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A Comparison of Vertical Bird Assemblages Between Abandoned Settlement Areas and Primary Dry Evergreen Forests in Western Protected Forest of Thailand

PRATEEP DUENGKAE [1]* AND VIJAK CHIMCHOME[1]

[1]*Forest Biology Department, Faculty of Forestry, Kasetsart University, Bangkok 10900, Thailand.*

ABSTRACT.- A Vertical stratification of the bird assemblage between abandoned settlement areas (ASA) and dry evergreen forests (DEF) was investigated in the western forest complex of Thailand, Natural World Heritage Site. The aim was to examine species diversity, vertical strata patterns, and niche breath of individual bird species between disturbance and primary forests. A permanent line transect was used for the field survey. Our research presents the results of a first study on vertical stratification of bird assemblages between abandoned settlement areas and primary forests in Thailand. The study revealed 170 bird species. Diversity indices of vertical strata in the ASA tended to be lower than those in the DEF sites. However, the bird community in the DEF and ASA was classified into 3 major groups: ground level group, lower canopy group (1-5 m in the ASA and 1-15 m in the DEF) and upper canopy group (5->25 m in the ASA and 15->25 m in the DEF). Most species were relatively generalized in their behavior and used resources across broad ranges of microhabitatas. The study also demonstrated that the ASA appeared to support less species richness than the DEF. The results of this study provide vital information in revealing patterns of assemblage structure and majors factors in the maintenance of species diversity. Further research should concentrate on these species to determine resource use pattern, and investigate the effect of forest fragmentation on their movements. Furthermore, this study deonstrated that bird diversity showed a clear recovery pattern after human resettlement. Recommendations are given to limit human disturbances as much as possible to allow for maximum avian diversity to recover.

KEY WORDS.- Vertical habitats, birds, diversity, recovery, tropical forest.

INTRODUCTION

Acting as an interface between the biosphere and atmosphere, the tropical forest canopy shows marked differences in its physical and biological characteristics compared to the understorey. Light intensity, humidity, the capacity to retain water, the physical structure of the environment, food resource availability, and species composition are factors that contribute to making the canopy a distinct component of a rain forest. The canopy is considered physically and biologically one of the most active components of tropical forests. More than half of the species present in a tropical forest may live in the canopy, and there are estimates that the bird biomass in the canopy may represent 60-70% of the total bird biomass in a tropical forest (Winkler and Preleuther, 2001).

* Corresponding author.
Tel. (662) 5790176 ext. 511
e-mail : prateep.du@ku.ac.th

The most species distribution and abundance may differ significantly from the canopy to the understorey, demonstrating that in some cases the environment and species are vertically stratified (Pearson 1971). The analysis of vertical distribution patterns and niche breadths of animals along such vertical gradients could provide one of the keys to the understanding of processes underlying species composition in animal communities of multi-layered forest habitats (Schulze *et al*., 2002). This fact together with the vertical stratification of some resources, such as fruits and insects, reveals that a vertical sample is necessary for a complete analysis of tropical avian communities. However, there are few studies concerning the vertical stratification of avian communities in Asian tropical forests. Most studies have been conducted in the neotropics and Australian tropics (Pearson, 1971; Winkler and Preleuther, 2001; Walther, 2002) where the forests are structurally and floristically different from Asian tropical forests.

Our research present the results of a first study on vertical stratification of bird assemblages between abandoned settlement areas and primary forests in Thailand. The aim was examine species diversity, vertical strata patterns, and niche breath of individual bird species in both habitats.

MATERIALS AND METHODS

1. Study Site

Thung Yai Naresuan Wildlife Sanctuary is located between longitude 14° 55′ to 15° 45′ north, and latitude 98° 25′ to 99° 05′ east. The topography is mountainous with elevations ranging from 800-1,200 m above mean sea level. The climate is subtropical with the average rainfall of 1,800 mm per year.

In 1957, before this forest area was gazetted as a wildlife sanctuary, hilltribes settled and begun converting the forest areas into agriculture land. In 1974, Thung Yai Naresuan was declared a wildlife sanctuary and in 1991 identified as a Natural World Heritage Site by UNESCO. In 1987, 30 years after the Hmong settlement, 13 Hmongís villages covered an area of about 80 km^2. Consequently, in 1987 Hmong villages were removed from Thung Yai Naresuan by Royal Forest Department and the Royal Thai Army. Karen villages; however, still reside in this area. This research focused on the abandoned settlements of Hmong hilltribe.

2. Site Selection

Data on bird assemblages in dry evergreen forests (DEF) and abandoned settlement areas (ASA) located in Thung Yai Naresuan Wildlife Sanctuary was recorded. The hill tribe villages in these areas were: Ka Ngae Kee (K), Ta Su Kee (T), Thung Na Noi (N) and Huay Num Khew (H). These 4 sites had different ages of abandonment and village area sizes. The elevations varied between 700-900 MSL (Table 1).

Table 1 Characteristics of the abandoned settlement area study sites

Sites	approx. time since abandonment (year)	approx. size area (km^2)	approx. Elevation (meters)
Ka Ngae Kee	~6	~16	~700
Ta Su Kee	~8	~8	~700
Thung Na Noi	~10	~16	~800
Huay Num Khew	~12	~2	~900

3. Bird Survey

The line transect method was used to survey the diversity and to estimate the abundance of birds. Three permanent transects with a total length of 1.8 km were set in 4 study sites. The line transects ran for 900 m in the ASA and continued for another 900 m in DEF, allowing for 100 meters for edge effects (Pattanawiboon, 1999). However, due to the small size of Huay Num Khew, only 2 permanent transects were set there. The transects were marked at every 100 m interval with aluminum tags. The bird survey was conducted from 7:00-10:00 am and 4:00-6:00 pm in each transect. It usually took 2-3 hours to complete the 1.8 km transect. The survey took about 2 days per each transect. Observations were made using binoculars (8X35). Every bird seen within an estimated 30 m of the transect line was recorded (Round and Brockelman, 1998). Data recorded included species, number, time, behavior, and estimated height above the ground. Bird surveys were not done on rainy, misty, and stormy days when bird observations and calls were limited.

The surveys were conducted 3 times a year in summer (March-May), rainy season (June-October), and winter (November-February) from the rainy season in 2000 to the summer season in 2003.

4. Analysis of Data

The data were compared between those in the ASA and in the DEF. For this study, a classification of strata was based on height above from ground. A description of vertical strata is given in Table 2.

The diversity of bird species in each strata was calculated using the Shanon-Wiener function(H?) (Ludwig and Reynolds, 1998) as follows:

$$H' = -\sum_{i=1}^{S} Pi \ln_{Pi}$$

where H' = Shanon-Wiener diversity index

$_{Pi}$ = the proportion of all the bird individuals which belong to the i-th species

S = the total number of bird species

Data used in analysis for constructing the dendrogram were the amount of Relative abundance of birds log (x+1) transformed before quantitative analysis. The cluster analysis technique based on the similarity index of Sorensen was used for grouping bird vertical strata. The cluster analysis was analyzed using

Table 2. Definations of vertical strata used in this study

Level	Terms	Height above from ground
1	Level 0	0 m : Ground
2	Level 1-5	1-5 m
3	Level 5-10	5-10 m
4	Level 10-15	10-15 m
5	Level 15-20	15-20 m
6	Level 20-25	20-25 m
7	Level >25	>25 m

RESULTS

1. Birds species diversity

One hundred and seventy species were observed during the study, with 119 and 133 species observed in the ASA and DEF, respectively. The complete list of species are provided in Appendix I. Fifty-five bird species were detected only in the DEF such as Great Hornbill (GRHB), Brown Hornbill(BRHB), Banded Kingfisher (BDKF) and Greater Necklaced Laughingthrush(GNLT), whereas 19 bird species were dectected only in the ASA and absent from DEF sush as Ashy Woodswallow (ASWS), Spotted Dove (SPDO), Black-shouldered Kite (BSKI), and Pied Bushchat (PIBC).

The *H′* in each strata ranged from 1.194 in the upper 25 m above ground of ASA and 3.743 in the 5-10 m of DEF (Fig. 1). Overall, the *H′* indicated high values in the middle strata, mostly between the second stratum (1-5 m) to forth stratum (15-20). However, the *H′* was lowest in the seventh stratrum (> 25 m) of the AHS, and lowest in the first stratum (on ground level) of the DEF.

Comparisons of the *H′* in a similar stratum between the ASA and the DEF sites indicated that the *H′* in the ASA except at ground level, tended to be lower than in the DEF ($P<0.05$; Fig. 1).

2. Bird similarity between vertical strata

The data describing the vertical stratum use of each bird species in the 2 habitats were analysed using multivariate cluster analysis. In broad terms, the bird community in both the DEF and ASA can be classified in to 3 major groups: ground level group, lower canopy group (1-5 m in the ASA and 1-15 m in the DEF) and upper canopy group (15-25 m in the DEF and 5-25 m in the ASA; See Fig. 2 and Fig. 3). The ground level bird group was characterised by their use of vertical strata and sites restricted to the ground level. The Barred Buttonquail (BRBT) was one such species found at the ground level of the ASA, whereas the Red Junglefowl (RJFO) was found only at the ground level of the ASA and DEF (Appendix I).

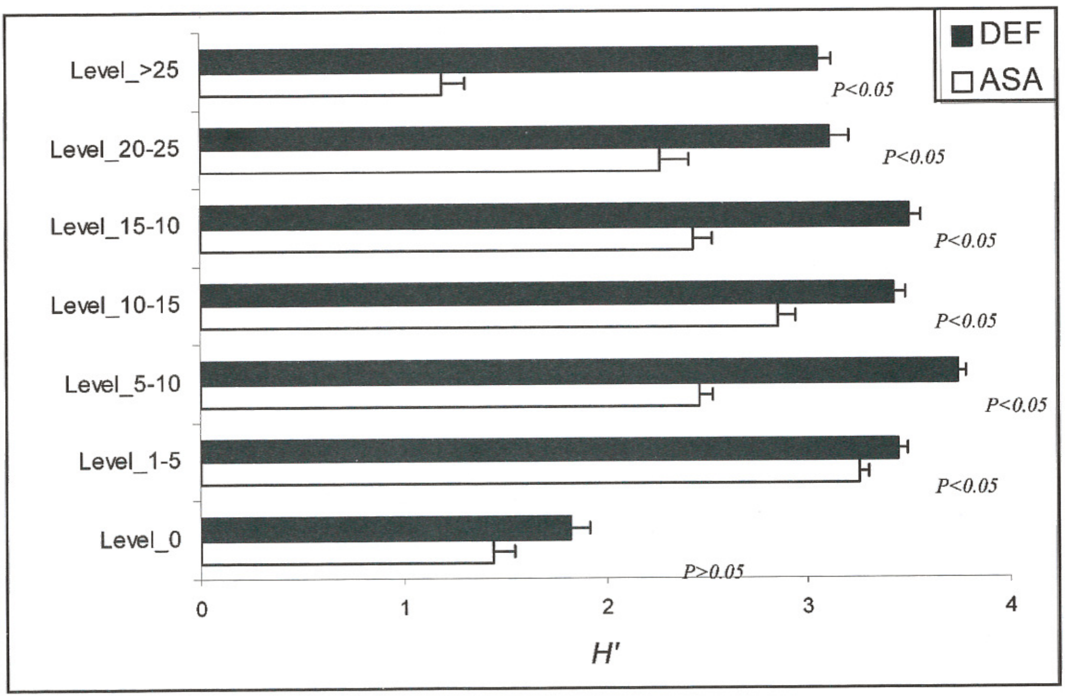

Figure 1 Vertical distribution of the Shanon-Wiener diversity index (± SD) in each levels between the dry evergreen forest(DEF) and abandoned settlement areas(ASA). The letter codes were explained in the table 1.

The lower canopy group of the ASA was a narrow ranged from 1-5 m above the ground, and included 21 bird species such as Chestnut-capped Babbler (CCBB), Scaly-breasted Munia (SBMN), White-rumped Munia (WRNN), and Dark-necked Tailorbird (DNTB). In contrast, the lower canopy group of the DEF ranged from 1-15 m above the ground and included a more diverse species composition. The upper canopy group of the ASA ranged from 5 m to >25 m above the ground and was more diverse. The upper canopy group of the DEF ranged from 15 m to > 25 m above the ground (See Fig. 2 and Fig.3).

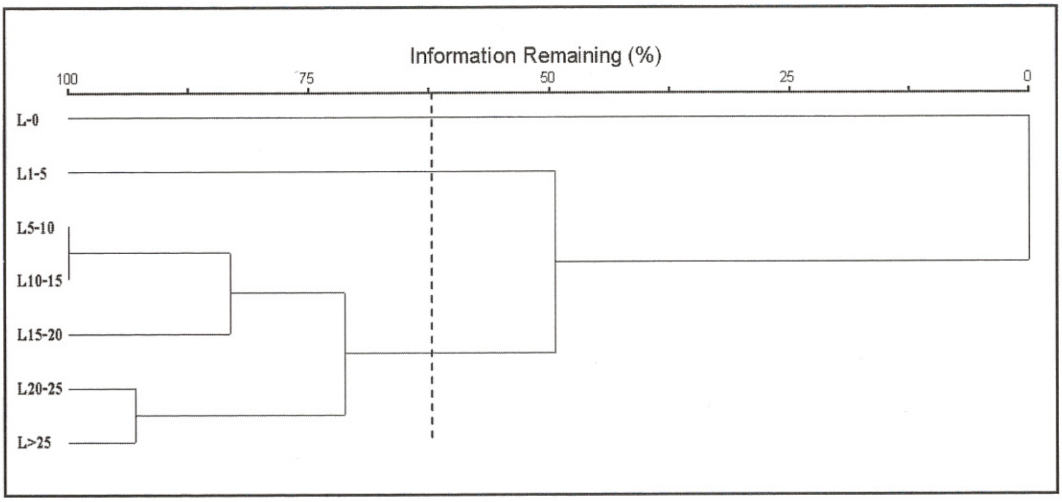

Figure 2. Cluster analysis illustrating the grouping of bird communities of the 7 vertical strata in the abandoned settlement areas (ASA). The letter codes are explained in Table 1.

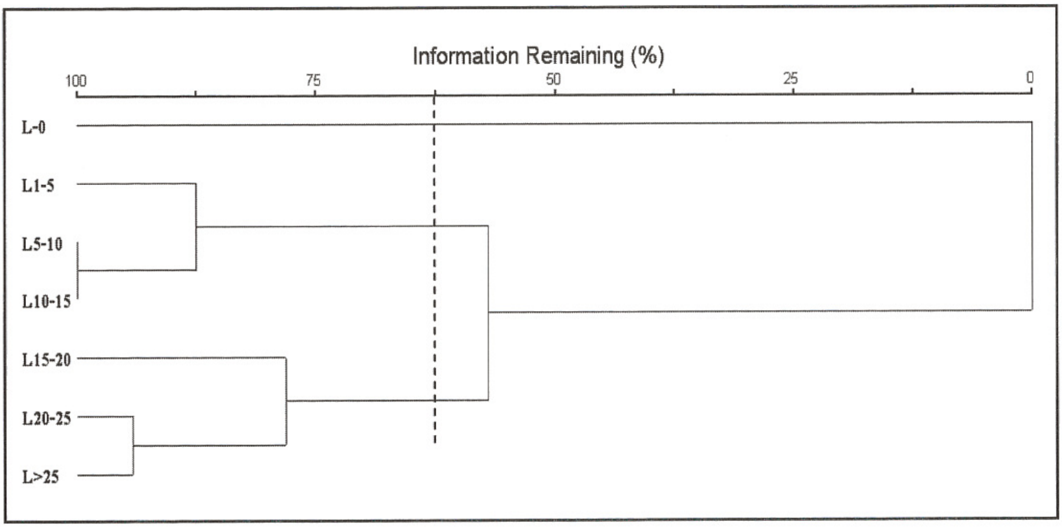

Figure 3. Cluster analysis illustrating the grouping of bird communities of the 7 vertical strata in the dry evergreen forest (DEF). The letter codes are explained in Table 1.

3. Specialisation in vertical habitat use

A height diversity index was calculated using the number of strata where each species lived and the relative amount of time in each stratum. This variable described how diverse the feeding strategy of each species was, and how evenly they distributed their foraging effort over the vertical strata. Essentially, these indicies described the degree of specialization in foraging stategy with respect to where in the forest each species used. The height diversity index of each bird species in both habitats is illustrated in Fig. 4 and Fig. 5 (the ASA and DEF, respectively).

There was a steady gradient from relatively specialized species (low H′ value) to relatively generalized species (high H′ value). A high standard deviation (SD) meant a greater degree of gerneralization in the use of the vertical strata. In general, there were more generalised species than specialised species. The Chestnut-capped Babbler (CCBB), Rufescent Prinia (RCPN), Buff-breasted Babbler (BBBB), and the Yellow-bellied Prinia(YBPN) were the most specialized species, whereas the Scarlet Minivet (SCMN), Asian Fairy Bluebird(AFBL), Mountain Imperial Pigeon(MIPG) and the Black-crested Bulbul (BCBU) were the most generalised species in the ASA. The Common Tailorbird (CMTB), Rosy Minivet (RSMV), Rufous-throated Partridge (RTPT), and Blyth's Leaf Warbler(BLWB) were the most specialized species, whereas the Great Barbet (GRBA), Greater Racket-tailed Drongo (GRDR), Black Bulbul (BLBU) and Asian Fairy Bluebird (AFBL) were the most generalized species in the DEF. The ground-dwelling species were the only group that showed a higher degree of specialisation in their selection of vertical structure (see in Appendix I). Barred Buttonquail (BRBT) was the most specialised species in the ASA and Red Junglefowl (RJFO) was the most specialised species in the ASA and DEF.

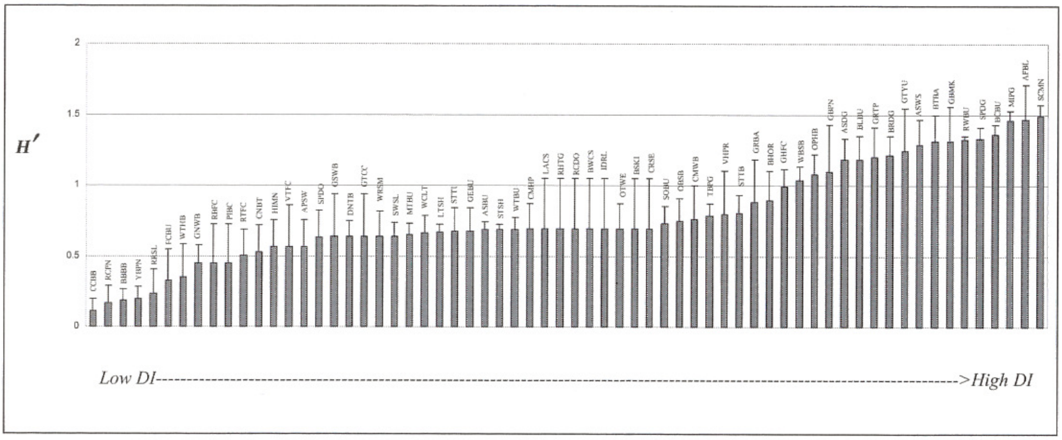

Figure 4. The Shanon-Wiener diversity index (± SD) for each bird species in the abandoned settlement area. (Species abbreviation defined in Appendex I) ; low DI= generalised species and high DI = specialised species

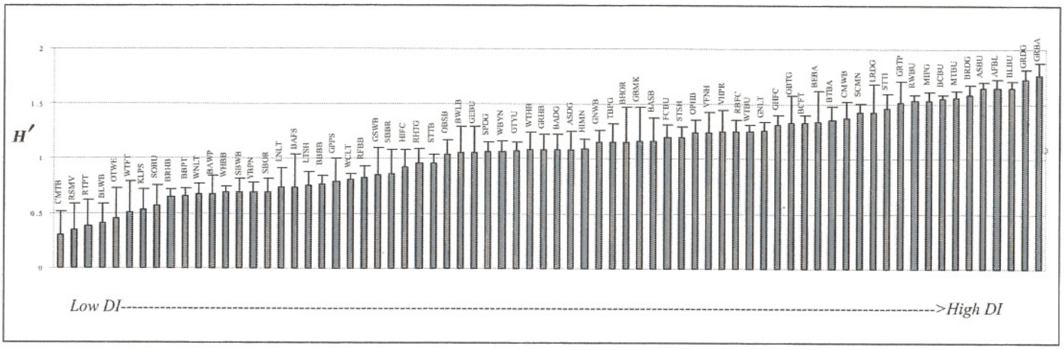

Figure 5. The Shanon-Wiener diversity index (± SD) in each bird species in the dry evergreen forest. (Species abbreviation defined in Appendex I) ; low DI= generalised species and high DI = specialised species

DISCUSSION

1. Birds species diversity

Using species diversity to examine the data found that the ASA appeared to support less species richness than the DEF. The general findings of this study reflected those found elsewhere (Johns, 1986; Ohno and Ishida, 1997; Round and Brockelman, 1998). John (1989) states that non-disturbed forest provided 2 important survival factors: food and microclimate, particularly in the understorey for avifauna. Also, Welford (2000) suggested that the number of bird species recorded in successively older abandoned pastures increased, but only half the number of species recorded in the undisturbed forest sites were recorded in the most mature pasture. Bird species richness, abundance and diversity in shifting cultivation increased rapidly and asymptotically during succession paralleling vegetation recovery as shown by positive correlations with fallow age (Raman *et al.* 1998).

Using diversity indices to examine vertical data revealed that the middle strata of a tropical forest accommodates many more species than either the ground or the top of the canopy. This is similar to a number of the studies (eg. Pearson (1975),Manopawitr (2000) and Walter (2002). The middle canopy is a complex three-dimentional environment offering a much greater array of foraging substrates (Pearson, 1977 and Winkler and Preleuther, 2001). This study supports this finding by showinh a much greater proportion of canopy species than other groups.

2. Bird similarity between vertical strata

The avian community in the vertical strata of the DEF and ASA was classified in 3 major groups: ground level group, lower canopy group and upper canopy group. Vertical segregation of bird species appears to be more prominent in the tropics with about 42% of 182 species restricted to the canopy (Winkler and Preleuther, 2001). Some feeding categories in Pearsonís (1975) study showed a clear vertical trend. Taking both insects and fruits was mainly observed on the ground level. Use of the vertical strata was the primary factor separating major groups within the avian assemblage, and the use of different foraging sites was an important factor in microscale niche differentiation (Manoprawitr, 2000). The results of this study showed that the vertical strata of bird assemblages were a significant factor to niche separation.

3. Specialisation in vertical habitats use

A study of the vertical distribution of a lowland forest bird community found that foraging height was the most important factor for separating species (Pearson, 1977). Pearson (1977) studied the foraging ecology of birds in a lowland rainforest in North Queensland and found that the vertical distribution of birds played a crucial role in tropical ecosystems by dispersing seeds, pollinating flowers, and controlling insect populations, and that it provides a good example of how the understorey community may not be a good representation of the local community as a whole (Manoprawitr, 2000).

The results of this study provide vital information in revealing patterns of assemblage structure and majors factors in the maintanance of species diversity. Further research should concentrate on these species to determine resource use pattern, and investigate the effect of forest fragmentation on their movements. Furthermore, this study demonstrated that bird diversity showed a clear recovery pattern after human resettlement. Recommendations are given to limit human disturbances as much as possible to allow for maximum avian diversity to recover.

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Appendix I Bird species, mean foraging height, and Shanon-Wiener Index of 170 species in the abandoned settlement area and dry evergreen forest.

No.	Scientific name	CODE	Level	ASA H'	Pop.	Level	DEF H'	Pop.
1	*Lophura leucomelanos* (Latham) 1790.	KLPS	1	0	9	1	0.53	9
2	*Arborophila brunneopectus* (Blyth) 1855.	BBPT	1	0	8	1	0.65	71
3	*Gallus gallus* (Linnaeus) 1758.	RJFO	1	0	8	1	0	23
4	*Blythipicus pyrrhotis* (Hodgson) 1837.	BAWP	1	0	1	3	0.67	5
5	*Iole virescens* Blyth 1845.	OLBU	1	0	1	3	0	2
6	*Upupa epops* Linnaeus, 1758.	CMHP	1	0.69	4	-	-	-
7	*Turnix suscitator* (Gmelin) 1789.	BRBT	1	0	2	-	-	-
8	*Muscicapa ferruginea* (Hodgson) 1845.	HIFC	2	0	3	1	0.64	3
9	*Phylloscopus borealis* (Blasius) 1858.	ACWB	2	0	2	1	0.69	2
10	*Prinia flaviventris* (Delessert) 1840.	YBPN	2	0.19	75	2	0.69	8
11	*Pellorneum tickeli* Blyth, 1859.	BBBB	2	0.19	66	2	0.77	88
12	*Orthotomus sutorius* (Pennant) 1769.	CMTB	2	0	54	2	0.31	11
13	*Macronous gularis* (Horsfield) 1822.	STTB	2	0.8	34	2	0.96	77
14	*Prinia rufescens* Blyth, 1847.	RCPN	2	0.16	26	2	0	10
15	*Nectarinia jugularis* (Linnaeus) 1766.	OBSB	2	0.75	20	2	1.04	11
16	*Hemixos flavala* (Blyth) 1845.	ASBU	2	0.69	16	2	1.65	72
17	*Stachyris nigriceps* Blyth, 1844.	GTBB	2	0	16	2	0	22
18	*Culicicapa ceylonensis* (Swainson) 1820.	GHFC	2	0.99	15	2	1.31	73

No.	Scientific name	CODE	Level	ASA H'	Pop.	Level	DEF H'	Pop.
19	*Ficedula parva* (Bechstein) 1792.	RTFC	2	0.5	10	2	0.64	3
20	*Alophoixus flaveolus* (Gould) 1836.	WTBU	2	0.69	9	2	1.25	203
21	*Stachyris striolata* (Muller) 1835.	SNBB	2	0	9	2	0	15
22	*Sasia ochracea* Hodgson, 1836.	WPPL	2	0	7	2	0.69	2
23	*Copsychus malabaricus* (Scopoli) 1788.	WRSM	2	0.64	6	2	0	8
24	*Prinia hodgsonii* Blyth,1844.	GBPN	2	1.1	3	2	0	6
25	*Acrocephalus bistrigiceps* Swinhoe, 1860.	BBRW	2	0	3	2	0	4
26	*Aethopyga saturata* (Hodgson) 1836.	BASB	2	0	1	2	1.16	11
27	*Phylloscopus ricketti* (Slater) 1897.	SBWB	2	0	1	2	0.69	6
28	*Celeus brachyurus* (Vieillot) 1818.	RFWP	2	0	1	2	0	1
29	*Cyornis rubeculoides* (Vigors) 1831.	BTFC	2	0	1	2	0	1
30	*Chalcophaps indica* (Linnaeus) 1758.	EMDO	2	0	1	2	0	5
31	*Pycnonotus aurigaster* (Vieillot) 1818.	SOBU	2	0.73	29	3	0.56	8
32	*Phylloscopus trochiloides* (Sundevall) 1837.	GNWB	2	0.45	24	3	0.69	2
33	*Arachnothera longirostra* (Latham) 1790.	LTSH	2	0.67	23	3	0.75	27
34	*Phylloscopus inornatus* (Blyth) 1842.	CMWB	2	0.76	11	3	1.37	19
35	*Pycnonotus flavescens* Blyth, 1845.	FCBU	2	0.33	10	3	1.2	28
36	*Serilophus lunatus* (Gould) 1834.	SBBR	2	0	2	3	0.86	18
37	*Harpactes erythrocephalus* (Gould) 1834.	RHTG	2	0.69	2	3	0.96	19

No.	Scientific name	CODE	Level	ASA H′	Pop.	Level	DEF H′	Pop.
38	*Alcippe poioicephala* (Jerdon) 1844.	BCFT	2	0	1	3	1.33	34
39	*Anthracoceros albirostris* (Shaw and Nodder) 1807.	OPHB	2	1.08	8	4	1.24	23
40	*Coracias benghalensis* (Linnaeus) 1758.	IDRL	2	0.69	2	4	0	1
41	*Yuhina zantholeuca* (Blyth) 1844.	WBYN	2	0	1	4	1.06	14
42	*Phylloscopus reguloides* (Blyth) 1842.	BLWB	2	0	1	4	0.41	14
43	*Hypothymis azurea* (Boddaert) 1783.	RBFC	2	0.45	6	5	1.25	26
44	*Melanochlora sultanea* (Hodgson) 1837.	STTI	2	0.67	5	5	1.46	22
45	*Timalia pileata* Horsfield, 1821.	CCBB	2	0.11	44	-	-	-
46	*Lonchura punctulata* (Linnaeus) 1758.	SBMN	2	0	32	-	-	-
47	*Lonchura striata* (Linnaeus) 1766.	WRNN	2	0	15	-	-	-
48	*Orthotomus atrogularis* Temminck, 1836.	DNTB	2	0.64	12	-	-	-
49	*Emberiza rutila* Pallas, 1776.	CNBT	2	0.53	9	-	-	-
50	*Saxicola caprata* (Linnaeus) 1766.	PIBC	2	0.45	6	-	-	-
51	*Luscinia calliope* (Pallas) 1776.	SRRT	2	0	3	-	-	-
52	*Centropus bengalensis* (Gmelin) 1788.	LSCC	2	0	3	-	-	-
53	*Phylloscopus tenellipes* Swinhoe, 1860.	PAWB	2	0	3	-	-	-
54	*Saxicola torquata* (Linnaeus) 1766.	CMSC	2	0	2	-	-	-
55	*Pellorneum ruficeps* Swainson, 1832.	PTBB	2	0	2	-	-	-
56	*Glaucidium brodiei* (Burton) 1836.	CLOL	2	0	2	-	-	-

No.	Scientific name	CODE	Level	ASA H'	Pop.	Level	DEF H'	Pop.
57	*Copsychus saularis* (Linnaeus) 1758.	OMRB	2	0	2	-	-	-
58	*Passer flaveolus* Blyth, 1844.	PBSR	2	0	2	-	-	-
59	*Lanius cristatus* Linnaeus, 1758.	GBSH	2	0	1	-	-	-
60	*Lanius collurioides* Lesson, 1834.	BUSH	2	0	1	-	-	-
61	*Merops viridis* Linnaeus, 1758.	BTBE	2	0	1	-	-	-
62	*Hierococcyx sparverioides* (Vigors) 1832.	LHCK	2	0	1	-	-	-
63	*Chrysomma sinense* (Gmelin) 1789.	YEBB	2	0	1	-	-	-
64	*Nectarinia asiatica* (Latham) 1790.	PPSB	2	0	1	-	-	-
65	*Muscicapa sibirica* Gmelin, 1789.	DSFC	2	0	1	-	-	-
66	*Pomatorhinus schisticeps* Hodgson, 1836.	WBSB	3	1.04	20	2	0	15
67	*Megalaima virens* (Boddaert) 1783.	GRBA	3	0.89	11	2	1.77	29
68	*Garrulax leucolophus* (Hardwicke) 1815.	WCLT	3	0.66	8	2	0.8	151
69	*Eumyias thalassina* Swainson, 1838.	VTFC	3	0.56	4	2	0.69	2
70	*Seicercus burkii* (Burton) 1836.	GSWB	3	0.64	3	2	0.85	9
71	*Dicrurus macrocercus* (Vieillot) 1817.	BADG	3	0	2	2	1.08	8
72	*Stachyris rufifrons* Hume, 1873.	RFBB	3	0	1	2	0.82	33
73	*Picumnus innominatus* Burton, 1836.	SPPL	3	0	1	2	0.56	4
74	*Pycnonotus melanicterus* (Gmelin) 1789.	BCBU	3	1.36	92	3	1.55	224
75	*Dicrurus aeneus* Vieillot, 1817.	BRDG	3	1.22	40	3	1.59	59

No.	Scientific name	CODE	Level	ASA H′	Pop.	Level	DEF H′	Pop.
76	*Hypsipetes leucocephalus* (Gmelin) 1789.	BLBU	3	1.18	27	3	1.65	97
77	*Megalaima asiatica* (Latham) 1790.	BTBA	3	1.31	26	3	1.35	28
78	*Arachnothera magna* (Hodgson) 1837.	STSH	3	0.69	25	3	1.2	60
79	*Dicrurus leucophaeus* Vieillot, 1817.	ASDG	3	1.18	22	3	1.08	22
80	*Dendrocitta formosae* Swinhoe, 1863.	GRTP	3	1.2	20	3	1.51	19
81	*Hypsipetes mcclellandii* Horsfield, 1840.	MTBU	3	0.65	17	3	1.55	96
82	*Irena puella* (Latham) 1790.	AFBL	3	1.47	14	3	1.65	50
83	*Phaenicophaeus tristis* (Lesson) 1830.	GBMK	3	1.31	12	3	1.16	11
84	*Loriculus vernalis* (Sparrman) 1787.	VHPR	3	0.8	7	3	1.25	28
85	*Mulleripicus pulverulentus* (Temminck) 1826.	GTYU	3	1.24	6	3	1.07	18
86	*Dicrurus paradiseus* (Linnaeus) 1766.	GRDG	3	0	5	3	1.72	27
87	*Hemipus picatus* (Sykes) 1832.	BAFS	3	0	1	3	0.74	8
88	*Pycnonotus jocosus* (Linnaeus) 1758.	RWBU	3	1.32	851	4	1.53	114
89	*Dicrurus hottentottus* (Linnaeus) 1766.	SPDG	3	1.33	105	4	1.06	133
90	*Oriolus xanthornus* (Linnaeus) 1758.	BHOR	3	0.9	10	4	1.15	7
91	*Zosterops palpebrosus* (Temminck) 1824.	OTWE	3	0.69	4	6	0.45	6
92	*Dicaeum concolor* Jerdon, 1840.	PLFB	3	0	2	7	0	4
93	*Streptopelia chinensis* (Scopoli) 1786.	SPDO	3	0.63	19	-	-	-
94	*Saroglossa spiloptera* (Vigors) 1831.	SWSL	3	0.64	15	-	-	-

No.	Scientific name	CODE	Level	ASA H'	Pop.	Level	DEF H'	Pop.
95	*Phylloscopus coronatus* (Temminck and Schlegel) 1847.	ECWB	3	0	4	-	-	-
96	*Centopus sinensis* (Stephens) 1815.	GTCC	3	0.64	3	-	-	-
97	*Hirundapus giganteus* (Temminck) 1825.	BBNT	3	0	3	-	-	-
98	*Coracina melaschistos* (Hodgson) 1836.	BWCS	3	0.69	2	-	-	-
99	*Streptopelia tranquebarica* (Hermann) 1804.	RCDO	3	0.69	2	-	-	-
100	*Aegithina lafresnayei* (Hartlaub) 1844.	GEIR	3	0	2	-	-	-
101	*Pericrocotus flammeus* (Forster) 1781.	SCMN	4	1.49	39	3	1.43	80
102	*Gracula religiosa* Linnaeus, 1758.	HIMN	4	0.56	8	4	1.09	13
103	*Chloropsis cochinchinensis* (Gmelin) 1788.	BWLB	4	0	2	4	1.06	5
104	*Ducula badia* (Raffles) 1822.	MIPG	4	1.46	52	5	1.53	72
105	*Coracina macei* (Lesson) 1831.	LACS	4	0.69	2	5	0.64	3
106	*Hirundo daurica* Linnaeus, 1776.	RRSL	4	0.23	16	-	-	-
107	*Iole propinqua* (Oustalet) 1903.	GEBU	5	0.67	5	2	1.06	5
108	*Picus mineaceus* Pennant, 1769.	BDWP	5	0	1	4	0	2
109	*Treron curvirostra* (Gmelin) 1789.	TBPG	5	0.79	65	5	1.15	32
110	*Spilornis cheela* (Latham) 1790.	CRSE	5	0.69	2	5	0	1

No.	Scientific name	CODE	Level	ASA H′	Pop.	Level	DEF H′	Pop.
114	*Artamus fuscus* £ Vieillot, 1817.	BSKI	5	0.69	2	-	-	-
115	*Chrysocolaptes lucidus* (Scopoli) 1796.	GTFB	5	0	2	-	-	-
116	*Accipiter trivergatus* (Temminck) 1824.	GRGH	5	0	1	-	-	-
117	*Cissa chinensis* (Boddaert) 1783.	CMGM	6	0	3	3	0.56	4
118	*Megalaima haemacephala* (Muller) 1776.	CPBA	6	0	1	3	0.64	3
119	*Megalaima australis* (Horsfield) 1821.	BEBA	6	0	1	4	1.33	5
120	*Hirundo rustica* Linnaeus, 1758.	BASL	7	0	2	-	-	-
121	*Polyplectron bicalcaratum* (Linnaeus) 1758.	GPPS	-	-	-	1	0.79	13
122	*Caprimulgus macrurus* Horsfield, 1821.	LTNJ	-	-	-	1	0.69	2
123	*Arborophila rufogularis* (Blyth) 1850.	RTPT	-	-	-	1	0.38	8
124	*Rallina fasciata* (Raffles) 1822.	RLCR	-	-	-	1	0	1
125	*Pitta cyanea* Blyth, 1843.	BLPT	-	-	-	1	0	1
126	*Napothera epilepidota* (Temminck) 1827.	EBWB	-	-	-	1	0	5
127	*Garrulax monileger* (Hodgson) 1836.	LNLT	-	-	-	2	0.73	20
128	*Hemicircus canente* (Lesson) 1830.	HPWP	-	-	-	2	0.69	2
129	*Chloropsis aurifrons* (Temminck) 1829.	GFLB	-	-	-	2	0.69	2
130	*Rhipidura albicollis* (Vieillot) 1818.	WTFT	-	-	-	2	0.5	5
131	*Napothera brevicaudata* (Blyth) 1855.	SKWB	-	-	-	2	0	1
132	*Napothera crispifrons* (Blyth) 1855.	LTVB	-	-	-	2	0	4

No.	Scientific name	CODE	Level	ASA H'	Pop.	Level	DEF H'	Pop.
133	*Ficedula solitaris* (Muller) 1835.	RBFC	-	-	-	2	0	1
134	*Harpactes oreskios* (Temminck) 1823.	OBTG	-	-	-	2	1.33	6
135	*Aegithina tiphia* (Linnaeus) 1758.	CMIR	-	-	-	2	1.04	4
136	*Lacedo pulchella* (Horsfield) 1821.	BDKF	-	-	-	2	0.69	2
137	*Sitta frontalis* Swainson, 1820.	VFNH	-	-	-	3	1.24	23
138	*Gampsorhynchus rufulus* Blyth, 1844.	WHBB	-	-	-	3	0.69	15
139	*Anorrhinus tickelli* (Blyth) 1855.	BRHB	-	-	-	3	0.65	23
140	*Pericrocotus roseus* (Vieillot) 1818.	RSMV	-	-	-	3	0.35	9
141	*Abroscopus superciliaris* (Blyth) 1859.	YBWB	-	-	-	3	0	8
142	*Dendrocopos canicapillus* (Blyth) 1845.	GCWP	-	-	-	3	0	2
143	*Tephrodornis gularis* (Raffles) 1822.	LASW	-	-	-	3	0	2
144	*Luscinia cyane* (Pallas) 1776.	SRBR	-	-	-	3	0	1
145	*Dicaeum ignipectus* (Blyth) 1843.	FBFP	-	-	-	3	0	2
146	*Phylloscopus schwarzi* (Radde) 1863.	RDWB	-	-	-	3	0	4
147	*Buceros bicornis* Linnaeus, 1758.	GRHB	-	-	-	3	1.08	8
148	*Oriolus traillii* (Vigors) 1832.	MROR	-	-	-	3	1.04	4
149	*Garrulax pectoralis* (Gould) 1836.	GNLT	-	-	-	3	1.26	33
150	*Terpsiphone paradisi* (Linnaeus) 1758.	APFC	-	-	-	3	1.1	3
151	*Oriolus tenuirostris* Blyth, 1846.	SBOR	-	-	-	4	0.69	6

No.	Scientific name	CODE	Level	ASA H'	Pop.	Level	DEF H'	Pop.
152	*Mulleripicus pulverulentus* (Temminck) 1826.	GSWP	-	-	-	4	0	2
153	*Zosterops erythropleurus* Swinhoe, 1863.	CFWE	-	-	-	4	0	30
154	*Psarisomus dalhousiae* (Jameson) 1836.	LTBR	-	-	-	4	0	1
155	*Treron sphenura* (Vigors) 1832.	WTPG	-	-	-	4	0	3
156	*Garrulax strepitans* Blyth, 1855.	WNLT	-	-	-	4	0.67	10
157	*Dicrurus remifer* (Temminck) 1823.	LRDG	-	-	-	5	1.43	9
158	*Macropygia ruficeps* (Temminck) 1834.	LCDO	-	-	-	5	0.69	2
159	*Pericrocotus cinnamomeus* (Linnaeus) 1766.	SMMV	-	-	-	5	0	1
160	*Pycnonotus atriceps* (Temminck) 1822.	BHBU	-	-	-	5	0	2
161	*Turdus obscurus* Gmelin, 1789.	EBTH	-	-	-	5	0	4
162	*Coracina polioptera* (Sharpe) 1879.	ICCS	-	-	-	5	0	1
163	*Chloropsis hardwickii* Jardine and Selby, 1830.	OBLB	-	-	-	5	0	1
164	*Accipiter soloensis* (Horsfield) 1821.	CLFC	-	-	-	6	0	1
165	*Spizaetus nipalensis* (Hodgson) 1836.	MTHE	-	-	-	6	0	2
166	*Elanus caeruleus* (Desfontaines) 1789.	SHKA	-	-	-	6	0	1
167	*Alcippe morrisonis* Swinhoe, 1863.	GCFT	-	-	-	6	0	1
168	*Megalaima franklinii* (Blyth) 1842.	GTBA	-	-	-	7	0	1
169	*Pericrocotus divaricatus* (Raffles) 1822.	ASMV	-	-	-	7	0	2
170	*Pycnonotus striatus* (Blyth) 1842.	SRBU	-	-	-	7	0	1