

## THE AVIFAUNA OF THE MO SINGTO FOREST DYNAMICS PLOT, KHAO YAI NATIONAL PARK, THAILAND

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### ABSTRACT

The 169 species of birds recorded on the 30 ha Mo Singto Forest Dynamics Plot, Khao Yai National Park, Thailand, are a subset of the 329 species recorded in the headquarters area of the park. Most of the Mo Singto-recorded species are typical of evergreen forest interior but the transient occurrence of a small number of other species, inhabitants of forest edge or more open habitats, is documented. Almost one third of species found on the plot were moderate to long-distance migrant, non-breeding, visitors. The largest foraging guilds were foliage-gleaning insectivores and sallying insectivores, together accounting for over one-third of all species. Though obligate frugivores were poorly represented, most insectivorous birds incorporated fruits in their diet.

The nearly 30-year history of avian recording at Mo Singto, with intensive community studies having been conducted in the past decade, and the location of the study plot near the submontane-montane transition, make it an ideal site for continuation of detailed monitoring, particularly that related to the impact of climate change.

Keywords: biodiversity, bird community, monitoring, species inventory, tropical forest

### INTRODUCTION

Observations of birds at Mo Singto, in Khao Yai National Park, have been made for as long as observations have been conducted on gibbons (BROCKELMAN & GITTINS, 1984; MARSHALL *ET AL.*, 1972; MARSHALL & SUGARDJITO, 1986), and for almost the same duration as on birds in the wider park area. Systematic compilation of a Khao Yai avifauna began soon after the park's establishment (DICKINSON, 1963, 1967; DICKINSON & TUBB, 1964, 1966; McCLURE, 1974). Both gibbon researchers and birdwatchers collected information on birds on the Mo Singto Forest Dynamics Plot (hereafter MFDP) from at least the early 1980s. A comprehensive inventory of the birds of Khao Yai and adjacent areas in what is known as the Dong Phraya Yen Forest Complex, was given in LYNAM *ET AL.* (2006) with updates in POBPRASERT *ET AL.* (2008).

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The establishment of a marked grid in 1998 provided a new opportunity and incentive to conduct detailed studies of the bird community involving individual colour-marking, territory mapping of birds, evaluating census methods, and studies of breeding biology and social behaviour (DHANASARNPAIBOON & ROUND, 2004; GALE *ET AL.*, 2009; NIMNUAN *ET AL.*, 2004; PIERCE, 2004, 2005, 2009; PIERCE & POBPRASERT, 2007; PIERCE AND ROUND, 2006; PIERCE *ET AL.*, 2004a, 2004b, 2007; POBPRASERT & GALE, 2010; POBPRASERT & PIERCE, 2010; POBPRASERT *ET AL.*, 2008; PRADITSUP *ET AL.*, 2007; ROUND & GALE, 2008; ROUND *ET AL.*, 2006; SANKAMETHAVEE *ET AL.*, 2009, 2010; SAVINI & SUKUMAL, 2009; SUKUMAL & SAVINI, 2009a, 2009b; SUKUMAL *ET AL.*, 2010; STEWARD, 2010; TOKUE, 2007.)

Detailed inventories and long-term data sets for tropical forest sites are rare. ROUND (1984) assessed avifaunal changes at another Thai site, Doi Suthep-Pui, over a 50-year period. Turnover, encompassing both apparent losses due to hunting and habitat degradation, and many additions (“new” records), was documented over this period. Assessment of faunal change is complex: some turnover may be stochastic in nature; some species may be extirpated through human activity; other “genuinely new” species may colonize due to changes in the environment or appear for short periods in response to ephemeral disturbance. Increased observer effort through time at any site will inevitably accumulate new records. Increasingly, climate change is recognized as a major anthropogenic disturbance that not only impacts habitats and plant distribution, but also causes distributional and behavioural changes in animals (e.g. CRICK & SPARKS, 1999; HICKLING *ET AL.*, 2006; SCHAEFER *ET AL.*, 2006).

Because of MFDP’s location in the heart of the 2,169 km<sup>2</sup> Khao Yai National Park its avifauna is exempt from hunting and most forms of direct human disturbance (though even there, some collection of high-value forest products, such as *Aquilaria* wood, is still carried out; BROCKELMAN *ET AL.*, 2011). The location of MFDP may prove to be an especially fortuitous choice for studying climate change-related impacts on the bird community since the plot is situated close to the lowland-montane ecotone (for Thailand and tropical SE Asia usually placed at 900–1000 m elevation; NEAL 1967; WHITMORE, 1975). ROUND & GALE (2008) demonstrated major changes in the relative abundance of two pheasant species (one lowland, one montane) in and around MFDP over a two-decade period which they hypothesized was related to warming temperatures.

The purpose of this paper, therefore, is to provide an updated inventory of bird species recorded on the Mo Singto Forest Dynamics Plot and to discuss this in the larger context of the park of which it is a small part. This will provide a baseline for assessing future turnover in the bird community, and will also be useful as a reference for ecological studies of interactions such as seed dispersal and predation.

## STUDY AREA AND METHODS

Details of MFDP are set out in BROCKELMAN *ET AL.* (2011). In brief, it is an area of 30 ha, located in closed-canopy, moist, evergreen forest habitat at elevations of 725 to 815 m. It lies within 500 m of the forest edge and park headquarters. The range of habitats and species diversity of plants and animals in the immediate surroundings was likely increased by the large expanse of forest clearings, formerly settled and cultivated areas, which became *Imperata* grassland and scrub when the park was established in 1962. Though grasslands are still burnt during management, clearings are gradually reverting to scrub and secondary forest. No clearings exist within the plot itself.

The species listed (Table 1) are all those recorded within the confines of the present-day plot. This includes those recorded opportunistically by birdwatchers and biologists from 1980 onwards; and those noted during systematic censuses of MFDP during 2002–2006 and subsequently (PIERCE & ROUND, 2006; ROUND *ET AL.*, 2006; POBPRASERT *ET AL.*, 2008; GALE *ET AL.*, 2009). It also includes species seen in the airspace over the plot. Observations were carried out year-round and the records also include species detected by mist-netting and capture in baited spring-traps. Nocturnal birds were detected both on and in the immediate vicinity of the plot by listening for calls at night while walking forest trails (though much less search effort was concentrated at night than during the day). All sight photographic and aural records (both those of the authors and those submitted by outside observers) were authenticated by peer-review.

The plot constitutes a small part of a plateau in the north-west quadrant of the park. This relatively homogeneous habitat and elevational zone, extending to the rim of the northern park scarp, and southwards to the summit of the Khao Khieo–Khao Rom scarp (1,350 m), and eastwards to the Haew Suwat waterfall, covers an area of roughly 60 km<sup>2</sup>. This corresponds to the “headquarters area” (hereafter Hq area) of the park. It is traversed by roads and trails and therefore frequently visited. At higher elevations, the forest grades into a montane forest type. At lower elevations, around the northern rim, it grades into a drier, semi-evergreen or mixed deciduous facies.

Besides providing a comprehensive listing of bird species known for MFDP, we have also listed all other species known for Hq area with reference to the baseline inventory for the park in LYNAM *ET AL.* (2006) and POBPRASERT *ET AL.*, 2008 (Table 2). We have omitted species listed by other authors where it cannot be established whether the records were from the Hq area as defined above. We discuss those that might have the potential to either colonise, disperse or stray into MFDP due to habitat change induced by ecological succession, human-induced or natural disturbance, or during random turnover. Taxonomic order and nomenclature are based on ROBSON (2008).

## RESULTS

### Species Found on MFDP

The 169 species recorded on MFDP (both residents and migrants or winter visitors) are a subset of the total of 329 species which have been recorded in the Hq area of the park as a whole (Table 1, Table 2). Of the MFDP-recorded species, 112 are thought to be resident (either on MFDP itself or in the immediately adjacent Hq area); one is a wet-season breeding visitor; 47 species are considered non-breeding (winter) visitors, seven are spring and autumn passage migrants. At least two species recorded on MFDP are represented in the park by both resident and wintering populations (Table 1).

Of these, 128 are more or less regular on MFDP, while another 41 are considered rare (< 10 sightings). In general, MFDP was very intensively surveyed and most rare species were considered to be genuinely rare, either because they were birds that tended to occur at low density and had large territories (e.g. most raptors) or were those normally characteristic of more open habitats. At least one aerial feeder (e.g. Asian House-martin) may have been under-recorded due to the difficulty of observing them from within closed canopy forest.

Table 1. List of bird species recorded on the Mo Singto Forest Dynamics Plot, Khao Yai National Park.

Seasonal status: resident/presumed resident (R); non-breeding visitor (N); breeding visitor (B); passage migrant (P); [ ] rarely recorded on plot (< ten records).

Habitats: grassland or scrub (G); forest or woodland (F); aerial feeders (A)

Guilds: Following JOHNS (1986), terrestrial insectivore–frugivore (TIF), bark-gleaning insectivore (BGI), arboreal insectivore–frugivore (AIF), arboreal faunivore/frugivore (FF), foliage-gleaning insectivore (FGI), terrestrial insectivore–faunivore (TIV), piscivore (P), diurnal or nocturnal raptor (R), sallying insectivore (SaI), sweeping insectivore (SwI), terrestrial insectivore (TI), insectivore–nectarivore (IN).

Common name	Scientific name	Seasonal status	Habitat	Guild
Scaly-breasted Partridge	<i>Arborophila chloropus</i>	R	F	TIF
Red Junglefowl	<i>Gallus gallus</i>	R	F	TIF
Silver Pheasant	<i>Lophura nycthemera</i>	R	F	TIF
Siamese Fireback	<i>Lophura diardi</i>	R	F	TIF
Malaysian Night-heron	<i>Gorsachius melanolophus</i>	[R]	F	P
Chinese Pond-heron	<i>Ardeola bacchus</i>	[N]	F	P
Jerdon's Baza	<i>Aviceda jerdoni</i>	[R]	F	R
Black Baza	<i>Aviceda leuphotes</i>	N	F	R
Oriental Honey-buzzard	<i>Pernis ptilorhynchus</i>	R,N	F	R
Crested Serpent-eagle	<i>Spilornis cheela</i>	R	F	R
Crested Goshawk	<i>Accipiter trivirgatus</i>	R	F	R
Shikra	<i>Accipiter badius</i>	R	F	R
Japanese Sparrowhawk	<i>Accipiter gularis</i>	P	F	R
Besra	<i>Accipiter virgatus</i>	[R]	F	R
Mountain Hawk-eagle	<i>Nisaetus nipalensis</i>	[R]	F	R
Eurasian Woodcock	<i>Scolopax rusticola</i>	N	F	TI
Spotted Dove	<i>Streptopelia chinensis</i>	[R]	G	TF
Barred Cuckoo-dove	<i>Macropygia unchall</i>	R	F	AF
Emerald Dove	<i>Chalcophaps indica</i>	R	F	TF
Thick-billed Green-pigeon	<i>Treron curvirostra</i>	R	F	AF
Wedge-tailed Green-pigeon	<i>Treron sphenurus</i>	[R]	F	AF
Mountain Imperial-pigeon	<i>Ducula badia</i>	R	F	AF
Vernal Hanging-parrot	<i>Loriculus vernalis</i>	R	F	AF
Chestnut-winged Cuckoo	<i>Clamator coromandus</i>	[N]	F	FGI
Large Hawk-cuckoo	<i>Hierococcyx sparveroides</i>	N	F	FGI

Table 1 (continued)

Common name	Scientific name	Seasonal status	Habitat	Guild
Hodgson's Hawk-cuckoo	<i>Hierococcyx nisicolor</i>	[R]	F	FGI
Indian Cuckoo	<i>Cuculus micropterus</i>	[N]	F	FGI
Banded Bay Cuckoo	<i>Cacomantis sonneratii</i>	R	F	FGI
Asian Emerald Cuckoo	<i>Chrysococcyx maculatus</i>	N	F	FGI
Violet Cuckoo	<i>Chrysococcyx xanthorhynchus</i>	[R]	F	FGI
Drongo Cuckoo	<i>Surniculus lugubris</i>	R	F	FGI
Greater Coucal	<i>Centropus sinensis</i>	[R]	G	TIV
Coral-billed Ground-cuckoo	<i>Carpococcyx renauldi</i>	R	F	TIV
Green-billed Malkoha	<i>Phaenicophaeus tristis</i>	R	F	FGI
Oriental Bay Owl	<i>Phodilus badius</i>	R	F	R
Mountain Scops-owl	<i>Otus spilocephalus</i>	R	F	R
Collared Scops-owl	<i>Otus lettia</i>	R	F	R
Oriental Scops-owl	<i>Otus sunia</i>	[N]	F	R
Spot-bellied Eagle-owl	<i>Bubo nipalensis</i>	[R]	F	R
Brown Wood-owl	<i>Strix leptogrammica</i>	[R]	F	R
Collared Owlet	<i>Glaucidium brodiei</i>	R	F	R
Asian Barred Owlet	<i>Glaucidium cuculoides</i>	R	F	R
Brown Boobook	<i>Ninox scutulata</i>	R	F	R
Great Eared Nightjar	<i>Eurostopodus macrotis</i>	R	F	SwI
Brown-backed Needletail	<i>Hirundapus giganteus</i>	R	A	SwI
Asian Palm-swift	<i>Cypsiurus balasiensis</i>	R	A	SwI
Orange-breasted Trogon	<i>Harpactes oreskios</i>	R	F	FGI
Red-headed Trogon	<i>Harpactes erythrocephalus</i>	R	F	FGI
Oriental Dollarbird	<i>Eurystomus orientalis</i>	[R]	F	SaI
Banded Kingfisher	<i>Lacedo pulchella</i>	R	F	TI
Black-backed Kingfisher	<i>Ceyx erithacus</i>	[P]	F	P
Blue-eared Kingfisher	<i>Alcedo meninting</i>	[R]	F	P
Blue-bearded Bee-eater	<i>Nyctyornis athertoni</i>	R	F	SaI
Chestnut headed Bee-eater	<i>Merops leschenaulti</i>	R	A	SaI
Northern Brown Hornbill	<i>Anorrhinus austeni</i>	R	F	FF
Oriental Pied Hornbill	<i>Anthracoceros albirostris</i>	R	F	FF
Great Hornbill	<i>Buceros bicornis</i>	R	F	FF

Table 1 (continued)

Common name	Scientific name	Seasonal status	Habitat	Guild
Wreathed Hornbill	<i>Aceros undulatus</i>	R	F	FF
Green-eared Barbet	<i>Megalaima faiostrica</i>	R	F	AIF
Moustached Barbet	<i>Megalaima incognita</i>	R	F	AIF
Blue-eared Barbet	<i>Megalaima australis</i>	R	F	AIF
Rufous Woodpecker	<i>Micropternus brachyurus</i>	R	F	BGI
Greater Yellownap	<i>Chrysophlegma flavinucha</i>	R	F	BGI
Laced Woodpecker	<i>Picus vittatus</i>	R	F	BGI
Greater Flameback	<i>Chrysocolaptes lucidus</i>	R	F	BGI
Black-and-buff Woodpecker	<i>Meiglyptes jugularis</i>	R	F	BGI
Heart-spotted Woodpecker	<i>Hemicircus canente</i>	R	F	BGI
Great Slaty Woodpecker	<i>Mulleripicus pulverulentus</i>	[R]	F	BGI
Long-tailed Broadbill	<i>Psarisomus dalhousiae</i>	R	F	FGI
Dusky Broadbill	<i>Corydon sumatranus</i>	[R]	F	FGI
Silver-breasted Broadbill	<i>Serilophus lunatus</i>	R	F	FGI
Banded Broadbill	<i>Eurylaimus javanicus</i>	R	F	FGI
Hooded Pitta	<i>Pitta sordida</i>	B	F	TIV
Blue Pitta	<i>Pitta cyanea</i>	R	F	TIV
Eared Pitta	<i>Anthocincla phayrei</i>	R	F	TIV
White-bellied Erpornis	<i>Erpornis zantholeuca</i>	R	F	FGI
Black-winged Cuckooshrike	<i>Coracina melaschistos</i>	N	F	FGI
Rosy Minivet	<i>Pericrocotus roseus</i>	N	F	FGI
Swinhoe's Minivet	<i>Pericrocotus cantonensis</i>	N	F	FGI
Scarlet Minivet	<i>Pericrocotus speciosus</i>	R	F	FGI
Black-naped Oriole	<i>Oriolus chinensis</i>	N	F	FGI
Silver Oriole	<i>Oriolus mellianus</i>	[N]	F	FGI
Large Woodshrike	<i>Tephrodornis gularis</i>	R	F	FGI
Bar-winged Flycatcher-shrike	<i>Hemipus picatus</i>	R	F	FGI
Common Iora	<i>Aegithina tiphia</i>	[R]	F	FGI
Great Iora	<i>Aegithina lafresnayei</i>	R	F	FGI
Ashy Drongo	<i>Dicrurus leucophaeus</i>	N	F	SaI
Bronzed Drongo	<i>Dicrurus aeneus</i>	R	F	SaI

Table 1 (continued)

Common name	Scientific name	Seasonal status	Habitat	Guild
Lesser Racket-tailed Drongo	<i>Dicrurus remifer</i>	N	F	SaI
Greater Racket-tailed Drongo	<i>Dicrurus paradiseus</i>	R	F	SaI
Hair-crested Drongo	<i>Dicrurus hottentottus</i>	N	F	IN
Black-naped Monarch	<i>Hypothymis azurea</i>	R	F	SaI
Asian Paradise-flycatcher	<i>Terpsiphone paradisi</i>	R,N	F	SaI
Japanese Paradise-flycatcher	<i>Terpsiphone atrocaudata</i>	[P]	F	SaI
Eastern Jungle Crow	<i>Corvus leuillanti</i>	[R]	F	TIV
Common Green Magpie	<i>Cissa chinensis</i>	R	F	FGI
Racket-tailed Treepie	<i>Crypsirina temia</i>	[R]	F	AIF
Tiger Shrike	<i>Lanius tigrinus</i>	[P]	F	TIV
Grey-backed Shrike	<i>Lanius tephronotus</i>	[N]	F	TIV
Black-throated Sunbird	<i>Aethopyga saturata</i>	R	F	IN
Ruby-cheeked Sunbird	<i>Chalcoparia singalensis</i>	R	F	IN
Little Spiderhunter	<i>Arachnothera longirostra</i>	R	F	IN
Thick-billed Flowerpecker	<i>Dicaeum agile</i>	R	F	AF
Yellow-vented Flowerpecker	<i>Dicaeum chrysorrheum</i>	R	F	AF
Plain Flowerpecker	<i>Dicaeum minullum</i>	[R]	F	AF
Fire-breasted Flowerpecker	<i>Dicaeum ignipectus</i>	R	F	AF
Blue-winged Leafbird	<i>Chloropsis cochinchinensis</i>	R	F	FGI
Asian Fairy-bluebird	<i>Irena puella</i>	R	F	FGI
White-rumped Munia	<i>Lonchura striata</i>	[R]	G	AF
Pin-tailed Parrotfinch	<i>Erythrura prasina</i>	N	F	AF
Grey Wagtail	<i>Motacilla cinerea</i>	N	F	TI
Common Rosefinch	<i>Carpodacus erythrinus</i>	[N]	G	AF
Velvet-fronted Nuthatch	<i>Sitta frontalis</i>	[R]	F	BGI
Golden-crested Myna	<i>Ampeliceps coronatus</i>	R	F	AF
Common Hill-myna	<i>Gracula religiosa</i>	R	F	AF
Orange-headed Thrush	<i>Zoothera citrina</i>	N	F	TIF
White's Thrush	<i>Zoothera aurea</i>	[N]	F	TIF
Siberian Thrush	<i>Zoothera sibirica</i>	[P]	F	TIF

Table 1 (continued)

Common name	Scientific name	Seasonal status	Habitat	Guild
Grey-sided Thrush	<i>Turdus feae</i>	[N]	F	TIF
Eyebrowed Thrush	<i>Turdus obscurus</i>	N	F	TIF
Siberian Blue Robin	<i>Luscinia cyane</i>	N	F	TI
White-throated Rock-thrush	<i>Monticola gularis</i>	N	F	TI
Slaty-backed Forktail	<i>Enicurus schistaceus</i>	[R]	F	TI
White-crowned Forktail	<i>Enicurus leschenaulti</i>	R	F	TI
Blue Whistling-thrush	<i>Myophonus caeruleus</i>	N	F	TI
Hainan Blue Flycatcher	<i>Cyornis hainanus</i>	R	F	SaI
Hill Blue Flycatcher	<i>Cyornis banyumas</i>	R	F	SaI
Verditer Flycatcher	<i>Eumyias thalassinus</i>	N	F	SaI
Rufous-bellied Niltava	<i>Niltava sundara</i>	[N]	F	SaI
Mugimaki Flycatcher	<i>Ficedula mugimaki</i>	[N]	F	SaI
Slaty-backed Flycatcher	<i>Ficedula hodgsonii</i>	[N]	F	SaI
Dark-sided Flycatcher	<i>Muscicapa sibirica</i>	N	F	SaI
Asian Brown Flycatcher	<i>Muscicapa dauurica</i>	N	F	SaI
White-rumped Shama	<i>Copsychus malabaricus</i>	R	F	TI
Sultan Tit	<i>Melanochlora sultanea</i>	R	F	FGI
Grey-headed Flycatcher	<i>Culicicapa ceylonensis</i>	N	F	SaI
Black-headed Bulbul	<i>Pycnonotus atriceps</i>	R	F	AIF
Black-crested Bulbul	<i>Pycnonotus flaviventris</i>	R	F	AIF
Stripe-throated Bulbul	<i>Pycnonotus finlaysoni</i>	R	F	AIF
Grey-eyed Bulbul	<i>Iole propinqua</i>	R	F	AIF
Puff-throated Bulbul	<i>Alophoixus pallidus</i>	R	F	AIF
Ashy Bulbul	<i>Hemixos flavala</i>	R	F	AIF
Asian House-martin	<i>Delichon dasypus</i>	[N]	A	SwI
Barn Swallow	<i>Hirundo rustica</i>	N	A	SwI
Red-rumped Swallow	<i>Hirundo daurica</i>	N	A	SwI
Asian Stubtail	<i>Urosphena squameiceps</i>	N	F	TI
Martens's Warbler	<i>Seicercus omeiensis</i>	N	F	FGI
Plain-tailed Warbler	<i>Seicercus soror</i>	N	F	FGI
Eastern Crowned Warbler	<i>Phylloscopus coronatus</i>	P	F	FGI
Sulphur-breasted Warbler	<i>Phylloscopus ricketti</i>	N	F	FGI



Table 1 (continued)

Common name	Scientific name	Seasonal status	Habitat	Guild
Claudia's Warbler *	<i>Phylloscopus claudiae</i>	N	F	FGI
Arctic Warbler	<i>Phylloscopus borealis</i>	P	F	FGI
Pale-legged Leaf-warbler	<i>Phylloscopus tenellipes</i>	N	F	FGI
Two-barred Warbler	<i>Phylloscopus plumbeitarsus</i>	N	F	FGI
Yellow-browed Warbler	<i>Phylloscopus inornatus</i>	N	F	FGI
Radde's Warbler	<i>Phylloscopus schwarzi</i>	N	F	FGI
Chestnut-flanked White-eye	<i>Zosterops erythropleurus</i>	N	F	AIF
Everett's White-eye	<i>Zosterops everetti</i>	R	F	AIF
Large Scimitar-babbler	<i>Pomatorhinus hypoleucos</i>	R	F	TI
White-browed Scimitar-babbler	<i>Pomatorhinus schisticeps</i>	R	F	FGI
Pin-striped Tit-babbler	<i>Macronous gularis</i>	R	F	FGI
Puff-throated Babbler	<i>Pellorneum ruficeps</i>	R	F	TI
Scaly-crowned Babbler	<i>Malacopteron cinereum</i>	[R]	F	FGI
Abbott's Babbler	<i>Malacocincla abbotti</i>	R	F	FGI
Black-throated Laughingthrush	<i>Dryonastes chinensis</i>	R	F	TI
White-crested Laughingthrush	<i>Garrulax leucolophus</i>	R	F	TI
Lesser Necklaced Laughingthrush	<i>Garrulax monileger</i>	R	F	TI
Dark-necked Tailorbird	<i>Orthotomus atrogularis</i>	R	F	FGI
Common Tailorbird	<i>Orthotomus sutorius</i>	[R]	F	FGI

\* Two taxa, Claudia's Warbler *Phylloscopus claudiae* and Hartert's Warbler *P. goodsoni* constitute a monophyletic group with Blyth's Leaf-warbler *P. reguloides*, with which they were formerly treated as conspecific (OLSSON ET AL., 2005). The Khao Yai-wintering taxon is tentatively listed as *P. claudiae* but the possibility that it might instead be *P. goodsoni*, recently recorded in N Laos by FUCHS ET AL. (2007) has not been excluded with certainty.

Table 2. List of additional bird species recorded in headquarters area of Khao Yai National Park.

Common name	Scientific name	Forest/ woodland	Grassland/ scrub	Water- bodies
Blue-breasted Quail	<i>Coturnix chinensis</i>		R	
Lesser Whistling-duck	<i>Dendrocygna javanica</i>			N
Little Grebe	<i>Tachybaptus ruficollis</i>			N
Asian Openbill	<i>Anastomus oscitans</i>			N
Black Stork	<i>Ciconia nigra</i>			N
Yellow Bittern	<i>Ixobrychus sinensis</i>			R
Von Schrenck's Bittern	<i>Ixobrychus eurhythmus</i>	P		
Cinnamon Bittern	<i>Ixobrychus cinnamomeus</i>		R	
Black Bittern	<i>Dupetor flavicollis</i>			N
Little Heron	<i>Butorides striata</i>			N
Eastern Cattle Egret	<i>Bubulcus coromandus</i>			R
Little Egret	<i>Egretta garzetta</i>			R
Spot-billed Pelican	<i>Pelecanus philippensis</i>			N
Little Cormorant	<i>Phalacrocorax niger</i>			R
Oriental Darter	<i>Anhinga melanogaster</i>			R
Common Kestrel	<i>Falco tinnunculus</i>		N	
Oriental Hobby	<i>Falco severus</i>	R		
Osprey	<i>Pandion haliaetus</i>			N
Black-shouldered Kite	<i>Elanus caeruleus</i>		R	
Black-eared Kite	<i>Milvus lineatus</i>		N	
Himalayan Griffon	<i>Gyps himalayensis</i>	N		
Short-toed Snake-eagle	<i>Circetus gallicus</i>		N	
Eastern Marsh-harrier	<i>Circus spilonotus</i>		N	
Pied Harrier	<i>Circus melanoleucos</i>		N	
Chinese Sparrowhawk	<i>Accipiter soloensis</i>	P		
Grey-faced Buzzard	<i>Butastur indicus</i>	N		
Common Buzzard	<i>Buteo buteo</i>	N		
Eastern Imperial Eagle	<i>Aquila heliaca</i>	N		
Booted Eagle	<i>Aquila pennata</i>		N	
Black Eagle	<i>Ictinaetus malayensis</i>	R		
Rufous-bellied Eagle	<i>Lophotriorchis kienerii</i>	R		

Table 2 (continued)

Common name	Scientific name	Forest/ woodland	Grassland/ scrub	Water- bodies
Changeable Hawk-eagle	<i>Nisaetus limnaeetus</i>	R		
Slaty-legged Crake	<i>Rallina eurizonoides</i>	N		
White-breasted Waterhen	<i>Amaurornis phoenicurus</i>			R
Ruddy-breasted Crake	<i>Porzana fusca</i>			N
Common Moorhen	<i>Gallinula chloropus</i>			N
Masked Finfoot	<i>Heliopais personatus</i>			N
Yellow-legged Buttonquail	<i>Turnix tanki</i>		R	
Barred Buttonquail	<i>Turnix suscitator</i>		R	
Black-winged Stilt	<i>Himantopus himantopus</i>			N
Pacific Golden Plover	<i>Pluvialis fulva</i>			N
Grey-headed Lapwing	<i>Vanellus cinereus</i>			N
Red-wattled Lapwing	<i>Vanellus indicus</i>		R	
Pintail Snipe	<i>Gallinago stenura</i>			N
Whimbrel	<i>Numenius phaeopus</i>			N
Common Sandpiper	<i>Actitis hypoleucos</i>			N
Green Sandpiper	<i>Tringa ochropus</i>			N
Wood Sandpiper	<i>Tringa glareola</i>			N
Spotted Redshank	<i>Tringa erythropus</i>			N
Oriental Pratincole	<i>Glareola maldivarum</i>		N	
White-winged Tern	<i>Chlidonias leucopterus</i>			N
Rock Pigeon	<i>Columba livia</i>		R	
Pale-capped Pigeon	<i>Columba punicea</i>	N		
Oriental Turtle-dove	<i>Streptopelia chinensis</i>		N	
Orange-breasted Green-pigeon	<i>Treron bicinctus</i>	R		
Ashy-headed Green-pigeon	<i>Treron phayrei</i>	R		
Pin-tailed Green-pigeon	<i>Treron apicauda</i>	N		
White-bellied Green-pigeon	<i>Treron sieboldii</i>	R?		
Red-breasted Parakeet	<i>Psittacula alexandri</i>	R		
Moustached Hawk-cuckoo	<i>Hierococcyx vagans</i>	R		
Himalayan Cuckoo	<i>Cuculus saturatus</i>		N	
Plaintive Cuckoo	<i>Cacomantis merulinus</i>		R	
Asian Koel	<i>Eudynamys scolopaceus</i>		R	

Table 2 (continued)

Common name	Scientific name	Forest/ woodland	Grassland/ scrub	Water- bodies
Lesser Coucal	<i>Centropus bengalensis</i>		R	
Buffy Fish-owl	<i>Ketupa ketupu</i>	R		
Blyth's Frogmouth	<i>Batrachostomus affinis</i>	R		
Grey Nightjar	<i>Caprimulgus jotaka</i>		N	
Large-tailed Nightjar	<i>Caprimulgus macrurus</i>		R	
Himalayan Swiftlet	<i>Aerodramus brevirostris</i>	N		
White-throated Needletail	<i>Hirundapus caudacutus</i>	P		
Silver-backed Needletail	<i>Hirundapus cochinchinensis</i>	R?		
Fork-tailed Swift	<i>Apus pacificus</i>	N		
House Swift	<i>Apus affinis</i>		R	
Indian Roller	<i>Coracias benghalensis</i>		R	
Stork-billed Kingfisher	<i>Pelargopsis capensis</i>			R
Ruddy Kingfisher	<i>Halcyon coromanda</i>	P		
White-throated Kingfisher	<i>Halcyon smyrnensis</i>		R	
Black-capped Kingfisher	<i>Halcyon pileata</i>			N
Common Kingfisher	<i>Alcedo atthis</i>			N
Blue-tailed Bee-eater	<i>Merops philippinus</i>		N	
Blue-throated Bee-eater	<i>Merops viridis</i>		P	
Common Hoopoe	<i>Upupa epops</i>		R?	
Lineated Barbet	<i>Megalaima lineata</i>	R		
Coppersmith Barbet	<i>Megalaima haemacephala</i>	R		
Eurasian Wryneck	<i>Jynx torquilla</i>		N	
Grey-capped Pygmy Woodpecker	<i>Dendrocopos canicapillus</i>	R		
Lesser Yellownappe	<i>Picus chlorolophus</i>	R		
Grey-headed Woodpecker	<i>Picus canus</i>	R		
Blue-winged Pitta	<i>Pitta moluccensis</i>	P		
White-browed Shrike-babbler	<i>Pteruthius flaviscapis</i>	R		
Chestnut-fronted Shrike-babbler	<i>Pteruthius aenobarbus</i>	R		
Slender-billed Oriole	<i>Oriolus tenuirostris</i>	N		
Maroon Oriole	<i>Oriolus traillii</i>	N		
Ashy Woodswallow	<i>Artamus fuscus</i>		R	

Table 2 (continued)

Common name	Scientific name	Forest/ woodland	Grassland/ scrub	Water- bodies
Black Drongo	<i>Dicrurus macrocercus</i>		N	
Crow-billed Drongo	<i>Dicrurus annectans</i>	P		
Brown Shrike	<i>Lanius cristatus</i>		N	
Burmese Shrike	<i>Lanius colluriooides</i>		N	
Olive-backed Sunbird	<i>Cimmyris jugularis</i>		R	
Crimson Sunbird	<i>Aethopyga siparaja</i>	R		
Golden-fronted Leafbird	<i>Chloropsis aurifrons</i>	R		
Plain-backed Sparrow	<i>Passer flaveolus</i>		R	
Red-throated Pipit	<i>Anthus cervinus</i>		N	
Olive-backed Pipit	<i>Anthus hodgsoni</i>	N		
Blyth's Pipit	<i>Anthus godlewskii</i>		N	
Richard's Pipit	<i>Anthus richardi</i>		N	
Paddyfield Pipit	<i>Anthus rufulus</i>		R	
Forest Wagtail	<i>Dendronanthus indicus</i>	N		
White Wagtail	<i>Motacilla alba</i>		N	
Eastern Yellow Wagtail	<i>Motacilla tschutschensis</i>		N	
Yellow-billed Grosbeak	<i>Eophona migratoria</i>		N	
Chestnut Bunting	<i>Emberiza rutila</i>		N	
Yellow-breasted Bunting	<i>Emberiza aureola</i>		N	
White-vented Myna	<i>Acridotheres grandis</i>		R	
Common Myna	<i>Acridotheres tristis</i>		R	
Chestnut-tailed Starling	<i>Sturnus malabaricus</i>	N		
White-shouldered Starling	<i>Sturnus sinensis</i>	N		
Purple-backed Starling	<i>Sturnus sturninus</i>	P		
Chinese Blackbird	<i>Turdus mandarinus</i>		N	
Japanese Thrush	<i>Turdus cardis</i>	N		
Dusky Thrush	<i>Turdus eunomus</i>	N		
Siberian Rubythroat	<i>Luscinia calliope</i>		N	
Rufous-tailed Robin	<i>Luscinia sibilans</i>	N		
Blue Rock-thrush	<i>Monticola solitarius</i>		N	
Grey Bushchat	<i>Saxicola ferreus</i>		N	
Eastern Stonechat	<i>Saxicola maurus</i>		N	
Pied Bushchat	<i>Saxicola caprata</i>		R	

Table 2 (continued)

Common name	Scientific name	Forest/ woodland	Grassland/ scrub	Water- bodies
Red-flanked Bluetail	<i>Tarsiger cyanurus</i>	N		
Chinese Blue Flycatcher	<i>Cyornis glaucicomans</i>	N		
Vivid Niltava	<i>Niltava vivida</i>	N		
Yellow-rumped Flycatcher	<i>Ficedula zanthopygia</i>	P		
Green-backed Flycatcher	<i>Ficedula elisae</i>	P		
Taiga Flycatcher	<i>Ficedula albicilla</i>		N	
Ferruginous Flycatcher	<i>Muscicapa ferruginea</i>	P		
Blue-and-white Flycatcher	<i>Cyanoptila cyanomelana</i>	P		
Oriental Magpie-robin	<i>Copsychus saularis</i>		R	
Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>		R	
Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>		R	
Himalayan Black Bulbul	<i>Hypsipetes leucocephalus</i>	N		
Asian House-martin	<i>Delichon dasypus</i>	N		
Common Sand-martin	<i>Riparia riparia</i>		N	
Yellow-bellied Warbler	<i>Abroscopus superciliaris</i>	R		
Sunda Bush-warbler	<i>Cetia vulcania</i>	N		
White-tailed Leaf-warbler	<i>Phylloscopus ogilviegranti</i>	R		
Chinese Leaf-warbler	<i>Phylloscopus yunnanensis</i>	N		
Dusky Warbler	<i>Phylloscopus fuscatus</i>		N	
Buff-throated Warbler	<i>Phylloscopus subaffinis</i>		N	
Yellow-eyed Babbler	<i>Chrysomma sinense</i>		R	
Japanese White-eye	<i>Zosterops japonicus</i>	N		
Chestnut-capped Babbler	<i>Timalia pileata</i>		R	
Black-browed Reed-warbler	<i>Acrocephalus bistrigiceps</i>		P	
Blunt-winged Warbler	<i>Acrocephalus concinens</i>		N	
Oriental Reed-warbler	<i>Acrocephalus orientalis</i>		P	
Thick-billed Warbler	<i>Acrocephalus aedon</i>		N	
Lanceolated Warbler	<i>Locustella lanceolata</i>		N	
Baikal Bush-warbler	<i>Bradypterus davidi</i>		N	
Bright-capped Cisticola	<i>Cisticola exilis</i>		R	
Rufescent Prinia	<i>Prinia rufescens</i>		R	
Yellow-bellied Prinia	<i>Prinia flaviventris</i>		R	
Plain Prinia	<i>Prinia inornata</i>		R	

### Habitat Use

Most species that occur on MFDP are inhabitants of the edge or interior of evergreen forest. Some are shared with either deciduous forest or secondary growth. Many have a broad altitudinal range, but there are no exclusively montane species. Some rarer MFDP species are larger birds that naturally occur at low density (Table 1). Great Slaty Woodpecker *Mulleripicus pulverulentus*, for example, is scarce in the Hq area of the park and is mostly found in association with lowland, old-growth forests (LAMMERTINK *ET AL.*, 2009). Mountain Hawk-eagle *Nisaetus nipalensis* and Malaysian Night-heron *Gorsachius melanolophus* may be similarly scarce. The former is assumed to require large territories, while the latter is secretive in addition to its apparent scarcity and seems primarily to inhabit lowlands (LEKAGUL & ROUND, 1991; THEWLIS *ET AL.*, 1998). Scaly-crowned Babbler *Malacopteron cinereum* may be representative of lowland species that approach their upper altitudinal limit on the plot. It appears to be patchy and thinly distributed in the Hq area of Khao Yai.

Some others have a special association with a particular habitat (e.g. Pin-tailed Parrotfinch *Erythrura prasina* is a semi-nomadic specialist in seeding bamboo (LEKAGUL & ROUND, 1991; WELLS, 2007). The scarcity of some others is harder to explain. Velvet-fronted Nuthatch *Sitta frontalis* occurs across a wide range of elevations, from lowlands to the montane zone. Its extreme scarcity on the plot (and, incidentally elsewhere in the Hq area) may be due to a preference for slightly more open forest than is found around the interior of Khao Yai. The species evidently bred on or near the plot in 2005, when there were four sightings during March–August, one of which involved two adults and two fledglings. None was recorded in subsequent years, however. At least two rare, resident, plot-recorded species, Blue-eared Kingfisher *Alcedo meninting* and Slaty-backed Forktail *Enicurus schistaceus*, are riparian species associated mostly with larger streams that move into MFDP (presumably from the Lamtakhong River) in mid- to late wet season as the few small streamlets that traverse the plot become swollen.

Five resident species recorded infrequently on MFDP but typical of more open habitats include Greater Coucal *Centropus sinensis*, Spotted Dove *Streptopelia chinensis*, Racket-tailed Treepie *Crypsirina temia*, Common Tailorbird *Orthotomus sutorius* and White-rumped Munia *Lonchura striata*; Table 1). These are either characteristic of, or regularly enter, open, deciduous woodland and bamboo (LEKAGUL & ROUND, 1991) and all but Racket-tailed Treepie are regularly present in edge habitats around the headquarters. There were several records of Racket-tailed Treepie, a bird of lowland deciduous habitats and scrub, often close to standing water (LEKAGUL & ROUND, 1991; ROBSON, 2002) in both the headquarters area of the park and on MFDP during 2004–2005 but the species evidently did not establish itself and has since seemingly since vanished from the park headquarters area. A sixth species, Plain Flowerpecker *Dicaeum minullum*, may also be placed with this group, in that it is regularly present in disturbed, more open woodland habitat around park headquarters. It probably tends to be associated with taller, better quality forest than the other members of this group, occurring elsewhere across a wide altitudinal range to an elevation of 1700 m (LEKAGUL & ROUND, 1991)

Most other species that occur infrequently on MFDP are migrants or non-breeding visitors found in a range of habitats. Chinese Pond-heron *Ardeola bacchus* is a waterbird that occasionally enters closed forest along streams.

### Seasonal Status

Assigning seasonal status to birds is not always straightforward. Many species are polytypic, with both discrete resident and migrant subspecies or populations occurring in the country, and it is not always clear which taxon or population occurs in the park Hq area or on MFDP. Only 114 of 169 MFDP-recorded species (67.5%) are considered residents and for only approximately half of these are there confirmed breeding records on MFDP. Most of the remainder are non-breeding winter visitors. A number of species that are widespread in forest habitats elsewhere in the country (Large Hawk-cuckoo *Hierococcyx sparverioides*, Black-winged Cuckooshrike *Coracina melaschistos*, Ashy Drongo *Dicrurus leucophaeus*, Lesser Racket-tailed Drongo *D. remifer*, Hair-crested Drongo *D. hottentottus*, Verditer Flycatcher *Eumyias thalassinus* and Grey-headed Flycatcher *Culicicapa ceylonensis*) are only known on the plot and in the Hq area of Khao Yai as non-breeding visitors. Hair-crested Drongos breed in lower elevation, deciduous forest around the park boundaries, but the great abundance of this species in evergreen forest, both on the plot and elsewhere around the park Hq during the winter months, lends support to the idea that these are more likely migrant *D. h. brevirostris* from countries to the north, rather than resident or short-distance migrant, up-slope dispersant *D. h. hottentottus*. The absence of resident Ashy Drongo from the plot is more puzzling since residents breed both in lower elevation deciduous forest around the eastern park margins, and in hill slope and montane evergreen forests elsewhere (LEKAGUL & ROUND, 1991; LYNAM ET AL., 2006). Lesser Racket-tailed Drongo is mainly montane and possibly resident in Khao Yai on the small areas of >1000 m habitat that lie 8–10 km S of the plot. (LYNAM ET AL., 2006). But both the Lesser Racket-tailed Drongos and Ashy Drongos that occur on MFDP during winter months are similarly more likely to be migrants from further afield than local dispersants.

The absence of resident populations of some of these species may be due to a variety of factors. The relative homogeneity of the closed evergreen forest habitat; the elevation of the plot, above the upper elevational limits of some species (itself presumably a consequence of preference for more open, deciduous or forest mosaic habitats) and historical (biogeographical) factors may all contribute. The Khao Yai Hq area is at too great an elevation to support the full complement of lowland (deciduous or forest mosaic) species, yet lacks any compensating diversity of either montane or other evergreen forest species (LYNAM ET AL., 2006). The same authors argued that the relatively depauperate nature of the resident evergreen forest avifauna might stem from Khao Yai constituting a relatively isolated block of evergreen forest which during Pleistocene interpluvial periods, would have been smaller than at present, surrounded by deciduous habitats, with even fewer connections to other evergreen isolates elsewhere in Thailand: to the north, south and east.

In a study of mixed species foraging flocks on MFDP, NIMNUAN ET AL. (2004) found 58 species (residents and migrants) that regularly participated. Although residents contributed 74% of individuals found in flocks, the sightings were biased towards resident species as the survey covered only the months May–October, when most migrants were absent. Even so, the most numerous birds counted (136 of 956 individuals, 14 % of all sightings) were one or two species of (migrant) leaf-warbler. If migrant species are excluded from the analysis, the relatively depauperate nature of the MFDP avifauna is immediately apparent. Just 11 species of resident bird contributed 67% of sightings of birds in flocks. The two predominant arboreal species, White-bellied Erpornis *Erpornis zantholeuca* (69 sightings) and Black-naped Monarch *Hypothymis azurea* (53 sightings) together contributed 17% of all individuals



observed. The single most abundant understorey-middle storey species on MFDP is the Puff-throated Bulbul *Alophoixus pallidus* (3.4 individuals/ha, GALE *ET AL.*, 2009) which is chiefly associated in territorial groups and contributed few (1.5%) mixed flock sightings.

### Foraging guilds

The largest guild among MFDP-recorded species was that of foliage-gleaning insectivores (46 species, 35.5%) followed by terrestrial insectivores and insectivore-faunivores (23 species in total); sallying insectivores (19 species), both diurnal and nocturnal raptorial birds (18 species), arboreal omnivores (16 species, mostly hornbills, barbets and bulbuls); arboreal frugivores (including granivores, not listed separately; 14 species). If granivores are excluded from the arboreal frugivore assemblage, this leaves only four pigeons, four flowerpeckers and two mynas. Though eight species of bark-gleaning insectivores (mostly woodpeckers) are listed for the plot, only four (Greater Flameback *Chrysocolaptes lucidus*, Laced Woodpecker *Picus vittatus*, Greater Yellownappe *Chrysophlegma flavinucha* and Heart-spotted Woodpecker *Hemicircus canente*), listed in declining order of abundance (ROUND *ET AL.*, 2006), are frequent.

Assigning species to guilds is necessarily imprecise. The seeds of small fruits were detected in the faeces of many ostensibly insectivorous species that were handled, including Abbott's Babbler *Malacocincla abbotti*, scimitar-babblers *Pomatorhinus* spp. and all three laughingthrushes (*Dryonastes chinensis* and *Garrulax* spp.). Both Laced Woodpecker and Greater Flameback were seen eating fruit. Among the commoner resident insectivores, only Hill Blue Flycatcher *Cyornis banyumas* has not yet been observed to take fruit. Other true flycatchers (Verditer Flycatcher *Eumayias thalassinus*, Taiga Flycatcher *Ficedula albicilla*) and "flycatcher guild" sallying insectivores such as Black-naped Monarch are likely to take fruits on occasion. While most neotropical trogons take a considerable proportion of fruit in their diet (PIZO, 2007; REMSEN *ET AL.*, 1993; RIEHL & ADELSON, 2008), the Asian species are primarily foliage-gleaning insectivores (ALI & RIPLEY, 1983; JOHNSGARD, 2000; STEWARD, 2010; WELLS, 1999). Nonetheless both Red-headed Trogon *Harpactes erythrocephalus* and Orange-breasted Trogon *H. oreskios* at Khao Yai have now been observed to take a small proportion of fruits.

In comparison with Sundaic lowland forest bird communities such as those at (e.g.) Pasoh and at Kuala Lompat, Malaysia (FRANCIS & WELLS, 2003; WONG, 1986), Khao Yai appears to have more generalist omnivores and fewer specialist insectivores or frugivores.

### Khao Yai Hq Species Not Yet Recorded on MFDP

A further 160 species (loosely divided into 60 forest or woodland inhabiting species, 70 grassland or scrub-associated species and 30 waterbirds and riparian species) have been recorded in the Hq area without being either seen or heard on MFDP (Table 2: LYNAM *ET AL.*, 2006; POBPRASERT *ET AL.*, 2008). The occurrence of so many species elsewhere in the Hq area relative to the number on MFDP can be attributed to the much larger area, and greater range of habitats, around the park Hq as a whole compared with the closed forest habitat of the plot. These additional habitats encompass grassland (both tall grass and mown grass or lawn), scrub, forest edge, roadside verge, parkland, large streams with associated riparian habitats, reservoirs, human habitations, power lines and other installations which provide nesting or foraging niches for a few species.

The 60 forest-inhabiting species comprise 23 resident/presumed residents and 37 migrants/non-breeding visitors, all of which may have the potential to occur on MFDP. At least two of the resident species, Lesser Yellowname *Picus chlorolophus* and Grey-capped Pygmy Woodpecker *Dendrocopos canicapillus* (the latter reported as “absent from the Hq area” by LYNAM *ET AL.*, 2006, but presence since noted in at least one season: author), seem to share the habitat preference of Velvet-fronted Nuthatch in that they occur across a wide range of elevations, often in more open forest. However they also occur in tall, mature, closed-canopy, lowland forest. The scarce lowland resident Moustached Hawk-cuckoo *Cuculus vagans*, two passage migrants (Ruddy Kingfisher *Halcyon coromanda* and Chinese Sparrowhawk *Accipiter soloensis*) and the scarce winter visitor Rufous-tailed Robin *Luscinia sibilans* have all been seen on the Mo Singto Nature Trail or elsewhere in the vicinity of the plot margins, and are therefore almost certain to occur on MFDP occasionally. A small number of birds (e.g. White-tailed Leaf-warbler *Phylloscopus ogilviegranti*, White-browed Shrike-babbler *Pteruthius flaviscapis* and Chestnut-fronted Shrike-babbler *P. aenobarbus*) are montane residents, and could conceivably disperse downslope to the elevation of the plot although the park populations of these species are relatively small, due to the limited areas of montane habitat and therefore the chances of detecting them may be slight.

The occurrence of some others, mainly lowland deciduous woodland, species (e.g. Red-breasted Parakeet *Psittacula alexandri*, Lineated Barbet *Megalaima lineata* and Golden-fronted Leafbird *Chloropsis aurifrons*) that occur chiefly around the margins of the headquarters plateau, at the deciduous-evergreen ecotone, is unlikely at present but could be plausible, especially if warming temperatures cause significant drying of the moist forest habitat.

The apparent absence from MDFP of some forest birds may simply be due to the difficulty of observing them in the canopy of enclosed forest—most records of (e.g.) migrant flycatchers are from forest edge, from the roads or other open areas.

The 70 species of grassland-scrub inhabiting birds recorded elsewhere in the Khao Yai Hq area may be divided into 39 non-breeding winter visitors and 31 residents. Their absence from MFDP is noteworthy given the relative proximity of such open habitats. Many of these open-country species (e.g. Red-wattled Lapwing *Vanellus indicus*) have colonized the headquarters area of the park within the past 20 years or so. Common Myna *Acridotheres tristis*, first recorded c. 2000, and White-vented Myna *A. grandis*, found as recently as 2006 (PDR own data) are even more recent arrivals. Natural habitat perturbation (e.g. major tree-falls caused by whirlwinds, affecting areas up to 0.3 ha) has occurred just off-plot at Mo Singto, and such infrequent natural events could in future create transient conditions on MFDP that might permit the temporary occurrence of smaller open country birds. Additionally most migrant species, including inhabitants of open country, have the potential to stray, and occur in unusual situations, and could therefore occur on the plot from time to time. Most waterbirds, on the other hand, have no likely prospects of being found on the plot due to the lack of significant water bodies (with the possible exception of riparian species such as kingfishers that may move up flood-swollen smaller tributaries in the wet season).

## DISCUSSION

While the avifauna of the Mo Singto Plot is largely composed of birds typical of the interior of evergreen forest, that around the larger headquarters area of Khao Yai National Park contains a wider array. In addition to evergreen forest species (including a very few montane species) are a few species more typical of deciduous forest habitats and bamboo; those that inhabit grassland and scrub, and waterbirds. Even so, some of these species occur at low densities or are distributed patchily around the headquarters area, or are rare or occasional transient visitors.

### What Future Changes Might We Expect?

Some turnover of species is a natural process which might be expected even without any human disturbance. Since Khao Yai was established as a park in 1962 the most obvious trends (inferred or observed) have been decreased direct persecution of birds and increased use by tourists. There has been a gradual increase in infrastructure (roads, buildings and other facilities) but impact on forest appears to have been slight. So far as known, no species has been lost since avifaunal recording started.

#### *Habitat succession*

Grasslands around the park Hq are derived from former cultivated fields and have been variously maintained by either burning or mowing as a means to maintain open grassy areas for ungulates (especially Sambar *Rusa unicolor*). While the respective merits of the two grassland management regimes (burning and mowing) have not been fully assessed it is nonetheless undeniable that many areas of former grassland around the park headquarters are gradually reverting to scrub and secondary forest, and this will undoubtedly cause some grassland-inhabiting species recorded in the park Hq area to decline or even disappear. Blue-breasted Quail *Coturnix chinensis* (already rare in the park), buttonquails *Turnix* spp., Red-whiskered Bulbul *Pycnonotus jocosus*, Bright-capped Cisticola *Cisticola exilis*, prinias *Prinia* spp., and grassland-inhabiting migrants such as Blunt-winged Warbler *Acrocephalus concinens* are representatives of this group. None of these species has been recorded on MFDP. The loss of grassland will impact on the overall species richness of the park Hq area without adding any further forest-living species.

#### *Human persecution*

Species that were formerly hunted (e.g. pheasants *Lophura* spp. and Red Junglefowl *Gallus gallus*; pigeons, especially Mountain Imperial-pigeon *Ducula badia*) would probably have increased in the first decade or more after the park's establishment and are now more or less common. Assuming that populations of these have probably reached carrying capacity, further population increase would seem unlikely (though some may have become more easily detectable due to behavioural habituation).

Illegal forest product collecting continues (BROCKELMAN *ET AL.*, 2011) and has the potential to pose a possible threat should any bird species be targeted by poachers. The communally roosting Red-whiskered Bulbul is known to be widely targeted elsewhere by commercial bird trappers supplying the cagebird trade, and numbers in the park Hq area, seemingly already

diminishing, possibly due to habitat change, could be potentially at risk from poachers. Hornbill chicks, widely targeted elsewhere (and certainly at risk in peripheral regions of Khao Yai), are not known to have been poached in the immediate Hq area. Evidence has emerged of a trade in owl carcasses from Malaysia, (apparently destined for the restaurants in China; SHEPHERD & SHEPHERD, 2009) while owls are much persecuted in Laos, and frequently seen in captivity (DUCKWORTH *ET AL.*, 1999). They could therefore also be at elevated risk in peripheral areas of Khao Yai and other Thai protected areas.

### *Increased recreational use*

The main direct human uses are tourism-related. In general there has been a great increase in vehicular traffic, and also foot traffic on park trails that approach within 100–200 m of the plot. There may be occasional cases where nests are abandoned due to inadvertent disturbance, or birds killed by vehicular collision, but because both roads and trails affect relatively limited areas, the impact is likely to be small. Road construction may well have contributed to the colonisation of the park Hq by open country species, however, since roads provide a narrow ribbon of edge habitat connecting the park margins with the park interior.

Canalization and concreting of small sections of riverbank, and the expansion of tourist facilities along waterways, could impact some riparian species, including bank-nesters such as kingfishers and forktails in the heavily used and developed Hq area.

A possible indirect effect of increased recreational use on the avifauna could be increased usage of forest around park Hq by the generalist omnivore Northern Pig-tailed Macaque *Macaca leonina*. Formerly either shy or scarce, macaques have learnt to utilize garbage and (illegal) hand-outs from tourists, and, now habituated, routinely beg for food along roadsides. They have become much more detectable in the past two decades, suggesting the possibility that their total population has increased. Macaques are the most frequently recorded predator of bird nests on MFDP (PIERCE & POBPRASERT, in prep.). If presently observed levels of nest predation by macaques are higher than formerly this might have the potential to induce changes in the productivity of the resident avifauna.

### *Climate change*

ROUND & GALE (2008) postulated that changes in the relative abundance of two pheasant species in the park headquarters area were due to rising temperatures that favour species characteristic of lowland, semi-evergreen forest at the expense of those that favour moister, montane or submontane conditions. Formerly only Silver Pheasant *Lophura nycthemera* was found on MFDP but in the past 15–20 years sightings of this species have been overtaken by lowland-inhabiting Siamese Fireback *L. diardi*. Other species that favour moist, sub-montane and montane, evergreen forest that are at present relatively frequent on MFDP, but that could decline, include Red-headed Trogon, the broadbills *Serilophus lunatus* and *Psarisomus dalhousiae*, and possibly Common Green Magpie *Cissa chinensis*, Hill Blue Flycatcher, and Fire-breasted Flowerpecker *Dicaeum ignipectus*. Corresponding lower elevation species that might increase in abundance include Orange-breasted Trogon, Banded Broadbill *Eurylaimus javanicus*, Racket-tailed Treepie, Hainan Blue Flycatcher *Cyornis hainanus* and Plain Flowerpecker. As already indicated, other species at present more typical of deciduous woodland and edge habitats might colonise the plot if rising temperatures induce significant change in the vegetation towards a semi-evergreen or deciduous facies.

Migrant species are at elevated risk from climate change (COPPACK & BOTH, 2002; BUTLER, 2003). Migrants have evolved migration strategies in response to a narrow range of environmental conditions on their breeding and wintering areas, each of which is affected by climate-change to a differing extent. While some tropical or sub-tropical wintering species may have adjusted their arrival times on their Palearctic breeding grounds in synchrony with earlier warm temperatures, other species have failed to do so. In some, this has led to loss of synchrony between an earlier-peaking food supply and production of young (which has not advanced as correspondingly early) reducing breeding success and survival of young (BOTH *ET AL.*, 2006). Changing weather patterns have likewise impacted the wintering areas of migrant birds. The winter survival of many western Palearctic breeding, Afrotropical wintering, migrants has been adversely affected by reduced rainfall and increased desertification in north equatorial Africa (PEACH *ET AL.*, 1991; BAILLIE & PEACH, 1992; SANDERSON *ET AL.*, 2006).

There is much less information on the Eastern Palaeartic-Indo-Malayan migration system. However, the preponderance of migrant birds in Khao Yai, both Palaeartic and Sino-Himalayan species, offers significant opportunity for detailed studies of their ecology and survival.

#### FUTURE RESEARCH

This paper is largely descriptive. Continued monitoring of avifaunal change on the Mo Singto Plot and elsewhere in the park headquarters is a priority for the future. Besides maintaining the inventory and documenting turnover of species, this should include monitoring of annual population levels of both resident and migrant bird species, through continued use of territory mapping combined with distance sampling or other detectability-based estimates. Preliminary data on density and biomass (ROUND *ET AL.*, 2006) is available for a wider range of species than treated in GALE *ET AL.* (2009) but needs revising and updating in the light of the latter's caveats on interpretation. Monitoring of bird population levels combined with detailed studies that yield information on (e.g.) productivity and habitat use by birds, together with detailed monitoring of forest dynamics may help understand the implications of climate-related environmental change for biodiversity conservation.

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