

Bird Community Characteristics During the Rainy and Dry Seasons in Lowland Dry Evergreen Forests of the Central Cardamom Protected Forest and the Seima Biodiversity Conservation Area in Cambodia

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Abstract: The goal of this study was to gain a greater understanding of the characteristics of bird communities during the rainy and dry seasons in lowland dry evergreen forests of the Central Cardamom Protected Forest and the Seima Biodiversity Conservation Area in Cambodia during July 2007 and December 2011. The 82 bird species were observed in the Central Cardamom Protected Forest and 72 bird species were observed in the Seima Biodiversity Conservation Area. The number of species and individuals were similar between rainy and dry seasons in both study areas. IUCN (International Union for Conservation of Nature) red list and CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) listed species such as the green peafowl (*Pavo muticus*), the Oriental pied hornbill (*Anhracoceros albirostris*), the great hornbill (*Buceros bicornis*) and the crested serpent eagle (*Spilornis cheela*) were recorded in this study. The primary threats to bird communities in and around both study areas were related to habitat conversion and poaching for local consumption. Habitat conversion and poaching should be strictly prohibited to conserve bird communities. Moreover, detailed management programs based on scientific research will be helpful for conservation of biodiversity.

Key words: Bird community, Cambodia, conservation, status

INTRODUCTION

On a global scale, tropical regions are critical for the conservation of biodiversity. There have been recent dramatic losses tropical species and their habitats (Rhim *et al.*, 2009). Cambodia may be one of the most biodiverse countries in Southeast Asia but there is a lack of information about the current state of biodiversity in the area.

In the past, 73% of Cambodia was forested (FAC, 2004). However, there was a severe loss of biodiversity and habitat destruction during the civil war. By 2002, only 61% of Cambodia was forested (WB, 2003). The 44 species of birds in Cambodia are internationally recognized as rare and endangered species (Seng *et al.*, 2003; Ouk, 2005). Large forested areas such as the Central Cardamom Protected Forest and the Seima Biodiversity Conservation Area are very important as core areas of biodiversity in Cambodia. Lack of the taxonomic information has led to an under-estimation of the importance of these areas as centers for endemic birds in Cambodia (Eames *et al.*, 2002).

Until the last decade of the 20th century, the Cardamom and Seima areas were poorly surveyed because of security risks and limited access due to lack of

infrastructure (Timmins and Soriyun, 1998; Holden and Thy, 2009). Very little field work has occurred in these areas to date. Many areas and most taxa remain undocumented, hampering efforts to develop effective conservation strategies. These regions are exceptionally biodiverse and contain a large number of globally threatened species (Fauna and Flora International, 2000). The establishment of protected area is progressing at varying speeds towards significant on-ground protection of habitat and wildlife (Holden and Thy, 2009).

Since, 2007 the International Cooperation Unit on Biodiversity and Environmental Conservation (ICUBEC) founded by the National Institute of Biological Resources in Korea has conducted biodiversity surveys for the conservation of birds and their habitat in Cambodia. The overall aim of this study was to understand the status of bird communities with the goal of conservation within the Central Cardamom Protected Forest and the Seima Biodiversity Conservation area in Cambodia.

MATERIALS AND METHODS

This study was carried out in the Central Cardamom Protected Forest and Seima Biological Conservation Area in Cambodia during July 2007 and December 2011. The

Cardamom Mountains are located in Southwest Cambodia and span >10,000 km² following the Northern margin of the Gulf of Thailand (Daltry and Momberg, 2000). The mountains are composed of forested peaks and foothills separated by low-laying basins and valleys. The Central Cardamom Protected Forest (12°00'N, 103°15'E) itself covers 401,313 ha of forest, mountains, wetlands, waterfalls, streams and other ecosystems. It was established in 2002 when the Cambodian government cancelled existing logging concessions in the area (Emmett and Olsson, 2005) and is managed by the Forestry Administration.

The Central Cardamom Protected Forest is cloaked with a variety of natural forest types according to altitude, aspect, geology and hydrology dry deciduous forest, semi-deciduous forest, lowland dry evergreen forest, hill evergreen forest, bamboo thickets and pine forest (Momberg and Weiler, 1999). The forest is recognized as an area of key biodiversity and rare species such as Siamese crocodiles, Asian elephants and pangolins can be found there. Most rainfall occurs from April to October during the Southwest monsoon season. Rainfall in some areas exceeds 4,000 mm annum⁻¹ (Ashwell, 1997). Fauna and flora are not uniformly distributed. The Central Cardamom Protected Forest contains a variety of distinct natural habitats each with their own characteristic wildlife communities (Fauna and Flora International, 2000).

The Seima Biodiversity Conservation Area is located in Eastern Cambodia (12°07'N, 106°54'E) and covers an area of 3,034 km². This area contains a variety of forest types from dense evergreen hill forests to extensive deciduous forests. Rainfall averages 2,500-3,400 mm year⁻¹. Monthly temperatures average 25-32°C. The area is an important refuge for many endemic species that are threatened throughout their ranges (ICUBEC, 2012).

Standard diurnal birding techniques were used and surveys were concentrated during periods of maximum bird activity (from dawn to late morning and from late afternoon to dusk), supplemented by night walks to detect nocturnal species. Informal interviews were also conducted with local people, particularly hunters and knowledgeable guides to gain additional information concerning larger key species such as pheasants and large waterbirds (Walston *et al.*, 2000).

Bird surveys were conducted along 2 km transects near Thmar Bang Station (11°40'47.9"N, 103°26'22.4"E) in Reusei Chhrum, Thmar Bang district, Koh Kong province and Seima Station (12°08'20.9"N, 106°55'2.9"E) in Srae Khtum, Kaev Seima district, Monduliri province.

Bird community surveys were performed in rainy season (August 2011; Central Cardamom Protected Forest, July 2007; Seima Biodiversity Conservation Area)

and dry season (December 2007; Central Cardamom Protected Forest, December 2011; Seima Biodiversity Conservation Area) using the line count technique (Bibby *et al.*, 1997; Hur *et al.*, 2003; Rhim *et al.*, 2009). Bird communities were analyzed based on species diversity. Bird species diversity values were calculated using the following equation (Shannon and Weaver, 1949):

$$H' = \sum_{i=1}^s (-P_i) \times \ln(P_i)$$

Where:

s = The number of categories

P_i = The proportion of individuals in the *i*th category

RESULTS AND DISCUSSION

Eighty two bird species were recorded in the Central Cardamom Protected Forest. In Central Cardamom Protected Forest, 103 individuals of 65 species were observed during the rainy season and 100 individuals of 60 species were recorded during the dry season. The bird species diversity index was higher in the rainy season than in the dry season. Coopersmith barbets (*Megalaima haemacephala*), green bee-eaters (*Merops orientalis*) and spotted doves (*Streptopelia chinensis*) were the dominant bird species during the rainy season. In the dry season, black-hooded orioles (*Oriolus xanthornus*), sooty-headed bulbuls (*Pycnonotus aurigaster*), yellowed-bellied prinias (*Prinia flaviventris*) and olive-backed sunbirds (*Nectarinia jugularis*) were dominant (Table 1).

Seventy two species of birds were observed in the Seima Biodiversity Conservation Area. The total number of species and individuals and the bird species diversity index were similar between the rainy and dry seasons. Chestnut-headed bee-eaters (*Merops leschenaulti*) and scarlet minivets (*Pericrocotus flammeus*) were the dominant species in the rainy season. In the dry season, spotted doves, Oriental pied hornbills (*Anthracoceros albirostris*), dark-sided flycatchers (*Muscicapa sibirica*), verditer flycatchers (*Eumyias thalassina*) and yellow-vented bulbuls (*Pycnonotus goiavier*) were dominant (Table 2).

The survey areas supported important populations of a number of regionally and globally threatened species. Certain IUCN red list and CITES-listed species such as the green peafowl (*Pavo muticus*), Oriental pied hornbill, great hornbill (*Buceros bicornis*) and crested serpent eagle (*Spilornis cheela*), all of which are rare in other parts of their range were observed in the study areas.

The Central Cardamom Protected Forest and Seima Biodiversity Conservation Area are primarily covered by

Table 1: Number of birds observed during the rainy and dry seasons within lowland dry evergreen forest, Central Cardamom Protected Forest, Cambodia

Common names	Scientific names	Seasons		Migration
		Rainy	Dry	
Chinese Francolin	<i>Francolinus pintadeanus</i>	2	1	R
Green Peafowl	<i>Pavo muticus</i>	1	-	R
Grey-capped Pygmy Woodpecker	<i>Dendrocopos canicapillus</i>	1	2	R
Black-headed Woodpecker	<i>Picus erythropygius</i>	1	-	R
Common Flameback	<i>Dinopium javanense</i>	2	1	R
Great Slaty Woodpecker	<i>Mulleripicus pulverulentus</i>	-	1	R
Lineated Barbet	<i>Megalaima lineata</i>	2	1	R
Green-eared Barbet	<i>Megalaima faiostricta</i>	1	1	R
Moustached Barbet	<i>Megalaima incognita</i>	1	2	R
Blue-eared Barbet	<i>Megalaima australis</i>	-	1	R
Coopersmith Barbet	<i>Megalaima haemacephala</i>	3	1	R
Oriental Pied Hombill	<i>Anthracoceros albirostris</i>	2	1	R
Great Hornbill	<i>Buceros bicornis</i>	1	2	R
Green Bee-eater	<i>Meropops orientalis</i>	3	1	R
Blue-throated Bee-eater	<i>Meropops viridis</i>	1	-	R
Chestnut-headed Bee-eater	<i>Meropops leschenaulti</i>	2	1	R
Indian Cuckoo	<i>Cuculus micropterus</i>	-	2	R
Banded Bay Cuckoo	<i>Cacomantis somneratii</i>	-	1	R
Indian Roller	<i>Coracias benghalensis</i>	2	1	R
Vernal Hanging Parrot	<i>Loriculus vernalis</i>	2	3	R
Alexandrine Parakeet	<i>Psittacula eupatria</i>	-	1	R
Blossom-headed Parakeet	<i>Psittacula roseata</i>	-	2	R
Common Hoopoe	<i>Upupa epops</i>	3	2	R
Crested Treeswift	<i>Hemiprocne coronata</i>	-	3	R
Mountain Scops Owl	<i>Otus spilocephalus</i>	1	-	R
Oriental Scops Owl	<i>Otus sunia</i>	1	1	R
Large-tailed Nightjar	<i>Caprimulgus macrurus</i>	1	-	R
Spotted Dove	<i>Streptopelia chinensis</i>	3	3	R
Pink-necked Green Pigeon	<i>Treron vernans</i>	1	-	R
Yellow-footed Green Pigeon	<i>Treron phoenicoptera</i>	1	1	R
Red-wattled Lapwing	<i>Vanellus indicus</i>	2	-	R
Crested Serpent Eagle	<i>Spilornis cheela</i>	1	1	R
Rufous-bellied Eagle	<i>Hieraaetus kienerii</i>	-	1	R
Collared Falconet	<i>Microhierax caerulescens</i>	1	-	R
Blue-winged Leafbird	<i>Chloropsis cochinchinensis</i>	1	-	R
Golden-fronted Leafbird	<i>Chloropsis aurifrons</i>	-	2	R
Brown Shrike	<i>Lanius cristatus</i>	-	2	W
Ashy Drongo	<i>Dicrurus leucophaeus</i>	2	1	R
Crow-billed Drongo	<i>Dicrurus annectans</i>	1	-	P
Bronzed Drongo	<i>Dicrurus aeneus</i>	1	2	R
Lesser Racket-tailed Drongo	<i>Dicrurus remifer</i>	-	2	R
Greater Racket-tailed Drongo	<i>Dicrurus paradiseus</i>	1	-	R
House Crow	<i>Corvus splendens</i>	2	-	R
Red-billed Blue Magpie	<i>Urocissa erythrorhyncha</i>	-	1	R
Rufous Treepie	<i>Dendrocitta vagabunda</i>	2	1	R
Grey Treepie	<i>Dendrocitta formosae</i>	2	-	R
Black-naped Oriole	<i>Oriolus chinensis</i>	-	2	W
Black-hooded Oriole	<i>Oriolus xanthornus</i>	2	4	R
Black-winged Cuckooshrike	<i>Coracina melaschistos</i>	1	-	R
Rosy Minivet	<i>Pericrocotus roseus</i>	-	3	W
Small Minivet	<i>Pericrocotus cinnamomeus</i>	-	2	R
Grey-chinned Minivet	<i>Pericrocotus solaris</i>	1	-	R
Long-tailed Minivet	<i>Pericrocotus ethologus</i>	1	-	R
Scarlet Minivet	<i>Pericrocotus flammeus</i>	2	4	R
Bar-winged Flycatcher-shrike	<i>Hemipus picatus</i>	1	2	R
White-browed Fantail	<i>Rhipidura aureola</i>	1	1	R
Common Iora	<i>Aegithina tiphia</i>	1	2	R
Rufous-winged Philentoma	<i>Philentoma pyrhopterum</i>	2	-	R
Blue Rock Thrush	<i>Monticola solitarius</i>	1	-	W
Dark-sided Flycatcher	<i>Muscicapa sibirica</i>	1	-	P
Verditer Flycatcher	<i>Eumyias thalassina</i>	1	1	W
Oriental Magpie Robin	<i>Copsychus saularis</i>	-	1	R
White-rumped Shama	<i>Copsychus malabaricus</i>	2	1	R
Pied Bushchat	<i>Saxicola caprata</i>	2	1	R
Black-collared Starling	<i>Sturnus nigricollis</i>	1	2	R
Vinous-breasted Starling	<i>Sturnus burmannicus</i>	1	3	R
Hill Myna	<i>Gracula religiosa</i>	2	1	R
Red-rumped Swallow	<i>Hirundo daurica</i>	3	-	W
Striated Swallow	<i>Hirundo striolata</i>	-	1	R

Table 1: Continue

Common names	Scientific names	Seasons		Migration
		Rainy	Dry	
Black-headed Bulbul	<i>Pycnonotus atriceps</i>	3	2	R
Sooty-headed Bulbul	<i>Pycnonotus aurigaster</i>	1	4	R
Stripe-throated Bulbul	<i>Pycnonotus finlaysoni</i>	1	1	R
Grey-breasted Prinia	<i>Prinia hodgsonii</i>	2	1	R
Yellow-bellied Prinia	<i>Prinia flaviventris</i>	2	4	R
Dark-necked Tailorbird	<i>Orthotomus atrogularis</i>	2	1	R
Thick-billed Warbler	<i>Acrocephalus caedon</i>	1	-	W
Two-barred Warbler	<i>Phylloscopus plumbeitarsus</i>	2	-	W
Yellow-vented Flowerpecker	<i>Dicaeum chrysorrheum</i>	1	1	R
Scarlet-backed Flowerpecker	<i>Dicaeum cruentatum</i>	3	2	R
Olive-backed Sunbird	<i>Nectarinia jugularis</i>	2	4	R
Little Spiderhunter	<i>Arachnothera longirostra</i>	1	1	R
White-rumped Murina	<i>Lonchura striata</i>	2	1	R
No. of species		65	60	-
No. of individuals		103	100	-
Species diversity index (H')		4.08	3.96	-

Table 2: Number of birds observed during the rainy and dry seasons within lowland dry evergreen forest, Seima Biodiversity Conservation Area, Cambodia

Common names	Scientific names	Seasons		Migration
		Rainy	Dry	
Red Junglefowl	<i>Gallus gallus</i>	1	1	R
Green Peafowl	<i>Pavo muticus</i>	3	-	R
Common Flameback	<i>Dinopium javanense</i>	-	2	R
Great Slaty Woodpecker	<i>Mulleripicus pulverulentus</i>	1	1	R
Lineated Barbet	<i>Megalaima lineata</i>	2	1	R
Green-eared Barbet	<i>Megalaima faiostricta</i>	1	3	R
Moustached Barbet	<i>Megalaima incognita</i>	1	1	R
Blue-eared Barbet	<i>Megalaima australis</i>	2	2	R
Coopersmith Barbet	<i>Megalaima haemacephala</i>	-	1	R
Oriental Pied Hornbill	<i>Anthracoceros albirostris</i>	2	4	R
Great Hornbill	<i>Buceros bicornis</i>	1	-	R
Stork-billed Kingfisher	<i>Halcyon capensis</i>	1	2	R
White-throated Kingfisher	<i>Halcyon smyrnensis</i>	3	1	R
Green Bee-eater	<i>Merops orientalis</i>	2	3	R
Chestnut-headed Bee-eater	<i>Merops leschenaulti</i>	6	2	R
Indian Cuckoo	<i>Cuculus micropterus</i>	1	-	R
Banded Bay Cuckoo	<i>Cacomantis somneratii</i>	-	1	R
Indian Roller	<i>Coracias benghalensis</i>	2	1	R
Vernal Hanging Parrot	<i>Loriculus vernalis</i>	3	1	R
Alexandrine Parakeet	<i>Psittacula eupatria</i>	2	1	R
Blossom-headed Parakeet	<i>Psittacula roseata</i>	-	3	R
Common Hoopoe	<i>Upupa epops</i>	2	1	R
Crested Treeswift	<i>Hemiprocne coronata</i>	4	2	R
Mountain Scops Owl	<i>Otus spilocephalus</i>	1	-	R
Large-tailed Nightjar	<i>Caprimulgus macrurus</i>	1	1	R
Spotted Dove	<i>Streptopelia chinensis</i>	3	6	R
Pink-necked Green Pigeon	<i>Treron vernans</i>	2	1	R
Yellow-footed Green Pigeon	<i>Treron phoenicoptera</i>	3	2	R
Red-wattled Lapwing	<i>Vanellus indicus</i>	1	-	R
Rufous-winged Buzzard	<i>Butastur liventer</i>	1	1	R
Rufous-bellied Eagle	<i>Hieraetus kienerii</i>	1	-	R
Collared Falconet	<i>Microhierax caeruleus</i>	2	1	R
Golden-fronted Leafbird	<i>Chloropsis aurifrons</i>	3	2	R
Brown Shrike	<i>Lanius cristatus</i>	2	1	W
Ashy Drongo	<i>Dicrurus leucophaeus</i>	1	4	R
Crow-billed Drongo	<i>Dicrurus annectans</i>	1	1	P
Lesser Racket-tailed Drongo	<i>Dicrurus remifer</i>	1	1	R
Greater Racket-tailed Drongo	<i>Dicrurus paradiseus</i>	-	2	R
House Crow	<i>Corvus splendens</i>	-	1	R
Red-billed Blue Magpie	<i>Urocissa erythrorhyncha</i>	1	1	R
Rufous Treepie	<i>Dendrocitta vagabunda</i>	2	1	R
Grey Treepie	<i>Dendrocitta formosae</i>	-	1	R
Black-naped Oriole	<i>Oriolus chinensis</i>	-	3	W
Black-hooded Oriole	<i>Oriolus xanthornus</i>	1	2	R
Black-winged Cuckooshrike	<i>Coracina melaschistos</i>	1	-	R
Rosy Minivet	<i>Pericrocotus roseus</i>	-	3	W
Small Minivet	<i>Pericrocotus cinnamomeus</i>	1	3	R

Table 2: Continue

Common names	Scientific names	Seasons		Migration
		Rainy	Dry	
Fiery Minivet	<i>Pericrocotus igneus</i>	2	1	R
Long-tailed Minivet	<i>Pericrocotus ethologus</i>	3	1	R
Scarlet Minivet	<i>Pericrocotus flammeus</i>	4	2	R
Bar-winged Fly catcher-shrike	<i>Hemipus picatus</i>	1	1	R
White-browed Fantail	<i>Rhipidura aureola</i>	-	1	R
Common Iora	<i>Aegithina tiphia</i>	1	1	R
Rufous-winged Philentoma	<i>Philentoma pyrhopterum</i>	2	1	R
Dark-sided Fly catcher	<i>Muscicapa sibirica</i>	2	4	P
Verditer Fly catcher	<i>Eumyias thalassina</i>	-	4	W
Oriental Magpie Robin	<i>Copsychus saularis</i>	1	1	R
White-rumped Shama	<i>Copsychus malabaricus</i>	3	-	R
Pied Bushchat	<i>Saxicola caprata</i>	2	-	R
Black-collared Starling	<i>Sturnus nigricollis</i>	1	-	R
Vinous-breasted Starling	<i>Sturnus burmannicus</i>	1	-	R
Common Myna	<i>Acridotheres tristis</i>	2	1	R
Red-rumped Swallow	<i>Hirundo daurica</i>	-	2	W
Black-headed Bulbul	<i>Pycnonotus atriceps</i>	3	2	R
Sooty-headed Bulbul	<i>Pycnonotus aurigaster</i>	3	2	R
Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	1	4	R
Grey-breasted Prinia	<i>Prinia hodgsonii</i>	1	1	R
Rufous-tailed Tailorbird	<i>Orthotomus sericeus</i>	2	-	R
Thick-billed Warbler	<i>Acrocephalus caedon</i>	-	1	W
Two-barred Warbler	<i>Phylloscopus plumbeitarsus</i>	-	1	W
Yellow-vented Flowerpecker	<i>Dicaeum chrysorrheum</i>	1	-	R
Olive-backed Sunbird	<i>Nectarinia jugularis</i>	2	1	R
No. of species		59	60	-
No. of individuals		107	104	-
Species diversity index (H')		3.93	3.91	-

evergreen forest. The forest surrounds many villages and has diverse wildlife. The proximity of the forest to villages means that villagers are frequently entering the forest to find wood and non-wood products. The Forestry Administration is responsible for controlling illegal activities in these areas (FACI, 2007).

The primary threats to avian diversity in and around the Central Cardamom Protected Forest and Seima Biodiversity Conservation Area are related to habitat conversion and poaching for local consumption (Mombert and Weiler, 1999; Walston *et al.*, 2000; ICUBEC, 2012). Logging is officially prohibited in both areas. Nevertheless, the threat of illegal logging exists and the regions are likely to undergo considerable population growth with associated pressures on biological resources (Emmett and Olsson, 2005). A number of resident bird species are targeted for bushmeat for personal consumption: notably pheasants, partridges, hornbills and parrots.

Logging undoubtedly has had negative effects on much of the faunal and floral communities and the precise causes are complex and warrant attention (Ashwell, 1997). Although, the forest superficially appears intact much of the forest is in fact heavily degraded with relatively few mature large trees and a broken canopy. Encroachment by

secondary growth and bamboo is prevalent in many areas. Logging has probably had its most profound effect on birds species needing large trees to nest, feed and roost in chiefly large hornbills, large woodpeckers and probably also larger raptors (Walston *et al.*, 2000; Hur *et al.*, 2003).

CONCLUSION

Conversion of habitats and poaching should be strictly prohibited for the conservation of bird communities in the Central Cardamom Protected Forest and Seima Biodiversity Conservation Area, Cambodia. Detailed ecological, social and economic evaluations are needed in the future. Furthermore, human development and welfare programs integrated with biodiversity conservation could be help with the protection and management of bird communities in these areas.

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