15. Global patterns of endemism and the conservation of biodiversity

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Abstract

The approach to conservation of biodiversity by the International Council for
Bird Preservation Biodiversity Project is described. The assumption is made
that centres of endemism are priorities for the conservation of biodiversity.
Birds were selected as a high priority target group, since most species are
known and described, and are present throughout all major ecosystems of the
world. Distributions of all species with breeding ranges restricted to
50 000 km² or less, were chosen as the study group. The analysis revealed that
2497 species (26 per cent of all birds) were shown to occur in 221 endemic bird
areas (EBAs) which cover about 5 per cent of the world’s land area. Two
questions were asked of the results: (1) Is there congruence of patterns of
endemism between different animal and plant groups? (2) Are endemic birds
good indicators for areas of endemism in other plant and animal groups?

Through a regional assessment of the 221 EBAs it is shown that there is good
congruence between global patterns of endemism in birds and other taxa,
although exceptions were noted for the several groups of organisms in the UK
and plants in the neotropics. It is argued that the 221 EBAs should be
conserved as a first priority, and that the International Council for Bird
Preservation Biodiversity Project is justifiable since collection of more
sophisticated data will take longer than conservation can wait.

Introduction

The conservation of biodiversity is one of the major global environmental
concerns of governmental and non-governmental conservation organizations,
particularly as warnings of imminent mass species extinctions are

Systematics and Conservation Evaluation (ed. P. I. Forey, C. J. Humphries, and R. I. Vane-Wright),
Biodiversity is not distributed evenly, and therefore an efficient approach to its conservation is to identify areas whose protection would ensure the continued survival and evolution of a high proportion of the world's biota. But how should these areas be selected?

One criterion which could be applied is species richness, exemplified by the 'megadiversity countries' concept of Mittermeier (1990). However, as Lovejoy and Oren (1981) have stated 'pursuit of the objective of maximum species diversity or even maximum species richness could lead to serious negative consequences if taken literally'. Many important components of biodiversity are not represented in countries or areas of high species richness or diversity, whilst a large number of the species they contain may be widespread and highly adaptable, under no immediate threat, and of no great conservation concern. Indeed, as Diamond (1976) stated, 'the question is not which reserve system contains more species, but which contains more species that would be doomed to extinction in the absence of refuges'.

Any strategy aimed at conserving biodiversity will need to consider places which hold concentrations of endemic species, i.e. species with limited distributions, as the loss of these areas would result in global extinctions. Studies which have incorporated both species richness and endemism include the botanical 'hotspots' analysis of Myers (1988, 1990) and 'critical faunas analysis' (Ackery and Vane-Wright 1984; Vane-Wright et al. 1991). Given the aim of conserving the full species complement of a certain taxonomic group, critical faunas analysis identifies the minimum set of areas which contain at least one viable population of every species. Like most methods, critical faunas analysis demands full knowledge of species' distributions for a certain taxon. Most of the world's species are not yet described or named, so this type of analysis is currently feasible for only a limited number of taxa.

The International Council for Bird Preservation's Biodiversity Project (ICBP 1992) has applied the idea that centres of endemism are priorities for conservation. The project has identified centres of avian endemism through the compilation of a data set more complete than is currently possible for any other life form. Birds are a group which are both taxonomically and distributionally well known, and additionally have dispersed to, and diversified in all regions of the world and virtually all terrestrial habitat types and altitudinal zones, thus enabling a global perspective. The distributions of all of the world's restricted-range bird species, defined as having breeding ranges below 50,000 km², were accurately mapped and analyzed to identify all areas with important concentrations. The analysis showed that 2,497 species, 26 per cent of the world's birds, are restricted to 221 Endemic Bird Areas (EBAs), which cover five per cent of the world's land area.

The ICBP study on birds also addressed two very important and related questions: (1) Is there congruence of patterns of endemism between different animal and plant groups? (2) Are endemic birds good indicators for areas of endemism in other vertebrate, invertebrate, and plant taxa? In other words, is there justification for extrapolating from birds to other life-forms for which the data collection will be a time-consuming challenge? In this paper we examine the general issue of whether patterns of endemism are similar between taxa, and illustrate this with a summary of the review of patterns of endemism in plants, invertebrates, and vertebrates presented in ICBP (1992). We then examine how the areas of endemism identified by ICBP for birds correspond to areas of importance for other groups, and discuss the implications for conservation of using birds as indicators of endemism and hence biodiversity.

Global patterns of endemism: a review

1. Analytical approach

During ICBP's research on biodiversity, information was assembled from a review of the available literature on patterns of endemism for terrestrial vertebrates, invertebrates, and plants. Where known, the number of species confined to a discrete geographical range was recorded. In some cases, areas of endemism were identified on the basis of a specialist's knowledge of a particular region and do not include information on the number of endemic species. An attempt was made to incorporate data from several different life-forms in all regions of the world, and for the purpose of data presentation the world was subdivided into six regions: Caribbean islands, Middle and North America; South America; Africa, Europe and the Middle East; Continental Asia; South-east Asian islands, New Guinea and Australia; and the Pacific islands. More extensive data and complete references are given in ICBP (1992).

The EBAs as identified by ICBP (1992) were used as a global framework to allow a comparison of patterns of endemism between different taxa. These EBAs are defined as areas in which two or more restricted-range bird species are confined. Additional restricted-range bird species may occur within but not be confined to an EBA. EBAs are found on isolated islands or comprise pockets of a particular habitat, especially in tropical forest zones. Regional EBA maps are given in ICBP (1992), for example Africa (Fig. 15.1).

(a) Africa. In continental Africa distributional data comparable to that available for birds are available only for mammals, amphibians, and reptiles. Patterns of endemism amongst these vertebrate groups demonstrate, on the whole, a high level of congruence, with the majority of identified areas of endemism being in the tropical region of Africa (Fig. 15.2).

The Afrotropical mountains are important centres of endemism for
Fig. 15.1  Endemic Bird Areas of Africa. Similar maps are available for other regions of the world in ICBP (1992).

amphibians (Groombridge 1987) as well as birds. Of the four most important areas for birds in terms of restricted-range species richness, three areas, the Cameroon mountains, the Albertine Rift mountains, and the Eastern Arc mountains, also contain the largest concentrations of endemic amphibians. The locations of recognized concentrations of endemic mammals (excluding bats) also correspond closely with the distribution of EBAs. Congruence between birds and mammals is not perfect, however, since the three richest areas for birds are not the same as the three richest areas for mammals, although all six areas are important for both groups (Table 15.1).

Additionally, several more widespread bird and mammal species are endemic to the arid habitats found in the north-east and south-west of the continent (Crowe and Crowe 1982; Kingdon 1990; Stuart et al. 1990).
The phytogeography of Africa is comparatively well documented (White 1983), but areas of floristic endemism have not been fully identified, and current research initiatives are concentrating on quantifying floristic richness and endemism at local levels (IUCN/WWF in prep.). It is only possible to state in general terms that there appears to be good congruence between botanical and avian endemism. However, in some areas of endemism there are differences in the importance of the area between taxa. For example, the importance of endemism and species richness in the Cape flora, with 6800 endemic species and 70 per cent endemism, greatly exceeds that of the vertebrates, including birds (Gibbs-Russell 1985).

Table 15.1. Comparison of endemism between birds, other animals, and plants in Africa. Bi = Birds; Ma = Mammals excluding bats; Am = Amphibians; Re = Reptiles; Mo = Terrestrial Molluscs; Bu = Butterflies; Pl = Vascular Plants. Figures refer to numbers of endemic species. Similar data are available for the other regions of the world in ICBP (1992).

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The high levels of endemism in the flora and fauna of Madagascar are well known. Phytogeographically, the island has been divided into two regional centres of endemism with the eastern humid forests being particularly rich in endemic plants. Many of the island’s endemic birds, mammals, and amphibians are also confined to these forests. Endemism amongst the invertebrate fauna parallels that of the vertebrate groups, with for example some 70 per cent of the butterflies (182 species) and 95 per cent of the terrestrial molluscs (361 species) being unique to the island (Table 15.1: also Jenkins 1987).

In common with most oceanic islands, the vertebrate faunas of the islands of the Atlantic and Indian Oceans are depauperate. Long isolation has, however, resulted in the development of some significant endemic faunas (Stuart et al. 1990). Those islands rich in endemic birds, namely the Canaries and Madeira, Principe and São Tomé, the Seychelles, the Comoros, and Mauritius, also contain a number of island endemics from other groups, however mammals (excluding bats) are poorly represented on these islands and few endemic species are found (Kingdon 1990).

(b) Caribbean islands, Middle, and North America. Patterns of endemism in the flora and fauna of the Caribbean Islands are relatively well documented (e.g.
large concentrations of endemic plants (1517 species) (Gentry 1986) and overlap with the only EBA identified in North America.

d South America. Most biogeographical studies of South America have concentrated on the lowland biota, particularly of Amazonia, where patterns of endemism have been presented for birds (Haffer 1987), lizards of the genus *Anolis* (Vanzolini and Williams 1970), heliconine and ithomiini butterflies (Brown 1987a), and trees of the families Bignoniaceae and Chrysobalanaceae (Prance 1987). A high degree of concordance between the location of proposed centres of endemism in each of these groups has been suggested (Simpson and Haffer 1978; Brown 1987b; but see Bevan et al. 1984).

The lowland forests of the Atlantic coast of Brazil are particularly notable for high degrees of endemism in both plant and animal species (Jackson 1978; Mori et al. 1981; Duellman 1982; Gracraft 1985; Brown 1987a; Mittermeier 1987); indeed five EBAs are located there. The lowland forests in the Chocó region of Colombia and Ecuador are also important being amongst the most species-rich of all known plant communities, with an estimated 10 000 species, of which a quarter are endemic (Gentry 1992). Gentry (1992) documented the flora of isolated ridges in western Ecuador and suggested that the very high local endemism—an estimated 20 per cent of vascular plants below 900 m are endemic to the region—is due to speciation of epiphytes, palms, and shrubs, possibly related to the broken nature of the terrain and the complex interspersion of different climates and vegetation types. There is also a high level of avian endemism in the Pacific lowlands and foothills of the Chocó, with over 50 restricted-range species confined to the area, which is matched in the reptiles and amphibians (Lynch 1979), and butterflies (Brown 1987a).

The biota of the submontane and montane habitats along the Andean chain remain one of the most poorly documented in all the Neotropics, but species richness and local endemism are thought to be high. There are 22 EBAs and 309 restricted-range species confined to the Andes, and this complex avian distribution pattern, particularly in the northern Andes, is well matched by the distribution of the locally endemic herpetofauna (Duellman 1979). The flora of the eastern slopes of the Andes has been identified by Myers (1988) as a global floristic ‘hotspot’.

d Asia. Analysis of endemic congruence in Asia is severely hindered by the lack of reliable distributional data for virtually all taxa other than birds. Comprehensive data-sets are available for most of the island groups in the region, but with few exceptions, equivalent data are not available for continental areas.

Sri Lanka, Taiwan, the archipelagos of the Andamans and Nicobar
Islands, and the Nansei Shoto have all been identified as EBAs, and are important for endemics in other vertebrate taxa (Collins et al. 1991). Knowledge of invertebrates on these islands is invariably poor, although the critical faunas analysis of Collins and Morris (1985) identifies the endemic swallowtail butterfly faunas of Taiwan, and the Andamans and Nicobars as of particular importance. Floristically, each of the main island groups contains many endemics (Davis et al. 1986), this being particularly well documented in the case of the south-western moist forests of Sri Lanka (Gunatilleke and Gunatilleke 1990).

On the Indian subcontinent there are four principal areas of endemism, all identified as EBAs: the Western Ghats; the state of Assam; and the western and eastern Himalayas (World Conservation Monitoring Centre 1989; Collins et al. 1991; ICBP 1992). The evergreen forests of the Western Ghats are rich in endemic fauna, with 16 endemic birds, 16 mammals, 17 reptiles, and 84 amphibians (Groombridge 1983), and also hold several distinct centres of local floristic endemism (Nair and Daniel 1986). Invertebrate distributions in India are generally poorly known, but the Western Ghats contain two endemic swallowtail butterflies (Collins and Morris 1985), and two endemic milkweed butterflies (Acker and Vane-Wright 1984). Both the western and eastern Himalayas and the state of Assam have been identified as centres of floristic endemism (Myers 1988; World Conservation Monitoring Centre 1989), but the precise geographical boundaries of these areas are unclear, and estimates of the size of the endemic flora vary, thus preventing detailed comparison with data available for endemic birds.

The endemic flora and fauna of China is of global significance, and yet is exceptionally poorly known to Western science (Davis et al. 1986). The country has 12 EBAs, of which several are considered to be important for other life-forms. High floristic endemism is suggested in the Sichuan and Yunnan Mountains (Ying Tsun-Shen and Zhang Zhi-Song 1984). The Central Sichuan mountains have several species of endemic primates (Eudey 1987), and the Giant Panda (Ailuropoda melanoleuca), whose distributions closely correspond to those of the endemic birds of the area.

Patterns of endemism in much of Indochina are also very poorly documented. The level of endemism of flora and fauna of Burma, Thailand, Laos, and Cambodia, whilst incompletely known, is believed to be relatively low (Collins et al. 1991). In contrast, endemism in the Vietnamese birds is high, with EBAs in the Annamese lowlands, Da Lat Plateau, and Cochinchina, although reliable distributional data are lacking for virtually all other groups. Floristic endemism is particularly high in the alpine zone of the Hoang Lien Son mountains in northern Vietnam, the rainforests of central Vietnam, and the montane forests of the Da Lat Plateau (Anon 1986).

(e) South-east Asian islands, New Guinea and Australia. Patterns of endemism within the region largely result from insular speciation and much of the available data are in the form of lists of single-island or island-group endemics. Distributional data comparable to the avifauna are available for mammals, reptiles, amphibians, swallowtail butterflies, and vascular plants.

Endemism in the avifauna of the islands of the Sunda Shelf, Wallacea, and the Philippines is high, with 25 EBAs and over 450 restricted-range bird species, which display considerable congruence with the patterns of endemism in other taxa. Single-island or island-group endemic birds, mammals, and reptiles are found throughout the region, particularly in the Philippine archipelago and the larger islands of Sulawesi, Borneo, Sumatra and, to a lesser extent, Java (MacKinnon and MacKinnon 1986; Hauge et al. 1986; Cox 1988). Endemism amongst the vertebrates of the smaller islands of the Lesser Sundas and Moluccas is less pronounced both proportionally and in terms of absolute numbers. Comparable invertebrate data-sets are provided for milkweed and swallowtail butterflies by Acker and Vane-Wright (1984) and Collins and Morris (1985). These analyses highlight the importance of the butterfly faunas of the Philippines, Sulawesi, and the smaller islands in the Lesser Sundas and Moluccas.

Floristic endemism is particularly high on the Sunda Shelf islands of Sumatra and Borneo, the islands of the Philippine archipelago, and in Peninsular Malaysia (Davis et al. 1986). The lowland forests of Sumatra and Borneo are the centre of evolution for the Dipterocarpaceae, whilst many mountains of the region are local centres of floristic endemism, with Mount Kinabalu in Sabah the best-known example. The flora of Peninsular Malaysia is particularly well studied and various estimates of endemism have been made: 30 per cent for tree species, 90 per cent for the Bignoniaceae, 80 per cent for the Gesneriaceae, and 50 per cent for the orchids (Earl of Cranbrook 1988). The high floristic endemism is in marked contrast to the peninsula’s vertebrate and invertebrate fauna, much of which is shared with Sumatra and Borneo (MacKinnon and MacKinnon 1986).

New Guinea supports a remarkable diversity of animals and plants, and is particularly rich in endemic forms in all taxa for which records exist (Diamond 1986). The island itself, with its complex topographic features and diversity of ecosystems, contains many centres of endemism. These areas can be broadly divided into the western and eastern Papuan islands, the central cordillera, the isolated north coast mountains, and the intervening areas of lowland. Distributional data necessary to identify these centres of endemism are currently available only for birds, although there is qualitative documentation of similar patterns in other taxa (Gressitt 1982).

Patterns of endemism within the Australian continent are already well known, with endemic congruence in all taxa for which information is available (Keast 1981; Heatwole 1987). Restricted-range species of birds,
mammals, reptiles, amphibians, and terrestrial molluscs are distributed peripherally in the north-west, north-east, south-west, and south-east of the continent. Endemism in the flora shows broadly similar trends, with the south-west and south-east regions particularly rich in locally endemic forms (Davis et al. 1986).

Pacific islands. The Pacific region’s importance in terms of global biodiversity conservation has, until recently, received little attention (Dahl 1986). Documentation of the biological resources of the region, in particular of the invertebrates and plants, is very incomplete, thus hampering an assessment of the extent of endemic congruence between taxa. There are 30 EBAs in the region, but the distributional data available for particular island groups for other vertebrates, terrestrial molluscs, Lepidoptera, and vascular plants are limited.

The Bismarck and Solomon archipelagos typify the difficulties of analyzing patterns of endemism in the region. These islands are of exceptional importance in terms of their endemic avifauna, encompassing eight EBAs which support over 150 restricted-range bird species. Unfortunately, information regarding other taxa is scarce. It has been suggested that as many as 23 mammals are confined to the two archipelagos (Musser 1987), although corroboration and further details are not available. Endemism in the reptile, amphibian, terrestrial mollusc, and butterfly faunas is thought to be high in the Solomons (Ackery and Vane-Wright 1984; Groombridge 1985; Dahl 1986), but similar data are unavailable for the Bismarcks. The size and endemicity of the flora are unknown for either archipelago (Davis et al. 1986).

More detailed information is available for the island groups of Vanuatu, Fiji, and New Caledonia. Each of these groups are EBAs, containing a rich endemic avifauna and display similar levels of endemism in several other taxa. Whilst the mammal faunas of these oceanic islands are depauperate, high levels of endemism are shown in the herpetofauna (Gibbons 1985; Groombridge 1985; Dahl 1986). The terrestrial mollusc and lepidoptera faunas, though imperfectly known, appear to have undergone extensive radiation and contain many endemics (Holloway 1984; Solem 1984; Wells 1985). In addition, New Caledonia has a particularly distinctive and ancient flora associated with the unusual geology of the island (Holloway 1979), and with 1400 endemic species it has the highest known plant endemism in the world at 89 per cent (Gentry 1992).

Hawaii is especially famous for its endemic flora and fauna with several taxa including birds, terrestrial molluscs, arthropods, and angiosperms having undergone adaptive radiation and displaying uniquely high levels of endemism (Loope et al. 1988). Radiation on a smaller scale has been documented on several isolated South Pacific island groups. The terrestrial mollusc faunas of the Society, Austral, Marquesas, and Tuamotu archi-

pelagos are particularly rich and contain many endemics, although recent large-scale extinctions severely depleted several islands (Wells 1985; Dahl 1986).

**Birds as indicators of areas of endemism**

The 221 EBAs are classified according to the degree of endemic congruence they display for the three major terrestrial life-forms, namely vertebrates (excluding birds), invertebrates, and vascular plants, all based on data extracted from the literature review. Since the global numbers of known species differ by orders of magnitude across taxa, it is necessary to set different thresholds for what is termed ‘significant’ or ‘globally significant’ endemism (Table 15.2). Significant endemism refers to 50 endemic species for vertebrates, and 500 species for invertebrates and vascular plants; globally significant endemism refers to 100 endemic species for vertebrates, and 1,000 species for invertebrates and vascular plants. These criteria are simply an initial suggestion and remain open to revision. If the insects were more fully known, higher thresholds would almost certainly be appropriate. Knowledge of certain taxa varies considerably in different regions of the globe, but assessment of comparable levels of significance would involve

<table>
<thead>
<tr>
<th>Score</th>
<th>Criteria</th>
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<tr>
<td>***</td>
<td>Significant endemism in at least two of the three major terrestrial life-forms (vertebrates, invertebrates, plants) or globally significant endemism for one major life-form. ***? is used if this level is probable from described endemism in the region but quantitative data applying to the same boundaries do not exist.</td>
</tr>
<tr>
<td>**</td>
<td>Significant endemism in at least one of the three major terrestrial life-forms (vertebrates, invertebrates, plants). **? is used if this level is probable but quantitative data applying to the same boundaries do not exist.</td>
</tr>
<tr>
<td>*</td>
<td>Some endemism among other vertebrates, invertebrates, or plants, with levels below the critical thresholds above.</td>
</tr>
<tr>
<td>?</td>
<td>Insufficient data to assess levels of endemism amongst other taxa.</td>
</tr>
</tbody>
</table>
unacceptable subjectivity. Quantitative information is not always available for the number of species confined to a particular area of endemism described in the literature, but uncertainty will be reduced by further analysis and publication of data for other groups.

The congruence rating assigned to each EBA was compared to the importance of the EBA for numbers of restricted-range bird species. Three categories of restricted-range bird species richness were calculated by fitting a regression line to the log-log graph of species number against area and seeing how each EBA compared with what would be expected for its area. EBAs with more than twice as many species as expected are classified as the richest (***) and those with fewer than the expected rank as the poorest (*) for bird richness.

The analysis shows that overall there is positive congruence amongst vertebrates, invertebrates, and plants: over 50 per cent of EBAs show globally significant endemism or significant endemism in at least one of these major life-forms (Table 15.3). The lack of data is evident, with 20 per cent of the EBAs having insufficient data to assess levels of endemism for taxa other than birds, though most of these areas have the lowest level of endemic bird species richness (Table 15.3). The locations of the EBAs and the congruence rating assigned to them is shown in Fig. 15.3. The comparison of bird species richness and importance for numbers of species from other taxa shows that although many EBAs important for high numbers of restricted-range bird species are important in terms of numbers of endemics from other taxa, this is not always the case. For example, 19 EBAs are exceptionally important for

<table>
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<th>Other group score</th>
<th>Restricted-range bird species richness</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><em><strong>/</strong></em>*</td>
<td>24</td>
<td>33</td>
</tr>
<tr>
<td><strong>/</strong>*</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td><em>/</em>*</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>?</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>53</td>
<td>68</td>
</tr>
</tbody>
</table>
a large number of restricted-range birds but less important for other taxa, and conversely 33 EBAs appear to be more important for taxa other than birds (Table 15.3).

Discussion

The literature review suggests that there is good congruence between global patterns of endemic for different life forms, supporting work by others (Simpson and Haffer 1978; Hauge et al. 1986; Collar and Stuart 1988; Gentry 1992). Our results show that the majority of areas identified on the basis of their restricted-range birds are also important for plant and other animal groups. Furthermore, on the basis of currently available information, it seems unlikely that many major terrestrial areas of high endemic fall outside of the 221 EBAs. Thus birds are good indicators of areas of endemic in other taxa.

A seemingly conflicting conclusion has been drawn from a recent analysis of species richness in Britain by Lawton et al. (this volume), who suggested that congruence between taxa exists only on a very coarse scale, and that national and local hotspots of species richness do not coincide across taxa. Two comments can be made on this apparent contradiction. Firstly, Lawton et al. are concerned with species richness and not endemic; and second, their analysis is based on a northern temperate country where restricted areas of endemic are not typically found, and where habitats are extensively modified and the flora and fauna much altered by human impact.

The identification of the EBAs was based on restricted-range criteria, hence they generally occupy relatively small areas (85 per cent are below 50 000 km²). However, areas of endemic occur at a variety of different scales, therefore there are some larger areas of endemic, to which more widely distributed bird species and other taxa are restricted, that were not considered under the criteria of the EBA analysis. These larger areas include the Amazon and Congo basins, the Namib-Karoo deserts, and the Greater Sundas, where endemics are not as concentrated and vulnerable as in the EBAs, but undoubtedly also need the attention of conservationists.

Conversely there are some taxa, for example plants, that have large numbers of species with extremely localized distribution patterns (Gentry 1986, 1992). In many cases, these small areas of extremely local endemic will be located within larger areas of avian endemic. For example, the cloud-forest at Centinela in Ecuador, documented by Gentry (1986, 1992) as containing levels of local endemic of 10–24 per cent (prior to its destruction), is located within the western side of the Andes of Colombia and Ecuador EBA. Similarly, the results of the Centre of Plant Diversity project (IUCN/WWF in prep.), a global study based on both quantitative and qualitative data, suggests that most areas of local floristic endemic on the African continent are contained within the framework of the African EBAs, one major exception being the European Mediterranean region (World Conservation Monitoring Centre 1992). Thus, information on locally endemic floras will be of particular importance in identifying the most important areas and sites within EBAs.

The approach followed in the ICBP study, which focused on the identification of aggregations of restricted-range bird species and has been shown to reflect endemic in other taxa, is undoubtedly a sensible and data efficient way of identifying key areas where species should be conserved so as to maintain overall global biodiversity. Gentry (1992) suggests that for Neotropical plants at least, patterns of endemic and diversity are largely non-coincident. In terms of conservation priorities however, concentration on restricted-range or endemic species is extremely important irrespective of the relationship between endemic and overall diversity. The conservation of areas with concentrations of restricted-range species will help to ensure the survival of a unique complement of species, many of which are threatened by virtue of the vulnerability of small areas to extensive habitat modification. Indeed, any strategy that embraces a minimum complementary set of sites to represent the world’s biodiversity will have to include coverage of these relatively small centres of endemic. Adequate protection of the 221 EBAs identified by ICBP would contribute to the survival of a disproportionately wide variety of birds and other life. Alternatively, massive extinction could be caused by modification or destruction of habitat in the most valuable places. There is an absence of data from many taxa from several regions of the world, but the collection of this data will take more time than conservation can afford to wait. As Erlich (1992) has commented, ‘it is critical that conservation biologists build on what is already understood about well-known organisms to develop tools that can be used to save biodiversity quickly and en masse’.

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