

# **Biogeographic and conservation implications of revised species limits and distributions of South Asian birds**

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Patterns of breeding species richness and endemism of South Asian birds are described and depicted. The impacts of a taxonomic revision on these patterns and on threat levels of the region's avifauna are discussed.

## **Introduction**

While working on a book on birds of the Indian subcontinent (Rasmussen & Anderton, 2005) I found that a large number of species-level changes were required due to enhanced knowledge of morphology and vocalizations. Some of these have been recently published elsewhere, and it is intended that scientific treatments of the remainder will appear in due course. Nearly all were originally recognized as full species but were then lumped, usually without published rationale, and usually during the Peters era, when the last large-scale regional revision appeared.

## **Methods and Materials**

The guiding principles of this revision were those of the Biological Species Concept, but as most candidate species are allopatric, the main criteria I used were presence of multiple significant, consistent morphological differences and major, consistent vocal differences in species with stereotyped vocalizations. Further changes will surely be necessary, as numerous other candidate full species exist in the region, but these require further study and/or data.

Data in electronic form were obtained from most of the museums listed in full in the Acknowledgements; for the BMNH, MCZ, NMNH and AMNH, data were obtained from museum registers and unpublished archives. For the following museums whose data were not available digitally, specimen data were obtained from published catalogues and expedition accounts (which do not usually include all the museum's relevant holdings): Bombay Natural History Society, Mumbai, India (Abdulali, 1968-1988; Abdulali & Unnithan, 1991-present); Colombo Museum, Colombo, Sri Lanka (Haly, 1887); Museum National d'Histoire Naturelle, Paris, France (Babault, 1920); National Museum of Natural History, Sofia, Bulgaria (Boev, 1997); University of Dacca, Dhaka, Bangladesh (Abdulali, 1974); Zoologisches Forschungsinstitut und Museum A. Koenig, Bonn, Germany (Martens & Eck, 1995); Museum für Naturkunde, Berlin, Germany (Ali, 1962); Zoological Museum, University of Copenhagen, Denmark (Paludan, 1959); Zoological Survey of India,

Calcutta, India (Biswas, 1947; Finn, 1901; Roonwal, 1939, 1941, 1942, 1947; Majumdar, 1984a, b, 1988; Mukherjee, 1953, 1954; Mukherjee & Dasgupta, 1986; Sclater, 1892); Zoologische Staatssammlung, München, Germany (Diesselhorst, 1968); and Zoological Survey of Pakistan, Karachi, Pakistan (Abdulali, 1974).

To determine species richness, I used a grid overlay on range maps which I had generated primarily from a database I assembled totalling some 230,000 specimens. Range maps thus generated clarified many distributional problems compared to previous maps based on the literature and sight reports. For species with problematic taxonomic histories and identifications, I used only verified specimens in mapping, and I checked out-of-range records. Where possible I avoided using undocumented sight and published records due to unverifiability.

I determined species richness for birds of South Asia by recording known or probable presence of each as a breeding species in each 1 degree cell. Levels of endemism of non-passerines were calculated both as the number and percentage of species in each cell that occur only within South Asia. Avifaunal similarity between regional areas was computed using the Sorensen's coefficient.

In order to compare the intra-regional avifaunas, clusters of grid squares representing each major habitat type/region of similarity in species richness were constructed as shown in fig. 1. This enabled the pairwise comparison of the avifauna of each cluster, both in terms of absolute numbers of shared species (below the diagonal) and using Sorensen's Coefficient of Similarity, which compares number of shared species in relation to numbers of species in each of the avifaunas being compared (table 1). Sorensen's coefficient  $S = 2a / (2a + b + c)$ , where  $a$  is the number of species in common between two regions and  $b$  and  $c$  are the number of breeding species in each of those regions.

### Overview of treatment of avifauna

We recognized a total of 1298 known or presumably regularly occurring species in South Asia, exclusive of vagrants and hypotheticals. This treatment involves 203 species-level differences from Ali & Ripley's (1983) Handbook of birds of India and Pakistan, and 131 species-level differences from Inskipp et al.'s (1996) An annotated checklist of the birds of the Oriental region; comparisons in this paper hereafter refer to the treatment in Inskipp et al. (1996). Of the differences from that treatment, 83 are species-level splits that increase the number of species in the region, seven were species previously overlooked for the region but for which I located museum specimens, two were newly described species, and most of the others

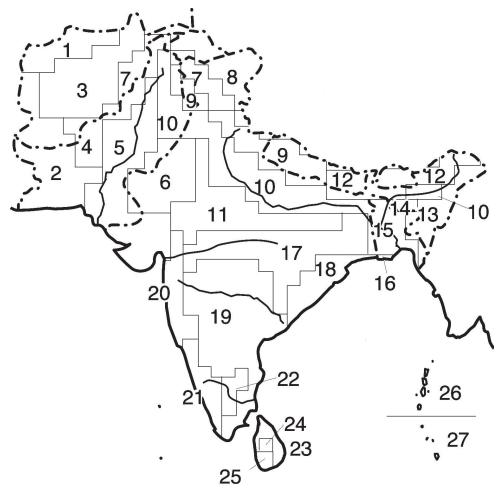


Fig. 1. Major intraregional avifaunal clusters in the Indian subcontinent. The numbers correspond with those in table 1.

were species-level splits with extralimital taxa. I also established the region's first hypothetical list of 83 species for which proof of occurrence is required; the number of hypotheticals more than cancels out the regional increase due to splits.

A few examples of species-level revisions and a brief justification for each follow:

The Water Rail, *Rallus aquaticus* sensu lato, was considered to be comprised of a western nominate group and the allopatric north-eastern breeding *indicus*, which differ moderately in morphology. I found that the two groups differ so markedly in vocalizations as to be surely better considered full species.

The Eurasian Stone-curlew, *Burhinus oedicephalus* sensu lato, was considered two racial groups, the W Palearctic nominate group and the *indicus* group of South and SE Asia. Both show clinal variation in overall colour, but *indicus* differs consistently in proportions and bill colour. Recordings from throughout the range of *indicus* have established that its vocalizations are markedly and consistently different from those of the nominate group.

The Pompadour Pigeon, *Treron pompadora* sensu lato, was comprised of four regional taxa and a several other extralimital taxa. All four regional forms differ moderately to markedly in plumage and proportions, although *affinis* from SW India and the dissimilar nominate from Sri Lanka have even been lumped racially. Formerly it was presumed that the long whistled songs of green pigeons were haphazard and variable, but analysis clearly demonstrates their highly stereotyped nature within each taxon. Each of the regional forms has a markedly different song, especially that of the nominate, and this is considered here to indicate full species status.

The Green Imperial Pigeon, *Ducula aenea* sensu lato, has many races from South Asia to the Philippines and Indonesia, but in South Asia all races are fairly similar with the marked exception of the Nicobar form *nicobarica*. On morphology it seemed a good candidate for full species status, and its vocalizations are so distinct from any in the wide repertoire of *aenea* as to leave no doubt that *nicobarica* is best considered a full species.

The Grey Nightjar, *Caprimulgus indicus* sensu lato, has been considered widespread in Asia, and the two continental forms even said to be perhaps indistinguishable. However, several plumage differences do exist. Their songs differ markedly, a fact somehow previously overlooked, in that *jotaka* gives a monosyllabic series while *indicus* gives a disyllabic series. Their eggs differ most of all, a fact known to 19th Century ornithologists but since largely forgotten, and a difference of unusual degree in the Caprimulgidae, which tend to be conservative in egg type. Thus *jotaka* and *indicus* are surely valid species, and the status of the Palau form *phalaena* is also being re-evaluated (N. Cleere, pers. comm.).

The Oriental Bay-owl *Phodilus badius* sensu lato has long been considered a single widespread species. However, numerous consistent morphological differences distinguish the rare W Ghats and Sri Lankan races from the widespread SE Asian group, and *assimilis* of Sri Lanka has a remarkably different song from the nominate, and is unquestionably a separate species.

The Greater Flameback *Chrysocolaptes lucidus* sensu lato, is as currently recognized, one of the world's most morphologically variable bird species. In South Asia, the Sri Lankan form *stricklandi* is too distinct both in morphology as in acoustic signals to be a subspecies. However, the W Ghats form *socialis*, which differs from wide-

spread *guttacristatus* mainly in its much smaller size, is remarkably different acoustically and should probably also be treated as a separate species. Extralimitally, the variation is even more extreme, with some five probably specifically distinct taxa just in the Philippines.

The Common Babbler, *Turdoides caudata* sensu lato, was comprised of two racial groups that had not recently been suggested to comprise different species, although Roberts (1992) had remarked on the very different vocalizations of the essentially Middle Eastern form *huttoni* as compared with the mainly Indian *caudata*. Analysis shows that their morphology and vocalizations are as different as certain other congeneric taxa considered full species.

The Long-tailed Wren-babbler, *Spelaornis chocolatinus* sensu lato, was comprised of three morphologically discrete racial groups, of which *reptatus* from N Myanmar and SW China was previously overlooked for the region. The song of the nominate from S Assam and Manipur remains unknown, but on the basis of morphology and the vocal differences between *reptatus* and *oatesi* (from W Myanmar), all three are surely better considered full species.

The Plain Flowerpecker, *Dicaeum concolor* sensu lato, was comprised of three dissimilar taxa presumably lumped on the basis of their plain colours and allopatry. However, their morphology strongly suggests this is incorrect, and vocalizations confirm their non-conspecificity.

The Spot-winged Rosefinch, *Carpodacus rodopeplus* sensu lato, was comprised of two broadly allopatric forms differing in a remarkable array of plumage and shape characters. They belong to a group of rosefinches with extremely simple, all-purpose vocalizations, and the presumably homologous calls are very different.

These are but a few of the many species-level changes enacted for South Asian birds.

### Impacts of these changes on biogeography

Breeding species richness (fig. 2a) in South Asian birds is lowest in the desert and high-montane regions of the far west and the Inner Himalayas, as well as in the isolated island groups of the Andamans and Nicobars. Species richness is highest in the Himalayas, hills south of the Brahmaputra, and southwestern Ghats, but is also relatively high in Sri Lanka and the wooded areas of the Indian Peninsula. Few or no regional endemics (fig. 2b) occur in Afghanistan, SW Pakistan, the Inner Himalayas, and northeastern India, and even the Andaman and Nicobars have relatively few regional endemics. Areas with high numbers of regional endemics include the Western Himalayas (not including Pakistan and Kashmir), the wooded areas of India, southwestern and central Sri Lanka, and especially the southern Western Ghats. Percent endemism (fig. 2c) in South Asian birds is, as with species richness and overall numbers of endemics, lowest in the far west and Inner Himalayas, but unlike species richness, the Himalayas and most of NE India and Bangladesh have low levels of endemism. Percent endemism is highest in the Indian Peninsula, including the non-forested central portion, the W Ghats, in Sri Lanka, and in the Andamans and Nicobars. Interestingly, although the W Ghats have many more species and endemics than Central India, the proportion of endemics is roughly the same between the two regions. Note also that the relatively species-poor Andamans and Nicobars have high percent-

ages of endemics. In comparison, very different patterns are evident for species richness versus levels of endemism. Whereas species richness is influenced primarily by climatic and habitat factors, endemism largely reflects geographic isolation and is heavily influenced by the artifact of political borders.

Afghanistan and western parts of Pakistan have little in common with the avifaunas of the rest of the region, as do the Inner Himalayas, and the Andamans and Nicobars have even less in common with the continental avifauna (table 1). Although they are often grouped together, the Andamans and Nicobars actually have only a moderate similarity to each other, and this study also showed that their similarity to each other is much less than previously thought due to unrecognized racial and specific differences, and to a much greater degree to erroneous attribution to one or both island groups of numerous species never definitely recorded there. The highest degree of similarity between avifaunas exists between the Western and Eastern Himalayas, the several subdivisions of the Indian Peninsula, and the three subdivisions of Sri Lanka (table 1). Sri Lanka's avifauna shows only a moderately high similarity to the Indian Peninsula. Species richness of 1 degree quadrants is virtually unaffected by the taxonomic revision (fig. 3) because nearly all split species are allopatric with the forms with which they were previously united. However, the present taxonomic treatment results in marked changes in levels of endemism as compared with Inskipp et al. (1996).

In general, areas of low endemism show the least change between treatments, while areas of high endemism and, especially, high geographic isolation show the greatest changes in levels of endemism. This

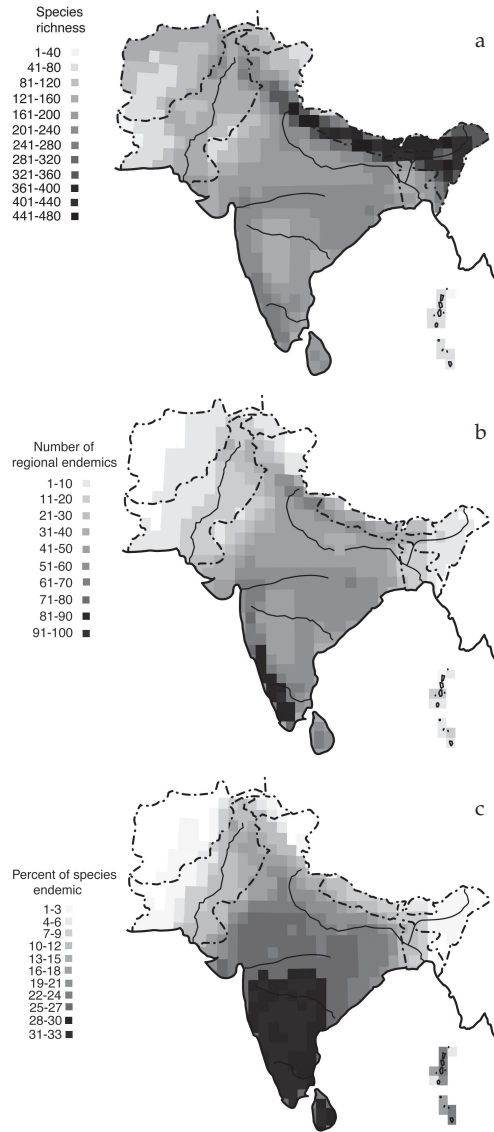
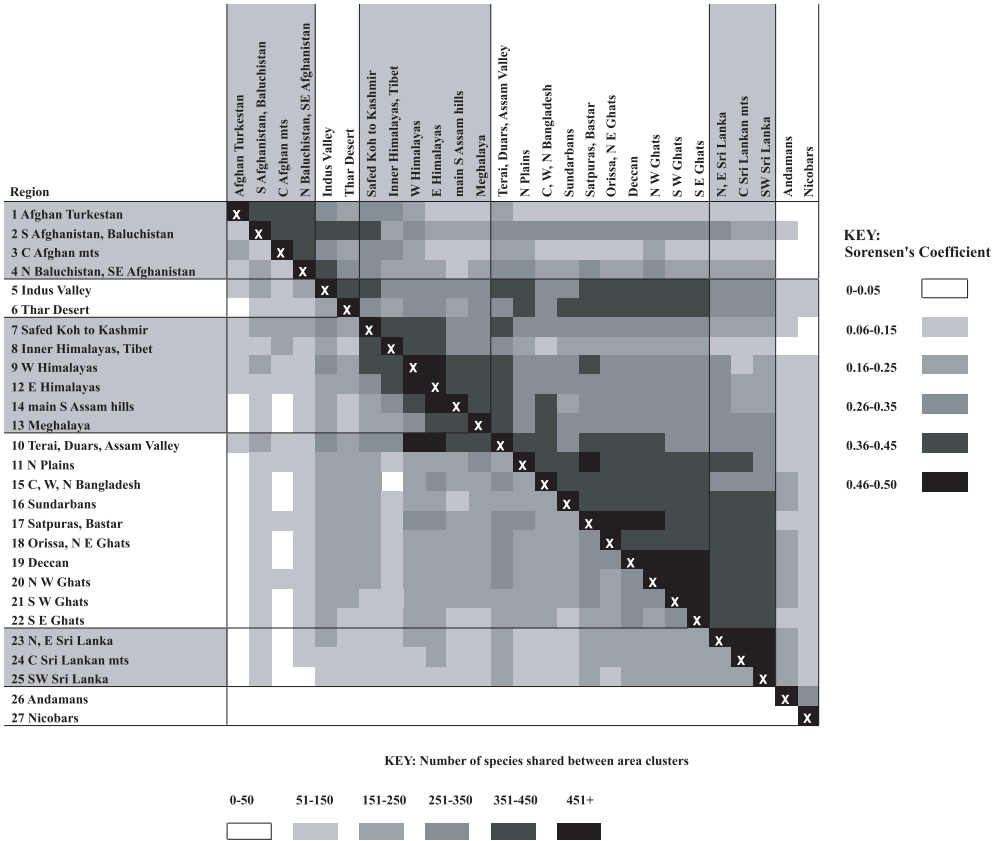


Fig. 2. Biodiversity of birds in the Indian subcontinent after species-level revisions adopted in Rasmussen & Anderton (2005): (a) species richness (number of breeding species per 1-degree square), (b) number of species per 1-degree square endemic to a region (as defined in figure 1), (c) species endemic to a region as percent of total species richness for each 1-degree square.

Table 1. Numbers of breeding bird species shared between area clusters (below the diagonal) and Sørensen's Coefficients between area clusters. The numbers of the regions correspond with those of figure 1.



effect further enhances the conservation importance of areas that already were known as centers of endemism, namely the southern Western Ghats, southwestern and central Sri Lanka, and the Andamans and Nicobars. In terms of the impact of the revision on regional avifaunal similarities, much the greatest change is between the sub-Himalayan region and the Himalayas with southeastern Asia, which now share some 39 fewer species. About 13 fewer species are shared between SE Asia and widespread taxa, and some ten species previously shared with Tibet are now considered full species. Other areas, such as South Asia vs NE Asia, the W vs E Palearctic, and Africa vs. Asia lose between four and six breeding species previously considered common to both. Within the region, isolated areas of high endemism decrease in similarity, with Sri Lanka and South India losing some five previously shared breeding species, and the Andamans and Nicobars losing two. However, the overall similarity of the Andamans and Nicobar breeding avifaunas is dramatically decreased by carefully scrutiny of evidence from specimens, which results in loss of several species previously thought shared between the two island groups.

### Impacts of species-level revision on conservation

In terms of the impact of this revision upon conservation, fewer newly split species are likely to fall into the higher threat categories (table 2) than might be feared, because most are reasonably widespread, common and/or adaptable. The newly-split species listed here are those which seem most likely to require listing in higher threat categories due to their small global ranges, habitat specialization, and/or low numbers.

The following are a few examples of species that, as a result of this revision, are new candidates for higher threat levels. The Andaman Barn-owl, *Tyto deroepstorffi* (which was also split by Koenig et al., 1999) is known only from a tiny area, based on five specimens and a few recent sightings. The two well-differentiated forms previously lumped as *Callene major* were already considered a single threatened species. With the fractionation of their ranges due to splitting, one or more may require listing at a higher threat level. The two extraordinarily differently plumaged forms previously united as *Sphenocichla humei* were considered marginal for listing as a threatened species, but now with the fractionation of their range into two, at least one will probably require listing as threatened.

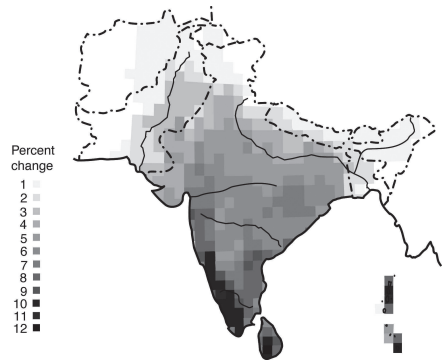


Fig. 3. Percent increase in number of endemic species per region after species-level revisions adopted in Rasmussen & Anderton (in press) when compared with Inskipp et al. (1996).

Table 2. Additional possibly endangered species to those recognised in BirdLife International (2001) based on species-level revisions adopted in Rasmussen & Anderton (2005).

Species name	Distribution
Andaman Teal <i>Anas albogularis</i>	Andamans
Indian Spotted Eagle <i>Aquila hastata</i>	Indian plains and hills, S-C Myanmar
Andaman Barn-owl <i>Tyto deroepstorffi</i>	Andamans
Ceylon Bay Owl <i>Phodilus assimilis</i>	Southern Western Ghats and SW Sri Lanka
Serendib Scops-owl <i>Otus thilohoffmanni</i>	SW Sri Lanka
Andaman Cuckooshrike <i>Coracina dobsoni</i>	Andamans
Sikkim Wedge-billed Babbler <i>Sphenocichla humei</i>	E Himalayas
Cachar Wedge-billed Babbler <i>Sphenocichla roberti</i>	S Assam hills, W Yunnan, N Myanmar
Nicobar Jungle-flycatcher <i>Rhinomyias nicobaricus</i>	S Nicobars
Large-billed Blue Flycatcher <i>Cyornis magnirostris</i>	E Himalayas (wintering W Malaysia)
Rufous-vented Prinia <i>Prinia burnesii</i>	plains of Pakistan and NW India
Swamp Prinia <i>Prinia cinerascens</i>	Brahmaputra Valley
White-bellied Blue Robin <i>Callene major</i> *	Southern Western Ghats, S of Palghat Gap
Nilgiri Blue Robin <i>Callene albiventris</i> *	Southern Western Ghats, N of Palghat Gap
Ceylon Scaly Thrush <i>Zoothera imbricata</i>	SW Sri Lanka

\*Included in BirdLife International (2001) as a single species, *Brachypteryx major*

## Conclusions

In conclusion, this revision of species limits of South Asian birds has a negligible effect on species richness within one-degree quadrants, due to the allopatry of nearly all affected taxa. Overall, the avifauna would show a rather slight rise in species richness due to the revision, except that it is cancelled out by the newly established hypothetical list. The revision has a marked effect on levels of endemism for geographically isolated areas, and especially for forested ones.

Finally, the revision will probably have only a moderate conservation impact. The number of potentially threatened species in the region was previously estimated by BirdLife International at about 6% of the total avifauna, and the revision is likely to increase that number only to about 7%.

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