Opinion: Taking Indian ornithology into the Information Age

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Abstract: Ornithology in India does not show the patterns of advance and professionalisation seen in other parts of the world. The descriptive foundations built by the spectrum of amateurs and professionals in the past are, depending on the species in question, weak, lacking or, inaccessible. Lack of access to primary literature and specimen data within the country has led to an expectation that further progress can only be made by scientists outside the country even though most of the advances in the past have been based on networks of collectors and observers working locally. There can be little growth in ornithology without access to strong descriptive foundations. Professionals are too few and cannot afford to work on such basic aspects. Amateurs need to be better informed so as to fill this gap by recording data and leaving a useful legacy for the future. The tools of the information age should be used to reach out across the country to increase the spread, numbers and quality of potential contributors and build databases that will enable long-term and large-scale studies.

A year before he died, Colin Bibby reviewed the achievements of field ornithology in Britain and declared it alive and flourishing (Bibby 2003). It would be hard for anyone to make similar claims for Indian ornithology. Modern ornithology in India is a British introduction and while a comparison with Britain makes historic sense, it may be considered unfair by some, especially since India has ten times the area of the United Kingdom.[1] Making up for that difference however, is a population that is almost twenty times greater.[2] The argument then is that the numbers of people associated with the study of birds[3] are vastly different, as are the underlying socio-economic conditions.[4] Although problems exist, great potential has so far been neglected. Technological changes now offer opportunities that should not be missed and it is time to reach out, recruit and meaningfully utilize the untapped innate interest across the region to improve the state of knowledge on Indian birds.

Growth and popularity

Early Indian ornithology closely reflected historic trends in Britain. It was mainly a British pursuit with few Indians involved.[5] The collection trend can be observed in the number of descriptions published each year (Fig. 1). Indian ornithology kept abreast of changes in Britain during the collection era. By 1900 most of the land birds had been described and the sub-species concept was introduced with geographic distributions roughly established by 1930 (Ali 1980). Observation-based ornithology may have arrived late, with field-guides authored by Hugh Whistler, the first edition being published in 1928, with subsequent editions in 1935 and 1941 and, Salim Ali, whose *Book of Indian Birds* arrived in 1941 and has since run into several editions and revisions, being the major driving forces. Post-independence ornithology in India seems to have failed to keep up with changes and advances elsewhere.

Birdwatching has been late in gaining popularity but has grown steadily. Many causes have been suggested for the low level of interest including religious sentiments preventing the collection of birds, lack of field guides and lack of encouragement at home or school (Ali 1980). The number of professional ornithologists has never been large although Ali (1980), in his review of Indian ornithology, suggested that it was growing:

1 Area: India 3.28 million sq. km, UK 0.24 million sq. km.
2 Population: India 1100 million, UK 60 million.
3 "Study" here is used in an inclusive sense.
4 In 2004 the number of graduates in India was 39.2 million with 22.3% of them in science (Shukla 2005).
5 The earliest 'Indian ornithologist' appears to be a mysterious K. C. Mukerjee who was known to A. O. Hume around 1884 (Moulton 2003).

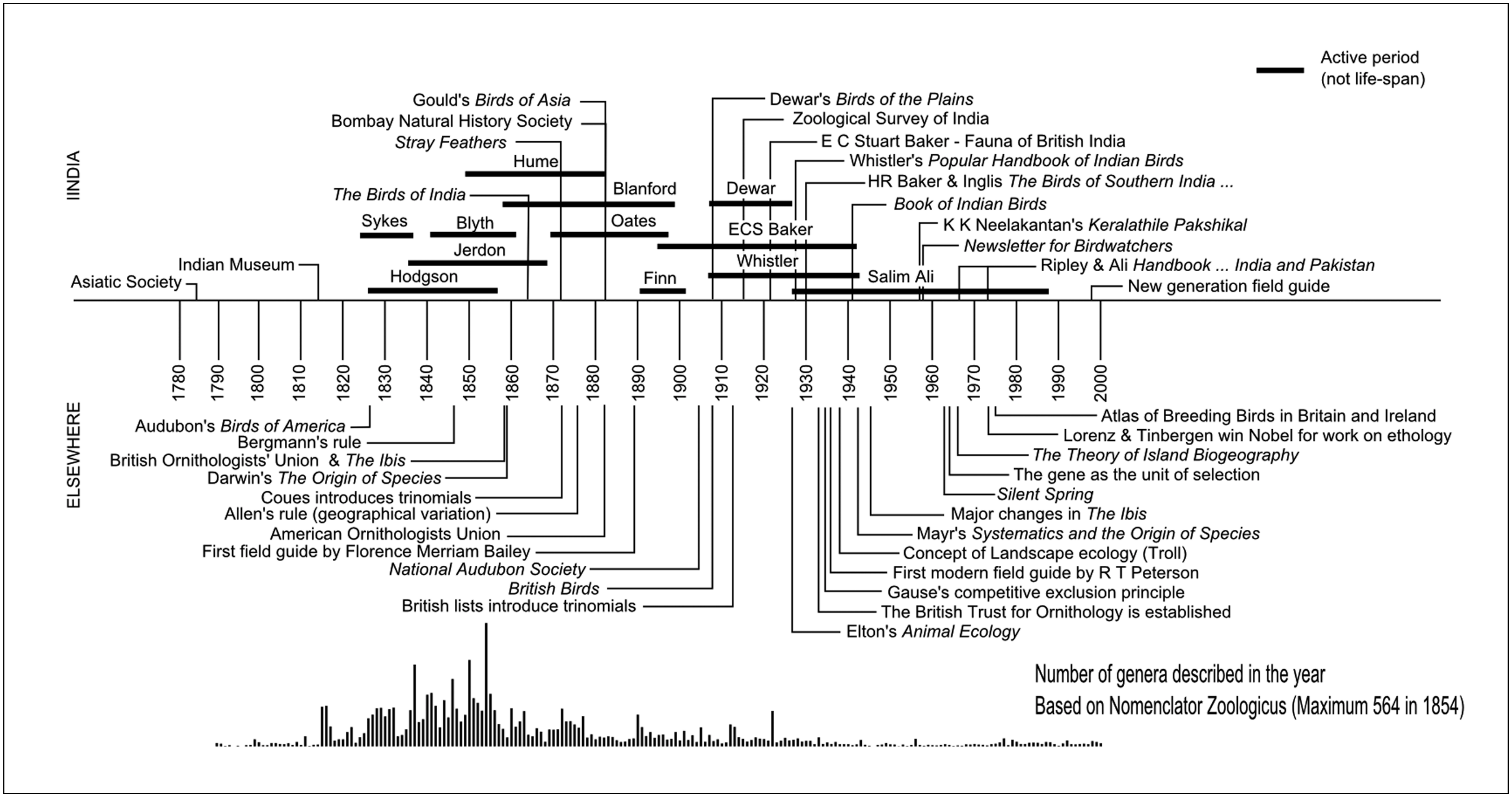


Fig. 1. A timeline of Indian ornithology.
The active periods of major ornithologists are marked by black bars and historic landmarks labeled above and below the timeline. The upper half deals with Indian ornithology. The histogram at the bottom indicates the number of genera described (not all are currently valid) worldwide per year and is an indication of the changing emphasis and methodology of ornithology.

> "Happily the emphasis has now turned to ecology and ethology, breeding biology, population dynamics, conservation, and studies that have essentially to do with the living bird. The economic importance of birds in a country so largely dependent on agriculture and forestry is just beginning to be adequately appreciated, and centres for research in economic ornithology have been set up in some of the recently started agricultural universities."

No major formal organisations have emerged either of professionals or amateurs. The few journals and newsletters that have networked the community have tried to accommodate the entire "amateur-professional" spectrum.

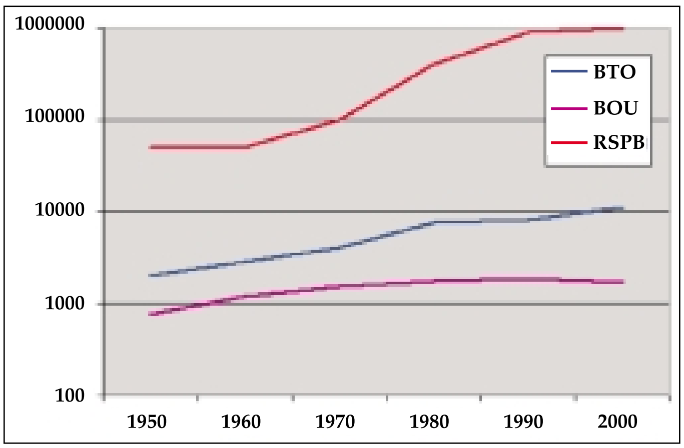


Fig. 2. Growth in membership of three British organisations during the same period. (Note the logarithmic scale.) The BOU grew slowly and declined after 1990. The RSPB has grown rapidly and reached a plateau, while the BTO continues to grow slowly and steadily (Bibby 2003).

The memberships of three major ornithology-related organisations in Britain show great variation in their growth. The oldest, the British Ornithologists' Union (BOU) was born in the collection era and shows slow growth with a declining trend starting around 1990. The Royal Society for the Protection of Birds (RSPB), established with a focus on conservation, grew exponentially and reached a million members in 1997. The British Trust for Ornithology (BTO), started with scientific aims, grows steadily but at a much slower pace than the RSPB (Fig. 2).

With no other large-scale membership-based organisations related to ornithology in India, only the Bombay Natural History Society (BNHS) can be used for a comparison of growth. The BNHS was an elite club of British naturalists in India and in its early days the only Indian members were mostly from the royalty. The *Journal of the Bombay Natural History Society* listed 240 members in 1886, 762 in 1894, and 1,242 in 1927. Today it stands at around 5,000. This suggests linear growth with the addition of about 50 members a year. An average regional email-based discussion group[6] on birds grows at around 100 members a year, even though these are restricted to English speaking subscribers with Internet access (M. B. Krishna, *by email*). These discussion forums do not charge subscribers and the vast difference in recruitment rates suggests that benefits and costs of membership have an important role in determining the growth of organisations.

Professionalisation

Historians have described the evolution of ornithology from a 'collection' craze to a scientific pursuit. The early science was mostly descriptive and based on specimens collected from around the world. By examining variations in specimens from different geographic locations, various patterns were observed and this led to the discovery of the principles of evolution. The methods of study changed over time, as did the practitioners, with wealthy collectors and amateurs giving way to professional curators and zoologists associated with museums and universities (Allen 1994). Later studies elucidated the mechanisms of evolution and speciation. This led to the establishment of ecological and biological principles that went beyond birds to span all living forms. The result was that studies increasingly used birds merely as models to test and verifying hypotheses based on these universal principles. Today, many scientists, who might have identified themselves as ornithologists in the past, are more likely to associate themselves with behavioural ecology, evolutionary biology, conservation biology or other fields defined by their theoretical foundations rather than taxonomic boundaries (Bibby 2003).

The changes in the nature of study resulted in a redefinition of the boundaries of ornithological journals. Some older journals resisted these changes. Johnson (2004) documents the case of The Ibis, which was established in 1859. While journals like British Birds, which started in 1907, began publishing papers on ecology, including Horace G. Alexander's, 'A practical study of bird ecology', as early as 1914, The Ibis would only admit habitat descriptions—the term 'ecology' did not appear in an article title until 1945. Ecologists led by David Lack and Reginald Ernest Moreau fought a long and bitter battle with its old-school editors, William Lutley Sclater and later Claud Buchanan Ticehurst[7]

Lack's study of natural selection in the Galapagos finches, Moreau's work on clutch size and a number of ecological studies by others were, according to the editors, either speculative, not verifiable, not generalisable, or merely 'elaborate plans and statistics' to prove 'commonplace knowledge'. Lack complained about the state of *The Ibis* to Ernst Walter Mayr, who had brought great reforms in American ornithology. Mayr responded, "it is common knowledge throughout the world that *The Ibis* is full of second-rate papers of colonial officers and faunistic lists of little general interest," (Johnson 2004). This situation changed only in 1945 following the death of Ticehurst in 1941.

Ali (1980) suggested that Indian ornithology had made similar transitions to the study of the "living bird" with

[6] Hugh Whistler worked in close collaboration with Ticehurst.
[7] The example used here is bngbirds, a network of birdwatchers in the Bangalore region.

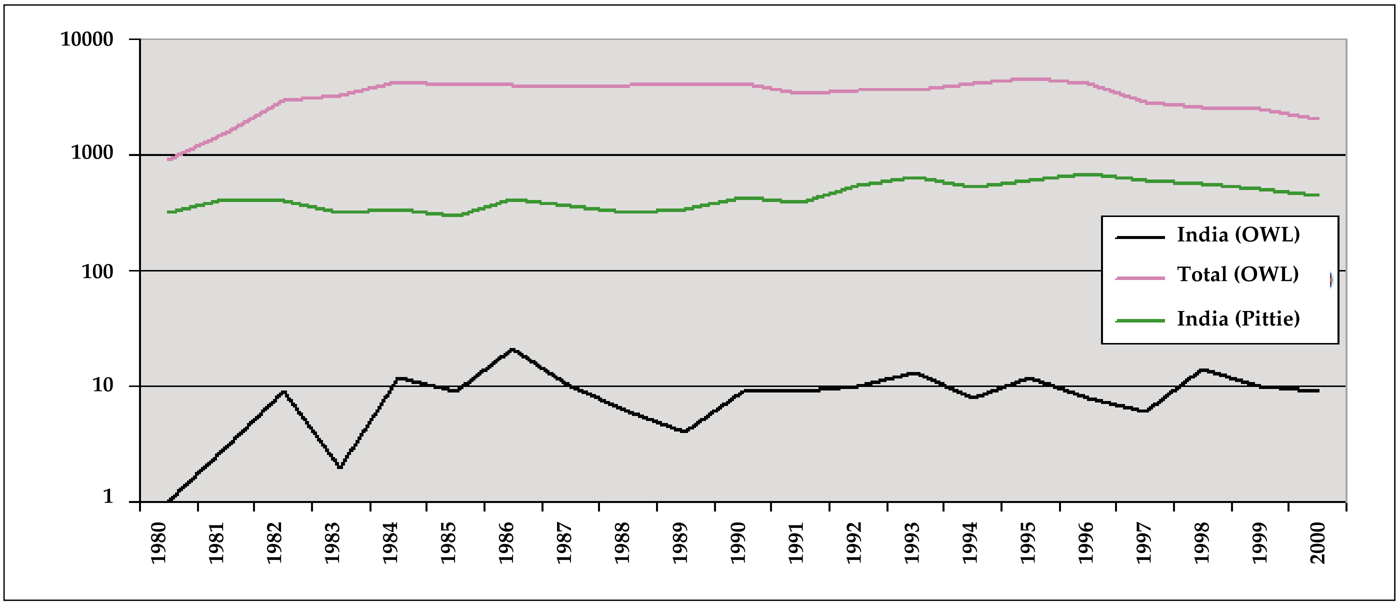


Fig. 3. Visibility of Indian publications. (Note the logarithmic scale)
The number of publications listed in the OWL database (Ornithological Worldwide Literature formerly Recent Ornithological Literature – ROL), containing the keyword "India", compared with an Indian bibliographic database on bird related publications (Pittie 2001).

"comparatively little scope for further taxonomical work on Indian birds":

> "The trend since then has been mainly towards a more intensive exploration of un-worked areas, and field studies of individual species, as well as of such problems as migration through large scale bird ringing[8], and other problems of an ecological nature."

A look at various bibliographic databases suggests that very few Indian publications have since been recognised internationally under the classification of "ornithology" (Fig. 3).

There are about 300–600 publications related Indian birds each year and around ten are listed in an international literature database.[9] The numbers of Indian scientists involved in ecological, behavioural, physiological or conservation biology studies are limited and even fewer of them work on birds. The academic study of birds in India is unlikely to show an upward trend in the near future with current socio-economic conditions making careers in science difficult. In contrast, career scientists are increasingly dominating British ornithology. Bibby (2003) notes that amateur contributions to the journal *British Birds* dropped from nearly 40% of all papers in 1956 to less than 10% in 1996. The professionalisation of ornithology has been associated with a number of observable features such as the specialisation of journals, formation of organisations, long lists of acknowledgements and an increase in the numbers of co-authors in publications (Pearson & Cassola 2007; Bautista & Pantoja 2000).

A common pattern in scientific studies has been formalised by the General Continuum of Scientific Perspectives on Nature (GCSPN) model (Killingsworth & Palmer 1992). This model suggests that many scientific studies advance in a predictable sequence of steps or phases. For instance, early biological studies begin with natural history and concentrate on field collection and description, followed by measurement in the field leading to laboratory studies, and then to theoretical studies. Pearson & Cassola (2007) suggested that this pattern of progress might eventually inhibit vital communication between scientists and non-scientist decision-makers, especially in conservation biology. In the progression of scientific phases, increasingly technical concepts and jargon tend to exclude more and more of those with potential interest in the outcomes of these studies. In addition, assuming that a field of study is in a later phase when the earlier phases obviously are not yet adequate to support highly advanced claims, could also lead to inappropriate conclusions and applications of the data.

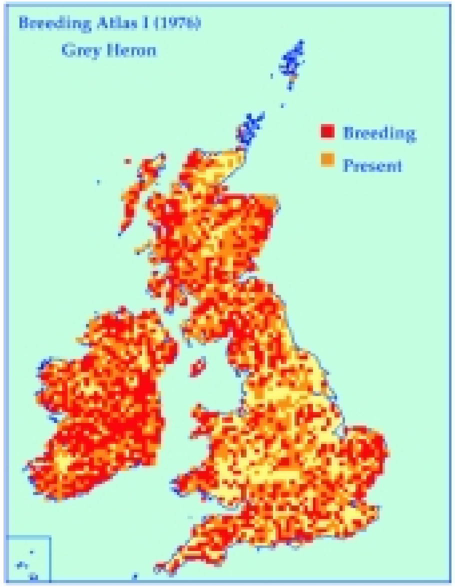
Career biologists in India, who *work on birds*, need to keep up with advances in other parts of the world and are likely to obtain funds only by pursuing contemporary laboratory or theoretical studies. The result is that these professionals cannot afford to gather basic descriptive data but are forced to undertake research in more advanced areas that contemporaries in other parts of the world are pursuing based on already well established descriptive foundations.

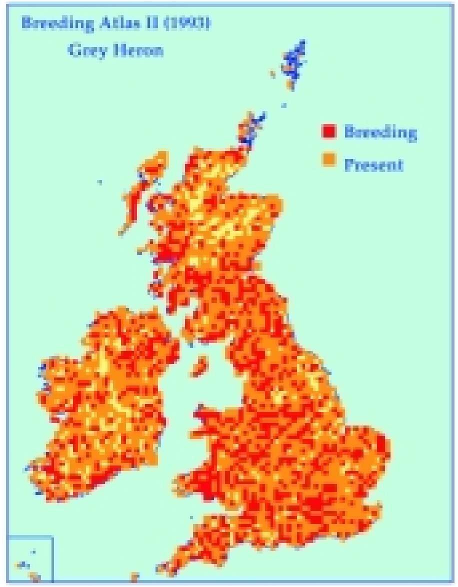
Descriptive foundations: a comparison

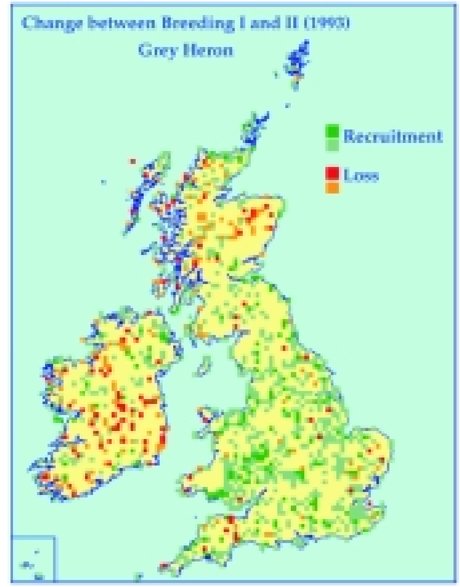
The quality and quantity of descriptive information available for birds in Britain is an eye-opener. The BTO website (http://www.bto.org/) provides a wide range of details for common species such as the Grey Heron *Ardea cinerea* that are based on more than fifty years of observation (Fig. 4).

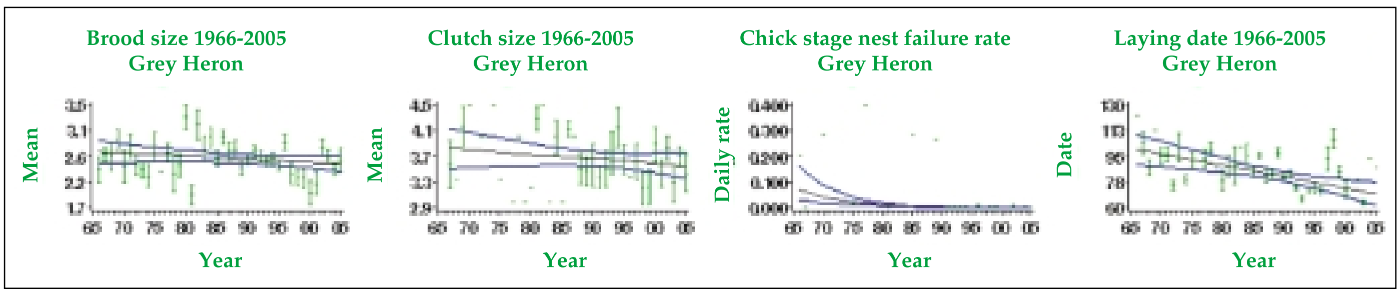
8 No migration atlases, life-tables or similar summaries of these ringing studies have emerged since.

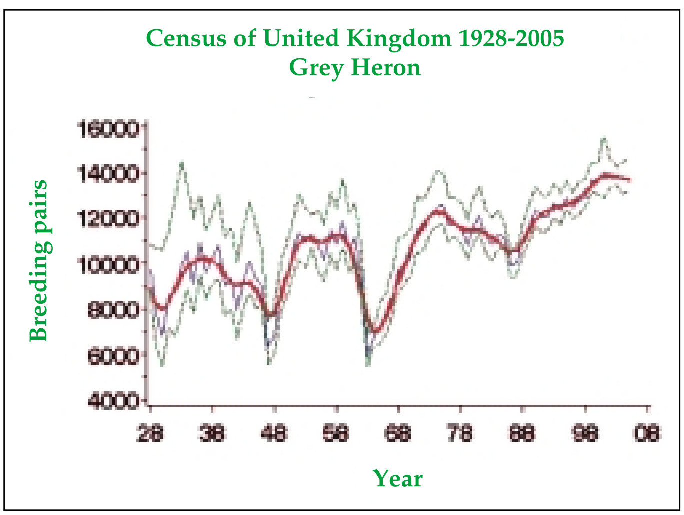
9 The figures are only indicative since the OWL bibliography, created by volunteers, is not exhaustive and not all India related ornithological works might be indexed with the keyword "India".

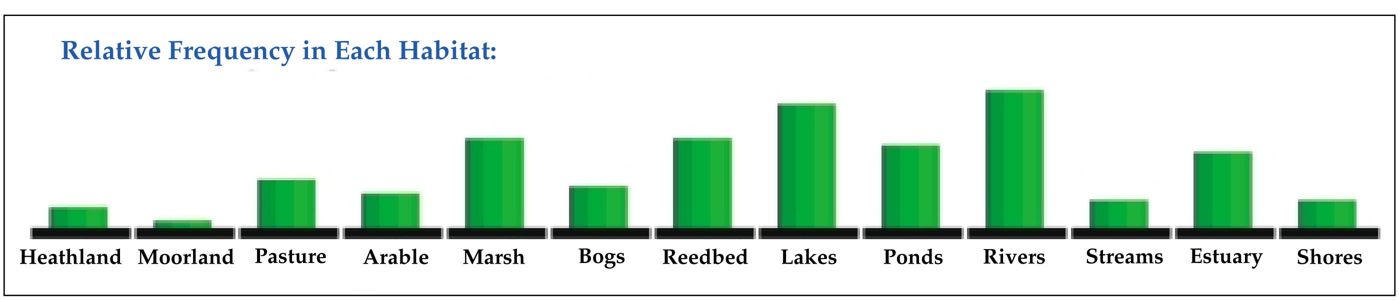

Breeding Atlas I (1976)
Grey Heron
Breeding
Present


Breeding Atlas II (1993)
Grey Heron
Breeding
Present


Change between Breeding I and II (1993)
Grey Heron
Recruitment
Loss


Brood size 1966-2005
Grey Heron
Mean
Year
Clutch size 1966-2005
Grey Heron
Mean
Year
Chick stage nest failure rate
Grey Heron
Daily rate
Year
Laying date 1966-2005
Grey Heron
Date
Year


Census of United Kingdom 1928-2005
Grey Heron
Breeding pairs
16000
14000
12000
10000
8000
6000
4000
28
38
48
58
68
78
88
98
08
Year


Relative Frequency in Each Habitat:
Heathland
Moorland
Pasture
Arable
Marsh
Bogs
Reedbed
Lakes
Ponds
Rivers
Streams
Estuary
Shores

Egg size	61 x 43 mm	
Egg weight	61.0 g (of which 8 % is shell)	
Number of nest records	369	Average number submitted annually
Clutch size	3–4 eggs 3.66 ±1.06 (2–7) N=264	Average ± 1 std deviation (and range in parentheses)
Incubation	27–27 days 26.95 ±0.90 (27–29) N=264	By the: Male + Female
Fledgling	50–55 days 52.87 ±2.62 (50–55) N=1506	
First clutches laid	12 Mar (19 Feb–2 May)	May be 2–3 weeks later further north
Number of broods	1 (2)	
Number ringed	607	Average number ringed annually
Adult survival	0.732	Proportion of adults surviving each year
Juvenile survival	0.261	Proportion of surviving the first year(s) of life: (to age 2)
Age at first breeding	2	
Typical lifespan	5 years	
Maximum recorded age	23 years 9 months	Maximum longevity of a ringed bird—as it may have been adult when ringed, actual age may be greater

Fig. 4. Grey Heron *Ardea cinerea* distribution maps (1976, 1993), changes in distribution, population trend, life-history and research parameters in UK. The egg-laying dates have steadily advanced with change in climate (pp. 126-127) (Baillie *et al.* 2007; Robinson 2005; BTO website).

The descriptive information available for common Indian species is telling in its lack of detail. Distribution maps provide a good example for evaluating the state of knowledge. Maps have become a compulsory feature of field guides only in recent times. The maps in *The Handbook* (Ali & Ripley 1968–1974) show the influence of Ernst Mayr; most of the maps aim to demonstrate allopatry (that congeners have disjunct ranges) and the emphasis is on the dividing boundaries. Maps in modern field guides are intended to help in identification by elimination of species that are unlikely for a given location. Maps in most of the newer field guides give a false sense of accuracy, one that most beginners may fail to question[10] (Fig. 5).

The situation with relatively common and easy to identify species like the Great Tit should only be considered as indicative. There has been no attempt to identify the extent to which basic information is missing. It is known that details on distribution, seasonality, arrival dates, food, foraging and breeding behaviour are missing for most species. In a review of agricultural ornithology, it has been pointed out that information on population structure, natality, mortality and dispersal are lacking even for the commonest species (Dhindsa & Saini 1994).

The value of primary data

There are indeed Indian ornithological works that cover descriptive aspects such as food habits, details on nesting and, morphometrics, but these provide only summaries rather than primary data. Primary data supports verifiability and is amenable to analysis. A shaded distribution map is a summary (albeit a subjective one) while primary data consists of points in space and time. Similarly, morphometrics for Indian bird specimens are available as summaries instead of sets of measurements for each specimen.[11] This makes it

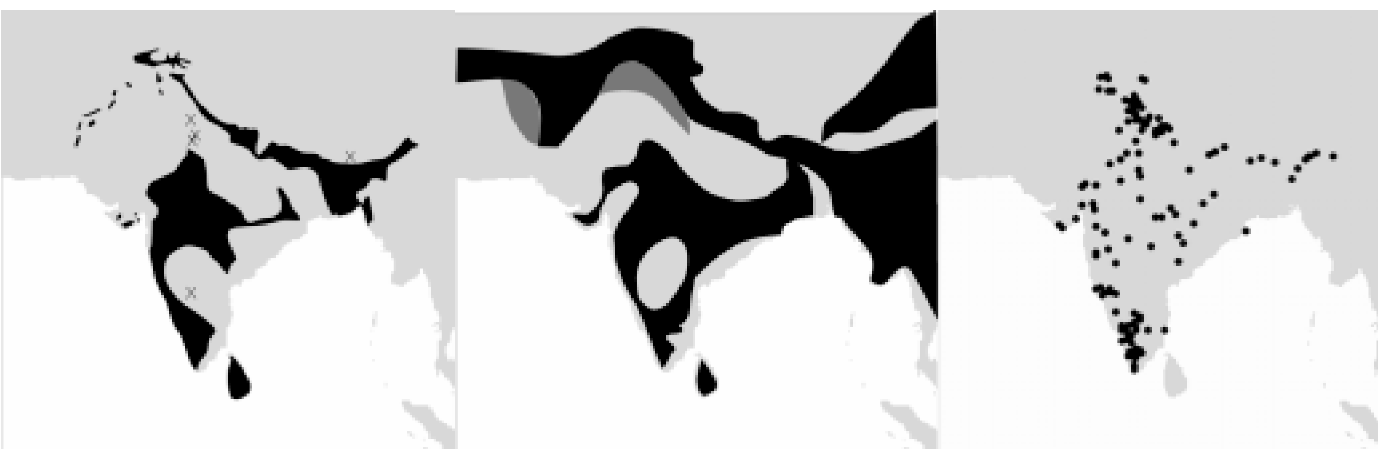


Fig. 5. The distribution maps for Great Tit *Parus major* based on information from (left to right) Grimmett *et al.* (1998), Rasmussen & Anderton (2005) and, Shyamal (2003). The spot map is based on 263 publicly verifiable records. The data behind the other maps is not public and therefore unverifiable. It is difficult to tell if the maps represent fact or artistic license.

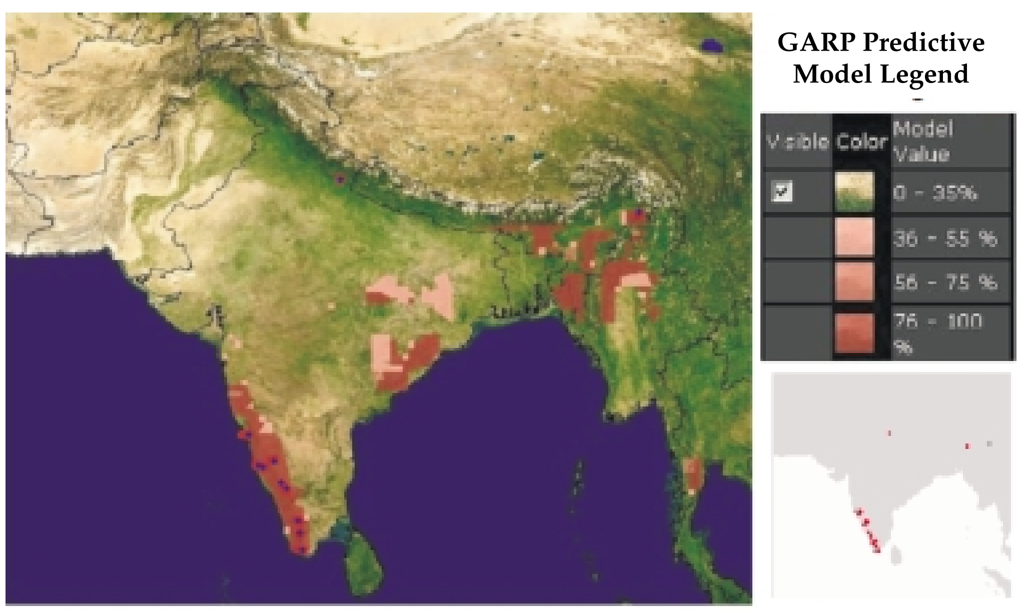
[10] Ali (1980) uses the past tense when pointing out the situation prior to the surveys of Whistler—"Precise knowledge of the spatial distribution of even the commoner birds within the subcontinent ***was*** lacking."

[11] Abdulali, H. [& others] 1968–1996; Unnithan, S. 2000–2005. A catalogue of the birds in the collection of Bombay Natural History Society [Parts 1–41]. *J. Bombay Nat. Hist. Soc.* Vols. 65–102. (Individual specimen data is not provided in this work, instead summaries include minimum and maximum readings, making it useless for the study of allometry or clinal variation).

impossible for someone to, say, arrange specimen data by latitude and examine clinal variation in size.[12] The fact that these descriptors were related to environmental factors that were liable to change, was perhaps not sufficiently apparent to the pioneers of Indian ornithology. An emphasis on the variability of life-history descriptors and their association with conditions prevailing at a particular place and time would have demonstrated the need for preserving primary data instead of reducing them to summaries. In some fields such as applied molecular biology, it has now become an established practice to maintain primary data (sequences) associated with published articles in databases (EMBL nucleotide sequence database). Bibby (2003) takes this idea further and sees the blurring of distinctions between journals and databases in the future. Every aspect of bird life is prone to change and summaries may miss these changes. Summarised data loses its value over time but primary data can continue to help in future comparison and analysis. Electronic databases that collect primary data can supplement journals. Journals cannot afford to publish primary data such as the average daily list of birds or isolated nuggets of information (such as the date of arrival of migrants, nesting, food habit, *etc.*) that may only show value when carefully compiled. A substantial number of publications cover occurrence of species at particular geographic locations. These records could be better stored in structured databases. Databases allow the identification of patterns in just the same way as museums enabled ornithologists to find patterns of variation in specimens (Fig. 6).

Beyond profession

How does British ornithology, *in spite of* specialisation and professionalisation, manage to obtain primary descriptive data on an annual basis? The answer lies in the organised use of a large volunteer force. Amateur volunteers contributing about 1.5 million person-hours annually achieve what professional scientists would consider as practically impossible to achieve on their own. These volunteer studies were started by the BTO in 1928 while similar attempts, such as the Christmas Bird Counts, had already begun in North America in the early 1900s. The early North American studies however did not produce many scientific results and it was only in 1966 that the more carefully designed Breeding Bird Survey (BBS) was started



Prediction map produced by Lifemapper in 2005 using a small subset of the BirdSpot records. Note that there was no record from the Eastern Ghats in the model set. It was only later on that a record from the Eastern Ghats was discovered in literature.

Fig. 6. About 16 records of the Rufous-bellied Eagle *Hieraaetus kienerii* were used to predict the distribution of the species using a computational procedure (Stockwell *et al.* 2006). The result suggested its occurrence in the Eastern Ghats and a record from the Tirumala Hills (Taher 1992) was later discovered. Unlike summarised data, primary records can be used for analysis in the future. Discrete distribution records are superior to maps based on subjective interpretation.

[12] Size reductions with climate warming have also been noted (Yom-Tov 2001).

(Barrow 1997; USGS 2007). The North American BBS is a long-term and large-scale study supported by the federal government of the USA and the trained volunteers receive tax waivers for expenses that they incur in participation. The survey requires participants to drive along prescribed 39.4 km (24.5 miles) long road stretches, stop at every 0.8 km (half-mile) and conduct three-minute point counts within a 0.4 km (quarter mile) radius. About 4,100 routes are covered across the US and Canada each year. The results are available for anyone to analyse and summaries provide information on distribution and change in population densities. The data from the BBS is used in numerous scientific publications including textbooks on macro-ecology (Brown 1995; USGS 2007) (Fig. 7).

Well-distributed observers

> "What is the next step? …Ultimately we should look forward to a time when there will be an ornithologist for every hundred or so square miles of India capable of enumerating the local species, and a central organization such as the Bombay Natural History Society to make maps showing the distribution of each species in India. As, however, this would require ten thousand or so ornithologists it is not immediately possible. But a start can be made."
>
> —Haldane (1959)

There are no estimates available for the number of people

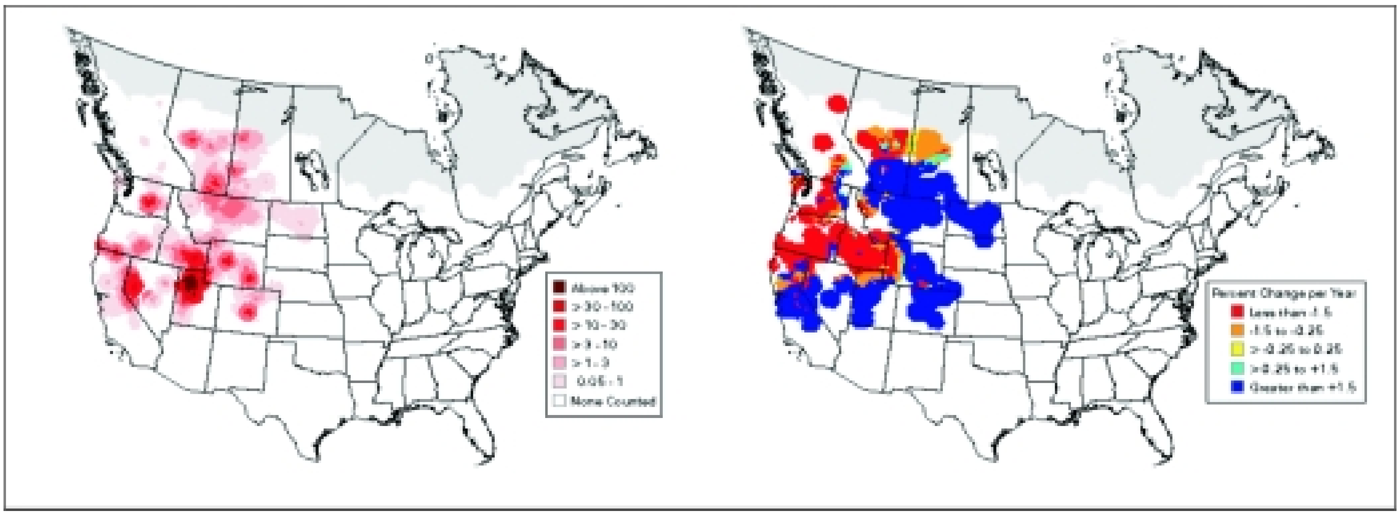


Fig. 7. California Gull *Larus californicus*
Left: Density map 1994–2003. Right: Trend map 1966–2003 (USGS 2007).

in India capable of identifying birds (defined, say, by the ability to identify the 100 commonest species in their locality). Sales estimates for field guides might provide some clue but such data is unavailable. However, numbers alone are not enough; their geographical distribution is equally important. Using observers to provide information about their local area has been a technique used since the collection era. Collectors made use of networks of correspondents to amass specimens. Expeditions were organised only to areas of special interest. Salim Ali and Hugh Whistler undertook expeditions requiring great expense and planning to survey some parts of India. It is instructive to note that the early pioneers of Indian ornithology used more economical approaches that continue to be used in modern large-scale surveys across Britain and North America.

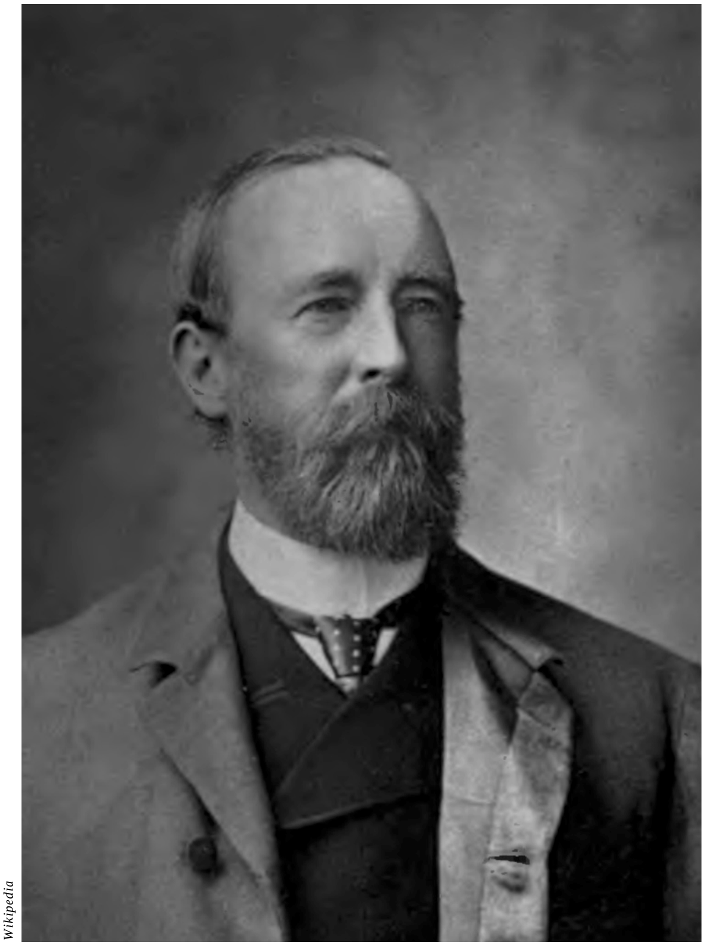
Thomas Caverhill Jerdon and Allan Octavian Hume, the *father of Indian ornithology*,[14] started collecting birds almost as soon as they reached India (Dickinson & Gregory 2006; Moulton 2003). Both made use of networks to cover more ground. Jerdon's *Birds of India* (1862) quotes the names of gentlemen-naturalists, fellow physicians and army officers

The collaboration between volunteers and professionals has rarely been harmonious and much has been written about the tensions between "amateurs" and "professionals" in ornithology[13] (Barrow 1997). The interactions have changed and historians predict that, "*there will always remain a division of labour between professionals and amateurs. But it may be more difficult to tell the two groups apart in future,*" (John Lankford quoted in Leadbeater & Miller 2004).

The vast amounts of information being accumulated in the US and UK are the result of collaboration between individuals. This kind of data gathering requires qualified volunteers, sampling techniques and infrastructure for organisation, compilation, analysis, storage and dissemination. Does India have these requirements? If not, what would be needed?

[13] The terms only refer to differences in the source of income and not to the nature of work.

[14] During Hume's time, Edward Blyth was considered the *father of Indian ornithology* but poor health, low pay, troubles with his employers, alcoholism and mental illness led to a decline in his stature (Murray 1888; Brandon-Jones 1997).



Allan Octavian Hume (1829–1912)

on every other page. This method was obviously more efficient than personally travelling to gather specimens or make observations. Jerdon's *Catalogue of the Birds of the Indian Peninsula* published between 1839 and 1841 listed 420 species of birds and in *Birds of India* (1862–1863) he had already covered 1,008 species (Kinnear 1952). Hume took networking to a new height (Fig. 8). In his works he acknowledges his correspondents and I extracted the names and locations of almost 200 from his *Game birds of India, Burmah and Ceylon* (1879–1881) along with their locations. When the locations of these contributors are mapped, we see that the only region that Hume's network failed to cover well was the Eastern Ghats. Descriptions of Hume's contributions have neglected the crucial role of his collection network. Hume himself was conscious of the role of his network and in 1869 wrote about his book (*My Scrap Book)* being a "*nucleus round which future observation may crystallize*," and sought the help of others around the country to, "*fill in many of the woeful blanks remaining in record*" (Moulton 2003).

The Bombay Natural History Society was established in 1883[15] just as Hume lost interest in ornithology. The old volumes of the *Journal of the Bombay Natural History Society* (started in 1886) provide information on the growth of interest in natural history in the period after 1883. The lists of subscribers and their locations provide some idea of the coverage achieved (Fig. 9).

There seems to be a persistent pattern of geographic neglect. I have attempted two methods to identify and highlight regions that need special attention. One approach used 55,000 bird records extracted from the BirdSpot

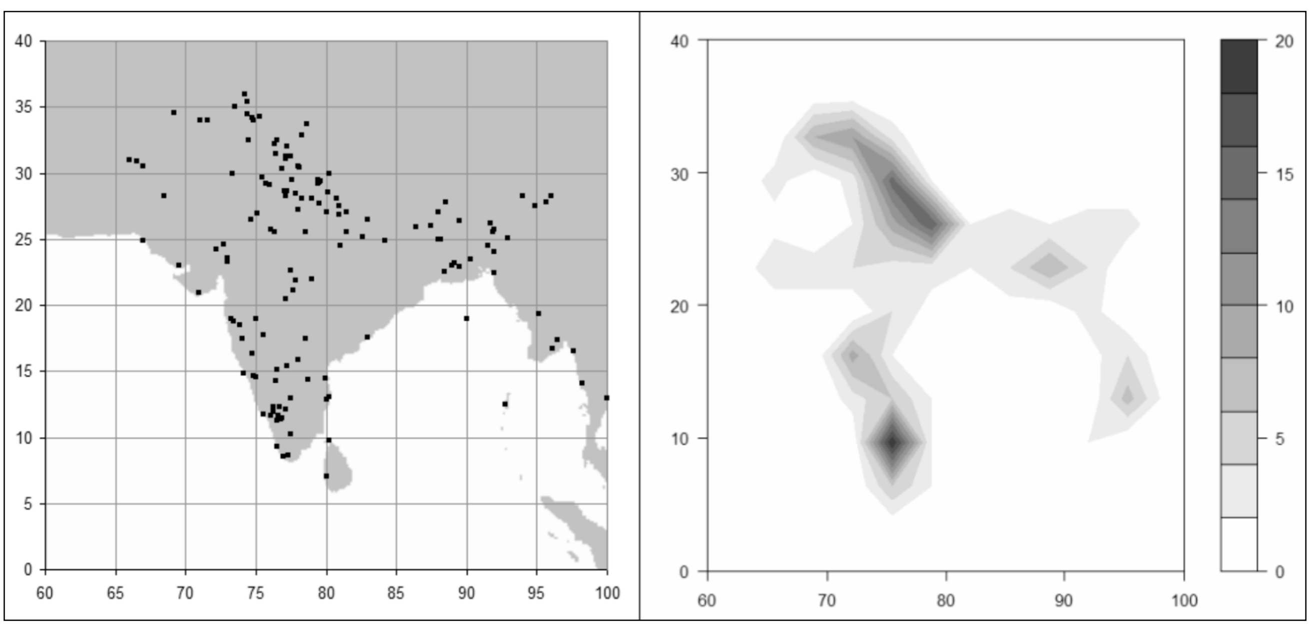


Fig. 8. Distribution of Hume's correspondents and the corresponding density map.
The eastern and central parts of India show the poorest coverage.

[15] The same year in which the American Ornithologists' Union (AOU) was established.

database (Shyamal 2003). These include data from museum specimens as well as observations published in journals and Internet discussion forums. The specimen records are limited to those that are accessible through the Global Biodiversity Information Facility (GBIF) framework (www.gbif.org). Data from the BNHS, Zoological Survey of India (ZSI) and the Natural History Museum (BMNH, London) are notably absent here. These 55,000 records were processed using a 2D kernel-based smoothing approach[16] to produce a shaded density map. Since this might reflect differences in data entry and sharing of data by BirdSpot users, a second set of data was also tried. Here the specimen collection locations listed in the gazetteer for the Indian Subcontinent (Lozupone *et al.* 2004) was used. This includes locations from Sri Lanka, which, incidentally, shows up as a well-sampled region. The resulting density map shows a similar pattern for the regions of poor coverage (Fig. 10). The rediscovery of Jerdon's Courser *Rhinoptilus bitorquatus* and

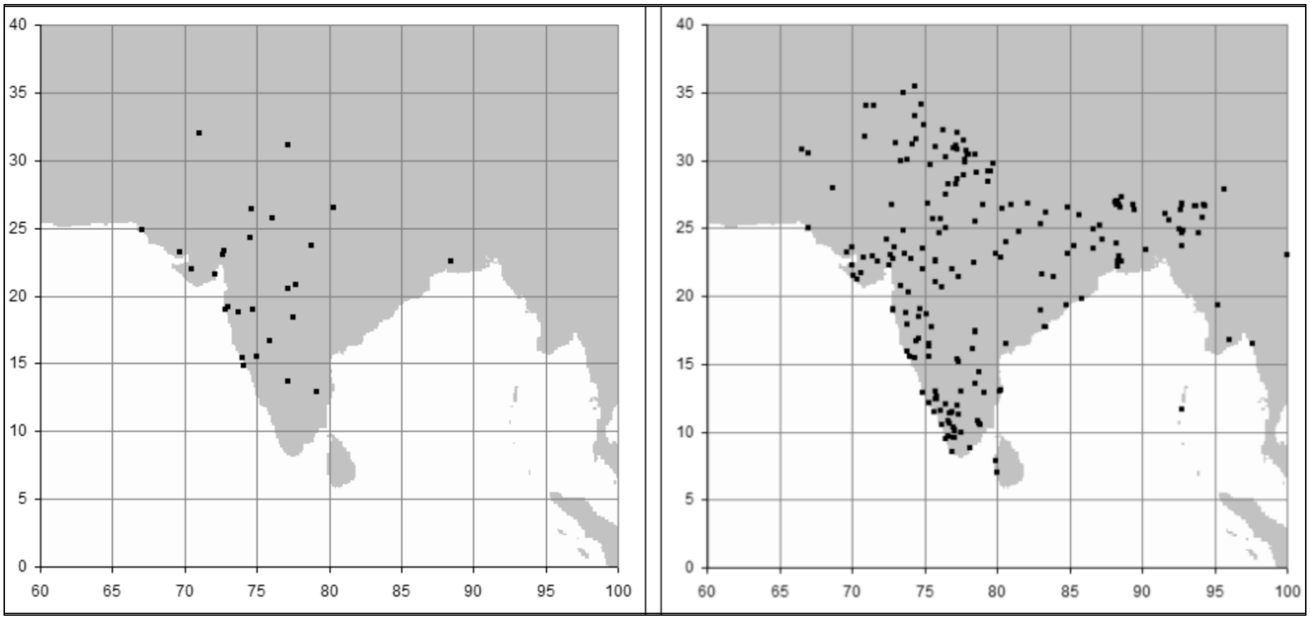


Fig. 9. Geographic coverage of the members of the BNHS in 1886 (left) and 1927 (right). The distribution in 1927 is to a large extent similar to that of Hume's correspondents. The points include many subscribers who may not have contributed such as patrons from the princely states, libraries of army regiments, clubs and associations.

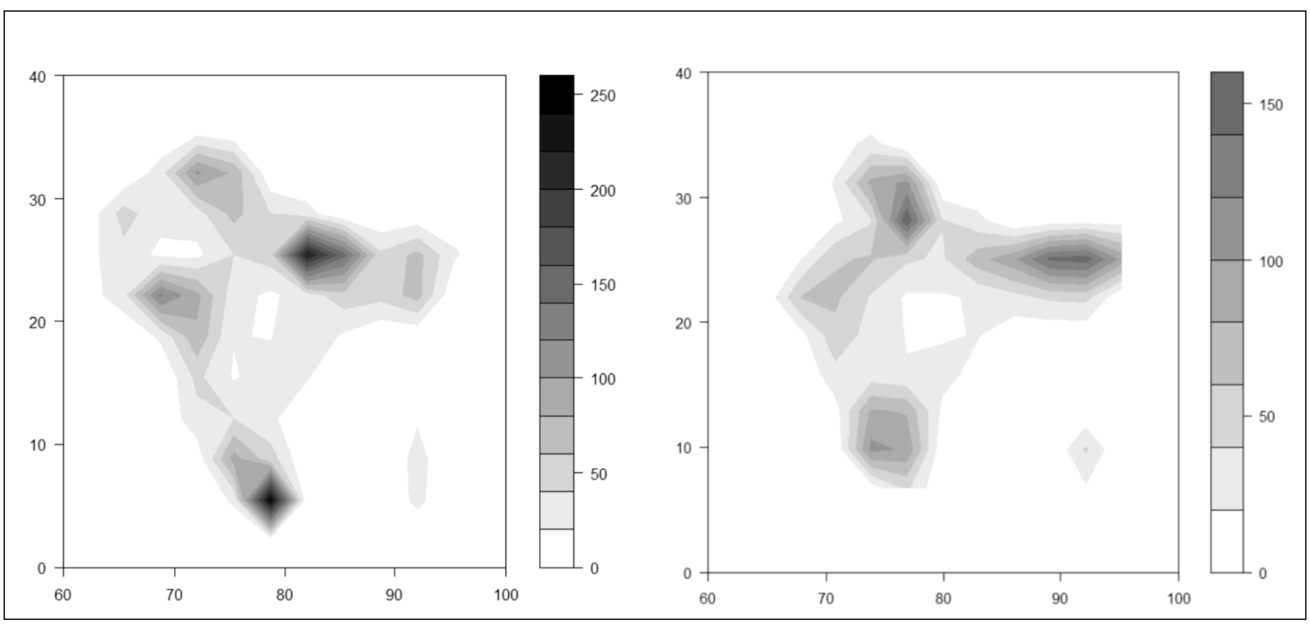


Fig 10. Coverage of India based on bird records.
Left: Based on localities mentioned in Lozupone *et al.* (Includes Sri Lanka).
Right: Based on localities of 55,000 records from BirdSpot (Shyamal 2003).

[16] The hist2d function of the gplots package in the open-source statistics software R was used (http://cran.r-project.org/).

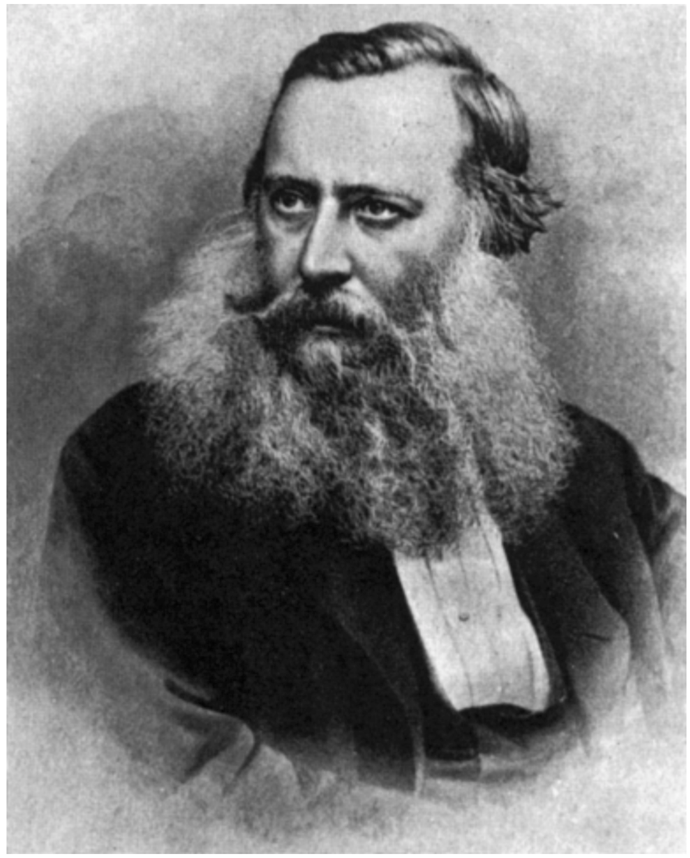
the range extension of Abbott's Babbler *Malacocincla abbotti* in the Eastern Ghats in 1983 is perhaps not surprising when viewed in this light!

How can coverage be improved? Suggestions to seek funds to launch expensive expeditions can only be short-sighted. The long-term solution would be to enhance local expertise and this calls for low-cost field guides in local languages. The role of field guides in enhancing knowledge has been well demonstrated from the time of Florence Merriam's first field guide in 1889 (Pearson & Shetterly 2006; Vuilleumier 1997; Ali 1980). In a review of neotropical ornithology, Vuilleumier notes the role of field guides and points out that field guides were earlier produced by museum-based or academic ornithologists, whereas modern field guides are written by ornithologists who derive an income from acting as birding tour guides. He also notes that the majority are written in English and meant for "northern-based" birders rather than professional or would-be professional ornithologists in and from Latin America (Vuilleumier 2003). Much of this is true for Indian field guides as well.[17] The need for the books to sell well and make profits, together with the fact that the guides are aimed at travelling birders (who can afford higher prices) means that there is no incentive for the author(s) to keep costs low. The author, being outside the country, resorts to obtaining photographs and information from contributors in India. These contributors in turn may need to be paid, as do museums for consultation of their specimens. The combined effect of all this is the high cost of production.

Making information, held by museums and libraries, freely available can cost little and go a long way toward enabling the creation of local reference material including field-guides. Volunteers can compile[18] such primary information to publish material tailored for local use at a low cost. For instance, educational brochures in Telugu on the Jerdon's Courser could easily be made by organisations in Andhra Pradesh if they had access to specimen data from the BNHS collections, photographs, historic texts from Jerdon's publications, etc., and such material could help create enthusiasm and excitement locally. This would have enabled local awareness initiatives that would have helped in conservation measures.

Well-informed observers

> "Some professionals will seek to defend their endangered monopoly. The more enlightened will understand that knowledge is widely distributed, not controlled in a few ivory towers. The most powerful organisations will combine the know-how of professionals and amateurs to solve complex problems. That is true in astronomy, software development and online games. It should be the path that our health, education and welfare systems follow as well."
>
> —Leadbeater & Miller (2004 p. 15)



Wikipedia

Edward Blyth (1810-1873)

The shortage of "ornithologists" in India needs to be overcome by enhancing the abilities of amateurs and letting them fill the gaps. Field guides are only introductory and any advance beyond identification will require access to scientific literature. Access to good libraries is a luxury that few in India have. Fortunately some international projects have made great strides to better the situation and projects such as the Smithsonian Biodiversity Heritage Library (http://www.biodiversitylibrary.org) and the Internet Archive (http://www.archive.org) are making scanned works available over the Internet. It would be good if tax-payer funded libraries in India followed suit and contributed scans of their holdings to these projects so as to benefit citizens.

An interest in birds is usually life-long and can lead to either professional or non-professional positions of expertise. Expertise is often gained by interaction with seniors and expert guidance is increasingly hard to obtain. Field ornithology groups have helped beginners and many of these groups have been supplemented by interactions through electronic discussion forums.

Museum specimens are invaluable references for descriptions, morphometrics and distribution and, laboratory studies. They have been called the ultimate

[17] Most works on Indian birds fail to include literature reviews, as seen in classics like *The Birds of the Western Palearctic.*

[18] Making copyrighted material available is not helpful in this and licensing is vital in enabling re-use of content.

"library of life" and free and open-access to specimen information has been recognised as a guiding principle for museums across the world (Peterson *et al.* 2005). Although most specimens from India are located outside the country,[19] information on them is increasingly accessible over the Internet in fulfillment of Article 17 of the Convention on Biodiversity, which requires the sharing of information.[20] (See www.gbif.org, www.conservationcommons.org) Some museums such as the Zoological Museum of the University of Amsterdam have gone a step further and made their type specimens available in 3D over the Internet for public access (http://ip30.eti.uva.nl/zma3d/). In stark contrast, Indian organisations such as the BNHS and the ZSI that hold collections do not make such information freely accessible to citizens or even to career scientists. In recent times, access to the collections of the Field Museum of Natural History (Chicago) made it possible to detect a persistent and erroneous record made by Walter Koelz of a Himalayan Rubythroat *Luscinia pectoralis* from Londa (Koelz 1942). This error was propagated by subsequent works, including those by Salim Ali (Prasad 2006). Science is based on verifiability and open-access is mandatory for any respectable scientific enterprise.

Ornithological journals are hard to obtain and the denial of access to scientific literature on biodiversity through copyright restrictions has even been likened to bio-piracy (Agosti 2006). Published journals were meant to aid science, but the profit motives of publishing companies and high costs have led many universities[21] around the world to switch to open-access initiatives such as the Public Library of Science (http://www.plos.org). The emphasis on information dissemination rather than profit has made many journals choose low-cost electronic media over print. In India, a few of the larger scientific bodies such as the Indian Academy of Sciences have already realised the importance of open-access. Journals like *Forktail* and *Indian Birds* have made some progress by making articles available online although none have fulfilled the requirements of the Budapest Open Access Initiative, which requires the granting of permission to copy, print, redistribute and reuse. This would help in the development of systems aimed at integrating information.

Low-cost monitoring techniques

As noted earlier, all aspects of bird life are dynamic with changes reflecting environmental factors. This implies that there is a need not just to study birds across the country but also to gather data continually over time. The North American Breeding Bird Survey is expensive (needing great organisational infrastructure, communication and access to automobiles) and it is worth looking at alternatives. Perhaps the most economical approach is the one used in the *Études des Populations d'Oiseaux du Quebec* (ÉPOQ – the study of bird populations of Quebec). Since the 1950s this project has collected lists of *all* bird species seen on trips to specific locations. These lists, termed as **'trip-lists'**, include information on the location, date, observers and time spent. The project obtains as many as 10,000 trip-lists annually. These trip-lists can be statistically analysed and it has been demonstrated that strong trends (increases or decreases over

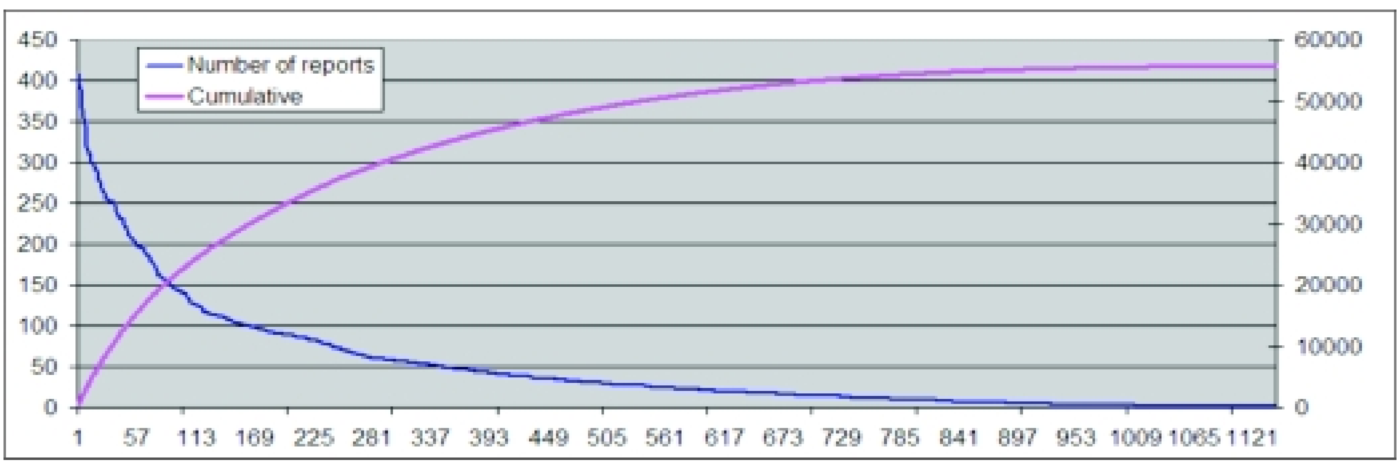


Fig. 11. The reporting rates for 1,144 species based on 55,000 records from BirdSpot (Shyamal 2003) ordered by reporting rate. The x-axis represents the ordered species with the commonest on the left and rarest to the right. The y-axis is scaled differently for the cumulative records curve (scale on right) and the frequency curve (scale on left). The well-known power-series pattern is seen in the rank-order relationship (Chu & Adami 1999). More than 80% of the reports are of 25% of the species. The species with the high reporting rates would be expected to have been well studied, however this assumption is incorrect. The commoner species are better targets for monitoring and low-cost field guides should focus on these.

[19] Ali (1980) noted that "the major foreign museums are perhaps better equipped" [for taxonomic studies] and further claimed that Indian students *fortunately* have the BNHS and ZSI collections *available* to them.

[20] Issues raised on the repatriation of specimens collected in the colonial era resulted in this move.

[21] Ethical issues also exist in the use of tax-payer funds to pay private publishers for scientific research.

time seen in the BBS data) can be detected from these (Droege *et al.* 1998). The data can also be used to produce seasonal bird distribution atlases. The value of trip-lists has already been realized in many parts of southern India with their posting on electronic discussion forums being encouraged. Reports that mention only selected species (such as those that the observer considers as rare or interesting) have little scientific value. The compilation or mixing up of trip-lists from different places and different times also destroys the value of the original data.

Reporting rates of birds show a characteristic rank-order relationship (Fig. 11). The taxa that lend themselves well as indicator species for monitoring are those with high reporting rates.

There is currently a bias in reporting with rare species being favoured over the commoner ones, and journal publishing and funding priorities further this skew. This bias can be seen in the spatial coverage of records when the distribution of the Jungle Crow *Corvus macrorhynchos* is compared with a composite of all species records (Fig. 12). Some of the rarer species are better studied than most of the commoner species. Transient observers noting only rarities will not help in the identification of any patterns. Sustainable and long-term scientific observation needs to be un-biased and local.

An operational species list

A standard reference list of species is an important pre-requisite for studies made by multiple observers. The concept of a "species" varies with application and a practical compromise is needed as a standard for collaboration involving field observation. Recent works (Rasmussen & Anderton 2005) have introduced numerous debatable "splits" and "lumps", but not all changes need to be recognised for the purpose of recording observational data. Expecting observers to note every fine racial difference may be counter-productive to collaboration although some of these riddles can now be settled thanks to advanced optics and digital photography. As a guiding principle, forms that can be determined unambiguously based on geography need not be separated. In other words, where allopatry (related taxa occurring in separate non-overlapping geographical areas) is clearly established, two closely related forms would be distinguishable from the geographic location alone. Visually separable forms that may overlap geographically should however be specifically recognised. The lack of an established standard list has resulted in muddled up records with observers failing to note taxa accurately even when they are distinctive. This confusion has been further aggravated by the aggressive promotion of international English name standards.[22] A couple of examples may clarify this. A "Hill Myna" reported from the Western Ghats can be unambiguously assigned to *Gracula indica* or *Gracula religiosa indica* depending on the taxonomic treatment preferred. So the need for having a "Hill Myna" and a "Southern Hill Myna" is not compulsory. On the other hand, a "Chestnut-tailed Starling" (in the sense of Grimmett *et al.* 1998) from the Western Ghats is ambiguous as this could refer to either the

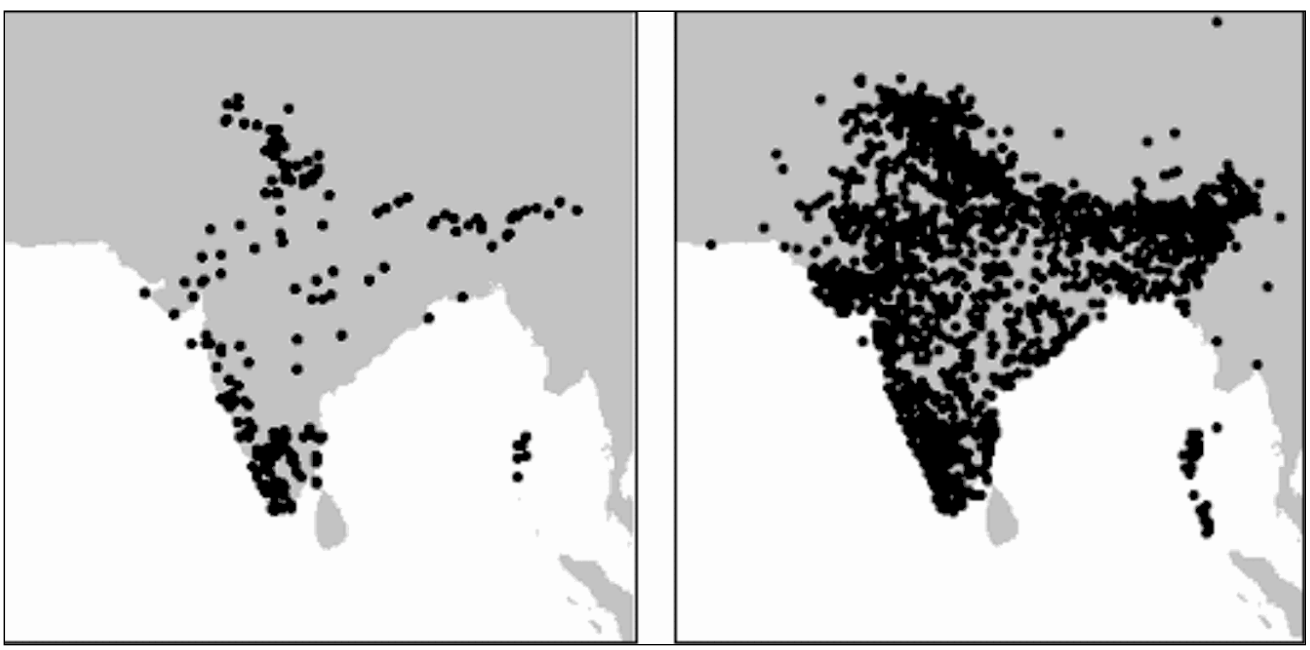
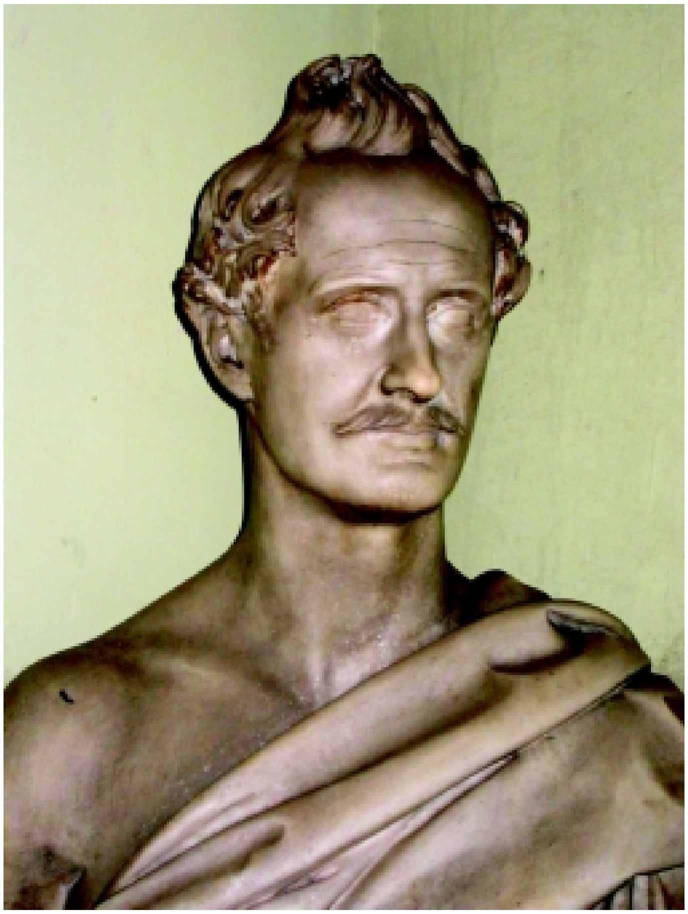


Fig. 12. Rarity bias in published studies: The map on left shows the distribution of Jungle Crow as spot records while the other shows the distribution of all species put together (55,000) combined. This indicates how common species are neglected in the quest for rarities. The Jungle Crow records are also better indicators of resident birdwatchers who can provide useful information in the longer run (Based on data from Shyamal 2003).

[22] For instance Gill & Wright 2006.



Aasheesh Pittie

Brian Houghton Hodgson (1800-1894)
Collection: Asiatic Society of Bengal

resident *Sturnus malabaricus blythii* or the migrant *Sturnus malabaricus malabaricus*. Field guides and species lists catering to trans-national birdwatchers or tourists do not consider these distinctions important. It is however vital for local organisations that gather information to evolve an operational list that is practical and can stand the test of time and one that is not merely based on the most popular or fashionable field-guide at that point of time.

Low-cost data compilation

Information technology offers new ways to gather data that are less expensive and more accurate as they allow direct data entry. Automated verification could detect and highlight potential errors during data entry. Systems could use the already accumulated data to identify outliers in freshly submitted data using a variety of statistical techniques. Such automatic error or outlier detection would improve the quality of data and avoid conflicts that tend to occur when people judge the veracity of records. Doubtful records may be "quarantined" until independent confirmation is obtained. The use of social networks (connections between observers based on co-observation, introduction to the system through invitations and allowing users to mark questionable records) can also make it possible to identify observers in need of training and prevent rogue users.

A central system that collects data requires a suitable infrastructure and the gravest risk of such a system is data loss. In collective enterprises, the best solution for preventing data loss has been the use of open-access and open-source licensing mechanisms. Allowing copying and modification aids evolution apart from allowing recovery and continuity in the event of any failure.

Assuming that the Internet will ultimately penetrate into the remote parts of India, it is important to consider the factors that would motivate individuals to contribute:

1. Recognition: ensuring credits for contributors.
2. Opportunities for advancement: enhancing the knowledge and skills of contributors by providing information and training.
3. Demonstration of value: demonstrating the value of individual data contribution is important. Computational systems can instantly compile new data and show the most up-to-date summaries.
4. Rewards: many contributors of earlier collaborative projects in India have been motivated by rewards such as free field guides (e.g. the Asian Wetland Bureau - Mid-winter waterfowl participants received reports and the complimentary field guides).
5. Opportunities for social interaction and networking: the possibilities of finding and interacting with other contributors in the geographical vicinity.

It is also worth noting the demotivating factors in such projects:

1. Misuse of data: Data collected by compilers can be misused for unfair gain from the sale of publications, garnering funds or other activities that may not ultimately benefit contributors. This kind of misuse can be avoided by open-access licensing, which will prevent any group from having exclusive access.
2. Organisational and institutional attitudes: Exclusive and authoritarian attitudes on the part of compiling organisations can reduce participation.
3. Failure to demonstrate value: The collection of data without production of results of value can be particularly harmful to collaborative projects.
4. Dilution of quality: Some contributors can be upset by their high quality data being combined with data from dubious sources. This can be avoided by clearly associating data with the contributors and allowing the separation of records.

Organisation

India does not as yet have an organisation that can centralize ornithological information or act as an information clearing-house. Several ornithological organisations have been started but none have demonstrated their value to ornithology or established clear policies to collaborate with amateurs. On the other hand several short-lived organisations have eroded the confidence of serious amateurs.

Centralization of observational and specimen data is vital in improving the state of ornithology but this can lead to conflict if the benefits are not shared. In the collection era, museum curators and wealthy collectors had an edge over their field collectors. Museum curators became authorities on systematics and taxonomy by virtue of their wider access to reference material, while field collectors did not gain similar benefits and there are some surprisingly early reports of the resulting conflict from India:

> "Whilst the face of our land is darkened with skin-hunters, deputed by learned Societies to encumber science with ill-ascertained species, no English zoological association has a single travelling naturalist … nor has one such body yet sought to invigorate local research."
>
> —Hodgson quoted in Johnson (2005)

Organisations empower individual members but inequalities in power often lead to conflict. It may be worthwhile for organisations to evolve policies that ensure that conflicts do not affect long-term aims and allow for recovery and continuity. In this age of information, the best insurance against such conflicts is the use of the principles of open access and free licensing (such as the Creative Commons; http://creativecommons.org/), which demonstrate that no unfair advantage is sought by the centralising organisation.

Concluding remarks

Post-Independence ornithology in India does not seem to have kept up with the advances made by British ornithology particularly in building strong descriptive foundations that are made available for subsequent generations to build upon and improve. Contributions to Indian ornithology have been largely by those in urban areas, in large part due to the lack of access to information. This urban bias has led to poor geographic coverage while a quest for rarities by transient observers has left resident species under studied. The divergent paths of career scientists and the lack of information have left a wide gap, with amateurs being unable to progress beyond identification skills. The result is that there is hardly any recruitment into professional ornithology. The Internet provides support for improving the quality of amateur contribution, networking and building databases of ornithological knowledge. New ways to collaborate, compile and analyse data will help in building foundations that aid long-term study and monitoring of birds.

Some may dismiss high-quality, long-term and large-scale bird monitoring as an esoteric quest. In the UK, data from such monitoring is one of fifteen indicators that the government uses to measure the *quality of human life* and this is perhaps the best demonstration of the value of ornithology or indeed science. Reaching this stage has not been easy even in the UK and Colin Bibby wrote in this regard:

> "Funds for pure academic research have their own origins and drivers but much of the growth in field ornithology has been funded on the back of environmental concerns. A variety of factors contributed to growth of conservation concern and awareness over the 50 years…
>
> "Field ornithology in Britain had already been well positioned to diagnose problems and to bring forward sound evidence even before the range of current needs had become so obvious. Conservation issues always have an opponent because vested interests always underlie exploitation of the environment. Evidence alone does not win political battles, but without sound evidence the conservation case is likely to lose to economic arguments even where these are faulted by omission of environmental costs. Ornithologists have played a large role in helping conservation in Britain onto a rational basis…
>
> "The conservation world has not widely and deeply convinced people beyond its own core of support that there is a serious crisis locally or globally. In particular, people have not been convinced that by robbing the environmental bank now we are building up big costs for the future and in time they will be seen to come in. The toughest issue of all to sell is that the underlying problem is the inequitable wealth and consumption of the societies who provide the members and benefactors who support the conservation organizations."
>
> —Bibby (2003)

The Internet has already changed the way ornithological information is collected and disseminated in the US and UK (see, for instance, http://www.avianknowledge.net). There have been a number of predictions made on the way information technology will affect science and the interactions between amateurs and professionals. The Internet has even been expected to change the way governments interact with citizens—moving from a "control and command" mode to a "share and inform" approach (Gadgil 2006). Governments may need more time to change, but small and agile organisations should keep up with the times and revitalise ornithology in India.

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