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THE PREVALENCE, DISTRIBUTION AND CHECKLIST OF AVIAN HAEMATOZOA IN THE INDIAN SUBCONTINENT

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INTRODUCTION

Over the years, there have been a number of small surveys of the haematozoa found in Indian birds, culminating in 1978 with the survey of McClure and his colleagues, representing the largest single survey carried out on birds of the Indian subcontinent. Many of the small surveys were deveoted to noting and describing new species of blood parasites in single individual birds or small samples of them, a situation exemplified by the work of de Mello and his colleagues during the 1930's. This mass of data has never been assembled and patterns of haematozoan distribution both by avian host and geographic region has not been attempted. This present study assembles and analyzes these data about the distribution and prevalence of avian blood parasites and speculates as to why such patterns may have occurred. Although this assemblage of data is small by contemporary standards, it is hoped that the data will illustrate the large gaps in our knowledge concerning the blood parasites of birds of the Indian subcontinent and suggest to future workers fertile fields for further fruitful exploration.

Interest in avian haematozoa in the Indian subcontient began in the 1890's when Ross first elucidated the life cycle of a *Plasmodium* species using a chicken. Since then a large number of widely disparate papers on avian blood parasites appeared in the literature and are listed in the Index Catalogue of Avian Haematozoa in India (Nandi, 1984). However, the literature on this aspect from other countries in the Indian sub-continent (viz. Bangladesh, Bhutan, Nepal, Pakistan, Sri Lanka) have not at yet been summarized either for the country or the Indian subcontinent as a whole. Largely for this reason some relevant papers on avian haematozoan surveys and taxonomic studies in these countries are cited in to provide a complete literature review of such studies for the subcontinent.

Studies on avian haematozoa in India include the earlier important reviews of Stephens and Christophers (1908) and Wenyon's (1926) global overview of bird blood parsites. De Mello (1937) and Bhatia (1938) provided useful summaries on avian haematozoa in India. Later, Nandi (1984) provided a useful summary of the state of the art up to that time with his index-catalogue of Indian avian haematozoa. Following this period, a number of authors presented taxonomic studies or the

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results of small surveys of Indian avian blood parasites. However, the project known as the Migratory Animal Pathological Survey (MAPS) funded by the US Army and conducted by McClure throughout the countries of southeastern Asia, India, Japan and Korea over a 10 year period was by far the single largest survey carried out on avian haematozoa in the Indian subcontinent. The results of this survey was published by McClure, Poonswad, Greiner and Laird in 1978.

Few studies have been carried out in Bangladesh. Laird and Lari (1959) presented the result of their survey of 262 birds of 27 species and Lari (1959) reported on a survey of sparrows and 15 other species of birds from Dacca, Bangladesh. McClure (1978) reported on the blood parasites in 180 birds from Bhutan and two birds from Nepal which highlights the paucity of information from this region. A number of small studies have been carried out in Pakistan following the description of *Haemoproteus handai* by Maqsood (1943) in Lahore. Laird and Lari (1959) re-described *Babesia moshkovskii* from *Corvus splendens* in Pakistan and Lari (1959) reported on *Plasmodium relictum* in 29 of 174 sparrows from Karachi. Mohiuddin and Pal (1967) reported *Haemoproteus* infections in 10 species of birds in Pakistan and *Plasmodium conturnixi* was described by Bano and Abbasi (1983) from quail from the Northwest Frontier Privince of Pakistan.

Several surveys of blood parasites have been carried out in Sri Lanka over the years starting with ones by Castellani and Wiley (1904, 1905). Later on, Dissanaike and his co-workers (1963, 1965, 1965) conducted probably the most extensive of the surveys and studies of life cycles of Sri Lankan avian haematozoa.

MATERIALS AND METHODS

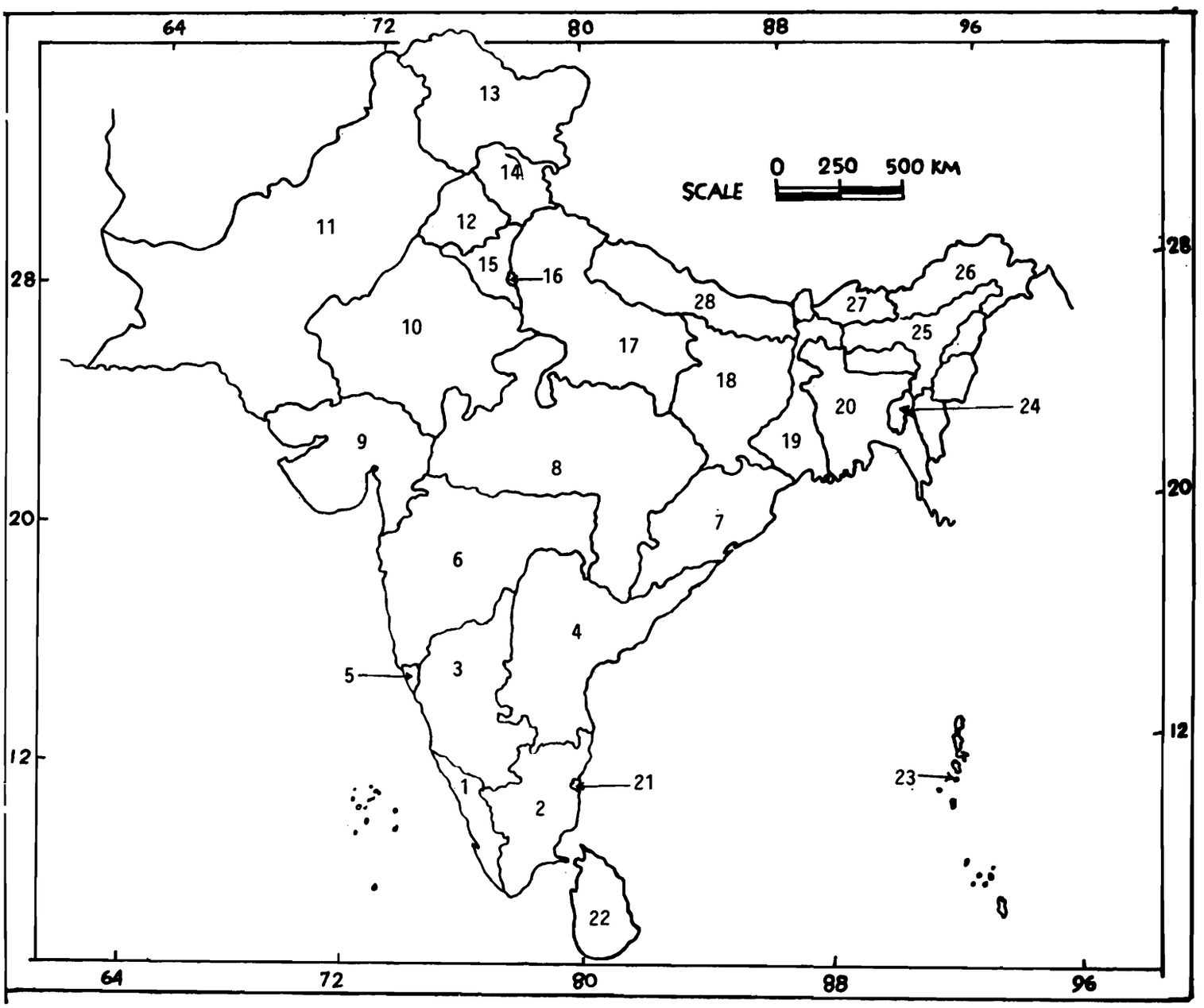
This study is based only on natural infections of blood parasites in birds of the Indian subcontinent, including Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka (Fig. 1). Records on the hosts and species of avian haematozoa recorded in the literature were extracted and the data assembled to present the prevalence and distribution of the blood parasites by avian host family and species (Table 1) and by host family/subfamily (Table 2). The prevalence of avian blood parasites in 21 states, union territories and five other countries of the Indian subcontinent were analyzed (Table 3). A list of the species of *Haemoproteus* and *Leucocytozoon* that are recorded or expected to be encountered in the various avian families of the Indian subcontinent is presented in Table 4 while a list of species of other haematozoa is shown in Table 5. A list of supplanted haematozoan species and their current names is provided in Table 6. Another list of current and supplanted names of avian hosts of the Indian subcontinent is appended in Table 7. The species of the genera *Haemoproteus* and *Leucocytozoon* are according to Bennett, Peirce and Earlé (1993) and the species and hosts of the genus *Plasmodium* are given by Bennett, Bishop and Peirce (1993). The species of the genus *Trypanosoma* are acoording to Bishop and Bennett (1992) but the taxonomy of this group is currently under revision by a number of researchers. The avian species of *Plasmodium* tend to have either a broad host range or very narrow host specificity. Microfilariae can only be identified when the embryos can be associated with the adults found in the tissues of the host ; no attempt has been made to identify these embryo worms. Although reference to species of the genus *Microfilaria* are frequently made, this genus does not exist as the worms involved are only embryos and therefore such names are invalid.

All records of blood parasites in birds from the Indian subcontinent are taken from primary sources which are listed in the References section of this monograph, which can be considered as a bibliography to the Indian subcontinent avian haematozoa. For the sake of brevity and to reduce redundancy, these sources are not listed in this paragraph. Some of references lack the specific data to determine prevalence of parasitism but are included to indicate distribution of the parasites.

RESULTS AND DISCUSSION

The prevalence and distribution of avian haematozoa in 11,900 feral birds (Tables 1,2) show that 277 avian species of 458 (60.4%) representing 53 of the 70 families/subfamilies examined were infected with a variety of species of blood parasites. Members of the genus *Haemoproteus* were the most frequently encountered (11.2%) haematozoan group. In descending order of frequency, species of *Plasmodium* (7.2%), microfilariae (4.1%), *Leucocytozoon* (2.1%) and *Trypansoma* (1.1%) were also encountered. A few birds (0.2%) were also infected with *Atoxoplasma*, *Babesia* and *Lankesterella*, to present an overall prevalence of 23.3% of the sample infected with blood parasites. The impact of these blood parasites on their feral avian hosts is discussed in some detail by Bennett, Peirce and Ashford (1993). The overall prevalence of *Haemoproteus* is considerably higher than the others groups of blood parasites and in fact, the prevalence of *Haemoproteus* is almost equal to all the other genera of praasites combined. All haemoproteids (with the exception of *Haemoproteus columbae* of the Columbidae) for which the life cycles and vectors are known (Bennett and Peirce, 1988) are transmitted by ornithophilic members of the genus *Culicoides* (Diptera : Ceratopogonidae), a genus with widespread distribution and ubiquitous breeding habits (Greiner et al., 1975). Species of *Leucocytozoon* are transmitted by ornithophilic simuliids (Diptera : Simuliidae), a family restricted to breeding in flowing streams or rivers. Avian species of *Plasmodium* are transmitted by culicine (but not anopheline) mosquitoes while species of *Trypanosoma* and microfilariae are transmitted by any of the three groups mentioned above although the microfilariae are probably vector-specific. Thin smear technique is an inadequate method to detect both *Trypanosoma* and microfilaria (Bennett, 1962 ; Woo, 1969) and hence the prevalence recorded for these parasites is undoubtedly low and not a true indication of the frequency of their occurrence. With this in mind, the fact that microfilaria are the third most frequently encountered haematozoan is surprising and suggests that these parasites are indeed common in Indian birds.

Species of *Plasmodium* are the second most frequently occurring group of parasites. The frequency of occurrence of this genus, which usually has low prevalence in avian populations (Bennett et al., 1982), may be due to the studies of Rao and Rao (1980) who recovered *Plasmodium* spp. in 375 of 979 (38%) birds in the Andhra Pradesh, Singh et al. (1951, 1952) who recovered *Plasmodium* spp. in 256 (23.6%) of 869 house sparrows and 214 pigeons and 12.6% of 278 weaver birds. These authors did not report on the presence or absence of other haematozoa so these records bias the overall results. Similarly, the prevalence of microfilaria is biased through the studies of Sen et al. (1965) who recorded only the filarioid nematodes in 161 (72.2%) of 223 jungle crows, *Corvus macrorhynchos*. However, the survey by McClure et al. (1978) represents the largest survey of birds of the Indian subcontinent in which all haematozoa encountered were recorded and the data from this survey probably represents a true picture of the prevalence and distribution of the blood parasites.



Map of the Indian subcontinent showing the various regions and union territories as follows :

1 Kerala ; 2 Tamil Nadhu ; 3 Karnataka ; 4 Andhra Pradesh ; 5 Goa ; 6 Maharashtra ; 7 Orissa ; 8 Madhya Pradesh ; 9 Gujarat ; 10 Rajasthan ; 11 Pakistan ; 12 Punjab ; 13 Jammu and Kasmir ; 14 - Himanchal Pradesh ; 15 Haryana ; 16 - Delhi (Union Territory) ; 17 Uttar Pradesh ; 18 - Bihar ; 19 - West Bengal ; 20 Bangladesh ; 21 Pondicherry (Union Territory) ; 22 Sri Lanka ; 23 Andaman & Nicobar Islands ; 24 Tripura ; 25 Assam ; 26 Arunachal Pradesh ; 27 Bhutan ; 28 Nepal.

The distribution and occurrence of the blood parasites in the various species and families of birds Tables (1, 2) shows that the prevalence of the blood parasites differed markedly from family to family (or subfamily). Of the 52 families/subfamilies of birds with more than 10 individuals sampled (Table 2), only four, the Anhingidae, Caprimulgidae, Hirundinidae and Rostratulidae, were negative for blood parasites. In all these cases (with the exception of Hirundinidae, the sample size was small and it is probable that the lack of blood parasites is more an artifact of small sample size than of host resistance to infection. The most heavily parasitized families (with more than 100 individuals sampled) were the Corvidae, Ploceidae and Capitonidae (Table 2), all of which had more than 50% of the sample infected with one or more genera of haematozoa. A number of families, such as the Charadriidae and Scolopacidae had very low prevalences of parasitism although the sample size was excellent. The low prevalence seen in these two families is typical of these groups throughout the world and probably reflects the behaviour of the birds which some how isolates or removes them from areas of high vector density. This aspect requires further research and elaboration.

In the 21 states and union territories and five other adjacent countries (Fig. 1.) of the Indian subcontinent studied (Table 3 — excluding India unspecified), no blood parasites were found in the birds from Tripura state, a negative finding undoubtedly associated with the small size. Similarly, the survey results from Nepal reflect the lack of sampling activity. Overall prevalence of 30% or higher was found in Bhutan and eight of the 20 remaining specified Indian regions while birds in four Indian regions had a prevalence in the range of 20-29% and birds in the remaining regions with adequate sample size had prevalences in the range of 9-19%.

A comparison between overall prevalence and specific prevalence of parasite genera shows that birds in Bhutan had a greater tendency for multiple infections. The overall prevalence of avian blood parasites in India was found to be 23.3% and species of *Haemoproteus* occurred in all states except Tripura, the only parasite genus to do so. Most of the other genera, however, had a wide distribution throughout India. *Leucocytozoon*, as might be expected, was most prevalent in the mountain states of Bhutan, Uttar Pradesh (Kumaon region) and Jammu and Kashmir (which was environmentally highly suitable for simuliid vectors), and was relatively uncommon in the more flat plains areas of India in which the breeding sites for simuliids is not so optimum.

This analysis of the available data on the distribution and prevalence of avian blood parasites in the Indian subcontinent has shown that blood parasites are quite abundant but that there distribution and prevalence markedly varies from region to region and avian family to family. Much of the variation is attributable to small and unequal sample sizes. However, the data does clearly indicate areas of weakness in which more data must be obtained before any clear conclusions can be drawn. One such area that requires extensive research is the fluctuation over a 12-month period of the prevalence of blood parasites in a population of birds over a time span of 2-3 years to obtain sufficient data. This type of data is required to clearly assess the difference in regional variation of prevalences as comparison of prevalences between various localities not carried out during the same time of year may well give highly erroneous results. The data shows that life cycle studies on species of *Haemoproteus* can be carried out in nearly any region of India with abundant material on hand. Life cycle studies, particularly those involving vector studies, of the other genera of blood parasites should be approached with caution and only undertaken in those regions where it is obvious that both abundant infections occur in the feral avian population, a prevalence that will

indicate the availability of suitable vectors in the area. These data also indicate that the study of the prevalence and distribution of avian haematozoa in the Indian subcontinent can and will provide numerous rewarding research topics for the future that will markedly advance our knowledge in this fascinating area.

SUMMARY

A total of 11,900 birds representing 450 species of 70 families and subfamilies from 21 regions/ States and countries of the Indian subcontinent were examined for blood parasites ; 2776 (23.3%) birds of 277 species belonging to 53 families/subfamilies harboured avian haematozoa. Species of *Haemoproteus* (11.2%) were that most commonly encountered group of blood parasites, followed by *Plasmodium* 7.2%), microfilariae (4.1%), *Leucocytozoon* (2.1%), *Trypanosoma* (1.1 %) and a few *Atoxoplasma* and *Lankesterella* (0.2%) listed as Others. The relatively high prevalence of species of *Haemoproteus* and the marked variation in the prevalence of blood parasites from avian family to family and region to region is discussed. A cheeklist of the avian haematozoa encountered or expected to be found in the Indian subcontinent is appended.

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TABLE 1. Prevalence of haematozoa in the birds of the Indian subcontinent. Abbreviations : ***Haem.*** = ***Haemoproteus*** ; ***Leuc.*** = *Leucocytozoon* ; micro. = microfilaria ; *Plasm.* = *Plasmodium* ; *Tryp.* = *Trypanosoma* ; Others = (***Atoxoplasma***, ***Babesia***, *Lankesterella*, unidentified parasites).

Family and Species	Number of birds		Haematozoa recorded					
	examined	infected	*Haem.*	*Leuc.*	micro.	*Plasm.*	*Tryp.*	Other
ACCIPITRIDAE	66	20	9	11	2		1	1
Accipiter badius (Gmelin)	25	7	3	5	1			
Accipiter nisus (Linnaeus)	4	2	1	1				
Accipiter trivirgatus (Temminck)	1	1		1				
Accipiter virgatus (Temminck)	3	1		1				
Butastur teesa (Franklin)	5	1			1			1
Buteo vulpinus (Gloger)	2	2	1				1	
Elanus caeruleus (Desfontaines)	5	2	1	1				
Gyps bengalensis Gmelin	2	1	1					
Haliastur indus (Boddaert)	3	0						
Ictinaetus malayensis (Temminck)	2	2	1	1				

Milvus migrans (Boddaert)	6	0						
Neophron perenopterus (L.)	3	0						
Spilornis cheela (Latham)	1	0						
Spizaetus cirrhatus (Gmelin)	4	1	1	1				
AEGITHINIDAE	101	21	7	9	5	1		3
Aegithina nigrolutea (Marshall)	12	2		2				
Aegithina tiphia (Linnaeus)	69	12	6	4	3			2
Chloropsis aurifrons (Temminck)	7	3	1	1		1		1
Chloropsis cochinchinensis (Gmelin)	7	4		2	2			
Chloropsis hardwickii (Jardine and Selby)	2	0						
Irena puella (Latham)	4	0						
ALAUDIDAE	65	9	7		1			1
Alauda gulgula Franklin	2	0						
Ammomanes phoenicurus (Franklin)	3	0						

Eremopterix griseus (Scopoli)	16	4	3					1
Gallerida cristata (Linnaeus)	22	2	2					
Gallerida deva (Sykes)	10	2	2					
Galerida malabarica (Scopoli)	5	1			1			
Mirafra assamica Horsfield	5	0						
Mirafra erythroptera Blyth	2	0						
ALCEDINIDAE	124	5	5		1			
Alcedo athis (Linnaeus)	43	0						
Alcedo hercules Laubmann	1	0						
Ceyx erythacus (Linnaeus)	5	0						
Halcyon pileata (Boddaert)	1	0						
Halcyon smyrnensis (Boddaert)	73	5	5		1			
Pelargopsis capensis (Linnaeus)	1	0						
ANATIDAE	511	28	17	10		1		1

Anas acuta Linnaeus	89	5	1	4				
Anas clypeata (Linnaeus)	1	0						
Anas crecca Linnaeus	109	4		4				1
Anas penelope Linnaeus	51	5	5					
Anas platyrhynchos Linnaeus	22	0						
Anas poecilorhyncha Forster	14	0						
Anas querquedula Linnaeus	59	1	1					
Anser anser Linnaeus	28	3	3					
Aythya ferina (Linnaeus)	70	5	5					
Aythya fuligula Linnaeus	28	2		2				
Dendrocygna javanica (Horsfield)	3	0						
Mergus merganser Linnaeus	1	0						
Netta rufina (Pallas)	32	2	1			1		
Nettapus coromandelianus (Gmelin)	2	1	1					

Tadorna ferugina (Pallas)	2	0						
ANHINGIDAE	12	0						
Anhinga rufa (Daudin)	12	0						
APODIDAE	9	0						
Apus affinis (Gray)	9	0						
ARDEIDAE	60	5		2	3		3	
Ardeola bacchus (Bonaparte)	1	0						
Ardeola grayi (Sykes)	32	1		1	1			
Ardea cinerea Linnaeus	6	1		1				
Bubulcus ibis (Linnaeus)	11	0						
Butorides striatus (Linnaeus)	2	0						
Egretta alba (Linnaeus)	1	0						
Egretta gularis Bosc.	1	0						
Egretta intermedia (Wagler)	4	1					1	

Ixobrychus minuta (Linnaeus)	1	1			1		1	
Nycticorax nycticorax (Linnaeus)	1	1			1		1	
ARTAMIDAE	1	0						
Artamus fuscus (Vieillot)	1	0						
BUCEROTIDAE	16	4	3		4		1	
Anthroceros malabaricus (Gmelin)	1	0						
Buceros bicornis Linnaeus	1	0						
Ptilolaemus tickelli (Blyth)	2	1			1			
Tockus birostris (Scopoli)	6	0						
Tockus griseus (Latham)	6	3	3		3		1	
BURHINIDAE	1	0						
Bruhinus oedicnemus (Linnaeus)	1	0						
CAMPEPHAGIDAE	108	22	12	7	1	2		
Coracina melanoptera (Ruppell)	1	0						

Coracina novaehollandiae (Gmelin)	7	1	1					
Hemipus picatus (Sykes)	6	0						
Lalage melaschista (Hodgson)	1	1			1			
Pericrocotus brevirostris (Vigors)	13	5	5					
Pericrocotus cinammomeus (Linnaeus)	7	2				2		
Pericrocotus etholagus (Bangs and Phillips)	1	0						
Pericrocotus flammeus (Forster)	18	0						
Tephrodornis pondicerianus (Gmelin)	52	12	6	7				
Tephrodornis virgatus (Temminck)	2	1						
CAPITONIDAE	114	67	56	12	8	2	1	1
Megalaima asiatica (Latham)	13	11	10		4			1
Megalaima australis (Horsfield)	1	1	1	1	1			
Megalaima franklini (Blyth)	1	1	1	1				
Megalaima haemocephala (Muller)	46	13	10		1	2		

Megalaima rubricapilla (Gmelin)	1	0						
Megalaima virens (Boddaert)	5	3	3	1			1	
Megalaima viridis (Boddaert)	25	25	20	9	1			
Megalaima zeylanica(Gmelin)	22	13	13		1			
CAPRIMULGIDAE	12	0						
Caprimulgus asiaticus Latham	3	0						
Caprimulgus indicus latham	3	0						
Caprimulgus macrurus Horsfield	6	0						
CHARADRIIDAE	179	2	1	1	1		1	
Charadrius alexandrinus Linnaeus	31	0						
Charadrius dubius (Scopoli)	57	0						
Charadrius leschnaulti Lesson	10	0						
Charadrius mongolus Pallas	1	0						
Pluvialis dominica **(Muller)**	**38**	**0**						

Vanellus indicus (Boddaert)	39	2	1	1	1		1	
Venellus malabaricus (Boddaert)	3	0						
CICONIIDAE	2	0						
Anastomus oscitans (Boddaert)	2	0						
CINCLIIDAE	1	0						
Cinclus palasii Temminck	1	0						
COLUMBIDAE	962	314	289	5	8	16	2	
Chalcophaps indica (linnaeus)	20	3			3			
Columba hodgsonii Vigors	1	0						
Columba livia Gmelin	674	267	267		1		2	
Ducula aenea Linnaeus	7	0						
Macropygia rufipennis Blyth	1	0						
Macropygia unchall (Wagler)	1	0						
Streptopellia chinensis (Scopoli)	86	22	6		1	15	1	

Streptopelia decaocto (Frivaldszky)	49	12	11	1			2	
Stretopellia orientalis (Latham)	8	2	1	2				
Streptopelia senegalensis (Linnaeus)	59	2	1	1	1			
Streptopelia tranquebarica (Herman)	1	0						
Treron bicincta (Jerdon)	3	2	2					
Treron curvirostris (Gmelin)	11	0						
Treron phoenicoptera (Latham)	37	1			1			
Treron pompadora (Bonaparte)	1	1			1			
Treron sphenura (Vigors)	3	2	1	1		1		
CORACIIDAE	62	9	9	3	1			
Coracias benghalensis (Linnaeus)	62	9	9	3	1			
CORVIDAE	616	396	30	6	183	193	3	1
Cissa chinesis (Boddaert)	4	3			3			
Cissa flavirostris (Blyth)	1	0						

Corvus macrorhynchus Wagler	243	164	2		162			
Corvus splendens Vieillot	294	190	3		2	189		
Dendrocitta formosa Swinhoe	3	1	1	1				
Dendrocitta frontalis Horsfield	3	2			2			
Dendrocitta vagabunda (Latham)	53	24	20	3	5	4	2	1
Garrulus glandarius (Linnaeus)	4	2	1	1	2			
Garrulus lanceolatus (Vigors)	11	10	3	1	7		1	
CUCULIDAE	143	29	24	5	6	1	2	1
Cacomantis marulinus (Scopoli)	26	0						
Centropus sinesis (Stephens)	46	14	12	1	2	1	1	1
Centropus toulou (Muller)	1	1	1					
Chalcites maculatus (Gmelin)	1	0						
Clamator coromandus (Linnaeus)	1	0						
Clamator jacobinus (Boddaert)	17	10	10	4	1			

Cuculus canorus Linnaeus	1	0						
Cuculus micropterus Gould	1	1					1	
Cuculus poliocephalus Latham	4	1	1		1			
Cuculus varius (Vahl)	1	1			1			
Eudynamys scolopacea (linnaeus)	42	1			1			
Rhopodytes tristis (lesson)	2	0						
DICAEIDAE	19	1	1					
Dicaeum concolor Jerdon	1	0						
Dicaeum cruentatum (Linnaeus)	1	0						
Dicaeum erythrorhynchos (Latham)	17	1	1					
DICRURIDAE	148	23	11		9	5	3	
Dicrurus adsimilis (Bechstein)	93	13	6		3	5	3	
Dicrurus aeneus Vieillot	11	0						
Dicrurus caerulescens (Linnaeus)	13	2	2					

Dicrurus hottentotus (Linnaeus)	2	0						
Dicrurus leucophaeus Vieillot	9	0						
Dicrurus macrocercus (Vieillot)	6	1	1					
Dicrurus paradiseus (linnaeus)	13	7	2		6			
Dicrurus remifer (Temminck)	1	0						
EMBERIZIDAE Emberizinae	22	1		1				
Emberiza cia (Linnaeus)	2	1		1				
Emberiza fucata Pallas	11	0						
Emberiza melanocephala Scopoli	9	0						
ESTRILDIDAE - Poephilinae	745	135	66			26	60	
Amandava amandava (Linnaeus)	32	1	1					
Lonchura kelaarti (Jerdon)	8	5	5					
Lonchura malabarica (Linnaeus)	275	44	16			4	33	
Lonchura malacca (Linnaeus)	243	50	22			22	24	

Lonchura punctulata (Linnaeus)	157	33	20				3	
Lonchura striata (Linnaeus)	30	2	2					
EURYLAIMIDAE	3	1	1					
Serilophus lunatus (Gould)	3	1	1					
FALCONIDAE	9	3	3					
Falco peregrinus Linnaeus	6	0						
Falco tinnunculus Linnaeus	3	3	3					
FRINGILLIDAE - Carduelinae	85	12	4	8	3		1	
Carduelis carduelis (Linnaeus)	8	0						
Carpodacus erythrinus (Pallas)	53	6	2	4	2			
Carpodacus pulcherrimus (Moore)	1	0						
Coccothraustus affinis (Blyth)	1	1		1	1			
Coccothraustus icteroides Vigors	1	1		1				
Leucosticta nemoricola (Hodgson)	1	0						

Melophus lathami (Gray)	14	2	1	1				
Petronia xanthocollis (Burton)	1	1	1					
Pyrrhula aurantiaca Gould	5	1		1				
GLAREOLIDAE	8	0						
Cursorius coramandelicus (Gmelin)	1	0						
Glareola lactea Temminck	1	0						
Glareola pratincola (Linnaeus)	6	0						
GRUIDAE	4	3	3					
Anthropoides virgo (Linnaeus)	3	2	2					
Grus antigone (Linnaeus)	1	1	1					
HIRUNDINIDAE	51	0						
Hirundo daurica Linnaeus	39	0						
Hirundo rustica Linnaeus	11	0						
Hirundo smithi (Leach)	1	0						

LANIIDAE Laniinae	176	77	32		50	13	14	
Lanius cristatus Ruppell	29	9	6		1	2		
Lanius excubitor Linnaeus	4	2	2					
Lanius schach Linnaeus	104	61	19		49	11	14	
Lanius tephronotus (Vigors)	4	0						
Lanius vittatus Valenciennes	34	5	5					
Lanius sp.	1	0						
LARIDAE	7	0						
Geochelidon nilotica (Gmelin)	1	0						
Larus genei (Brehm)	1	0						
Sterna albifrons Pallas	1	0						
Sterna aurantia Gray	1	0						
Sterna bengalensis Lesson	1	0						
Sterna hirundo Linnaeus	2	0						

MEGAPODIDAE	1	1	1					
Megapodius freycinet (Gaimard)	1	1	1					
MEROPIDAE	102	23	20	1	2	1		
Merops leschenaulti Vieillot	4	0						
Merops orientalis Latham	92	22	20		2	1		
Merops philippinus Linnaeus	1	0						
Merops superciliosus Linnaeus	2	0						
Nyctyornis athertoni (Jardine and Selby)	3	1		1				
MOTACILLIDAE	129	28	25		2	2		
Antus hodgsoni Richmond	46	6	5		1			
Anthus novaeseelandiae (Gmelin)	16	2	2		1			
Anthus trivialis (Linnaeus)	1	0						
Dendronanthus indicus (Gmelin)	8	3	3					
Motacilla alba Linnaeus	19	7	6			1		

Motacilla cinerea Tunstall	28	9	9					
Motacilla flava Linnaeus	9	0						
Motacilla madaraspatensis (Gmelin)	2	1				1		
MUSCICAPIDAE - Monarchinae	93	6	4		2	1		
Hypothymis azurea (Boddaert)	47	2	2					
Terpsiphone paradisi Linnaeus	46	4	2		2	1		
Muscicapinae	162	33	28	3	2	3		
Culicicapa ceylonesis Oberholser	14	0						
Muscicapa hyperythra (Blyth)	4	0						
Muscicapa latirostris Raffles	4	2	2					
Muscicapa muttui (Layard)	4	1	1					
Muscicapa parva Bechstein	50	4	4					
Muscicapa sapphira (Blyth)	1	1			1			
Muscicapa sibirica Gmelin	7	3	3					

Muuscicapa striata (Pallas)	6	5	5					
Muscicapa sundara (Hodgson)	10	9	7	2		2		
Muscicapa superciliaris Jerdon	3	1	1					
Muscicapa thalassina Swainson	9	1				1		
Muscicapa tickelliae (Blyth)	50	6	5	1	1			
Rhipidurinae	17	3	2		1	2		
Rhipidura albicollis Vieillot	4	0						
Ripidura albogularis (Lesson)	12	2	2			2		
Ripidura aureola (Lesson)	1	1			1			
Sylviinae	664	108	102	3	2	5	3	1
Acrocephalus agricola Jerdon	23	4	4	1				
Acrocephalus arundinaceous Linnaeus	15	3	3					
Acrocephalus dumetorum Blyth	82	37	37	1			2	
Acrocephalus stentoreus (Hemprich and Ehrenberg)	87	11	11	1				

Hippolais caligata (Lichtenstein)	14	5	5			1		
Locustella certhiola (Pallas)	1	0						
Megaluris palustris Horsfield	18	0						
Orthotomus sutorius (Pennant)	95	3	3					
Phragmaticola aedon (Pallas)	11	8	8					
Phylloscopus colybita (Vieillot)	50	1	1					
Phylloscopus fuscatus (Blyth)	12	1				1		
Phylloscopus inornatus (Blyth)	16	1	1					
Phylloscopus occipitalis (Blyth)	2	1	1					
Phylloscopus subaffinis (Ogilvie-Grant)	1	0						
Phylloscopus tenellipes Swinhoe	4	0						
Phylloscopus trochiloides (Sundevall)	8	1	1					
Prinia buchanani Blyth	7	1						1
Prinia flaviventris (Delessert)	9	0						

Prinia gracilis (Lichtenstein)	3	2	2					
Prinia hodgsoni Blyth	6	1	1					
Prinia socialis Sykes	42	2	1			1	1	
Prinia subflava (Gmelin)	39	5	4			1		
Prinia sylvatica Jerdon	5	2	1		1			
Seicercus affinis Hodgson	2	1			1			
Sylvia communis Latham	1	1	1					
Sylvia curruca (Linnaeus)	90	13	13			1		
Sylvia hortensis (Gmelin)	21	4	4					
Timaliinae	452	91	45	44	12	5	3	3
Actinodura egertoni Gould	2	0						
Actinodura nipalensis (Hodgson)	3	2	2	2				
Alcippe castaneceps (Hodgson)	5	4	2	1				1
Alcippe poioicephala (Jerdon)	34	2	2					

Chrysoma sinense (Gmelin)	49	3		3		1		
Dumetia hyperythra (Franklin)	36	2		2				
Garrulax albogularis (Gould)	5	2		2				
Garrulax caeruleus (Hodgson)	1	1		1	1			
Garrulax erythrocephalus (Vigors)	2	1				1		
Garrulax lineatus (Vigors)	11	3			1	2		
Garrulax monileger (Hodgson)	4	1			1			
Garrulax pectoralis (Gould)	1	0						
Garrulax squamatus (Gould)	3	1			1			
Garrulax striatus (Vigors)	2	0						
Garrulax variegatus (Vigors)	6	2		1	1			
Heterophasia capistrata (Vigors)	16	14	7	13		1		
Leiothrix argentauris (Hodgson)	1	1	1					1
Macronus gularis (Horsfield)	9	0						

Minla cyanouroptera (Hodgson)	5	3	2	3				
Minla ignotincta Hodgson	4	1		1				
Minla strigula (Hodgson)	6	3		2				1
Myzornis pyrrhoura Blyth	4	1		1				
Pellorneum ruficeps Swainsn	53	0						
Pomatorhinus erythrogenys Vigors	1	0						
Pomatorhinus ochraceiceps Walden	1	0						
Pomatorhinus ruficollis Hodgson	3	1		1	1			
Pomatorhinus schisticeps Hodgson	31	0						
Pteruthius flaviscapis (Temminck)	1	0						
Sphenocichla humei (Mandelli)	1	0						
Stachyris nigriceps Blyth	1	0						
Stchyris ruficeps Blyth	5	1					1	
Turdoides caudata (Dumont)	28	7	6	1	1			

Turdoides malcomi (Sykes)	25	4	3	1	1			
Turdoides striatus (Sykes)	84	25	17	7	2		2	
Turdoides subrufa (Jerdon)	2	0						
Yuhina bakeri Rothschild	2	1			1			
Yuhina flavicollis Hodgson	4	3	2	2				
Yuhina xantholeuca (Blyth)	1	1	1					
Turdininae	563	120	64	39	31	4	2	4
Brachypteryx montana Horsfield	1	0						
Copsychus malabaricus (Scopoli)	8	1	1					
Copsychus saularis (Linnaeus)	102	31	27		3	1	1	
Enicurus immaculatus (Hodgson)	1	1	1					
Enicurus shistaceus (Hodgson)	1	0						
Erithacus brunneus (Hodgson)	23	1	1					
Erithacus calliope (Pallas)	20	0						

Luscinia svecicus (Linnaeus)	59	4	3		1			
Monticola cinclorhynchus (Vigors)	23	13	13	6	1			
Monticola solitaria (Linnaeus)	3	0						
Myiophoneus caeruleus (Scopoli)	4	2	2					
Phoenicurus caeruleocephalus Vigors	7	1		1				
Phoenicurus ochrurus Gmelin	37	2	2					
Saxicola caprata (Linnaeus)	24	3	1	1		1		
Saxicola ferrea Gray	1	0						
Saxicola torquata (Linnaeus)	25	1		1				
Saxicoloides fulicata (Linnaeus)	78	14	3	2	9	2		2
Tarsiger cyanurus (Pallas)	8	2		2				
Turdus boulboul (Latham)	2	1	1					
Turdus dissimilis Blyth	1	0						
Turdus merula Linnaeus	33	7	3	4	2			

Turdus ruficollis Pallas	22	6	4	5				1
Turdus unicolor Tickell	16	6	1	5				1
Zoothera citrina (Latham)	63	24	1	12	15		1	
Zoothera dauma (Latham)	1	0						
NECTARINIDAE	130	25	21	2		2		
Aethopyga gouldiae (Vigors)	2	0						
Aethopyga saturata (Hodgson)	1	1	1					
Arachnothera longirostris (Latham)	2	1		1				
Arachnothera magna Blyth	2	1		1				
Nectarina asiatica (Latham)	75	14	12			2		
Nectarina lotenia (Linnaeus)	3	1	1					
Nectarina minima (Sykes)	13	2	2					
Nectarina zeylonica (Linnaeus)	32	5	5					
ORIOLIDAE	41	9	2	3	5		2	

Oriolus oriolus (Linnaeus)	25	3	1	2			1	
Oriolus trailii (Vigors)	1	1	1				1	
Oriolus xanthornus Linnaeus	15	5		1	5			
PARADOXORNITHIDAE	2	0						
Paradoxornis atrosuperciliaris (Godwin-Austen)	2	0						
PARIDAE	49	18	1	15	3	1		
Parus major Linnaeus	24	7		7				
Parus monticolus Vigors	17	6		6	2			
Parus xanthogenys Vigors	8	5	1	2	1	1		
PASSERIDAE	1734	399	85		14	350		3
Passer domesticus (Linnaeus)	1646	380	67		12	350		3
Passer hispaniolensis (Temminck)	20	6	5		1			
Passer montanus Linnaeus	1	0						
Passer rutilans Temminck	5	1	1					

Petronia xanthocollis Burton	62	12	12		1			
PHALACROCORACIDAE	3	0						
Phalacrocorax niger Vieillot	3	0						
PHASIANIDAE - Phasianinae	763	155	2	20	17	108	6	1
Arborophila atrogularis (Blyth)	1	0						
Arborophila rufogularis (Blyth)	1	1	1					
Arborophila torqueola Valenciennes	3	1		1				
Coturnix coramandelica (Gmelin)	118	33		1		32		
Coturnix coturnix (Linnaeus)	109	6				1	5	
Francolinus francolinus (L.)	30	0						
Francolinus pictus (Jardine and Selby)	2	1		1				
Francolinus pondicerianus (Gmelin)	106	27		3	1	22	1	
Gallus gallus Linnaeus	176	13		4	9			
Gallus layfayetti Lesson	39	9		8		1		

Gallus sonnerati Temminck	45	1				1		
Galloperdix spadicea (Gmelin)	2	1		1				
Ithaginis cruentus (Hardwicke)	2	2				2		
Lophura leucomelana (Latham)	2	0						
Perdicula argoondah (Sykes)	21	8		1	7			1
Perdicula asiatica (Latham)	102	50				50		
Perdicula erythroryhncha (Latham)	1	0						
Pavo cristata Linnaeus	1	1	1					
Polyplectron bicalcaratum (Linnaeus)	1	0						
Tragopan satyra (Linnaeus)	1	1				1		
PHOENICOPTERIDAE	8	0						
Phoeniconais minor (Geoffrey)	1	0						
Phoenicopterus roseus Linnaeus	7	0						
PICIDAE	121	22	19	2	5	2		

Blythipicus pyrrhotis (Bonaparte)	1	0						
Chrysocolaptes festivus (Boddaert)	1	0						
Chyrosocolaptes lucidus (Scopoli)	2	0						
Dendrocopos auriceps (Vigors)	5	0						
Dendrocopos himalayensis (Jardine and Selby)	4	0						
Dendrocopos mahrattensis (Latham)	35	7	7			1		
Dendrocopos nanus (Vigors)	1	0						
Dinopium benghalense (Linnaeus)	6	1			1			
Hemicircus canente (Lesson)	1	0						
Jynx torquilla Linnaeus	38	7	7		1			
Micropternus brachyurus (Vieillot)	1	0						
Picoides macei (Vieillot)	1	0						
Picumnus innominatus Burton	1	0						
Picus canus Gmelin	1	1	1					

Picus chlorolophus Vieillot	11	2	1	1	1	1		
Picus flavinucha (Gould)	3	3	3		2			
Picus squamatus (Vigors)	6	1		1				
Picus xanthopygeus (Gray and Gray)	2	0						
Sasia ochracea Hodgson	1	0						
PITTIDAE	41	6		3	4	1	1	
Pitta brachyura (Linnaeus)	39	5		3	3	1	1	
Pitta nipanensis (Hodgson)	2	1			1			
PLOCEIDAE	297	151	102		12	53	1	1
Ploceus benghalense (Linnaeus)	22	9	9			2	1	
Ploceus manyar (Horsfield)	10	4	4					
Ploceus megarhynchus Hume	3	0						
Ploceus philippinus (Linnaeus)	262	138	89		12	51		1
PODICIPEDIDAE	5	0						

Podiceps rufficollis (Pallas)	5	0						
PSITTACIDAE	67	4	4					
Loriculus vernalis (Sparrman)	1	0						
Psittacula alexandri (Linnaeus)	2	0						
Psittacula columboides (Vigors)	2	0						
Psittacula cyanocephala (Linnaeus)	17	3	3					
Psittacula eupatria (Linnaeus)	14	0						
Psittacula krameri (Scopoli)	30	1	1					
Pstittacula longicauda (Boddaert)	1	0						
PTEROCLIDIDAE	22	15				15		
Pterocles indicus (Gmelin)	1	0						
Pterocles exustus Temminck	21	15				15		
PYCNONOTIDAE	421	153	87	32	30	6	19	3
Criniger flaveolus (Gould)	1	1	1					

Hypsipetes flavalus (Blyth)	3	0						
Hypsipetes indicus (Jerdon)	5	3	3					
Hypsipetes madagascariensis (Muller)	33	14	11	2		2	1	
Hysipetes viridiscens (Blyth)	2	0						
Pycnonotus burmanicus Blanf. and Oates	40	33	7	2	27		12	
Pycnonotus cafer (Linnaeus)	125	34	9	24	1	2	1	1
Pycnonotus flavescens (Blyth)	1	0						
Pycnonotus jocosus (Linnaeus)	82	18	12	3	1	1	4	
Pycnonotus leucogenys (Gray)	57	7	2	1		1	1	2
Pycnonotus luteolus Lesson	67	41	40		1			
Pycnonotus melanicterus (Gmelin)	4	2	2					
Pycnonotus striatus (Blyth)	1	0						
RALLIDAE	37	2	2					
Amaurornis phoenicurus (Boddaert)	18	0						

Fulica atra Linnaeus	3	0						
Gallinula chloropus (Linnaeus)	14	2	2					
Porzana pusilla (Pallas)	1	0						
Rallus striatus Linnaeus	1	0						
RECURVIROSTRIDAE	1	0						
Himantopus himantopus (Linnaeus)	1	0						
ROSTRATULIDAE	26	0						
Rostratula benghalense (Linnaeus)	26	0						
SCOLOPACIDAE	545	4	1		1	2		
Actitis hypoleucos Linnaeus	7	0						
Arenaria interpres (Linnaeus)	3	0						
Calidris minutus (Leisler)	22	0						
Calidris testacea (Pallas)	1	0						
Capella gallinago (Linnaeus)	155	0						

Capella megala Swinhoe	3	0						
Capella stenura (Bonaparte)	23	0						
Numenius phaeopus (Bonaparte)	5	0						
Philomax pugnax (Linnaeus)	3	1	1					
Scolopax rusticola Linnaeus	1	1			1			
Tringa glareola Linnaeus	147	0						
Tringa hypoleucos (Linnaeus)	17	2				2		
Tringa nebularia (Gunnerus)	37	0						
Tringa ochropus Linnaeus	26	0						
Tringa stagnitilis (Bechstein)	35	0						
Tringa totanus (Linnaeus)	46	0						
Xenus cinereus (Guldenstaedt)	14	0						
SITTIDAE	25	4	4	1	1		1	
Salpornis spilanotus Franklin	3	0						

Sitta castanea Lesson	16	3	3	1	1		1	
Sitta frontalis Swainson	6	1	1					
STRIGIDAE	69	31	27	4	2	2	3	
Asio flammeus (Pontopiddan)	1	0						
Athene brama (Temminck)	34	9	5	1	1	2		
Bubo coromandus (Latham)	7	4	4					
Glaucidium brodei (Burton)	4	2	2	1			1	
Glaucidium cuculoides (Vigors)	3	2	2	1	1		1	
Glaucidium radiatum (Tickell)	4	3	3					
Ketupa zeylonensis (Gmelin)	1	1	1					
Ninox scutellata (Raffles)	1	1	1					
Otus bakkamoena Pennant	10	7	7	1				
Otus scops Linnaeus	1	1	1				1	
Strix aluco Linnaeus	3	1	1					

STURNIDAE	588	120	63		14	33		2
Acridotheres fuscus (Wagler)	22	4	2		2			
Acridotheres gingianus (Latham)	26	2	2					
Acridotheres tristis Linnaeus	211	23	11		3	9		
Aplonis panavensis (Scopoli)	1	0						
Gracula religiosa Linnaeus	3	1			1			
Mino coronatus (Blyth)	1	0						
Sturna contra Linnaeus	79	20	14		4	17		
Sturnus malabaricus (Gmelin)	78	25	9		2	16		1
Sturnus pagodarum (Gmelin)	98	22	2		1			1
Sturnus roseus (Linnaeus)	43	19	19		1			
Sturnus vulgaris Linnaeus	26	4	4					
THRESKIORNITHIDAE	78	2	2					
Plagadus falcinellus (Linnaeus)	30	0						

Ptaltalea leucorodia Linnaeus	7	1	1					
Pseudibis papillosa (Temminck)	1	1	1					
Threskiornis melanocephalus (Latham)	40	0						
TROGONIDAE	1	1	1					
Harpactes fasciatus (Pennant)	1	1	1					
TURNICIDAE	33	8			8			
Turnix suscitator (Gmelin)	33	8			8			
TYTONIDAE	1	0						
Tyto alba (Scopoli)	1	0						
UPUPIDAE	90	12	1	3	3	4		1
Upupa epops Linnaeus	90	12	1	3	3	4		1
ZOSTEROPIDAE	77	35	29	1	1	4		1
Zosterops palpebrosa (Temminck)	77	35	29	1	1	4		1
GRAND TOTAL	11900	2776	1334	256	490	866	136	29

TABLE 2. Prevalence of haematozoa in avian families and subfamilies of the Indian subcontinent. Abbreviations as in Table 1

Family/subfamily	Number of birds			Haematozoa recorded					
	examined	infected	%infected	*Haem.*	*Leuc.*	micro.	*Plasm.*	*Tryp.*	Other
Accipitridae	66	20	30.3	9	11	2		1	1
Aegithinidae	101	21	20.8	7	9	5	1		3
Alaudidae	65	9	13.9	7		1			1
Alcedinidae	124	5	4.0	5		1			
Anatidae	511	28	5.5	17	10		1		1
Anhingidae	12	0							
Apodidae	9	0							
Ardeidae	60	5	8.3		2	3		3	
Artamidae	1	0							
Bucerotidae	16	4	25.0	3		4		1	
Burhinidae	1	0							

Campephagidae	108	22	20.3	12	7	1	2		
Capitonidae	114	67	58.8	56	12	8	2	1	1
Caprimulgidae	12	0							
Charadriidae	179	2	1.1	1	1	1		1	
Ciconiidae	2	0							
Cinclidae	1	0							
Columbidae	962	314	32.6	289	5	8	16	5	
Coraciidae	62	9	14.5	9	3	1			
Corvidae	616	396	64.3	30	6	183	193	3	1
Cuculidae	143	29	20.3	24	5	6	1	2	1
Dicaeidae	19	1	5.3	1					
Dicruridae	148	23	15.5	11		9	5	3	
Emberizidae-Emberizinae	22	1	4.6		1				
Estrildidae - Poephilinae	745	135	18.1	66			26	60	

Eurylaimidae	3	1		1					
Falconidae	9	3	33.3	3					
Fringillidae Carduelinae	85	12	14.0	4	8	3		1	
Glareolidae	8	0							
Gruidae	4	3		3					
Hirundinidae	51	0							
Laniidae - Laniinae	176	77	43.7	32		50	13	14	
Laridae	7	0							
Megapodidae	1	1		1					
Meropidae	102	23	22.5	20	1	2	1		
Motacillidae	129	28	21.3	25		2	2		
Muscicapidae	1951	361	18.5	245	89	80	20	8	8
Monarchininae	93	6	6.5	4		2	1		
Muscicapinae	162	33	20.4	28	3	2	3		

Rhipidurinae	17	3	17.6	2		1	2		
Sylviinae	664	108	16.2	102	3	2	5	3	1
Timaliinae	452	91	20.1	45	44	12	5	3	3
Turdinae	563	120	21.0	64	39	31	4	2	4
Nectarinidae	130	25	19.2	21	2		2		
Oriolidae	41	9	21.9	2	3	5		2	
Paradoxornithidae	2	0							
Paridae	49	18	36.7	1	15	3	1		
Passeridae	1734	399	24.2	85		14	350		3
Phalacrocoracidae	3	0							
Phasianidae Phasianinae	763	155	20.3	2	20	17	180	6	1
Phoenicopteridae	8	0							
Picidae	121	22	18.1	19	2	5	2		
Pittidae	41	6	14.6	3	4	1	1		

Ploceidae	297	151	50.8	102		12	53	1	1
Podicipedidae	5	0							
Psittacidae	67	4	5.9	4					
Pteroclididae	22	15	68.1				15		
Pycnonotidae	421	153	36.3	87	32	30	6	19	3
Rallidae	37	2	5.4	2					
Recurvirostridae	1	0							
Rostratulidae	26	0							
Scolopacidae	545	4	0.7	1		1	2		
Sittidae	25	4	16.0	4	1	1		1	
Strigidae	69	31	44.9	27	4	2	2	3	
Sturnidae	588	120	20.4	63		14	33		2
Threskiornithidae	78	2	2.6	2					
Trogonidae	1	1		1					

Turniciade	33	8	24.2			8			
Tytonidae	1	0							
Upupidae	90	12	13.3	1	3	3	4		1
Zosteropidae	77	35	45.5	29	1	1	4		1
TOTALS :	11900	2776		1334	256	490	866	136	29
PERCENTAGE :			23.3	11.2	2.1	4.1	7.2	1.1	0.2

TABLE 3. Prevalence of haematozoa in different regions of the Indian subcontinent. Abbreviations as in Table 1. Percentage of infections in parentheses.

Region	Total birds		Haematozoa recorded					
	Examined	Infected	*Haem.*	*Leuc.*	Micro.	*Plasm.*	*Tryp.*	Other
Indian regions	11185	2651 (23.7)	1299 (11.6)	219 (2.0)	480 (4.3)	814 (7.3)	133 (1.2)	23 (0.2)
Andaman & Nicobar	8	2	1		1			
Andhra Pradesh	1125	405 (36.0)	14 (1.2)	3 (0.2)	14 (1.2)	375 (33.3)	1 (0.1)	
Arunachal Pradesh	61	19 (31.1)	5 (8.1)		14 (22.9)			
Assam	41	13 (31.7)	11 (26.8)	1 (2.4)	3 (7.3)	1 (2.4)		
Bihar	8	1	1					
Delhi (U. T.)	1505	431 (28.6)	109 (7.2)			317 (21.0)		
Goa*	419	144 (34.4)	92 (22.0)	15 (3.6)	31 (7.4)	6 (1.4)	34 (8.1)	
Gujarat	372	79 (24.7)	67 (18.0)	12 (3.2)	4 (1.1)	2 (0.4)	1 (0.2)	1 (0.2)
Himachal Pradesh	6	1	1					
India - unspecified	993	153 (15.4)	76 (7.6)	19 (1.9)	84 (8.5)	6 (0.6)	7 (0.7)	5 (0.5)

Jammu and Kashmir	296	54 (18.2)	30 (10.1)	18 (6.1)	4 (1.3)	6 (2.0)		
Kerala	15	9 (60.0)			9 (60.0)			
Maharashtra	1264	295 (23.2)	232 (18.4)	77 (6.1)	30 (2.4)	14 (1.1)	6 (0.05)	8 (0.05)
Madhya Pradesh	6	1		1				
Orissa	353	68 (19.2)	49 (13.9)	10 (2.8)	6 (1.7)	4 (1.1)	6 (1.7)	
Pondicherry (U.T.)	133	18 (13.5)				18 (13.5)		
Punjab	340	157 (46.0)	153 (45.0)		1 (0.3)	7 (2.0)	3 (0.9)	
Rajasthan	1783	175 (9.8)	143 (8.0)	32 (2.0)	7 (0.4)	15 (0.8)	2 (0.1)	4 (0.2)
Tamil Nadu	813	143 (17.6)	115 (14.1)	16 (2.0)	5 (0.6)	4 (0.5)	2 (0.3)	1 (0.1)
Tripura	18	0						
Uttar Pradesh	101	55 (54.4)	16 (15.8)	12 (11.9)	12 (11.9)	35 (34.6)		15 (14.8)
West Bengal	1525	428 (28.0)	184 (12.0)	3 (0.2)	232 (15.2)	39 (2.5)	29 (1.9)	4 (0.2)
Adjacent countries	715	125 (17.5)	35 (4.9)	37 (5.1)	10 (1.4)	52 (7.3)	3 (0.4)	6 (0.8)
Bangladesh	262	23 (8.8)	5 (1.9)			17 (6.5)		19 (0.4)

Bhutan	180	61 (33.9)	28 (15.5)	29 (16.1)	10 (5.5)	4 (2.2)	3 (1.6)	5 (2.7)
Nepal	2	1	1					
Pakistan	232	31 (13.3)	1 (0.4)			30 (12.9)		
Sri Lanka	39	9 (23.0)		8 (20.5)		1 (2.5)		
TOTALS	11900	2776 (23.3)	1334 (11.2)	256 (2.1)	490 (4.1)	866 (7.2)	136 (1.1)	29 (0.2)

**Note* : Goa includes Goa State, Daman and Diu Union territory.

TABLE 4. The species of *Haemoproteus* and *Leucocytozoon* encountered or expected in birds of the Indian subcontinent.

Avian families and subfamilies	Haemoproteus	Leucocytozoon
Accipitridae	*elani* ; *nisi*	*toddi*
Aegithinidae	*aegithinae*	*chloropsidis* ; *irenis*
Alcedinidae	*fusca* ; *halcyonis*	
Anatidae	*nettionis*	*simondi*
Ardeidae	*mathislegeri*	*ardea*
Bucerotidae		*bucerotis*
Capitonidae	*bilobata* ; *cornuata* ; *thereicerycis* ; *xantholamae*	
Charadriidae	*nascimentoi*	*souusadiasi*
Columbidae	*columbae*	*marchouxi*
Coracidae	*coraciae* ; *eurystomae*	*eurystomae*
Corvidae	*danilewskyi* ; *picae*	*sakharoffi*
Cuculidae	*centropi*	*centropi*
Dicaeidae	*dicaeus*	
Dicruridae	*dicruri*	
Estrildidae Poephilinae	*orizivora*	
Eurylainidae	*eurylaimus*	
Falconidae	*tinnunculus* ; *brachiatus*	*toddi*
Fringillidae Carduelinae	*chloris*	*dutoiti*

Gruidae	*antigonis*	
Laniidae - Laniinae	*lanii*	
Megapodiodiae	*megapidius*	
Meropidae	*manwelli, meropis*	*nyctyornis*
Motacillidae	*anthi* ; *motacillae*	
Muscicapidae		
Muscicapinae	*balmorali* ; *pallidus*	
Rhipidurinae	*rhipiduris*	
Sylviinae	*sylvae* ; *wenyoni*	*phylloscopus*
Timallinae	*timalus*	*liothricis*
Turdinae	*fallisi*	*macclurei* ; *shaartusicum*
Nectariniidae	*sequeirae*	*nectariniae*
Oriolidae	*orioli*	*oriolus*
Paridae	*majoris* ; *parus*	*majoris*
Passeridae	*passeris*	
Phasianidae Phasianinae	*rileyi*	*macleani*
Picidae	*bennetti* ; *borgesi* ; *velans*	*squamatus*
Ploceidae	*quelea*	
Psittacidae	*handai*	
Pycnonotidae	*otocompsae* ; *philippensis* ; *sanguinis*	*brimonti* ; *pycnonoti*

Rallidae	*gallinulae*	
Scolopacidae	*contortus*	
Sittidae	*sittae*	
Strigidae	*noctuae* ; *syrnii*	*ziemanni*
Sturnidae	*pastoris*	
Threskiornithidae	*plataleae*	
Trogonidae	*trogonis*	
Upupidae	*upupae*	*communis*
Zosteropidae	*killangoi* ; *zosteropis*	*zosteropis*
Incertae sedis	*asturisdussumieri, herodiadis, himalayanus, moruny, raymundi, tephrodornis*	

TABLE 5. The species of other Haematozoa recorded in birds of the Indian subcontinent

Valid species	Incertae sedis
Genus	Trypanosoma
avium	*centropi*
brimonti bakeri	*cuculi*
corvi	*delhiense*
hannae	*fulicae*
lanii	*gymnorhidis*
	ixobrychi
	knowlesi
	lobivanelli
	milvi
	moruni
	nycticoracis
	turdoides
	urolonchae
Genus	Lankesterella
adiei	
lainsoni	
Genus	Toxoplasma*
	butasturis
	fulicae
Genus	Hepatozoon
adiei	
Genus	Babesia
moshkovskii	
tropicus	
Genus	Plasmodium
circumflexum	*coturnixae***
coturinixi	*herodiadis*
dissanaike	*heroni*
gallinaceum	*polare* (by Ray *et al*, 1933)
juxtanucleare	
nucleophilum	
relictum	
vaughani	

NOTE : * The status of the species of *Toxoplasma* is uncertain. If these two species viz., *T. butasturis* and *T. fulicae* indeed prove to be toxoplasmids, both the parasites may then be referred to as *Toxoplasma gondi.*

** *Plasmodium* (*Garnhamella*) *coturnixae* Sarkar and Ray, 1972 is erroneously referred to as a nomen nudum by Bennett and Bishop (1992). In fact, it is a species incertis sedis as declared by Greiner et al (1975).

TABLE 6. List of supplanted haematozoan parasite species and their current names

Supplanted species	Current name	Supplanted species	Current name
Genus Haemoproteus		*Genus Haemoproteus*	
bramae	*noctuae*	*celli*	*noctuae*
cerchneisi	*tinnunculi*	*danilewskyi* var. *tinnunculus*	*tinnunculi*
fringillae (in *Copsychus*)	*faliisi*	*fulica*	*gallunulae*
galathea	*plataleae*	*garnhami*	*oryzivorae*
glaucidii	*noctuae*	*gymnorhidis*	*passeris*
halcyonis var. *fusca*	*fusca*	*lonchuri*	*oryzivorae*
maclolophi	*majoris*	*morneti*	*pastoris*
oryzivorae (in *Ploceus* spp.)	*quelae*	*oryzivorae* (in timaline brids)	*timalus*
sturni	*pastoris*	*thereicerycis* var. *zeylanicus*	*thereicerycis*
Genus Leucocytozoon		*Genus Leucocytozoon*	
ardeolae	*ardeae*	*coraciae benghalensis*	*eurystomi*
danilewskyi (Nandi & Mandal, 1978)	*ziemanni*	*dubreuli* (Nandi & Mandal, 1978)	*pycnonoti*
enriquesi	*chloropsidis*	*fringillinarum* (Nandi & Mandal, 1978)	*dutoiti*
melloi	*eurystomi*	*molpastis*	*brimonti*
neavei (de Jong, 1971)	*macleani*	*sabrazesi*	*macleani*
Genus Plasmodium		*Genus Plasmodium*	
centropi	*relictum*	*choloropsidi*	*relictum*
gallinulae	*Haemoproteus gallinulae*	*pericrocoti*	*relictum*
ploceii	*relictum*	*praecox* var. *munia*	*relictum*
splendensae	*nemen nudum*	*venkataramiahii*	*nomen nudum*
Genus Trypanosoma		*Genus Trypanosoma*	
avium bakeri	*brimonti bakeri*	*avium bakeri* (in corvids)	*corvi*
bramae	*avium*	*columbae*	*hannae*
garruli	*corvi*	*grewali*	*nomen nudum*

TABLE 7. Current and supplanted generic terminology for avian hosts of the Indian subcontinent, according to Biswas (1952) and Ali and Ripley (1968-74).

Current generic name	Supplanted generic name	Current generic name	Supplanted generic name
Acridotheres	*Aethiospar*	*Accipiter*	*Astur*
Anas	*Nettion, Spatula*	*Anthropoides*	*Antigone*
Calidris	*Erolia*	*Charadrius*	*Leucoptinus*
Coracina	*Grancalus, Lalage*		
Dicrurus	*Chaptia*	*Egretta*	*Demiegretta, Herodias*
Falco	*Cerchneis*	*Grus*	*Antigone*
Lonchura	*Aidemosyne, Munia, Uroloncha*	*Megalaima*	*Thereiceryx, Xantholaema*
Parus	*Maclolophus*	*Perdicula*	*Cryptoplectron*
Pycnonotus	*Dissemerus, Elathea, Molpastes, Otocompsa*	*Sturnus*	*Pastor, Sturnaria, Sturnopastor*
Nectarinia	*Leptocoma*	*Petronia*	*Gymnorhis*
Terpsiphone	*Techitrea*	*Treron*	*Crocopus, Dendrophasa, Sphenocercus*
Vanellus	*Lobivanellus*	*Zoothera*	*Geocichla*