rokavorn, Andong Bor and Prey Srorng. The first two of these areas probably support viable populations since they contain significant areas of DDF habitat.

Siamese Fireback (*Near-threatened*). This secretive pheasant was seen in both CFs that contained significant areas of Semi-evergreen and Evergreen forest, the biome to which it is restricted, namely Sangkrou Preychheu and Prey Srorng. Most species of *Lophura* pheasants are fairly resilient to both habitat degradation and hunting pressure (F. Lambert pers. obs), which means that despite the on-going problems with illegal logging and, perhaps trapping in these CFs the species is likely to survive in the near-future since both these CFs still have significant areas of suitable habitat.

3.1.3. Biome-restricted species in the community forests

The Deciduous Dipterocarp Forests and its associated habitat mosaic of Semi-evergreen and Evergreen Forests found in Oddar Meanchey is part of an important biome that stretches in Cambodia from eastern Banteay Meanchey Province east to Monduliri Province (Seng Kim Hout *et al.* 2003). The area coincides, to a large extent, with the Lower Mekong Dry Forests Ecoregion as defined by WWF (Figure 3.3). This unique landscape once dominated southern Indochina and Thailand, but has been much reduced in area to the extent that the only large examples of the habitat are now to be found in Cambodia, particularly in Preah Vihear and Monduliri Provinces. Throughout the region the habitats of this biome are being cleared rapidly so that any areas that afford protection to these habitats will have conservation significance in the future.



Figure 3.3. Lower Mekong Dry Forests Ecoregion. Source WWF 2010.

In this respect, it is important to recognize that several of the CF areas presently support relatively intact communities of the DDF biome-restricted birds (Table 3.3). Sixteen of 25 bird species that BirdLife/WCS list as being restricted to the biome were found in Sorng Rokavorn, for example, and it may be that some of the other nine bird species restricted to this biome were overlooked or have never occurred in the area. Further survey work is likely to discover additional biome-restricted birds in the individual CFs. Clearly, however, the extensive area of DDF in Sorng Rokavorn and its associated complex of species merit recognition within the framework of HCV.

Table 3.3. Biome-restricted bird species confirmed present in the four Community Forests surveyed in Oddar Meanchey. Scientific names of birds are provided in Table 3.1. (✓) indicates a species that was identified based on interviews alone and not confirmed by the field team.

		Sorng Rokavorn	Andong Bor	Prey Srorng	Sangkrou Preychheu	Romdoul Veasna
Indo-Malayan Tropical Dry Zone (Total 25 species)						
Green Peafowl		✓				(✓)
Black-headed Woodpecker		✓	✓	✓	✓	
Lineated Barbet		✓	✓	✓	✓	✓
Blossom-headed Parakeet		✓	✓	✓	✓	
Yellow-footed Green Pigeon		✓	✓			
Rufous-winged Buzzard		✓	✓	✓		
White-rumped Falcon		✓	✓	✓		
Racket-tailed Treepie		✓				
Indochinese Cuckooshrike		✓			✓	
Small Minivet		✓	✓	✓		✓
White-browed Fantail		✓	✓	✓	✓	
Common Woodshrike		✓	✓			
Black-collared Starling		✓				
Burmese Shrike (<i>*see note below</i>)				✓	✓	
Sooty-headed Bulbul		✓	✓			
Streak-eared Bulbul			✓	✓	✓	
Brown Prinia		✓	✓	✓		
Indochinese Bushlark		✓	✓	✓		
Indochinese Moist Tropical Forests (21)						
Scaly-breasted Partridge				✓	✓	✓
Siamese Fireback				✓	✓	
Green-eared Barbet		✓	✓	✓	✓	✓
Hainan Blue Flycatcher		✓	✓	✓	✓	✓
Stripe-throated Bulbul			✓	✓	✓	
Lesser Necklaced Laughingthrush		?				✓

**Burmese Shrike is listed as restricted to the Sino-Himalayan Subtropical Forest Biome by Seng Kim Hout et al. (2003) but in Cambodia this is a bird of DDF and highland deciduous pine forests and the listing may be an error.*

3.2. Mammals

This section details the results of surveys for mammal signs. Survey coverage across the CFs is shown in Appendix 5, whilst a list of all species identified in each of the five CFs surveyed can be found in Appendix 6. Relevant results are presented cumulatively across CFs as an annotated list of key species, distinguished as being of global or regional importance. Relevant site specific information is also presented for each CF area surveyed. Evidence of mammal presence was taken from a variety of sources: surveys for animal signs, including direct observations, tracks, faeces and scratch marks; photographing of trophies or confiscations; and interview evidence.

3.2.1. Overview

Evidence of 26 species listed in Table 3.4 was found during surveys across all CFs visited, of which 20 species were confirmed to occur based on direct observations, physical material (e.g. pangolin scale, porcupine quill) or unequivocal identification of track and faeces combined. A further six species were provisionally reported based on the presence of tracks or faeces (Appendix 6).

Of the recorded species, nine were of High Conservation Value and listed as globally threatened by IUCN. Five of these species were confirmed to be present within at least one CF: Banteng EN, Sun Bear (VU), Sunda Pangolin (EN), Northern-Pig-tailed Macaque (VU), and Pileated Gibbon (EN); and four were putatively recorded from track: Dhole (EN), Gaur (VU), Eld's Deer (VU) and Sambar (VU). A detailed account for each of these important species and their presence across the CFs of Oddar Meanchey is provided in the section below.

In addition, three threatened or near-threatened species were thought to potentially still occur within some CFs, based on reports obtained during interviews. Subsequent potential evidence was found to indicate that these reports may have been accurate for the following species: Hog Deer (*Axis porcinus*), Tiger (*Panthera tigris*) and Leopard (*Panthera pardus*). Tracks of a large cat species were found although it was not possible to substantiate their presence from additional sources of evidence or confirm the species as the track size and gait was consistent with that of a large Leopard or small Tiger. Tracks consistent with the size and morphology of Hog Deer were found in the marshy area to the south of Sorng Rokavorn, it is not however possible to unequivocally identify the species from track as there is considerable overlap with other deer species that were found to be present.

Table 3.4. A complete list of mammal species recorded in the REDD project CFs of Oddar Meanchey IUCN Red List: nTh - near Threatened; VU - Vulnerable; EN – Endangered

Bold denotes confirmed presence as defined by sightings, unequivocal track or camera-trap

*Habitat indicates the most likely habitat for the species but it is not definitive as variation in preferences do occur

DDF – Deciduous Dipterocarp Forest, SE – Semi-Evergreen, WL – Wetland, NS – none specific

Scientific Name	Species	Habitat*	IUCN Threat Status	CITES App.	National Status
<i>Cuon alpinus</i>	Dhole	DDF	EN	I	Rare
<i>Canis aureus</i>	Golden Jackal	DDF		III	Common
<i>Bos gaurus</i>	Gaur	DDF	VU	I	Rare
<i>Bos javanicus</i>	Banteng	DDF	EN		Rare
<i>Panthera pardus</i>	Leopard	DDF	nTh	I	Rare
<i>Rucervus eldii</i>	Eld's Deer	DDF	VU	II	Endangered
<i>Cervus unicolor</i>	Sambar	DDF	VU	I	Common
<i>Axis Porcinus</i>	Hog Deer	WL	EN	I	Endangered
<i>Helarctus malayanus</i>	Sun Bear	SE	VU	I	Rare
<i>Manis javanica</i>	Sunda Pangolin	SE	EN	II	Rare
<i>Macaca fascicularis</i>	Long-tailed Macaque	SE		II	Common
<i>Macaca leonine</i>	Northern Pig-tailed Macaque	SE	VU	II	Common
<i>Hylobates pileatus</i>	Pileated Gibbon	SE	EN	I	Rare
<i>Sus scrofa</i>	Eurasian Wild Pig	NS			Common
<i>Muntiacus vaginalis</i>	Northern Red Muntjac	DDF			Common
<i>Trangulus kanchil</i>	Lesser Mousedeer	NS			Common

<i>Paradoxurus hermaphroditus</i>	Common Palm Civet	NS		III	Common
<i>Catopuma temminckii</i>	Asiatic Golden Cat	DDF	nTh	I	Rare
<i>Felis chaus</i>	Jungle Cat	NS		I	Rare
<i>Prionailurus bengalensis</i>	Leopard Cat	NS		I	Common
	civet other	NS			
<i>Ratufa bicolor</i>	Black Giant Squirrel	NS	nTh	I	Rare
<i>Callosciurus finlaysonii</i>	Variable Squirrel	NS			Common
<i>Menetes berdmorei</i>	Indochinese Ground Squirrel	NS			Common
<i>Tamias rodolphii</i>	Cambodian Striped Squirrel	NS			Common
<i>Tupaia belangeri</i>	Northern Treeshrew	NS			Common
<i>Martes flavigula</i>	Yellow-throated Marten	NS			Common
<i>Herpestes urva/ H. Javanicus</i>	Crab-eating Mongoose/ Small Asian mongoose	NS		III	Common
<i>Hystrix brachyuran</i>	Malayan Porcupine	NS			Common
<i>Lepus peguensis</i>	Burmese Hare	NS			Common

3.2.2. Globally threatened focal species found during surveys

The nine globally threatened species of High Conservation Value found within the CFs were:

Eld's Deer *Recervus eldii* (Vulnerable)

No direct field observations were made of the species, but putative evidence of a population was found in Andong Bor CF. Medium-sized deer tracks, believed to be too large for Northern Red Muntjac and too small for Sambar were found at several locations in an area to the south-east of the CF, north of the river lining the southern CF boundary of (306570 1543671). Photographic records were made of the tracks using a size standard. Recent presence of Eld's Deer was also consistently reported by the local guides at Andong Bor and during interviews, during which description and identification of picture cards appeared to be accurate.

In addition to the size of the track being consistent with that of Eld's Deer and not Sambar the local people indicated during interviews that they have never observed Sambar in the wild but only recognized it from books. They also indicated that the deer they see regularly in the CF have antlers consistent with those of Eld's Deer. A cautionary approach was taken to track identification and therefore these tracks were considered to be provisional records, however, they were identified as most likely to be of Eld's Deer origin based on diagnostic features of the track and faeces including size, morphology, shape and character (see Timmins *et al.* 2003 and Owens 2009 for discussion). Signs of Eld's Deer are summarized in Table 3.5.

Sambar *Rusa unicorn* (Vulnerable)

Presence of Sambar was reported during interviews at two of the four CFs (Prey Srong and Srong Rokavorn) and although there were no direct observations during surveys, there were tracks consistent with the size and morphology of Sambar observed in these same CFs. Signs of Sambar are summarized in Table 3.5.

Banteng *Bos javanicus* (Endangered)

Most interviewees across CFs reported having seen Banteng in the last two years, with the majority of reports actually being within the last year. Reports were consistent between interviewees and were supported by ancillary information that was indicative of the species in question. Putative evidence of Banteng was found in 3 of the 4 community forests surveyed. Both Sorng Rokavorn and Sangkrou Preychheu provided evidence of more than one individual. However, with the exception of Sorng Rokavorn, where there were tracks and dung that were most likely to be of Banteng origin from several individuals, all other signs appeared to have been left during the rainy season. Information obtained from interviews also confirmed this perspective, with reports indicating that they are seasonal visitors during the rainy season.

Fresh tracks believed to be of Banteng origin were observed and recorded at several locations within Sorng Rokavorn. A Banteng resting sites was identified during surveys at Sorng Rokavorn on the 24th December. Presence of Banteng in this CF was confirmed by camera-trap photos from the first week of December (Front Cover). On 14th November, tracks were also observed near a watering hole at Sangkrou Preychheu and along the western border of the CF adjacent to an open grassland area, between UTM 395048 1550244 and 395007 1552731. The forest type at Sangkrou Preychheu along the western border is mainly Evergreen and may explain the absence of these ungulates within the forest itself. A series of tracks most likely to be of Banteng origin were also observed at Prey Sorng CF, in the vicinity of a Chob (river source) but were most likely remaining from the rainy season (386504 1549571). Signs of Banteng are summarized in Table 3.5.

The records of Banteng presence from the three southeastern CFs, in combination with records from KPWS, may indicate the presence of small but viable populations of Banteng in Oddar Meanchey. Given their globally threatened status and diminishing numbers within Cambodia, the project site could represent an important location for their global viability.



Figure 3.4: Male Banteng photographed by camera trap in Sorng Rokavorn Community Forest, December 2010 (Venerable Bun Saluth).

Gaur *Bos gaurus* (Vulnerable)

Recent tracks that were most likely of Gaur origin were found adjacent to a watering hole in Sangkrou Preycheu on 13th November. A clear set of eight prints from one individual was sufficiently convincing to provide putative evidence of Gaur at this location (395999 1550296).

The presence of Gaur was reported from two of the CFs surveyed but putative evidence was only observed in Sangkrou Preycheu. Reports indicated that the Gaur are likely seasonal visitors within all the CFs, only present in the rainy season. With the exception of Sorng Rokavorn, there are no substantial permanent water sources in the community forest patches, which is consistent with only seasonal use of the area by Gaur. Reports indicated that historically there were more substantial herds (5-8 individuals) but that in recent years the sightings of either animals or what appears to be their track have been very infrequent. Most of the sightings reported were from 2008 and before, suggesting that in most of the CFs Gaur are rare. The vicinity of the Kulen Promtep Wildlife Sanctuary to the Sangkrou Preycheu CF may represent a source for the individuals present in the rainy season, although this would require them crossing a major highway. The presence of Gaur is summarized in Table 3.5.

Table 3.5. Signs presumed to be those of important ungulate species: Sambar, Eld's Deer, Banteng and Gaur found during the surveys

Date	Community Forest	Putative ID	Location (UTM)		Sign
13-Nov-10	Sangkrou Preychheu	Banteng	397518	1549912	old track
13-Nov-10	Sangkrou Preychheu	Banteng	395952	1549948	track
18-Nov-10	Prey Srong	Banteng	386908	1548942	track
24-Nov-10	Sorong Rokavorn	Banteng	374663	1564899	track
24-Nov-10	Sorong Rokavorn	Banteng	374476	1565434	bed
24-Nov-10	Sorong Rokavorn	Banteng	375013	1564600	track
24-Nov-10	Sorong Rokavorn	Banteng	375155	1563556	track
26-Nov-10	Sorong Rokavorn	Banteng			skull
26-Nov-10	Sorong Rokavorn	Banteng	368302	1557222	track
26-Nov-10	Sorong Rokavorn	Banteng	368302	1557222	track
13-Nov-10	Sangkrou Preychheu	Gaur	396910	1549152	track
6-Nov-10	Andong Bor	Eld's Deer	307550	1545743	track
13-Nov-10	Andong Bor	Eld's Deer	308320	1541666	faeces
12-Nov-10	Andong Bor	Eld's Deer	307010	1543546	track
13-Nov-10	Sangkrou Preychheu	Sambar	396910	1549152	track
17-Nov-10	Prey Srong	Sambar	386665	1551665	track
24-Nov-10	Sorong Rokavorn	Sambar	373135	1563787	track
24-Nov-10	Sorong Rokavorn	Sambar	375155	1563556	track
26-Nov-10	Sorong Rokavorn	Sambar	368302	1557222	track

Northern Pig-tailed Macaque *Macaca leonina* (Vulnerable)

A group of three individuals was seen adjacent to the CF patrolling station in Sangkrou Preychheu on 13th November. Several sightings of Northern Pig-tailed Macaques occurred between the 12th and 14th November at Sangkrou Preychheu. Northern Pig-tailed Macaques were also seen on one occasion in the early morning at Prey Srong CF, in the evergreen part of the forest. No evidence of Northern Pig-tailed Macaques was found at either of the other two sites, which is likely to represent a habitat preference of the species. Interviewees at other sites indicated the presence of macaques at sites outside the DDF present in Andong Bor and Sorong Rokavorn. The presence of this globally threatened primate is encouraging as it suggests that these CFs are able to sustain viable populations. Sightings of Northern Pig-tailed Macaques are summarized in Table 3.6.

Pileated Gibbon *Hylobates pileatus* (Endangered)

At least three groups were heard in the south of Sangkrou Preychheu on the 13th November based on the distribution of simultaneous calls heard from one location. A potential fourth group was also heard from a different location. One location where Pileated Gibbons were heard was confirmed to represent one male, one female and one juvenile that were directly observed. A group was heard distantly on 14th November from the north of the same CF but was considered to be one of the same groups. During interviews, Pileated Gibbons were also reported to occur at Romdoul Veasna and Prey Srong CFs. A viable population of Pileated Gibbons within Sangkrou Preychheu represents a significant record for this globally Endangered species. Records of Pileated Gibbons are summarized in Table 3.6.

Table 3.6. Visual and acoustic records of important primates encountered in the Community Forests of Oddar Menachey during surveys.

Date	CF Name	Species	Location UTM		Record
12-Nov-10	Sangkrou Preycheu	Pig-tailed macaque	398149	1553180	Visual
12-Nov-10	Sangkrou Preycheu	Pig-tailed macaque	398454	1552579	Visual
13-Nov-10	Sangkrou Preycheu	Pig-tailed macaque	398528	1551517	Visual
14-Nov-10	Sangkrou Preycheu	Pig-tailed macaque	396807	1549854	Visual
19-Nov-10	Prey Srong	Pig-tailed macaque	388265	1551746	Visual
12-Nov-10	Sangkrou Preycheu	Pileated Gibbon male + female	400306	1552567	Hear
13-Nov-10	Sangkrou Preycheu	Pileated Gibbon	398528	1551517	Visual/Hear
13-Nov-10	Sangkrou Preycheu	Pileated Gibbon female + baby	397850	1550274	Visual/Hear
13-Nov-10	Sangkrou Preycheu	Pileated Gibbon male + female	397953	1550626	Hear
13-Nov-10	Sangkrou Preycheu	Pileated Gibbon male + female	397953	1550626	Hear
13-Nov-10	Sangkrou Preycheu	Pileated Gibbon	397726	1550121	Hear



Figure 3.5. Golden Jackal on the plains of northern Cambodia. (Jonathan C. Eames)

Dhole *Cuon alpinus* (Vulnerable) and **Golden Jackal** *Canis aureus*

The presence of Golden Jackal within the project site was confirmed by a sighting of a single animal at Srong Rokavorn CF. The two species of wild dog found within Cambodia can be distinguished on the basis of their colouration, size and ecology, including their feeding ecology and calling behavior. Although no direct observations of Dhole occurred during the survey period, interviewees from

several of CFs reported seeing groups of wild dogs consistent with the description of Dhole and footprints associated with scat at what appeared to be latrine sites¹¹ probably of this species were found in two of the four CFs (Sorng Rokavorn, Sangkrou Preycheu). Dhole and Golden Jackal overlap in their distribution within Cambodia and therefore are likely to co-occur within the project site. Therefore, care must be taken not only in distinguishing wild dogs from domestic or feral dogs but also between these two sympatric wild dog species when interpreting signs from dogs in the field. Interviewees correctly indicated the appropriate image when reporting sightings of this species, although the Khmer name used was not the one apparently assigned to this species in the Khmer scientific literature. Dhole are well-known for their distinctive high-pitched whistling calls, which can be distinguished from the more typical howl of the Golden Jackal. In combination with descriptions of the size and colouration, presence of both wild dog species was suggested by the description and renditions of vocalizations by interviewees. Nevertheless, inclusion of Dhole was recorded as provisional in the absence of more substantiated evidence.

Sunda Pangolin *Manis javanica* (Endangered)

This species was identified on the basis of a scale presented during interviews at Romdoul Veasna CF that had reportedly been taken from a wild animal in 2004. No recent records were provided however, and no evidence of their contemporary existence within the CFs was found in any other CF. Most CFs reported continued presence of pangolins but all agreed that they were previously plentiful and now very hard to find. Reports from all CFs suggested a former abundance but that pangolins are heavily targeted for trade and numbers have declined substantially in recent years due to increased hunting pressures. No sign of this species was found during field surveys but reports of animals being removed from the forest in the last year and sold to traders from Siem Reap were reported from all of the community forests where interviews were conducted. Combined with its high market value, the mostly sedentary life-style of this species makes it a very easy target and numbers have dwindled throughout its range in recent years, particularly resulting from the increase in trade to Thailand. Lack of evidence from the field surveys and reports during interviews confirm the expectation that this species was formerly abundant in this area but populations have been heavily persecuted in recent years.

Sun Bear *Helarctos malayanus* (Vulnerable)

No direct observations were made of this species but reliable accounts were given by local former hunters from two of the CFs (Sangkrou Preycheu and Sorng Rokavorn). Evidence of their former presence in Sorng Rokavorn was presented in the form of a bear skull and pelt that was confiscated in 2004. There were, however, no recent sightings reported during interviews and the survey did not elucidate any scratch marks or track from any bear species.

Asiatic Golden Cat *Catopuma temminckii* (Near-threatened)

A series of recent tracks believed to be of Asiatic Golden Cat origin based on the print size and gait was putatively identified in Sorng Rokavorn CF between the hills and the marshland to the south of the survey area. Tracks 30mm x 28mm were considered too large to be of Leopard Cat or Jungle Cat origin and too small to be that of a Leopard. Large cat prints are often difficult to identify to species due to the overlap between young or small individuals of the large species and large adults of the small species. Therefore, this record is very tentatively reported and would benefit from camera-trapping at the site for confirmation.

¹¹ A latrine site is an area where animals come to defecate repeatedly or in groups

Leopard *Panthera pardus* (Least Concern)

A series of recent tracks of a large cat with pad measurements of 80mm x 90mm were found in open grassland on 26 November along a trail to the south of Sorng Rokavorn CF (UTM 370651, 1556789). The size and shape of the tracks were consistent with Leopard origin. Leopards are wide ranging large cats with a distribution across Africa and Asia. There are various recognized subspecies of Leopard the variation across its range however, is not sufficient to warrant species distinctions. Although Leopards are threatened by habitat loss and poaching there are low but healthy population numbers across its wide distribution thus resulting in a status of least concern. The importance of the presence of Leopard within the project site, therefore, is related to its role as a predator – its existence indicating the presence of populations of prey species that are sustaining for a large predator.



Figure 3.6. Large cat prints photographed in Sorng Rokavorn CF (Vittoria Elliott)

Tiger *Panthera tigris* (Endangered)

Not unexpectedly, no confirmed records were found of Tiger presence within the project site, accounts of recent sightings of large striped cat were reported at several of the CFs with credible descriptions and details to the encounter. Several interviewees at Sangkrou Preycheuu recounted sighting a large striped cat, ‘the size of a small horse’ that crossed the path in front of a wagon pulled by a cow that bent to its knees at sight of the large cat. A credible description was provided of a regular dry season visitor to a dry season pond near the Thai border in Rolus Thom CF. Given the global status of Tigers, confirmation of the species presence at these two sites would be of interest and could benefit from a camera-trap survey at these two locations. Should the sightings be confirmed, both sites are adjacent to larger forest areas that may represent suitable habitat and prey base for this species.

Hog Deer *Axis porcinus* (Endangered)

Presence of Hog Deer was indicated during interviews by clear descriptions and positive identification from photographs. The correct Khmer species name was assigned to the photographs by interviewees and their descriptions indicated an awareness of the distinction between this and other deer species. During field surveys tracks that were consistent with the size and morphology of Hog Deer were found in an area of wetland marshy habitat to the south of Sorng Rokavorn CF. This habitat type is consistent with the preferences of Hog Deer. A population of this Endangered ungulate, if confirmed, would be an important find. Hog Deer, historically had a wide distribution

across Asia but have seen rapid and recent declines in population numbers throughout their range. Believed to be extinct in Cambodia until 2006, since which small remnant populations have been found dotted around the marshy grasslands of Cambodia (Timmins *et al.* 2008). It will be important, therefore, to verify the existence of Hog Deer in the Project site, potentially through camera-trapping efforts in the future.

3.2.3. Relative abundance of commoner mammal species across CFs

Although Eurasian Wild Pig, Northern Red Muntjac, civet, Leopard Cat and Burmese Hare were found to be present across all CFs the relative abundance of these species was different between the locations surveyed. In particular, there was a general low abundance of Northern Red Muntjac in Andong Bor and Sangkrou Preychheu, although in the latter it is most likely because the habitat type of evergreen forest is less suitable for Northern Red Muntjac. Eurasian Wild Pig was also found to be less abundant in the Andong Bor CF relative to others. Although a range of species were found in Prey Srong, the relative rate of encounter of animal signs was distinctly less than in the other sites surveyed. Observations and interviews indicated particularly high levels of human activity in this forest, including hunting. Srong Rokavorn represented the most prolific of the CFs surveyed for mammal presence with evidence of the more common species relatively frequently encountered in addition to the threatened species detailed above. This likely results from a combination of the habitat, number of water sources and size of this latter CF. It is also possible that the threat of land mines and the efficiency of the patrol team, headed by a conservation-concerned monk, provides some protection to the animals in this CF.

3.3. Other Taxa of Note

Elongated Tortoise *Indotestudo elongata*

Surveys for taxa other than birds and mammal were not undertaken in November 2010. It is worth mentioning, however, that one Endangered species (Asian Turtle Trade Working Group 2000) was recorded; live specimens of Elongated Tortoise were found in Prey Srong, Sangkrou Preychheu and Srong Rokavorn) and a shell of the same species was provided during the interview at Andong Bor CF (Figure 3.6). This species occurs from the Indian subcontinent to West Malaysia and Indochina. In Cambodia, they have been recorded in the eastern and southwestern Mekong plains as well as in the Cardamom Mountains (WWF 2010b). Yellow-headed Tortoises are under intense pressure throughout their range due to over-harvest for food and the pet trade. This species is listed in CITES Appendix II.



Figure 3.7. Shell of Elongated Tortoise collected in Andong Bor CF (Frank Lambert)

3.4. Invasive and Domestic Species in the Community Forests

Invasive species are infiltrators that invade and cause harm to ecosystems beyond their historic range. Their establishment can threaten not only native ecosystems but also affect commercial, agricultural, and even recreational activities dependent on these ecosystems. Human actions (both unintentional and intentional) are usually the primary means of invasive species introductions and spread to new locations. In addition, domestic animals also have the potential to spread disease to populations of wild animals and in some cases to interbreed with closely related species, and hence contaminate the gene pool of the wild species. Domestic animals are often also vectors of invasive species.

3.4.1. Invasive species in the CFs

The biodiversity team did not include a botanist, so that most invasive plant species were certainly overlooked. The only invasive species identified during the field surveys was the neotropical shrub *Lantana camara* (Figure 3.7), which was found to dominate significant areas in and around degraded, burnt forest in Sangkrou Preychheu CF. The IUCN/SSC Invasive Species Specialist Group (2010) note that *Lantana camara* is a significant weed that is established and expanding in many regions of the world and which impacts severely on agriculture as well as on natural ecosystems. The plants can grow individually in clumps or as dense thickets, crowding out more desirable species. In disturbed native forests it can become the dominant under-story species, disrupting succession and decreasing biodiversity. At some locations in the world, infestations have been so persistent that they have completely stalled the regeneration of rainforest for three decades.



Figure 3.8. the neotropical shrub *L.camara* found in Sangkrou Preychheu

3.4.2. Domestic species in the CFs

Domestic animals or feral populations of animals such as dogs and cats within the CFs of the REDD Project in Oddar Meanchey have the potential to negatively impact on various mammals species. Domestic or feral dogs may, for example, spread diseases such as rabies or canine distemper to populations of Dhole or Golden Jackal). Whilst little is understood about the transmission of such diseases as it relates to these Asian species, the IUCN Red List lists the spread of canine distemper as a possible threat to Dhole and it is widely acknowledged that domestic dogs pose a significant risk as reservoirs for infectious diseases, especially for wild canids, but also for other carnivores. Examples that illustrate this include the devastating outbreak of canine distemper in lions (*Panthera leo*) in

which an outbreak killed more than a thousand individuals in the Serengeti and others in the Masai Mara National Reserve in Kenya during the mid 1990s (Roelke-Parker *et al.* 1996). Hyaenas, Bat-eared Foxes and Leopards were also affected. Another disease potentially spread by domestic dogs to wild animals in Cambodia is rabies: during the early 1990s, for example, rabies killed more than half of the Ethiopian Wolves (*Canis simensis*) in the Bale Mountain National Park (Aguirre 2009). In addition, domestic dogs and feral populations of dogs or domestic cats have the potential to compete for food with indigenous carnivores, and to prey on indigenous wildlife. An additional cause for concern of the presence of domestic canids within the CFs is the potential for hybridization between domestic or feral animals and their wild counterparts, thus contaminating the wild species genepool.

Wild cattle such as Banteng are also potentially at risk from the spread of diseases from domestic cattle that are either grazed within or are herded through the CFs or adjacent forested areas that Banteng and other wild ungulates use. Domestic buffalos are also sometimes to be found in CFs where they may be used to drag carts and other heavy loads, as observed in Sangkrou Preychheu. There is also considerable risk for interbreeding between Banteng and domestic cattle, although the risk of this and consequences have been poorly-studied.

Within the context of this REDD project, it would therefore seem to be pragmatic to encourage local people not to graze or water their cattle within Sorng Rokavorn, where there is convincing evidence for a wild population of Banteng. On the other hand, the grazing of domestic buffalo (but not cows) in areas of DDF where natural grazing levels are low (including all of the CFs visited by the survey team) benefits large waterbirds such as storks and ibises and Green Peafowl by removing the grasses and herbs that otherwise quickly take over ponds and *trapeangs* where such species habitually feed, and by creating areas of mud around the *trapeangs* (H. Wright *in litt.* 2010, Wright *et al.* 2010). The likelihood of finding wild Asian Buffalo (*Bubalus arnee*) within the project area is exceedingly low and therefore hybridization with domestic individuals is unlikely. However, care must be taken when making recommendations to encourage or introduce the use of CFs by domestic animals that any additional impacts are fully investigated. For example, domestic buffalo dung is a source of contamination of water sources elsewhere in Cambodia.



Figure 3.9. Domestic dogs are regularly taken into the CFs by local people (Andong Bor)
Such dogs pose a serious threat to some wildlife of conservation concern.

4. BIODIVERSITY SECTION for CCBA PROJECT VALIDATION

4.1. Net Positive Biodiversity Impacts

4.1.1. How the 'without project' scenario would affect biodiversity

Based on existing information relating to the rate of habitat clearance in the project area, Anon. (2009) noted that "In the absence of the project it is likely that forest habitat in the project area will be reduced by 20% in the next 10 years through land clearing, illegal logging and fires. In addition, forest degradation will reduce the density of the understory vegetation and disrupt the natural age distribution of trees, leading to a substantial loss of habitat".

Whilst fire occurs naturally in DDF and the vegetation exhibits a high-degree of fire-tolerance, this is not true for evergreen elements of the forest mosaic in the region. In this regard, it is worthy to note that fires are prevalent in all the reserves, and may be particularly damaging in Semi-evergreen and Evergreen Forest areas where local people harvest resin from dipterocarp trees. These trees are habitually burnt near the base where the resin is collected and it appeared that this practice had on occasion resulted in more widespread fires that had spread to other areas of understory or may have even killed adjacent canopy and sub-canopy trees. Whilst the dipterocarp trees that produce resin may appear to have survived this burning, there is a distinct possibility that the damage to their roots in the topsoil, and to organisms associated with this layer, may result in the slow die-off of such trees if fires are not controlled. Furthermore, the loss of the understory in Evergreen and Semi-evergreen forest will reduce the capacity for the forest to regenerate naturally and opens up possibilities for invasive species to get a foothold in the habitat. Evidence that exotic *Lantana* has already established in some areas was obtained in Sangkrou Preycheu where some extensive areas of heavily degraded and burnt forest were dominated entirely by this plant.

Table 4.1. Summary of net biodiversity benefits provided by the project.

Without-project scenario	With-project scenario	Net effect
Diversity of forest dependent species, some of which are globally threatened and/or biome-restricted, will remain the same or more likely decrease as forested areas drop below critical sizes.	Reduction of timber loss caused by illegal logging and burning has the potential to stabilize forest cover at near present levels and hence prevent local extinctions and population declines	Positive
	Targeted reforestation with native trees will increase habitat size for forest dependent species. Planned use of NTFPs will encourage sustainable use of forest and an appreciation of need to preserve it.	Positive
Unsustainable use of valuable tree species (those used by local people for timber and NTFP collection) will result in declines or loss of species in	The project will increase the population of important and threatened tree species by using their seedlings in reforestation efforts and	Positive

Without-project scenario	With-project scenario	Net effect
and around the CFs	develop management plans to ensure sustainable use of NTFPs.	
In areas of Semi-evergreen and Evergreen Forest the loss of native trees and hunting of wildlife will lead to local disappearance of seed-dispersing wildlife species such as Oriental Pied Hornbill, (which is heavily hunted in the region) Green Imperial Pigeon and Pileated Gibbon that would otherwise help natural forest regeneration	Patrolling by local people has the potential to reduce the levels of hunting of species such as Oriental Pied Hornbill that are key species for the dispersal of seeds of certain forest tree. Monitoring activities may instill an increased appreciation for wildlife and may reduce the cultural predilection for hunting.	Positive
Populations of threatened species such as Banteng primates and Sunda Pangolins will be severely reduced or locally extirpated through hunting.	Patrolling by local people could reduce levels of hunting to more sustainable levels, and in the long-term may result in levels dropping to near zero for most species	Positive
Increase in disturbed sites due to logging and fire in Semi-evergreen and Evergreen Forest will facilitate the establishment of invasive alien species of plants and animals	Reducing destruction of forest and incidence of fire in non-fire tolerant habitats in the CFs will make it more difficult for pioneer-type invasive alien species to become established.	Positive
Invasive plant species such as <i>Lantana</i> will establish and may become dominant in degraded and burnt areas of Semi-evergreen and Evergreen Forest areas and prevent natural regeneration	Assisted Natural Regeneration measures will include silvicultural practices such as the removal of invasive species.	Positive

4.1.2. Effects of project on High Conservation Values

The project is designed to reverse the trend of forest loss and degradation within the project area through patrolling to deter logging and other illegal activities and through the use of silvicultural treatments designed to enhance and restore native forest habitat. Sustainable use of existing and new NTFPs will encourage and promote forest protection efforts by local stakeholders. Overall, these activities will have a positive effect on HCVs by reducing the pressure on species of high conservation concern within the CFs and by reducing the rate of forest loss in all biomes.

Within a global context, the conservation of Banteng within Sorng Rokavorn is probably the most important contribution to biodiversity conservation that the REDD project can make to species conservation efforts in the region.

4.1.3. Offsite biodiversity impacts

Based on observations and tasks carried out during the biodiversity surveys, the following potential negative offsite biodiversity impacts were identified:

Curtailement or reduction in levels of illegal logging and hunting within the CFs through measures such as patrolling will likely displace illegal loggers and hunters to other sites outside the CFs where there are no checks or controls on their activities. Although several of the CFs contain forests that have large trees, which is good for the carbon value, these forests do not necessarily correspond with quality habitat or that which is best for biodiversity. The habitat within the CFs therefore is not necessarily the most appropriate for the species of interest and even if the species are present within the CF, areas adjacent will act as a constant sink for those species should the hunting continue outside the CF.

In addition, displacement of illegal activities to non-Community Forest locations within Oddar Meanchey could increase the pressure on other areas that are important to wildlife, such as Kulem Promtep Wildlife Sanctuary, which borders Sangkrou Preycheu CF. However, the same or a higher level of protection should be provided to the Wildlife Sanctuary and it is envisaged that all forested areas within the province will inevitably be the focus of illegal logging and hunting (as is already the case in Kulem Promtep Wildlife Sanctuary) regardless of whether the REDD project goes ahead. The project therefore, although potentially temporarily increasing the pressure on adjacent forested areas, should in the long term prevent the CFs from suffering the same inevitable fate, and the displacement potential should not therefore be viewed as a negative impact. Furthermore, it is worth noting that some of these “illegal” activities are currently likely to be carried out by members of the local community who may be positively influenced through their experience of and involvement with the REDD project and who will potentially modify their opinions and behavior with regard to illegal activities.

Demand for timber is likely to increase as human populations and settlements grow within the province and mitigation of forest loss outside of the CFs will require stronger enforcement and protection mechanisms to be put in place by the government or other agencies. Enforcement would likely need to be combined with simultaneous reforestation efforts to be effective. The problem of forest loss in the province is on such a scale that it can be considered to be outside the control of the REDD project. Nevertheless, the REDD project can act as a demonstration project in the region by sharing its experience and expertise in key areas such as forest management through silviculture and enforcement through the patrolling by local villagers, and hence has the capacity to provide a net positive influence of biodiversity and natural habitats in areas outside of the project sites. Furthermore, the fact that the project was borne of a community forest program means that the local communities are already supportive of the project and its outcomes and the realization of benefits from protecting the forest will inevitably encourage more support from additional members of these communities and hence likely reduce the level of illegal activities.

5. BIODIVERSITY IMPACT MONITORING

Biodiversity impact monitoring is an important component in the management of any protected area, including such areas as Community Forests where the key management objective is to keep the area under natural forest cover. It also has an important educational dimension since it has the potential to instill an appreciation for wildlife that may be lacking in the various communities around the CFs. Generating an interest in the wildlife that is present in the various CFs through participation in a monitoring program has the potential to increase the likelihood that conservation efforts will succeed if local people start to see wildlife as something other than a resource for exploitation for trade or sustenance. Providing alternatives to destructive usage of the forest in the form of sustainably harvesting NTFPs and identifying alternative revenue generating practices such as tourism can also encourage the continued support and additional recruitment of community members to the objective of forest protection.

A major difficulty in designing such a monitoring program for this particular project site is the non-continuous nature of the forest patches and their diverse characters. Although all CFs are all within the province of Oddar Meanchey and have historically suffered a similar fate due to exploitation of the forest, including exploitation by the military during the Vietnam occupation and Khmer Rouge era, more recently there have been differences in the level of activity and amount of exploitation within the various CFs. In addition, the clear difference in size and habitat types and quality within the forest patches has a significant impact on the design of a monitoring strategy that will be effective in such a unique CF system.

The four CFs that were the focus of the biodiversity surveys were chosen specifically because of their larger size, location in relation to other existing forest areas, and to ensure sufficient coverage of a represented forest types. Although the total area surveyed represents approximately 50% of the total area of the REDD project, it would be inadvisable to extrapolate the results of the biodiversity surveys to encompass all 13 CFs. The CFs chosen for the biodiversity survey work were identified because of features that would maximize the chance of finding globally important populations of threatened species and good examples of intact wildlife habitats within them. Logically, therefore, some of the smaller CFs that were not surveyed are less likely to encompass High Conservation Values, particularly since they will likely become more isolated in the long-term. The block of four CFs along the western part of the border with Thailand (extending from Prey Srors CF to Yeay Kaov CF) is an exception in this respect because their total area is relatively large¹².

The four CFs surveyed are probably representative of other CFs in the flatter lowlands of Oddar Meanchey but may not be representative of parts of the Evergreen Forests that dominate the escarpment along the Thai border, where six of the CFs are located, including the block of four mentioned above. However, at the present time it is not possible to undertake comprehensive biodiversity surveys along this escarpment and it would probably also be difficult to carry out regular monitoring activities within parts of these areas, as a result of on-going border tensions and the existence of mine fields. Visitors are required to obtain permission to enter the area from the Cambodian military and to take soldiers into the forest. This made it impossible to conduct biodiversity surveys in these CFs during November 2010.

Despite the disparate mosaic of Community Forest patches, a biodiversity monitoring strategy can be designed that is applicable to only the largest CFs where resources have the highest potential for successful implementation and can contribute to positive outcomes for threatened wildlife.

¹² But note that the area is already being affected by an influx of migrants and military families and by the construction of new roads for military purposes

5.1. Devising the Monitoring Program

Despite widespread past and current logging in some places and evidence or reports of exploitation of the fauna, all CFs visited demonstrated some level of continued presence of important species and a keen desire by the local community to protect and preserve what remains. In each of the communities there were at least some members with relevant skills who with the right additional training should be able to identify and monitor a selection of key species of interest within the forest. With sufficient time and resources, these key community members could help others within the community to develop the necessary recognition skills and abilities in order to establish a basic continual monitoring program that can be supported on an annual basis by experts in the field. If well established, the continuous baseline data that the local community could collect would be invaluable for informing an annual survey.

With limited funds available at the outset, the basic tools for monitoring that will be developed during a workshop¹³ are based on the existing skills base and knowledge of the local community. The current species selected for monitoring therefore does not include all those that would be selected to be monitored by a team of fully-equipped scientific experts; however they are key conservation species that are identifiable to a minimally-trained observer and will nevertheless allow immediate collection of valuable information on the biodiversity of the project area. With additional funding for training and equipment it should be possible for the local community to monitor the full list of species detailed in Table 5.2. With the addition of funding through REDD there should be sufficient funds to carry out monitoring in all four of the recommended CFs whilst other CFs will be able to continue basic monitoring activities opportunistically during patrols.

Whilst monitoring systems should ideally be conducted by trained experts, financial and logistic constraints mean that this is not always possible. The suggested strategy, therefore, enables the local communities to immediately start to contribute to the monitoring system whilst providing longitudinal data that would otherwise not be possible. In the long-term, and with additional financial provisioning that would allow for increased training and equipment needs, as well as higher levels of expert input, it should be possible for a local based strategy to include monitoring of all the key species identified to occur within the CFs during this survey period.

Ideally, specific indicators chosen for any biodiversity monitoring program should have the following attributes:

- *Specific* – clearly and directly relating to achieving objectives of monitoring;
- *Measurable* – in a quantifiable way wherever possible;
- *Systematic* – similar results should be obtained whoever carries out assessment;
- *Realistic* – measurable in a cost-effective manner with available resources;
- *Sensitive* – able to change frequently enough that it will be detected by monitoring (preferably at least annually).

Within the context of the REDD project, the monitoring program is required to focus on High Conservation Values such as threatened species and examples of intact natural ecosystems. But whilst it would seem to be fundamentally important to immediately monitor the state of all

¹³ An initial workshop will be held in early January 2011

threatened species within the CFs this is not necessarily practicable since some of these species are too rare or too difficult to detect with basic equipment, and because the tools available to the local people responsible for monitoring are at present very limited. Whilst members of the CF committee's presently own at least one camera and one GPS, they do not have other basic biodiversity survey equipment such as field guides and binoculars or more sophisticated equipment such as digital sound recording gear. Furthermore, even with intensive training, the skills (of local community members) necessary for some monitoring tasks (such as data analysis and interpretation) will remain below the level required, and therefore the level of accuracy needs to be verified by trained experts to ensure the data collection is being carried out effectively.

Successful implementation of biodiversity monitoring and conservation by the project will therefore be reliant on a commitment to provide additional resources in the long-term for data analysis and an annual audit of the on-going data collection. Thus the initial list of species that would make suitable indicators for a provisional monitoring program within the CF sites is limited. In order to undertake a more comprehensive monitoring program over the 30-year project period, not only would funds be needed to provide CF monitoring teams with good-quality binoculars and other equipment, but professional biologists would need to be employed to undertake periodic monitoring activities that employ techniques that only professionals could implement.

Hence an initial, low-budget monitoring program as it relates to species is necessarily constrained by not only attributes of the species themselves, but also by the lack of equipment and technical expertise of the communities who will be responsible for monitoring.

5.2. Which Community Forests to Include in the Monitoring Strategy

With the exception of the largest CF, Sorng Rokavorn at 18,261ha, and perhaps four others that are over approximately 6,000ha (Sangkrou Preychheu, Prey Srong, Romdoul Veasna, Rolus Thom and Andong Bor), the remainder of the CFs are essentially too small to sustain healthy populations of any large mammals and/or provide sufficient habitat for any of the globally threatened birds found during the surveys. Furthermore, most CFs do not have permanent water sources throughout the year, which will have a significant negative impact on the recruitment of large mammals and birds dependent on permanent water resources. The following monitoring program is therefore not recommended for implementation across all 13 CFs for reasons of cost versus benefits.

It is therefore suggested that the monitoring recommendations are implemented, initially at least, only in the CFs most likely to be able to maintain viable populations of the most important mammal and bird species: Sorng Rokavorn, Sangkrou Preychheu, Prey Srong and Andong Bor. In addition, should it become possible to undertake work within the CFs on the Thai border, notwithstanding any risk of mines, four CFs along the northern border form a continuous chain of Evergreen Forest that may be important for certain species and would consequently be worth monitoring. It would not, however be necessary to provide the tools for monitoring to all four community forest committees as monitoring within the largest two (Rolus Thom and Romdoul Veasna) would be sufficient to provide overall biodiversity information for the area.

It would be prudent to implement the monitoring strategy, including the provision of the training and equipment for biodiversity assessment, only in a maximum of six of the 13 CFs, which nevertheless encompass approximately 70% of the total area (Table 5.3). The only additional site that would potentially be worth monitoring in the long run is Ratana Ruka CF. However, when asked about animal presence locals indicated the adjacent Sorng Rokavorn for the presence of the majority of animals reported, and heavy logging activity was observed in Ratana Ruka during the reconnaissance visit in June 2010. It is also more or less surrounded by land concessions which will

inevitably have a negative impact on the forest and its biodiversity. For these reasons it is not recommended that this CF would be worth including in the monitoring program at this time but should encroachment remain low, it may be worth considering including it in the monitoring program in the future.

5.3. Types of Indicator

BirdLife in Indochina (2008) identified three main types of indicator appropriate to a biodiversity monitoring program of the type required for the REDD project:

- *State Indicators:* State indicators refer to the condition of a site, with respect to its important species' populations. State indicators might be population counts of the species themselves. They might also include measurements of the extent and quality of the habitat required by these species.
- *Pressure Indicators:* Pressure indicators identify and track the major threats to important species' populations at the site. Examples include rates of habitat loss or hunting.
- *Response Indicators:* Response indicators identify and track conservation actions: for example, implementation of conservation activities or support to a protected area from other agencies or local communities.

Overall, indicators should ideally be selected that cover all three categories, but for the purpose of the REDD project the most important to put in place at the beginning of the project fall under the categories of state and pressure indicators. Table 5.1 provides an outline of the indicators that are recommended for this project. Whilst most of these indicators are global, in that they apply to all the CFs, Indicator 5 in Table 5.1, "Presence and relative abundance of key indicator species" cannot be prescribed uniformly across the different CFs because there are significant differences between the various CFs in terms of habitat and species composition. Furthermore, as stated above, extrapolation of biodiversity survey results to all CFs is inadvisable, so that in some cases it is not clear if those species recommended for monitoring actually occur in some CFs. It is therefore not possible to choose a meaningful monitoring program based on a single species list that will provide relevant information for all CFs, nor is it recommended that all CFs be monitored in the same way. For reasons outlined above, some CFs are just too small to maintain any viable populations of key species and any monitoring resource provision would have low impact in these areas. It is therefore recommended that the resources be targeted at the CFs where they can be put to the most practical use and that each CF is treated as an individual site for the basis of biodiversity monitoring.

The species chosen for monitoring therefore differ between CFs, being dependent on the predominant habitat type present. For example, Pileated Gibbons would not be monitored in DDF predominant CFs as they are not expected to be found in this habitat and therefore any interpretation of their absence would be erroneous. Table 5.2 shows the species that are considered to be most appropriate to monitor for the different CFs.

Table 5.1. Summary of State and Pressure Indicators for Monitoring Changes in Biodiversity within the CFs of the REDD Project

Indicator	Measurement	Source of Information	Suggested Assessment Interval and Timing	Justification
1. Change in forest area in each CF	Area of and boundaries of natural forest in the CF. [This can only be undertaken by an organization such as Pact with expertise in remote sensing.]	Satellite images;	Every 2-4 years depending on budget available.	Measures the current ecological integrity of the CFs. Decreases in area of forest in any CF denotes loss of habitat.
2. Changes in number of people living within CFs	Number of houses and occupants within CF boundaries	CF monitoring team. Satellite images	CF team on-going. See Table 5.4. Satellite images every 3-4 years	There are already some houses within some CF boundaries and any increase will inevitably lead to ecological degradation.
3. Change in forest quality in each CF	Number of trees >30cm dbh and number of cut stumps in sample plots and along line transects within the CF	Surveys of each transect and sample plots by CF members	Annually in March, when grass is short	These measurements will indicate the level of threat posed by illegal logging, and the effectiveness of the project in addressing this key threat
4. Change in forest area and quality in the surrounding landscape	Area of primary forest, secondary forest, plantation, scrub and agricultural land in the leakage zone [This can only be undertaken by an organization such as Pact with expertise in remote sensing.]	Satellite images	2005 image compared against 2000 image in June 2008, 2008 image will be compared against 2005 image in 2010	This indicator measures the ecological integrity of the leakage zone, the level and intensity of pressure on forested land in the project area, and the effectiveness of the project in addressing this threat
5. Presence and relative abundance of key indicator species	See Table 5.2 for details relating to specific species to be included.	Surveys of each transect by CF monitoring team; Survey for threatened species by professional team if additional funding is available. See Table 5.4.	Transects are surveyed every month by CF members trained to undertake this work. See Table 5.4. <i>Minimum requirements include a GPS and camera.</i> Professional field assessment in key CFs annually.	This indicator measures the biological integrity of the NP, the level of threat posed by illegal hunting and the effectiveness of the project in protecting habitat and species of conservation concern
6. Changes in abundance of key NTFPs in the CFs	Number or density of key NTFPs. See Table 5.4 for full details.	Transects and general observations	Transects or survey plots	Monitoring of NTFPs is an essential component of the initial monitoring program

Table 5.2. Appropriate Indicator Species for Biodiversity Monitoring by Local Community

Habitat Types: DDF - Deciduous Dipterocarp Forest, WF - Wetter Forests (Semi-evergreen and Evergreen Forest), Wet - Wetland habitats.

Residents are those species that do not make longer-distance movements. Other species may only be non-breeding visitor or may regularly move outside CF boundaries in search of water or food resources. *IUCN Red List categories:* CR – Critically Endangered; EN – Endangered; VU – Vulnerable; nTh – Near-threatened.

Requirements: (T) indicates training required to develop identification skills; (E) indicates additional equipment requirements, aside from field guides:

PB – song playback equipment, B – binoculars, CT – camera-trap

Name	Local Name	Habitat	Red List	Traded or hunted?	ID by locals possible?	Resident Y=yes, N-No
Birds						
Black-headed Woodpecker	No specific name	DDF			Y (T)	Y
Great Slaty Woodpecker	No specific name	DDF	VU		Y (T)	Y
White-bellied Woodpecker	No specific name	DDF			Y (T)	Y
White-rumped Falcon	No specific name	DDF			Y (T)(E-PB)	Y
Hill Myna		DDF-WF		Y	Y	Y?
Green Peafowl	<i>Granyaup</i>	DDF		Y	Y	Y
Oriental Pied Hornbill		WF		Y	Y	Y
Siamese Fireback		WF	nTH	Y	Y (T)	Y
Black-necked Stork	No specific name	Wet	nTH		Y (T)	N?
Greater Adjutant	No specific name	Wet	EN		Y (T)	N?
Lesser Adjutant	No specific name	Wet	VU		Y (T)	N?
Vultures	<i>Tmat</i>	DDF-WF	EN		N (T) (E-B)	N?
Mammals						
Banteng	<i>Dom song</i>	DDF-WF	EN	Y	Y (E-CT)	Y?
Gaur	<i>Kting</i>	SEF	VU	Y	Y(T) (E-CT)	Y?
Pig-tailed Macaque	<i>Svar ongkap</i>	WF	VU	Y	Y (T)	Y
Pileated Gibbon	<i>Toit</i>	WF	EN	Y?	Y	Y
Eld's Deer	<i>Romiang</i>	DDF	VU	Y	Y(T) (E-CT)	Y
Sunda Pangolin	<i>Bung roul</i>	DDF-WF	EN	Y	Y	Y
Dhole	<i>Cuon alpinus</i>	DDF-SEF	VU	Y	Y (T)(E-CT)	Y?
Large cats*	<i>Klar tom bong</i> (Tiger); <i>Klar rokun</i> (Leopard)	DDF-WF	CR (Tiger)	Y	Y (T) (E-CT)	Y?

*Tiger (CR) and Leopard (Near-threatened)

Table 5.3. Community Forests and Species to Include in the Initial Monitoring Program

Birds: GP - Green Peafowl; GSW - Great Slaty Woodpecker; WBW - White-bellied Woodpecker; BHW - Black-headed Woodpecker; HM - Hill Myna

WRF - White-rumped Falcon, SF - Siamese Fireback; Adj - Adjutant storks, BNS - Black-necked Stork, OPH - Oriental Pied Hornbill

Mammals: Ban - Banteng, Cats -large cats (Tiger/Leopard), Deer - large deer; PTM - Pig-tailed Macaque; Pil - Pileated Gibbon, Gib - gibbons, Pan - Pangolin

CFs in **red** are those that may be too small to support populations of any of the suggested indicator species in the long-term

? Indicates that the species is not confirmed for the CF: the first monitoring periods will be used to determine if the suggested indicator is present

Community Forest Name	Size (ha)	EF	DDF & Mixed	Non-forest	Monitoring Indicator Species (based on habitat type)
Andong Bor	6,114	0%	97%	3%	GSL, WBW, BHW, WRF, OPH, Deer, Pan, HM
Chhouk Meas	383	79%	19%	1%	CF is considered to be too small to act as a refuge for any of the indicator species in the long term
Dung Beng	1,843	40%	53%	7%	CF is considered to be too small to act as a refuge for any of the indicator species in the long term
Ou Yeay Kaov	960	91%	0%	9%	CF is connected to Rolus Thom: it is recommended that monitoring only be done in the latter
Phaav	2,025	95%	1%	4%	CF is considered to be too small to act as a refuge for any of the indicator species in the long term
Prey Srong	6,344	72%	19%	9%	GSL, WBW, BHW, WRF, ?HM, SF, OPH, Pil, PTM, Pan
Prey Srons	1,605	94%	0%	6%	CF is connected to Romdoul Veasna: it is recommended that monitoring only be done in the latter
Ratanak Ruka	12,733	4%	90%	5%	Not recommended for inclusion in the initial monitoring program (GSL, WBW, BHW, WRF, OPH, HM, Pan)
Rolus Thom	6,443	62%	3%	35%	GP, ?SF, ?HM, Cats, Pan
Romdoul Veasna	6,009	59%	1%	40%	GP, ?HM, Gib, Pan
Samaky	1,079	92%	6%	1%	CF is considered to be too small to act as a refuge for any of the indicator species in the long term
Sangkrous					
Preychheu	4,151	89%	6%	5%	SF, GP, HM, OPH, Ban, Pil, Cats, Pan, Gaur
Song Rokavorn	18,164	9%	85%	6%	GSL, WBW, BHW, WRF, GP, OPH, HM, Adj, BNS, Ban, Cats, Deer, Pan

Over the course of the project life-time it would be expected that, at least on an annual basis, a team of scientific experts would be employed to oversee the implementation of the monitoring plan in order to: (a) verify that the data collection process is working well and, if necessary, provide additional training and feedback; (b) replicate and extend the effort applied to biodiversity assessment in order to provide more robust baseline data; (c) obtain data from the most appropriate season; (d) potentially add additional taxonomic groups that were outside the scope of this initial biodiversity assessment but which would potentially be valuable indicators (e.g. herpetofauna); (e) extrapolate and interpret the longitudinal data collected on an on-going basis; and (f) ensure the management strategy is being effectively implemented from a biodiversity point of view. By providing this additional scientific support it should potentially be possible to obtain quantitative data, given that there will be a greater timeframe in which to collect the information. In addition, the use of mark-recapture within a systematic camera-trapping survey, should also be able to provide a quantitative assessment of populations, if they are suitably abundant.

5.4. Details of Long-term Monitoring Options and Strategy

The current budget available for monitoring biodiversity within the CFs will limit the initial scope to which the recommended strategy can be implemented. This section outlines the long-term monitoring strategy that can be immediately undertaken with details provided in the subsequent 'high budget' section for the recommended additional activities that should form part of an on-going effective monitoring program. When additional funds become available as a result of the REDD validation process, it is strongly suggested that a number of additional monitoring activities be incorporated to the monitoring program, and that professional biologists be involved in such monitoring at regular intervals. There is also a need to extend the database on the fauna and flora within the CFs by undertaking additional surveys in the CFs to establish a more robust baseline that incorporates seasonality, and potentially to incorporate other taxa, in particular herpetofauna (preferably during the wet season) bats, and butterflies.

It is recommended that the long-term monitoring strategy include the following elements, and that responsibilities are assigned as shown in Table 5.4. The majority of these can and should be implemented as soon as possible following the workshop in the first quarter of 2011, as they should not require additional major logistic or financial investment¹⁴ for implementation. It is important that the implementation of these strategies be well synchronized with other aspects of the PD in order to -ordinate activities for maximum efficient and ultimately efficacy.

- **Additional training.** Within the first four months of 2011, a three-day field-based training session and workshop will be required to build on the workshop that will be conducted in January 2011. This should be specifically tailored to the level of financial and logistic commitment possible from the REDD Project implementing agency. Specialists will need to be employed to provide this training.
- **Transect walks by local villagers.** At least once a month¹⁵, local teams should conduct a two-day survey in the selected CFs (Table 5.3) including: **(a) Night survey:** an early morning (4-6am) 'night survey' focused on obtaining direct observations of nocturnal mammal species; **(b) Dawn bird survey:** a three-hour focused dawn bird survey (from just after 6am) to listen for recognizable bird calls and/or sightings as indicated in Table 5.2; and **(c) Opportunistic transect observations:** to observe and record signs of animals and birds including

¹⁴ though it should be noted that basic equipment such as field guides are lacking

¹⁵ once there is sufficient funding this number should increase to twice a month, potentially once each by different observers. Access may not be possible at some times during the year

photographing tracks, marking of waypoints where observations occur, marking sightings of large waterbirds, recording of nesting sites of species listed in Table 5.2. Attempts should be made during the first day and following the night and morning surveys to maximize the total distance searched whilst maintaining a pace that is appropriate for maximizing sighting opportunities. The information from this two-day survey should be recorded systematically in datasheets and notebooks provided.

- **Opportunistic continual data collection.** Each time any member of the CF has a requirement to enter the forest for patrolling or other activities, they should carry with them the camera, GPS unit and a notebook in order to document any sightings of interest (e.g. track from the target species, large waterbirds, calling Green Peafowl or Pileated Gibbon etc.) and mark the location on a GPS unit with the appropriate photograph number. The time and date, GPS co-ordinates, location, photograph number (as it appear on the camera), purpose of visit to the CF and name of observer should also be noted in a notebook dedicated to the collection of information pertaining to the patrols and surveys. This data should be transferred to a 'master' notebook held by the Head of the Community Forest Committee on return from the forest to ensure it is filed appropriately (Section 5.6.1 below provides further details).
- **Initial 12-month mapping of all extant routes and pathways.** All GPS units should be set to record the routes that are covered by the individuals patrolling and surveying within the CF. Initial attempts should be made to walk and thereby record the routes of all trails that exist within the community forest and along its borders. This data can be used to improve the quality and accuracy of existing maps.
- **Initial 12-month mapping exercise.** Collection of records over the initial 12-month period to map existing features of relevance to biodiversity and evidence of historic/current forest usage both illegal and permitted). This will establish baseline values for the level of activity and disturbance to which later records collected during on-going 'threat and usage surveys', as detailed below, can be compared. This should be recorded and noted by marking waypoints for harvesting of NTFPs, the location of resin trees, evidence of hunting (e.g. snares) with details of predicted target species, evidence of recent logging, location and condition of water sources (e.g. water level), presence of non-community members (e.g. visitors from elsewhere), location of settlements and dwellings, agricultural usage (e.g. rice fields) and presence of domestic animals. Attempts should also be made to estimate how recent the activity occurred. Full details should be recorded in a designated notebook.
- **On-going monitoring of forest usage and threats.** During transect walks and opportunistic visits evidence of forest usage (both illegal and permitted) and threats should be recorded and additional locations of features detailed above should be marked as waypoints.
- **Documentation of past hunting.** Efforts to collect photographic records of trophies and other animal remains should be made whenever possible.
- **Data recording at the community level.** A single member of each CF should be assigned the task of maintaining the data sheets and records information from the designated notebooks.
- **Collation of Data.** An assigned member of the REDD Implementing agency should collect all the information from the CFs within the monitoring scheme at least once a month. Tasks would include downloading GPS data (waypoints and routes), photographs and any other information obtained during surveys and patrols, and maintaining them in a database that can be provided to a scientific advisor at a convenient time point.

5.5 Higher-Budget Monitoring Scenario

Whilst villagers can undertake the monitoring described above using a low budget, and start immediately, in the long-term additional funds should be secured to provide a more scientifically rigorous approach. In particular, if concerns about biodiversity conservation are to be taken seriously, it is clear that more comprehensive, periodic monitoring using more quantitative techniques to complement the villager-based work is required. The only sure method to detect population trends for taxa of conservation concern, and to feed back such information into management decisions, is to invest more heavily in additional professional biodiversity surveys and a more rigorous monitoring program informed by on-going consultation with biodiversity specialists.

It is envisaged that elements in the low budget scenario can be immediately implemented with the current resources available and that following the injection of funding in the long-run, additional monitoring aspects that require a higher budget can be incorporated into the strategy. Thus in the long-term, the monitoring program will incorporate not only all the monitoring by villagers that is detailed above, but also the following additional elements:

- **Employment of a trained scientific advisor** - to oversee the entire monitoring program; preferably a Khmer biology graduate who has worked with biodiversity and conservation NGO's and has experience of interpreting biodiversity data and directing a monitoring program. The trained advisor will be dedicated to collating and interpreting the data and providing regular feedback to inform the on-going strategy and to visit the recommended CF sites on a monthly basis. This individual should seek relevant advice, guidance and expertise from the scientific and conservation community.
- **Additional training.** The provision of an additional one-week training session, after the initial 12-month period informed by the mapping exercise, followed by six-monthly two to three-day workshops. These training sessions should include specific field-based teaching that further develops skills and recognition abilities of local villagers.
- **Technical support.** Following the collation of information regarding all trails within the CFs, a more systematic approach to the survey location and repeat coverage should be implemented, including designation and marking of permanent transects. There is a need for significant technical support to set up and manage the proposed transect system.
- **Professional annual bird and mammal surveys.** Additional annual bird and mammal surveys conducted by a team of professional experts to provide more detailed abundance data, and to assess the on-going success of the monitoring program.
- **Camera trapping.** A comprehensive camera-trapping program, implemented by the local community with initial assistance from the scientific advisor would provide unequivocal documentation on the presence and distribution of larger fauna, and for some species, valuable information on minimum numbers and movements.
- **Surveys for other fauna.** Surveys by professional biologists to identify other faunal elements of conservation concern, including for example, bats, herpetofauna and butterflies.
- **Nest monitoring scheme.** Villagers could be involved in active searches for nesting sites of large waterbirds or, for example, Indian Spotted Eagle if it is found in any CF. This could form the basis for both a conservation intervention (paid nest-protection) and a monitoring system for these species.

- **Invasive species assessment.** Identification, mapping, monitoring and selected removal of invasive plant species (e.g. *Lantana camara* and invasive *Acacia* species if they occur) may be an appropriate activity in some instances.
- **Molecular species identification and mark-recapture.** Use of techniques to verify the species of origin of faecal and hair samples collected during routine CF visits and surveys will provide unequivocal evidence of the presence of species that are difficult to identify from signs alone (e.g. Dhole versus Asiatic Golden Jackal). Subsequent routine collection of samples for mark-recapture approaches could be implemented for important species (e.g. Banteng, Gaur and big cats) to provide more robust estimates of population sizes and structure, geographic distribution, movements, individual identification, etc. This would have to be undertaken by qualified population geneticists.



Figure 5.1. The Endangered Green Peafowl is a key species to monitor in the Community Forests where it occurs. Under a low-budget scenario basic data on its occurrence can be collected during transect walks and opportunistic observations. Under a higher-budget monitoring program the population size and area requirements could be ascertained.

(photo: Western Siem Pang, Jonathan C. Eames)

Table 5.4. Summary of Monitoring Activities and Responsibilities with Timeframes

Type of Monitoring	Timeframe	Responsible: Data Collection/ Documentation	Short-term Storage	Long-term Storage	Data Analysis & Interpretation
Low Budget Monitoring Program					
Additional three-day workshop and field training	Within the first three months of 2011, a three-day field-based training session and workshop	REDD Project Implementing Agency and professional consultants hired to conduct workshop	REDD Project Implementing Agency	REDD Project Implementing Agency	N/A
Mapping of all extant routes and pathways	Over the initial 12 month period attempts should be made to walk with a GPS along each path or trail that exists within each CF thereby mapping them	Local CF committee members.	At least once a month, an assigned member of REDD Implementing Agency to visit each CF and download data from GPS units to a laptop computer		REDD Project Implementing Agency to combine into Geographic Information System (GIS)
Mapping Exercise - of extant water sources, forest usage (e.g. resin trees, harvesting of NTFPs), and evidence of illegal activities (e.g. logging, snares, hunting)	Over the initial 12 month period attempts should be made to walk with a GPS along each path or trail that exists within each CF thereby mapping them		At least once a month, an assigned member of REDD Implementing Agency to visit each CF and download data from GPS units to a laptop computer		

Type of Monitoring	Timeframe	Responsible: Data Collection/ Documentation	Short-term Storage	Long-term Storage	Data Analysis & Interpretation
Low Budget Monitoring Program					
On-going monitoring evidence of forest usage and threats (both illegal and permitted)	On a continual basis for the life-time of the Project	Local CF committee members.	One CF member per CF assigned to collect and store data from survey team after each CF visit	REDD Project Implementing Agency	REDD Project Implementing Agency to combine into Geographic Information System (GIS)
Opportunistic continual data collection	On any visit to the CFs, Incidental recording		One CF member per CF assigned to collect and store data from survey team after each CF visit		REDD Project Implementing Agency to out-source identification of photographs of tracks etc. and analysis ³
Transect walks by local villagers	Three different transect routes (totaling a distance of 10K) to be covered per CF. At least once each per month ¹ , Transects to include searches for animal signs and opportunistic observation and recording of bird presence		One CF member per CF assigned to collect and store data from survey team after each CF survey		Dependent on level of expertise of Scientific Advisor may require additional support initially or on an on-going basis from professional scientists or may need to be out-sourced to biodiversity consultants

Type of Monitoring	Timeframe	Responsible: Data Collection/ Documentation	Short-term Storage	Long-term Storage	Data Analysis & Interpretation
Low Budget Monitoring Program					
Night Survey	At least once a month ¹ a mammal survey to be conducted in the three hour period prior to dawn	Local CF committee members.	One CF member per CF assigned to collect and store data from survey team after each CF survey	REDD Project Implementing Agency	Dependent on level of expertise of Scientific Advisor may require additional support initially or on an on-going basis from professional scientists or may need to be out-sourced to biodiversity consultants
Dawn Bird Survey	At least once a month ¹ a bird survey to be conducted in the three hour period post-dawn, transects should be walked at a rate of 1km/hr				
Active Search for nests of important species	Following 2nd workshop, one search day every month during the nesting season for appropriate species				Information to be passed on by Scientific advisor to professional organization
Documentation of past Hunting	On a continual basis for the life-time of the Project		One CF member to be assigned the task of collating this information		To be passed on to professional service provider on an annual basis as part of the professional bird and mammal survey

Type of Monitoring	Timeframe	Responsible: Data Collection/ Documentation	Short-term Storage	Long-term Storage	Data Analysis & Interpretation
Higher-budget Monitoring Program					
Additional Training	Initial one week session after initial 12 month period	REDD Project Implementing Agency	N/A	N/A	N/A
On-going training	From January 2012, one 2-3 day workshop to be held every 6 months	REDD Project Implementing Agency	N/A	N/A	N/A
Camera trapping	Camera traps should be placed out at relevant locations and data cards exchanged every two-weeks. In the first 12-months - to locate the most relevant sites, camera-traps should be moved to new sites once a month	Local CF committee members (initially with assistance from professionals).	One CF member per CF assigned to collect and store SD cards until downloaded to a laptop (once a month)	REDD Project Implementing Agency	Initial sorting of photos could be undertaken by the REDD Implementation agency. Identification of species captured on film etc. will require consultation of relevant skilled individuals from other agencies.
Invasive species assessment	Annually if funds become available	Local CF committee members	N/A	N/A	REDD Project Implementing Agency

Type of Monitoring	Timeframe	Responsible: Data Collection/ Documentation	Short-term Storage	Long-term Storage	Data Analysis & Interpretation
Higher-budget Monitoring Program					
DNA mark-recapture Program	Collection and storage of faecal samples on an on-going basis during CF visits. Collection of samples every month	Local CF committee members	One CF member per CF assigned to collect and store samples from survey team after each CF survey	REDD Project Implementing Agency ²	Organization/ individual with required skills.
Green Peafowl surveys	Following training to be conducted on an annual basis with intensive efforts at correct time of year (Feb-March)				
Pileated Gibbon mapping	Following training, continuous records collected by CF, and annual assessment as part of professional monitoring by team of scientific experts				

Type of Monitoring	Timeframe	Responsible: Data Collection/ Documentation	Short-term Storage	Long-term Storage	Data Analysis & Interpretation
Higher-budget Monitoring Program					
Nest Monitoring Scheme	Continual paid protection - exact timings to be decided through consultation with an organization with experience of implementing these schemes	Local CF committee members	One CF member per CF assigned to collect and store samples from survey team after each CF survey	REDD Project Implementing Agency ²	If considered to be worthwhile - Would require involvement and potentially funding from a professional conservation organization for initial set-up and implementation
Annual professional bird and mammal surveys	Following training, continuous records collected by CF, and annual assessment as part of professional monitoring by team of scientific experts	Organization/ individual with required skills.	Organization/ individual with required skills.	Organization/ individual with required skills.	Organization/ individual with required skills.

Notes relating to superscripts in Table:

1. Once there is sufficient funding this number should increase to twice a month, potentially once each by different observers. Access may not be possible at some times during the year.
2. A dedicated individual to collect data sheets and download from cameras and GPS from each CF, at least once per month.
3. Scientific Advisor overseeing entire monitoring program and seeking relevant advice, guidance and expertise from the scientific and conservation community

5.6. Requirements for Implementation of the Biodiversity Monitoring Program

The following section outlines the requirements for successful implementation of the monitoring program. It also sets out a clear indication of the level of CF Committee and REDD Project Implementing Agency commitment in order to achieve the goals outlined in table 5.4. Details are provided for both a low and higher budget scenario, summarized in Table 5.4.

5.6.1. Minimum commitment and requirements for successful implementation of the initial plan:

1. brief training of those responsible for data collection with emphasis placed on existing skill sets to develop an effective monitoring strategy for certain key, easily identifiable species
2. allocation of small budgets to cover costs of necessary supplies such as batteries for GPS units, the provision of faunal guides (e.g. Suon Phalla 2002, Tan SETHA & Poole 2003, Walston 2008) and dedicated field notebooks.
3. assignment of an individual to oversee data collection and storage who will be responsible for:
 - regular data compilation from field workers and careful data storage by the REDD Project implementation agency;
 - identifying 'best-practices' for data collation and storage: data collected in the field will need to be stored in one location for each CF and organized in a meaningful way. It is essential to identify a systematic data management process for: data collection – transfer – storage – analysis;
 - provide feedback to the CFs on the 'best practices' and designate the most appropriate timeframe for data compilation;
 - identifying problems in data collection that can be rectified.;
4. identification of requirements for data analysis and interpretation - This will require the REDD implementation agency to identify appropriate organizations or individuals who have the necessary skills for the analysis and interpretation of the biodiversity monitoring data;
5. assignment of responsibilities for the monitoring activities and stages of data management. Effective response to any problems that are identified at any stage of the process will require a feedback system that is capable of reaching those villagers who are collecting primary data in the field. Table 5.4 outlines the recommendations for who should be responsible for the various activities relating to the monitoring process, as well as timeframes.

Following the injection of additional funding to the project, successful implementation of the additional monitoring aspects will require:

6. increased equipment provision for the local teams that are collecting the primary data, such as good quality binoculars, camera-traps and sound playback equipment;
7. provision of additional field training and development of monitoring activities to include additional species of importance (such as any important herpetofauna, invertebrate or aquatic species that are found in the CFs);
8. commitment to annual professional biodiversity surveys and out-sourcing of analysis and interpretation where appropriate to ensure the integrity of the data being collected;

Once both the low and higher budget elements are implemented, it should be possible for the local data collection teams of non-scientific observers to collect information on all key species identified to occur within the CFs visited by the field team during November 2010.

5.7. Details of Specific Monitoring Activities

Table 5.5 suggests the most appropriate field methods to employ for monitoring selected indicator species. The following sections provide detailed information relating to the monitoring methodology that is recommended.

5.7.1. Incidental recording of key species

Members of the CF regularly enter the forest to patrol or to collect NTFPs. It would be pragmatic to take advantage of such activities by using them as a means to collect anecdotal biodiversity information that will form an important part of the monitoring of biodiversity at the sites. Some of the animals of highest conservation concern are so rare that they may not be recorded during standardized transect data collection, but they may be occasionally encountered at other times. It is therefore recommended that members of the CF routinely carry their GPS¹⁶ and camera when they enter the forest as well as data recording sheets or a notebook specifically designed to ensure that all necessary data is collected.

During visits to the forest, CF community members should be encouraged to (1) note down sightings of any species of bird or mammal of conservation concern, (2) take appropriate photographs of animals and tracks of mammals of particular concern, such as large ungulates, large cats, bears or Sunda Pangolins. These species are shy and are usually only detected by the tracks and signs that they leave behind. If funding is available, it is recommended that plaster casts be made of all tracks of large cats and bovids that are found in the CFs since casts ensure that the local villagers record the ridge detail of the tracks that may be missed with photographic evidence alone, thus making it easier to assign them to a particular species.

5.7.2. Standardized recording of target species along transects

A monitoring strategy would have to take into consideration the risk from mines. From a biodiversity perspective, mine clearance would not be recommended as it would be damaging for the forest and in some areas the mine risk appears to have been providing protection to the forest. For example, in the northern part of Sorng Rokavorn where there is a perceived mine risk by the locals, as indicated during interviews, there also appears to be less logging activity, although due to the mine risk this perception is based on observations from outside the forest alone.

Table 5.2 provides a list of target species that should be the focus of monitoring within the CFs during the early phase of the project. As stated above, some of these species are rare and/or elusive or only likely present in a small subset of CFs, meaning that their presence may only be detected infrequently during data collection along standardized transects. Species falling into this category are Black-necked Stork, adjutants, vultures (in the case of the latter, its occurrence has not yet been confirmed for any CF), large cats, large ungulates (bovids and large deer), and Sunda Pangolin. Other species are known to be relatively common in some of the CFs and all are suitable for monitoring purposes because (1) local people can already recognize them or can be trained to recognize them (2) they can be identified without the need for sophisticated equipment, (3) changes in their status will provide meaningful information on changes in habitat variables.

¹⁶ It is recommended that all CFs be provided with the same model as a means of simplifying training and data analysis. In this regard, the Garmin GPSmap 60CSx is considered to be ideal.

Table 5.5. Suggested Survey Methods for Selected Indicator Species

Habitat Types: DDF – Deciduous Dipterocarp Forest, WF - Wetter Forests (Semi-evergreen and Evergreen Forest), Wet - Wetland habitats

Audio indicates that the species can be detected by voice, whilst playback indicates that playback of the species' vocalization can be used to find it.

Name	Habitat	Sight	Audio	Playback	Tracks*	Camera Trapping	Potential Confusion Species
Birds							
Black-headed Woodpecker	DDF	✓	✓	✓			other woodpeckers
Great Slaty Woodpecker	DDF	✓	✓				other woodpeckers
White-bellied Woodpecker	DDF	✓	✓				other woodpeckers
White-rumped Falcon	DDF	✓	✓	✓			
Green Peafowl	DDF	✓	✓				none
Oriental Pied Hornbill	WF	✓	✓				None likely except Great Hornbill near Thai border
Siamese Fireback	WF	✓					Red Junglefowl
Black-necked Stork	Wet	✓					other storks, cranes
Greater Adjutant	Wet	✓					other storks, cranes, vultures
Lesser Adjutant	Wet	✓					other storks, cranes, vultures
Vultures	DDF-WF	✓					eagles/raptors/adjutants
Mammals							
Banteng	DDF-WF	✓			✓	✓	domestic cows, Gaur, large Sambar (tracks)
Gaur	WF	✓			✓	✓	domestic cows, buffalos, Banteng (tracks)
Pig-tailed Macaque	WF	✓			✓		Long-tailed Macaque
Pileated Gibbon	WF	✓	✓				None
Eld's /Sambar	DDF	✓	✓		✓	✓	Hog Deer (tracks, sightings), young bovids
Sunda Pangolin	DDF-WF	✓			✓	✓	None
Large Cats	DDF-WF	✓			✓	✓	other cats

**NB in the majority of cases, tracks are non-confirmatory, but provide a good indication of locations for camera-trap placement*

It is important to note that separate transect walks are required for the various survey activities, as it is not possible to focus on all elements at the same time. Separate time periods and/or survey teams are therefore, required to conduct dawn bird transects and direct observation night surveys for mammals, whilst general observations for birds, surveys for signs and playback could be combined together at a subsequent time period. Each survey requires a different “search image” and different time frames. Transects for birds should be walked from just after dawn, at a recommended pace of about 1km per hour, and should last about 3 hours in total, and direct observation night surveys should be conducted during the hours of darkness (preferably in a 3 hour window following dusk or prior to dawn). There is however, no time limit for undertaking a mammal survey for signs since the main activity is to locate and record faeces and footprints, nor for noting general observations or conducting playback. Surveys can, nevertheless, be carried out along the same routes at the different time periods, provided that attempts are made to avoid destroying signs under foot.

5.7.3. Selected indicator species

The following paragraphs provide the justification for including the various species (Table 5.2) in the monitoring program. Although decline or changes in an individual species may not necessarily be a specific indicator of threats and/or pressures on the ecosystem, taken in combination changes in the rates of observation of several species may be of biological significance.

Great Slaty Woodpecker. This species is listed as Vulnerable by IUCN and is therefore of conservation concern. It was found in all CFs that were surveyed for more than one morning. It is a large gregarious species with large (though undocumented) area requirements that vocalizes regularly with very distinctive call and therefore, should be easily recognizable after minimal training. Changes in abundance of this species may be expected to occur if the area of DDF habitat is significantly reduced. However, it is probably a long-lived species so populations could potentially persist in CFs even if no longer viable.

Black-headed Woodpecker. This is a gregarious woodpecker that is largely restricted to DDF and is easily found in areas where DDF habitat is in reasonable condition. As with Great Slaty Woodpecker, it is presently widespread in the CFs with this habitat and its presence is easily detected because it has a distinctive voice and conspicuous behavior. If detection rates of this species decline dramatically during transect walks it could indicate habitat degradation or loss.

White-bellied Woodpecker. This woodpecker is also easily detected by voice and easy to identify by sight. It can be found in all forested habitats within the CFs. Like Great Slaty Woodpecker, this is a large woodpecker with large range requirements. Declines in numbers within the CFs where it presently occurs may indicate degradation of suitable habitat since, like Great Slaty Woodpecker, it needs larger trees for breeding.

White-rumped Falconet. This is another biome-restricted species that is confined to DDF. It is considered to be Near-threatened by IUCN and hence would be appropriate to include in the monitoring program. It is a tiny raptor that occurs in the canopy of DDF but if its vocalizations are learnt it can be detected during transect walks. In addition, it is very responsive to playback of its call, so in an ideal monitoring program playback using an mp3 player with small speakers at 300m intervals would provide a good picture of its distribution and abundance within the CFs in DDF habitats. It can probably survive in fairly small areas of DDF forest, since it is a small raptor, but it appears to be associated with habitat of relatively good quality, so a decline in abundance may indicate deteriorating habitat quality.

Oriental Pied Hornbill. This is the only hornbill that was detected in any of the CFs visited and is easily recognized by local people. It prefers areas where there are patches of Semi-evergreen and Evergreen forest, particularly near water. It is gregarious and noisy, so easily detected once its voice is known. Local people regularly hunt this species; the biodiversity team saw the recent remains of at least five individual Oriental Pied Hornbills at four different camp fires in Sangkrou Preychheu and Prey Srong. Monitoring the encounter rates of this species along transects could therefore provide an insight into both loss of suitable habitat and into hunting. Wing and tail feathers of this species are easily identified at camp fires and can be recorded when encountered to give a measurement of on-going hunting.

Hill Myna. This is a popular cage bird and captive individuals were observed in several villages around the CFs. Whilst it is a widespread species with a large global distribution and is not considered globally threatened (BirdLife International 2009b), it is probably under considerable trapping pressure in Oddar Meanchey. This would explain why it was only found to be relatively common in Sornng Rokavorn, with transect encounter rates of up to 0.43 encounters/hr/km and one sighting of a flock of 24 individuals¹⁷. Elsewhere, it was only recorded during one transect count, at Sangkrou Preychheu where one bird was seen on one transect walk. It was not detected in any other CFs visited during the surveys, although distant birds may have been heard in Andong Bor and it may well be present in the area at low densities. Based on its habitat requirements, it also seems likely that the species occurs in the block of four CFs along the Thai Border and in the Semi-evergreen Forest patches around water sources of Ratanak Ruka.

Siamese Fireback. This is a near-threatened terrestrial pheasant species that appears to still be widespread in Semi-evergreen and Evergreen Forest habitats. Like other *Lophura* pheasants in the region it is likely quite resilient to low levels of hunting and logged habitats, but it would be unlikely to survive in areas that have been substantially opened up by logging and subsequent burning of the understory. Monitoring its occurrence along transects that run through Evergreen and Semi-evergreen Forest areas could therefore provide an indication of hunting levels and habitat quality, particularly as it pertains to the all-important understory of seedlings and regeneration potential. Its footprints are fairly distinctive (Figure 5.2) but could be confused with those of Red Junglefowl. Those involved in the monitoring program need to be aware of this confusion species and clear about identification features of both species in the field.



Figure 5.2. Footprint of Siamese Fireback from Sangkrou Preychheu. (Vittoria Elliott)

¹⁷ This would be an exceptional sighting anywhere in its range and suggests the presence of a robust population in this CF.

Black-necked Stork, Greater and Lesser Adjutant and vultures. None of these species may be resident in any of the CFs, although at least one village informant near Sorng Rokavorn mentioned that in the past trees had been felled to obtain the chicks of breeding storks. Nevertheless, all of these species are considered to be threatened so any records of them in any CF would be significant and worth recording. In the long-term, systematic recording of sightings would enable the project to identify where they regularly feed, the seasonality of visitation and whether or not there are small breeding populations in the CFs or surrounding areas. Such information can be fed into existing Cambodian-wide conservation efforts for these species. Vultures (most likely the Critically Endangered Red-headed Vulture *Sarcogyps calvus*) were reported to have been seen at a carcass just to the south of Sorng Rokavorn in 2009 and confirmation of their presence and specific identity in the area would make a useful contribution towards the vulture conservation projects being undertaken by WCS Cambodia and BirdLife International in Indochina.

Pileated Gibbon. Gibbons are very easy to detect by voice and ideal for monitoring through fixed point transects. They are confined to Semi-evergreen and Evergreen Forest areas. Declines in encounter rates over time will indicate hunting pressures and/or loss of suitable habitat.

Northern Pig-tailed Macaque. At least two species of macaque occur in the REDD project area, Long-tailed and Pig-tailed. Local people who regularly work in the forest and ex-hunters are well aware of the differences, which are partly behavioral (Northern Pig-tailed Macaque is much more terrestrial in its habits). Hence this species is a good choice for monitoring. Declines in numbers could indicate hunting or loss of Evergreen and Semi-evergreen Forest habitat.

Banteng. Populations of Banteng in Southeast Asia have declined so significantly that the species is now considered to be Endangered (Timmins *et al.* 2009). Any sightings or other evidence of this species within the 13 CFs is therefore of global significance. During the biodiversity surveys evidence was collected that indicated the presence of at least one herd of Banteng that was using parts of the Sorng Rokavorn CF. Ideally, longer term surveys can be undertaken to determine the exact number of animals involved and to devise the best methods to monitor this population. Confirmation of the existence and herd size within the other CFs where Banteng was detected would also be a positive outcome of a monitoring strategy. Although tracks can be used to indicate presence and distribution, such tracks can be confused with those of cattle, Gaur or even large Sambar, and the use of more sophisticated monitoring techniques, such as use of camera-traps, should be considered as an additional monitoring tool in the long term.

Within a global context, the conservation of Banteng within Sorng Rokavorn is probably the most important contribution to biodiversity conservation that the REDD project can make to species conservation efforts in the region.

Gaur. Tracks of this species were seen in Sangkrou Preychheu and local people reported seeing several animals. In view of its conservation status, this species should be a target species for the monitoring program in this CF. However, it seems likely that the Gaur in Sangkrou Preychheu are dependent on the persistence of forest to the south of the CF, and since the forest in this area is part of a land concession and is due to be converted, the likelihood of a small population of Gaur surviving in the long-term is minimal. Population sizes may be too low for monitoring activities to detect changes in population sizes.

Eld's Deer and Sambar. Since there is no unequivocal evidence for the occurrence of Eld's Deer (Figure 5.3) within the CFs, any sightings of larger deer should be carefully documented. It seems highly likely that some of the larger deer tracks seen in Andong Bor (perhaps all), and perhaps in Sorng Rokavorn, relate to Eld's Deer but verification is needed. Although a population of Eld's Deer is

more globally significant, presence of either species of large deer is of conservation importance and therefore monitoring of large deer from track nevertheless provides important information. In the long-term, the use of camera traps may be the best way to verify which deer species occur within the CFs. Changes in populations of large deer will most likely reflect changes in hunting levels.

Large cats. Local villagers reported sightings of large cats in several CFs but no unequivocal evidence was obtained to verify which species they had observed. Since most of their observations were made at night without good flashlights, or in the day with no binoculars and their ability to distinguish prints was highly questionable, claims of Tiger as opposed to Leopard must be treated with great caution. Tiger has become so rare in Cambodia as a result of targeted hunting that there have been no confirmed sightings or camera trap photographs from any sites for several years. The only recent records relate to tracks, many of which fall within the size range of a large Leopard. Hence any sightings of large cats need thorough documentation, and good photographs that include an object for easy size comparison should be taken of any large cat prints found within the CFs. Ideally, plaster casts of any large cat prints should be made in addition to photographs. Population sizes may be too low for monitoring activities to detect changes in population sizes.



Figure 5.3 A male Eld's Deer photographed in Western Siem Pang (Jonathan C. Eames). Confirmation that this species occurs within any of the CFs should be a priority for monitoring and the use of camera traps would assist greatly in this undertaking.

Sunda Pangolin. According to villagers, hunting pressure has reduced populations of pangolins to very low levels in all the CFs visited, although some probably survive. Clear prints, especially of the front foot, are distinctive and should be recognizable to local people undertaking monitoring. Population sizes may be too low for monitoring activities to detect changes in population sizes.

Dhole. Interviews and surveys suggested the presence of Dhole within several of the CFs. Although tracks from wild dogs are too easily confused with those of domestic animals, the presence of tracks can be used to inform camera-trapping placements, which can thus confirm the identity of the canid

species at the sites. If confirmed to be of this species, it would be worth considering including it in future monitoring.

There are of course many other species of mammal and bird within the CFs (as well as faunal elements not surveyed during November 2010) that could potentially be incorporated into the monitoring program. However, the majority of species can not readily be identified by local people (most birds for example) and for the majority of the commoner mammals such as Eurasian Wild Pig, Burmese Hare or Northern Red Muntjac that can be recognized by track, faeces or sighting, it would not be clear how to interpret changes in abundance detected through monitoring. Very robust population estimates would be required to detect changes in population sizes because where they occur they are usually numerous. These species are regular prey items for several taxa and are therefore biologically predisposed to support high levels of predation and as such it would seem logical to assume that they can also sustain relatively high human hunting pressures. Tracks of other mammals, such as wild dogs and smaller cats are too easily confused to be of use in the low-budget monitoring program.

Nevertheless, the list of species that can be monitored within the 'higher budget' scenario could be expanded to include all bird and mammal species considered to be of conservation importance. Due to the brevity and timing of the field survey period in November 2010, there is potential that certain bird and mammal species of importance that would otherwise be included in a monitoring strategy may not have been observed. Species that may have been missed and that might be worth monitoring include, for example, Binturong *Arctictis binturong*, White-winged Duck, White-shouldered Ibis, Indian Spotted Eagle, Great Hornbill *Buceros bicornis* and Coral-billed Ground-Cuckoo *Carpococcyx renauldi*.

5.7.4. Green Peafowl surveys

Green Peafowl are an ideal species for a monitoring program because they are well-known, seasonally vocal and easy to identify. The biodiversity surveys identified three CFs in which Green Peafowl still occur, although perhaps only Sorng Rokavorn supports a good population. Green Peafowl can be monitored within these three CFs by simply recording their presence at a particular location on a particular date (and where possible, recording group size) during the initial low-budget monitoring program.

Once more funding is available, they can be monitored using the method outlined in Brickle *et al.* (1998)¹⁸. During the surveys no baseline data could be collected on this species because they were not calling. Training for surveys that target Green Peafowl and the surveys themselves can only be carried out when the birds are calling, mainly from January to March. Such surveys need to cover relatively large areas of the CFs if they are to be meaningful. Collection and analysis of data may require input from a professional biologist.

5.7.5. Mapping of individual Pileated Gibbon groups

Pileated Gibbons are very vocal during the early morning, so that this species can relatively easily be detected. Hence it is possible to map the location of calling individuals quite accurately, and in doing so, provide the baseline data for monitoring the "fate" of each group. Collecting the baseline data to map the location and range of each group would require a concerted periodic census effort over several months at the sites where this species occurs. Breeding success and survival of young

¹⁸ Surveys used the distinctive calls of this species to identify distribution by carrying out surveys for Peafowl at the time of maximum calling of male Peafowl, in the period prior to and including the breeding season.

animals could also be monitored if binoculars were available to those undertaking monitoring activities.

5.7.6. Use of camera traps at key sites

Digital camera traps can be deployed at key sites within the CFs in order to, for example (a) clarify which species of large deer occur at which sites, and (b) to help ascertain the number of individuals of species at specific sites, such as Banteng in Sorng Rokavorn. Digital cameras such as the Bushnell Trophy Cam Trail Camera are ideal for long-term monitoring since one set of top quality alkaline batteries is sufficient for the camera to be deployed for several months, and because this particular camera uses infra-red rather than a flash to take pictures at night. The information gained from the use of such cameras could be used to provide input into management programs for the individual CFs to ensure that they take account of the needs of threatened species.

5.7.7. Monitoring the distribution and extent of *Lantana*

As mentioned above, *Lantana camara* is an invasive shrub that has the potential to adversely affect forest regeneration over large areas as well as impact negatively on agriculture. In the long-term, it would be advisable to include this species in the monitoring program and to make efforts to destroy it wherever it gets a foothold. Increases in areas dominated by this species would clearly indicate that habitat is being degraded through logging or burning.

5.8. Note on Interpretation of Monitoring Results

Although no studies have been undertaken to specifically show that extinctions will occur naturally in smaller areas of forests in Oddar Meanchey, evidence has shown that localized extinctions do occur in other forest types in the region as a result of degradation and isolation (e.g. in lowland Sundaic rain forests: Lambert & Collar 2002). Hence, as forest cover decreases in Oddar Meanchey, it can be expected that some species will be lost from smaller CFs over time even if the forest within the CFs remains intact and undisturbed. Interpretation of monitoring results over the 30-year project period therefore needs to take account of what is happening on the borders of each CF: declines or extinctions of some species within the smaller CFs may only be prevented in the long-term if conservation actions are prescribed and implemented in forests outside of the project area. It also needs to be recognized that some species within the CFs, such as large cats, may already be doomed to extinction since local populations may be too small to be viable. It needs to be understood that just because a species is present in a CF does not mean that it is able to reproduce.

6. RECOMMENDATIONS

The following list of recommendations relate mainly to simple steps that can be taken to help protect HCVs within the CFs of the REDD Project:

- Limitation of domestic animals within the CFs:

Ideally a complete ban of domestic species from the CFs would be the only way to use track to monitor the wild cousins of these species. Realistically it is not going to be possible to place a complete ban. For cattle and buffalo - as long as animals are kept along paths and not allowed to wander off uncontrolled it should be possible to gain some idea of their presence followed up with confirmation from camera trap evidence. For dogs however it would be difficult to rely on any track-based information with domestic and potentially also fertile dogs accessing the CFs. If there is any possibility that dogs can be controlled so that they are not wandering off pathways this could help but will require some discussion of feasibility and desire within the community.

At present it would not be possible to designate exclusion zones as although it is known where animals were observed during the surveys of November 2010, they could have been present elsewhere at this time and just not seen. In addition, this only represents where they were during November, which does not mean they are not present elsewhere at other times of the year. Future discussions with community forest members should focus on identifying what may or not be possible in terms of restricting access of dogs or other domestic animals. Potentially as more data is accumulated for the forests it may be possible to provide some sort of designation of areas that are less important for wild animals and where access could be allowed. The recommendation is therefore to attempt at present to minimize access as follows:

- Villagers should be discouraged from taking their dogs into the central zone of the CF areas because dogs may spread disease to wildlife, may be used for hunting and may compete for food with native fauna;
- Villagers also should be discouraged from grazing cows in parts of any CF where they might come into contact with Banteng because of the risk of disease transmission and/or interbreeding. With the considerations detailed above, attempts should be made to limit grazing from within the heart of the CFs and the experience of the field team suggests that this should be possible. At the very least, restricting domestic bovids to the main pathways and not allowing them to wander off unattended will help with track identification off the trails.
- Villagers should be discouraged from moving their cows and buffalo through the CFs because such animals are often dispersal vectors of introduced plant species;
- Villagers should be discouraged from using electric fencing in the CFs to protect their rice fields from wildlife since the current in such fences is sometimes sufficient to kill animals as large as deer (and also, presumably, humans).
- Strict provisions against hunting should be enforced within the CFs through a process of continuing patrols. If possible it is recommended that powers be given to the local CF patrol teams to stop any illegal activities that they see occurring in the Community Forests. The CF committee involvements should help with reducing threats (from them at least) and the more people who are involved with the monitoring and patrolling the fewer people will be likely to hunt.

- Nest protection and protection of breeding areas could be implemented with additional financial support and following efforts to locate nesting sites. Protection schemes have been implemented successfully in other conservation areas and potentially could be incorporated into the monitoring strategy in Oddar Meanchey with guidance from experienced specialists.

Other Recommendations:

- Sorng Rokavorn CF should be added to the network of IBAs recognized by BirdLife International. This will increase the international profile of this particular site;
- The maps of CFs contain errors, particularly in relation to the location of tractor tracks through the CFs. Although these roads may change their courses from year to year, most of the major tracks are stable and it would be relatively easy to map them by using a GPS that can record the tracks;
- The implementation organization should consult botanical specialists for selection of sites and strategy for implementation of the silviculture and reforestation activities proposed.

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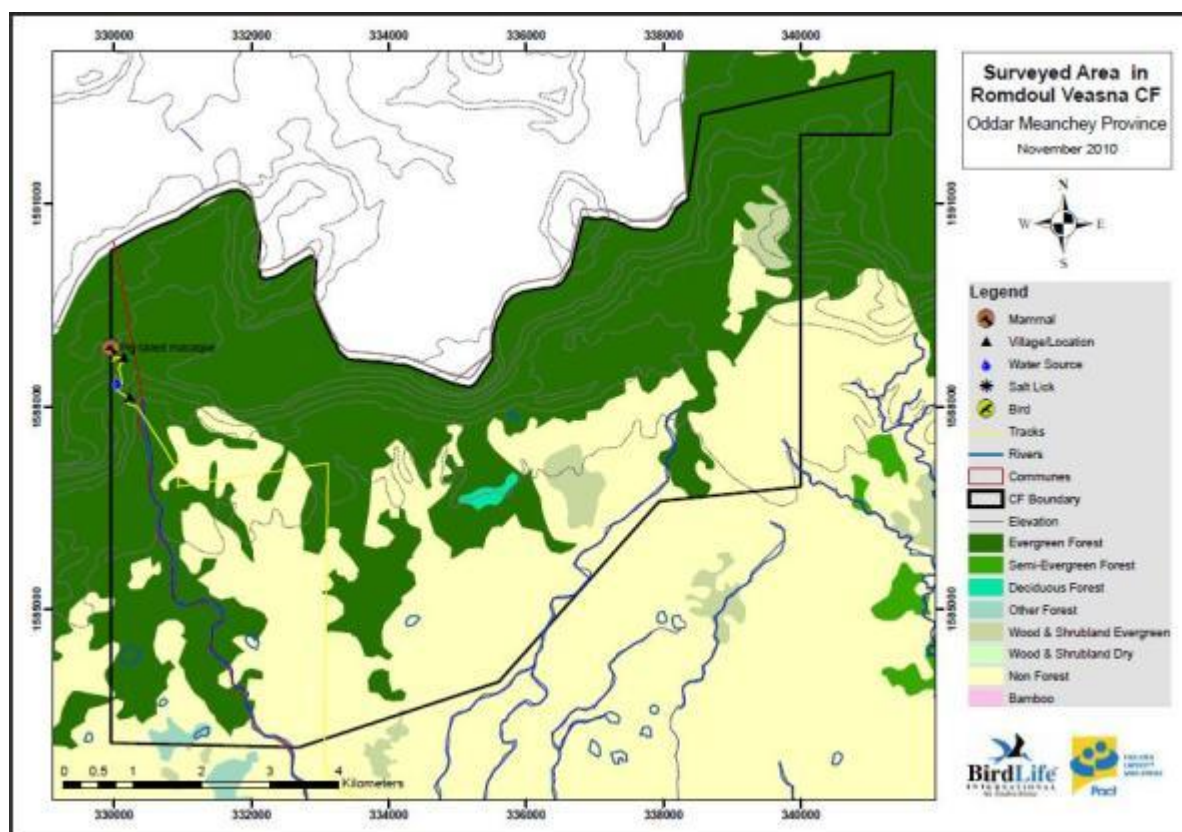
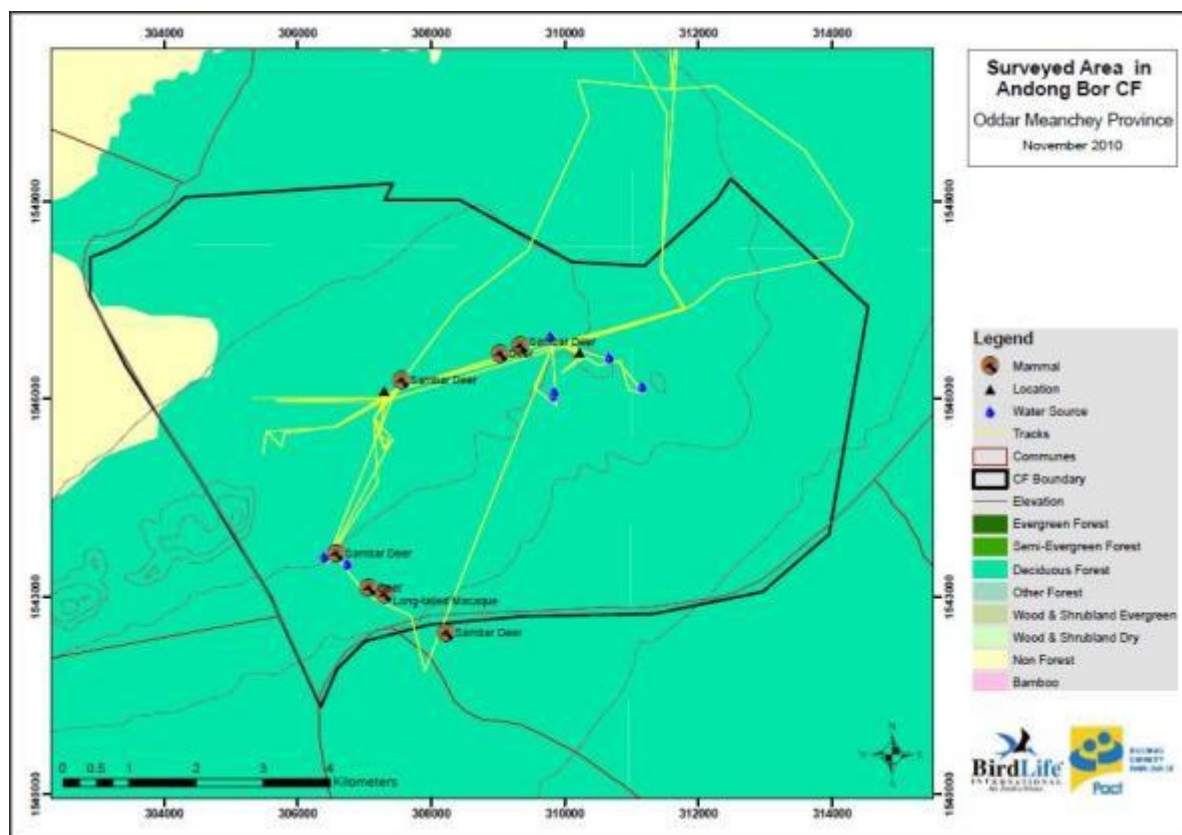
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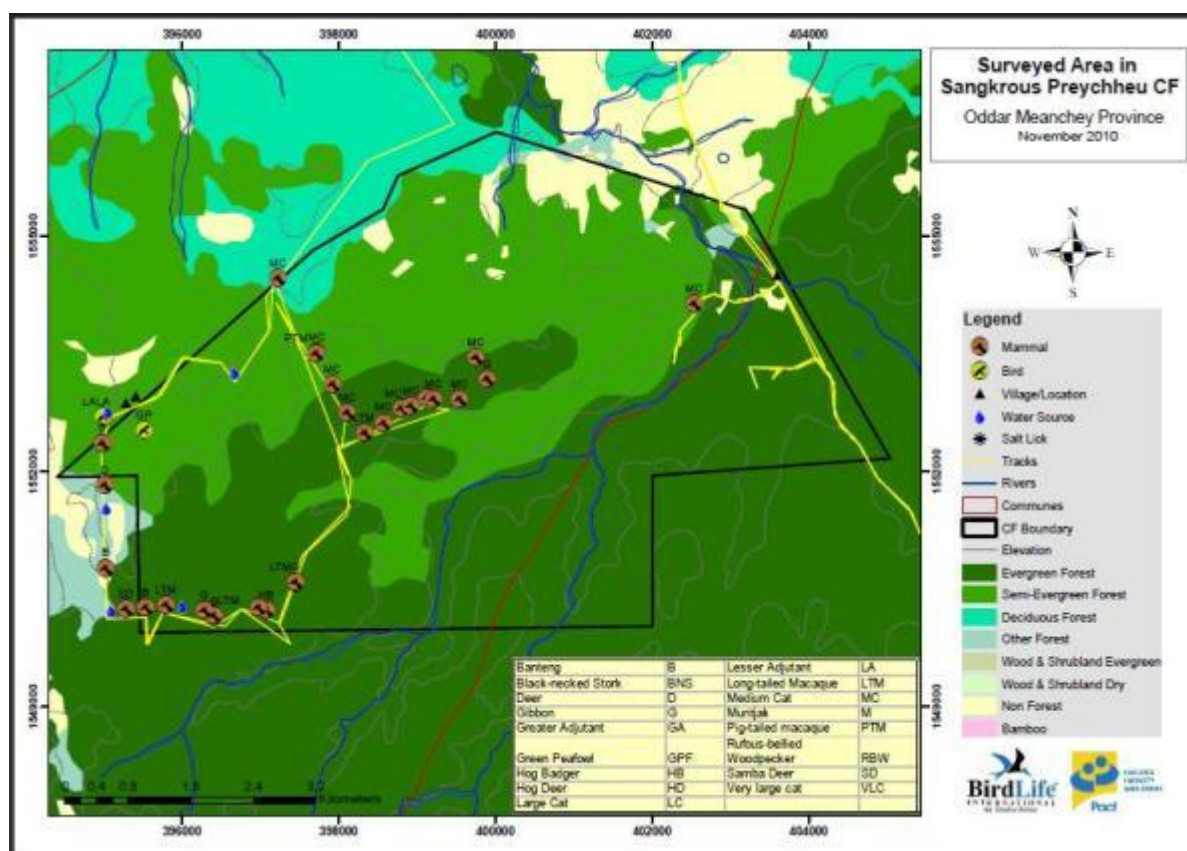
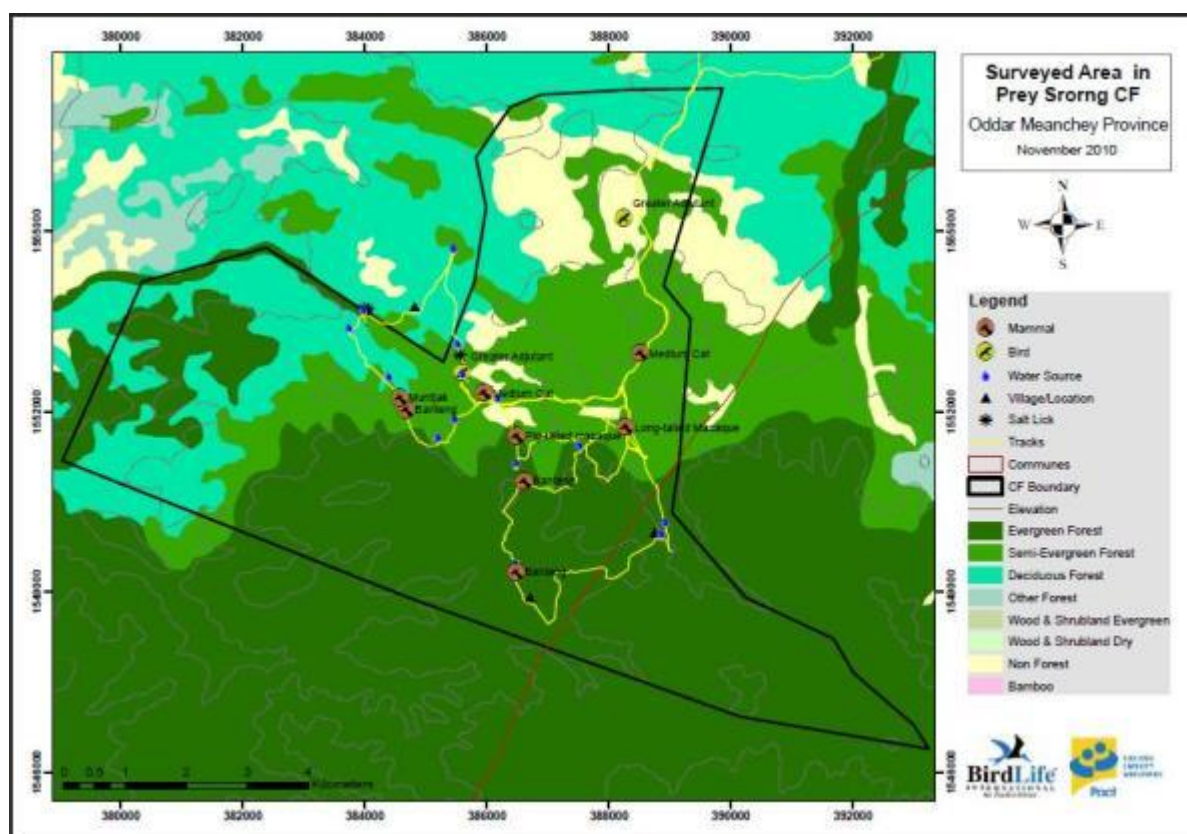
8. APPENDICES

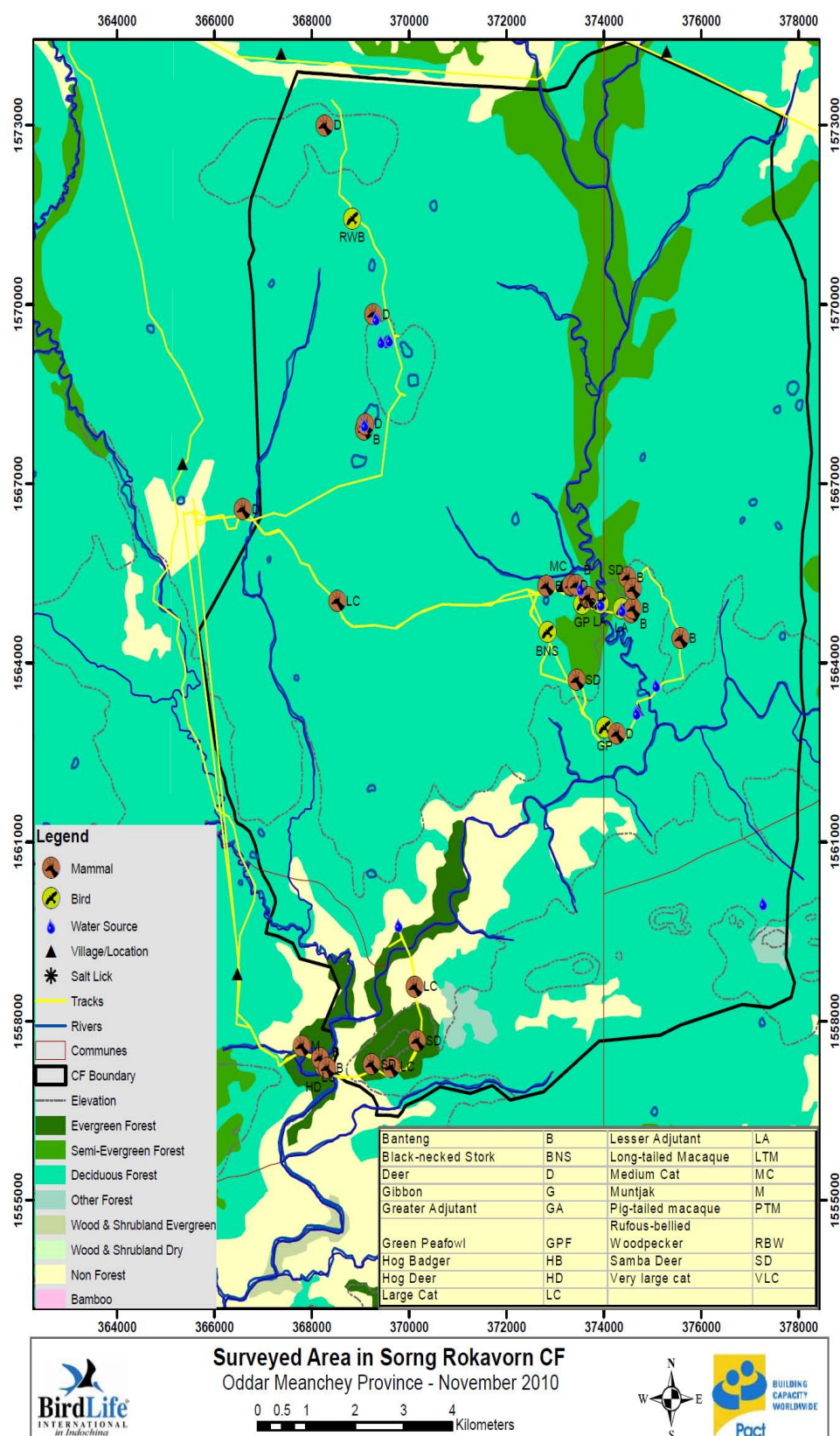
Appendix 1. Field Schedule showing dates of community interviews and biodiversity survey field work.

Date (2010)	Field Schedule
3-Nov	Team meeting in Phnom Penh. Purchase necessary field supplies
4-Nov	Meeting with staff at Halo to discuss mine risks in community forest areas
	To Samroang - meet with CDA reps Stay in Samroang
5-Nov	To CF#1 - Andong Bor CF - community interviews - targeted at ex-hunters
	Exploratory visit to Andong Bor
6-Nov	Moved to camp in Andong Bor. Biodiversity surveys
7-9 Nov	Biodiversity surveys Andong Bor
10-Nov	Romdoul Veasna CF and Rolus Thom-Interviews and collect photos/ materials from former hunters
11-14 Nov	Biodiversity surveys Sangkrou Preychheu
15-Nov	Community Interview and arranging visit to Prey Sorng
16-Nov	Community interviews for Prey Sorng CF. Travel to camp in CF.
17-19 Nov	Biodiversity Surveys Prey Sorng
20-Nov	Biodiversity surveys Sangkrou Preychheu SE sector
21-Nov	Community interviews for Sorng Rokavorn in Thmey Village, Tum Nob village, & Bak Nim Village
22-Nov	Community interview for Sorn Rokavorn in Sras Yeh Chheok. Started biodiversity surveys on walk to camp
23-27 Nov	Biodiversity Surveys in Sorng Rokavorn.
28-Nov	Discussions with monk, camera trap training, search for antlers
29-Nov	Fix vehicle and motorbike in Siem Reap
30-Nov	Return to PP

Appendix 2. Maps showing the trails that were the main focus of the field surveys and locations where sightings of particular interest were made. Note – trails within the CF boundaries represent the extent of mammal surveys.







Appendix 3. Sample Monitoring Data Sheet

[English Language Version]

Date/: **Start time/:**
Transect description / Location (e.g. NW from BC)/:
CF/:

Personnel/:

GPS start position/GPS:

GPS end position:

GPS setting: India Thailand UTM

Camera/:

NB. Ensure that GPS and camera time and date are synchronized/:

Species	Sign type (sighting, track, faeces, voice)	Time	UTM E: N:	Location Name	Number sighted	Scat Number	Photo Number	Notes (e.g. what it was doing, habitat type; How was it identified)

Appendix 4a. Details of Bird Transects

Transect Name	Date	Start location	Start time (am)	Finish location	Finish time	Time (hrs)	Transect distance (km)
Andong Bor 1	7/11/2010	307299E 1546127N	6:30	309836E 1546138N	10:30	4.00	2.8km
Andong Bor 2	8/11/2010	307299E 1546127N	6:15	306823E 1543307N	9:15	3.00	2.7
Andong Bor 3 #	9/11/2010	307299E 1546127N	6:05	306049E 1545293N	10:20	4.20	3.5
Sangkrou Preychheu 1	12/11/2010	397624E 1554189N	6:20	400291E 1552860N	10:40	4.20	4.2
Sangkrou Preychheu 2	13/11/2010	397624E 1554189N	6:05	397947E 1550487N	10:40	4.35	4.2
Sangkrou Preychheu 3	14/11/2010	395517E 1552526N	6:40	397624E 1554189N	9:20	2.40	3.5
Prey Srong 1	17-Nov-10	388970E 1551029N	6:15	389044E 1553732N	10:00	3.45	2.9
Prey Srong 2	18-Nov-10	388970E 1551029N	6:20	385987E 1552334N	9:00	2.40	3.7
Prey Srong 3	19-Nov-10	389298E 1553561N	6:05	389871E 1557403N	9:20	3.15	3.8
Sorong Rokavorn 1	23-Nov-10	373550E 1564990N	6:05	369596E 1564420N	9:05	3.00	3.9
Sorong Rokavorn 2	26-Nov-10	368208E 1557268N	6:20	370277E 155698N	9:20	3.00	2.3
Sorong Rokavorn 3	28-Nov-10	368457E 1573844N	6:05	369237E 1571126N	9:05	3.00	3.2

- Andong Bor 3 track was via 306850E 1543448N

Appendix 4b. Birds observed along timed transects within Community Forests

Numbers refers to a single observation; h = heard only; abund means no count made because the bird was common with > 10 contacts

AB - Andong Bor ; SP Sangkrou Preycheu; PS – Prey Srong; SR – Srong Rockavorn

Transect Name:	AB1	AB2	AB3	SP1	SP2	SP3	PS1	PS2	PS3	SR1	SR2	SR3
Phasianidae												
Chinese Francolin	h		1							h	1	
Scaly-breasted Partridge							h					
Red Junglefowl								1	h	h		1
Siamese Fireback						1						
Green Peafowl										1		
Ciconiidae												
Black-necked Stork											1	
Ardeidae												
Javan Pond Heron									1		1	
Falconidae												
White-rumped Falcon									1			
Collared Falconet											2	
Accipitridae												
Jerdon's Baza												
Black Baza								3	1			
Oriental Honey Buzzard												
Crested Serpent Eagle			h						1		1	h
Crested Goshawk			1								1	
Shikra											1	
small accipiter									1			
Rufous-winged Buzzard	1											
Grey-faced Buzzard	[1]											

Transect Name:	AB1	AB2	AB3	SP1	SP2	SP3	PS1	PS2	PS3	SR1	SR2	SR3
Changeable Hawk-Eagle					1					1		
Turnicidae												
Barred Buttonquail											h	
Charadriidae												
Red-wattled Lapwing	2											
Columbidae												
Red Turtle Dove	2,2											
Spotted Dove	abund	abund	abund			h			abund	abund	abund	abund
Emerald Dove				1								
Zebra Dove											h,h	
Orange-breasted Green Pigeon									2		2,1	h
Thick-billed Green Pigeon				h	6,h	h,h,1	h	h				
Yellow-legged Green Pigeon	4											
Green Imperial Pigeon					h,1	h				3	3,h	
Psittacidae												
Vernal Hanging Parrot				1,1,1		h	h		1,1,1		1	
Blossom-headed Parakeet	2,2		1,1,5,1,1						2	Hx3,2,2,2,4,2	6,2,1	3,h,1
Red-breasted Parakeet		1	3						12,2,3,3	abund	abund	abund
Cuculidae												
Violet Cuckoo												
Green-billed Malkoha				1,2		1	h					2
Greater Coucal		h	h					h		h,h	1	
Strigidae												
Collared Owlet								h				
Asian Barred Owlet						h						h

Transect Name:	AB1	AB2	AB3	SP1	SP2	SP3	PS1	PS2	PS3	SR1	SR2	SR3
Apodidae												
Brown-backed Needletail												
Hemiprocnidae												
Crested Treeswift	1	h	h	1					h		h,h	4
Trogonidae												
Orange-breasted Trogon				1,1,h	h,h,h			h	h			
Coraciidae												
Indian Roller	1,1	1							1	1,1	1,h,1,1	h
Alcedinidae												
Banded Kingfisher							h,h	h				
Common Kingfisher												
Meropidae												
Chestnut-headed Bee-eater								3,1			1	
Upupidae												
Common Hoopoe	2								1			1
Bucerotidae												
Oriental Pied Hornbill				2,h,h,h	h,h,2	2,h,6	h,h,h,5	hx3,2,2,15	h,h,1		hx5,1	12,h
Ramphastidae												
Lineated Barbet		1		1,h,h,1	1,h,h	1			h,h,h	h,h,h	abund	h,h,h,1,2
Green-eared Barbet	h,h	h	1	1,h			h,h,h	h,h,1,1,h	h	h	h	
Blue-eared Barbet				h	h		h,h	h				
Picidae												
Rufous-bellied Woodpecker												1

Transect Name:	AB1	AB2	AB3	SP1	SP2	SP3	PS1	PS2	PS3	SR1	SR2	SR3
Grey-capped Pygmy Woodpecker	,1	h							1	h,h		h,2
Fulvous-breasted Woodpecker	1,h	1	1							?h	?	?h
White-bellied Woodpecker	h	h	h	h					1,h	1	3,h	h,h
Lesser Yellow-naped Woodpecker						1						
Greater Yellow-naped Woodpecker						2	h	h				1
Laced Woodpecker					2,h	h,h		h,h			1?	
Streak-throated Woodpecker			1	1						h	h	h
Black-headed Woodpecker									2,1	2,h,3,h	2,2,h,3,h	h,h,h,4,h
Grey-headed Woodpecker									2			h
Common Flame-backed Woodpecker	2		1	h		2	1		1	1,1,1	1,2	1,1,h,2,1
Greater Flame-backed Woodpecker											1	
Heart-spotted Woodpecker											1,h	
Great Slaty Woodpecker							h		h	h	5	h
woodpecker sp				h				h		h		
Eurylaimidae												
Banded Broadbill				h			h,h	h				
Genera Incertae sedis												
Large Woodshrike						1						
Common Woodshrike	2		2							1,3	1	
Aegithinidae												
Common Iora	1			1						h		2
Great Iora						1			1			
Campephagidae										h,h,3		
Large Cuckoo-shrike	1,1,1,h,h	h,h									1	h
Indochinese Cuckoo-shrike				1					1			
Rosy Minivet											2	5
Ashy Minivet								2,3	2		8	4
Small Minivet	6								6	6,4,h,8		4

Transect Name:	AB1	AB2	AB3	SP1	SP2	SP3	PS1	PS2	PS3	SR1	SR2	SR3
Scarlet Minivet											4,1,2	
Bar-winged Flycatcher-shrike				1				2,3,2	1			6
Laniidae												
Burmese Shrike									1			
Oriolidae												
Black-naped Oriole				abund	1,h,1,h,h	h	abund	abund	h		1	
Black-hooded Oriole	h,h	1,h,h	1,1,h						1,h	h	2,2,2,hh,2	1,h
Dicruridae												
Black Drongo	2											
Ashy Drongo	1,1	1	1			1,1		2		3	2,2,1,1,1,1	1
Bronzed Drongo				1,2	1			2			2	
Hair-crested Drongo				2						1	1	2
Greater Racket-tailed Drongo		2,1	1,2	2,1	2,2	1,h,h,1,h,1	2	h x 5,1,1	h	4,h	3,2,1,1,h	h,3,2
drongo sp							h					
Rhipiduridae												
White-browed Fantail	2		1						2	2		
Monarchidae												
Black-naped Monarch				h,1,1	h,h	1,1,1	h,1,1	h,h,1				h,h
Asian Paradise-flycatcher				1	h		h					
Japanese Paradise-flycatcher												
Corvidae												
Red-billed Blue Magpie											R09-0057	
Rufous Treepie											1	4,3
Racquet-tailed Treepie											2	
Large-billed Crow/Jungle Crow												

Transect Name:	AB1	AB2	AB3	SP1	SP2	SP3	PS1	PS2	PS3	SR1	SR2	SR3
Hirundinidae												
Barn Swallow										1	150	
Alaudidae												
Indochinese Bushlark											2	
Cisticolidae												
Brown Prinia	1										6,1,2	
Rufescent Prinia	1,2		6,3						h	2,h,3	3,4	
Grey-breasted Prinia	4,2	h	1,2							2,2,6	4,h,2,3,4,2	h,h,4
Yellow-bellied Prinia											2	
Genera Incertae Sedis												
Dark-necked Tailorbird				abund	h,h,1	h,h,h	h x 8	h x 7,1	h	h,h	h	
Pycnonotidae												
Black-headed Bulbul										2		
Black-crested Bulbul				abund	3,1,3,2,h	1,h,1,h,h	h,2,2,h	h x 5				1
Sooty-headed Bulbul	4,2,2	2,4	5,4,5,2,2,2,1,4							2,1,3,2,1	2,2,3	2,h,h
Stripe-throated Bulbul							2,h,6	1			1	
Streak-eared Bulbul								1	3			
Puff-throated Bulbul				1	2,1,2		h					
Black Bulbul												
Sylviidae												
Asian Stubtail				h								
Dusky Warbler											1,1,h	
Radde's Warbler				1		1	1	1		1	1	
Buff-throated Warbler												1
Yellow-browed Warbler		h,h,1	h	abund	h	h,h,1	h,h,h,h	abund	1	1	h,h,h,h	h,h,h,h,h,h
Two-barred Greenish Warbler	1,1,h	1,1,h,h	1	abund	h,h,h,1	hx5,1	h,1	h,2,h,1,1				1
Pale-legged Leaf Warbler			h	h,h,h,h	abund	h,h	abund	abund	h,h		h,h,h	

Transect Name:	AB1	AB2	AB3	SP1	SP2	SP3	PS1	PS2	PS3	SR1	SR2	SR3
Eastern Crowned Warbler												
Blyth's Leaf Warbler				2	2							
Leaf Warbler sp						1						
Timaliidae												
Puff-throated Babbler	h	h	1,2,1		2,h,h		h,h,1		h,h,h,1,h	h,h,h	h,h,h,h	2,1
Buff-breasted Babbler												
Abbott's Babbler					2,h,h		h					
Scaly-crowned Babbler					2	h						
Striped Tit-Babbler		4		abund	abund	h x 5	h x 5,2,3	h x 8	h,h,6,h	h	h,h,h	
Chestnut-capped Babbler	4		3						4,2,h	h,h	3,3	
White-crested Laughing-thrush		4	h,h,h	h		h	h,h,h,h	h,h,h,6	h,h,6,h	h		h,2,h
Lesser Necklaced Laughing-thrush											1?	
Zosteropidae												
Oriental White-eye						h						
Irenidae												
Asian Fairy-bluebird					h,h	1,1	h,h	2				
Sittidae												
Neglected Nuthatch									2			1
Sturnidae												
Hill Myna						1				2	h,24,1	1,h
Common Myna										?6		
Black-collared Starling										2		
Muscicapidae												
Siberian Rubythroat											1	
Siberian Blue Robin					h?		h?					
Oriental Magpie-Robin									1			

Transect Name:	AB1	AB2	AB3	SP1	SP2	SP3	PS1	PS2	PS3	SR1	SR2	SR3
White-rumped Shama		h			1	h,1	h,h,h	h				
Common Stonechat											1	
Pied Bushchat	1,1,1,1,2									1	1,2	
White-throated Rock Thrush				1								
Dark-sided Flycatcher		1										
Asian Brown Flycatcher	1	1				1		1			1	
Red-breasted Flycatcher	1	2,1,1,1	1,1	1		1,h,1	h,h,1	h,h,h,1	1,1		2,h,h	h,h,1,h
Hainan Blue Flycatcher		h	1	abund	abund	abund	abund	abund	h,h,h,1			2,h,h
Tickell's Blue Flycatcher					h,h,h							
Grey-headed Canary-Flycatcher		1	2	h,h	2,2	h,h	h,h					
Chloropseidae												
Blue-winged Leafbird	1			2,1		1						
Golden-fronted Leafbird											1,1	
Dicaeidae												
Plain Flowerpecker			h								1,h,h,h	h,h,h
Flowerpecker sp									1,h			
Nectariniidae												
Ruby-cheeked Sunbird												
Brown-throated Sunbird				1								
Purple Sunbird	1,2	1	2,1	1							h	h?
Olive-backed Sunbird				1			hx4,1,2,4	h,h		2		2
Sunbird sp					2	h,h						
Estrildidae									2			
White-rumped Munia											2	
Black-headed Munia											1	
Motacillidae												
Olive-backed Pipit			h						2			

Appendix 4c. Encounter rates for birds observed along timed transects within CFs.

Rates are given as number of individuals or groups encountered per km per hour of transect

Column "G" indicates which species are usually gregarious

Transect Name:		AB1	AB2	AB3	SP1	SP2	SP3	PS1	PS2	PS3	SR1	SR2	SR3
Siamese Fireback							0.012						
Green Peafowl											0.085		
Black-necked Stork												0.146	
White-rumped Falcon										0.084			
Yellow-footed Green Pigeon	G	0.089											
Blossom-headed Parakeet	G	0.178		0.34						0.084	0.68	0.438	0.315
Orange-breasted Trogon					0.171	0.165			0.113	0.084			
Banded Kingfisher								0.198	0.113				
Oriental Pied Hornbill	G				0.228	0.165	0.036	0.396	0.678	0.252		0.876	0.21
White-bellied Woodpecker		0.089	0.123	0.068	0.057					0.168	0.085	0.292	0.21
Black-headed Woodpecker										0.168	0.34	0.73	0.42
Great Slaty Woodpecker								0.099	0.113	0.084	0.085	0.146	0.105
Pale-legged Leaf Warbler				0.068	0.171	0.55	0.024	0.99	1.243	0.168		0.438	
Hill Myna	G						0.012				0.085	0.438	0.21
Black-collared Starling											0.085		

Appendix 5. Survey coverage across CF sites compared to the size. AB – Andong Bor, SPC – Sangkrou Preychheu, PS – Prey Srong, SR – Srong Rokavorn.

Community Forest Transect Number	Date 2010	Day	CF Size	Distance km	Night Survey Timing
AB1	06-Nov	1	6,114ha	6.5	
AB Night1	06-Nov	1		4.3	18.00 - 20.00
AB2	07-Nov	2		12.6	
AB3	08-Nov	3		10.3	
AB Night2	09-Nov	4		3.4	03.00 - 06.00
<i>Total Transect Distance for Andong Bor</i>				37.1	
SPC1	11-Nov	1	4,151ha	8.1	
SPC2	12-Nov	2		19.9	
SPC3	13-Nov	3		24.9	03.00 - 06.00
SPC4	14-Nov	4		15.4	03.00 - 06.00
SPC5	20-Nov	5		8.6	
<i>Total Transect Distance for Sangkrou Preychheu</i>				76.9	
PS1	16-Nov	1	6,344ha	9.5	
PS2	17-Nov	2		24.3	
PS3	18-Nov	3		14.6	03.00 - 06.00
PS4	19-Nov	4		10.1	03.00 - 06.00
<i>Total Transect Distance for Prey Srong</i>				58.5	
SR1	23-Nov	1	18261ha	10.9	
SR2	24-Nov	2		17.9	04.30 -06.00
SR3	25-Nov	3		17	03.00 - 06.00
SR4	26-Nov	4		18.9	
SR5	27-Nov	x	x	0	x
SR6	28-Nov	6		12.1	
<i>Total Transect Distance for Prey Srong</i>				76.8	
Romdoul Veasna	21-Nov	1	6,016ha	5.1	
Rolus Thom	10-Nov	0	6,443ha	0	

Appendix 6. List of Mammals found within the CFs and details of the evidence by which they were identified

DO - direct observation, T - track, Sc - Scat, Ev - evidence, H - hear, I - interview

Bold denotes confirmed presence as defined by sightings, unequivocal track or camera-trap photograph

IUCN Red List: nTh - near Threatened; VU - Vulnerable; EN – Endangered.

The predominate forest types for each CF are indicated as follows: DDF - Deciduous Dipterocarp Forest, SE - Semi-Evergreen

Scientific Name	Species	Khmer Name	IUCN Threat Status	CITES	Andong Bor (DDF)	Sangkrou Preychheu (SE)	Prey Srong (SE)	Sorng Rokavorn (DDF)	Romdoul Veasna (SE)
<i>Cuon alpinus</i>	Dhole	ផ្កែព្រៃ	EN	I	x	T/Sc/I	I	T/Sc/I	I
<i>Canis aureus</i>	Golden Jackal	ផ្កែចក់		III	T/Sc/I	T/Sc/I	T/Sc/I	DO/Sc/T	T
<i>Bos gaurus</i>	Gaur	ខ្លា	VU	I	x	T/I	x	x	x
<i>Bos javanicus</i>	Banteng	ទន្សោង	EN		x	T/I	T/I	T/Sc/I/CT	x
<i>Panthera pardus</i>	Leopard	ប្លាវឱន	nTh	I	I	I	I	T/I	I
<i>Rucervus eldii</i>	Eld's Deer	រមាំង	VU	I	T/Sc/I	T/I	x	T?	x
<i>Cervus unicolor</i>	Sambar Deer	ប្រើស	VU	II	T?	T	T	T	x
<i>Axis Porcinus</i>	Hog Deer	គ្នាន់	EN	I	x	x	x	T/I	x
<i>Helarctus malayanus</i>	Sun Bear	ខ្លាឃ្មុំតូច	VU	I	x	I	x	I/Ev	I
<i>Manis javanica</i>	Sunda Pangolin	ពង្រួល	EN	II	x	T/I	x	T	I/Ev
<i>Macaca fascicularis</i>	Long-tailed Macaque	ស្លាត្តាម		II	T/I	DO/H/T/I	DO/T/I	I	I
<i>Macaca leonina</i>	Northern Pig-tailed Macaque	ស្លាត្រាស	VU	II	x	DO/H/T/I	DO/H/I	x	I
<i>Hylobates pileatus</i>	Pileated Gibbon	ទោចម្ពុដ	EN	I	x	DO/H/T/I	I	x	H/I
<i>Sus scrofa</i>	Eurasian Wild Pig	ជ្រូកព្រៃ			DO/T/Sc/I	DO/T/Sc/I	DO/T/Sc/I	T/Sc/I	T/I

<i>Muntiacus vaginalis</i>	Northern Red Muntjac	ឈ្នួស				DO/T/Sc/I	DO/T/I/H	DO/H/T/I/Sc/I	T/Sc/I	T/I
<i>Trangulus kanchil</i>	Lesser Mousedeer	ក្តាន់ព្នែងតូច				T/Sc/I	DO/T/I	DO/T/I	T/I	T/I
<i>Paradoxurus hermaphroditus</i>	Common Palm Civet	សំពោចក្រអូប		III		T/Sc/I	DO/T/I	DO/T/I	T/Sc/I	T/I
<i>Catopuma temminckii</i>	Asiatic Golden Cat	ខ្លាឈ្លើងមាស	nTH	I		T/Sc	T	x	T	x
<i>Felis chaus</i>	Jungle Cat	ឆ្កែព្រៃ		I		T	T	T	T	x
<i>Prionailurus bengalensis</i>	Leopard Cat	ឆ្កែដាវ		I		T/Sc/I	DO/T/I	T/I	T/I	x
	civet other	សំពោចផ្សេងៗទៀត				T/I	T/I	T/I	T/I	T
<i>Ratufa bicolor</i>	Black Giant Squirrel	កំប្រុកធំ	nTh	II		DO/I	DO/I	DO/I	DO/I	I
<i>Callosciurus finlaysonii</i>	Variable Squirrel	កំប្រុកពណ៌				DO	DO	DO	DO	DO
<i>Menetes berdmorei</i>	Indochinese Ground Squirrel	កង្កែប				DO	DO	DO	DO	x
<i>Tamias rodolphii</i>	Cambodian Striped Squirrel	កង្កែបក្អមជា				DO	DO	DO	DO	x
<i>Martes flavigula</i>	Yellow-throated Marten	សំពោចកឈ្លើង				T	T	T	T	T
<i>Herpestes urva/ H. javanicus</i>	Crab-eating / Small Asian Mongoose	ស្ពាន់		III		T	T/I	T	T/I	T
<i>Hystrix brachyura</i>	Malayan Porcupine	ប្រមា				T/I	T/I	T/Ev/Sc/I	T/I	T/I
<i>Lepus peguensis</i>	Burmese Hare	ទន្សាយគល់				T/Sc/I	T/Sc/I	T/Sc/I	T/Sc/I	x

