

Introduction

Why a new checklist?

Checklists of birds of the world are not particularly strong on introductions. Of 12 that we have examined, the mean number of pages devoted to introducing the work is 4.9 (range 2–10). Each of these studies—all of them, with the exception of Peters (1931), dating from 1974 or later (and of course “Peters” was only finished in 1986)—has its value and place, and several of them (Peters 1931–1986, Morony *et al.* 1975, Sibley & Monroe 1990, Dickinson 2003) represent major successive building-blocks of modern ornithology. Even so, the modesty with which they have announced themselves to the world is notable. There are usually some extremely simple statements of intent, usually some explanation of the taxonomy followed and associated issues, and various items of house-keeping relating to such matters as ranges and sources; and then the list begins.

If the introduction to this new checklist runs on out of all proportion to precedent, we hope it will not be—and not be thought to be—from lack of modesty. On the contrary, we want the vision we have in this book to be immediately apparent to its users, which is to involve them, stimulate them, and make them part of the process by which it can be constantly improved. This cannot perhaps be as interactive as *HBW Alive* or the BirdLife discussion forums (birdlife.org/globally-threatened-bird-forums), but it nonetheless offers the opportunity for ornithologists around the world to contribute fact and opinion by way of feedback to the evidence the book provides, whether directly to Lynx or to BirdLife, or indirectly through separate publications (see The future of the *Checklist* below).

This work has several features—other than the length of its introduction—that set it somewhat apart from other checklists. It illustrates each species in colour; it updates as accurately as space allows the written ranges of both species and subspecies, and provides a newly revised map; it gives French, German and Spanish as well as common alternative English names; and where appropriate it offers some information about the taxonomic relationships of particular species. The combination of image, map and text in a double-page spread is, we hope, a powerful and convenient way of encapsulating key data on a species, and by this means we hope to bring each bird more to life than would be the case were it just a dry string of names occupying a single line of text across a page, and thereby increase the level of engagement with it that each user of the book may have.

Nevertheless, for us the most distinctive feature of the book—and this is simply an observation, not a claim for its importance—is the approach it adopts to species-level taxonomy. Checklists are typically conservative, in that they make secondary use of existing lists, taking rapid decisions over particular taxonomic problems but certainly not exploring and resolving issues as in a primary text. Here, however, we have been motivated to dare to attempt something more. From over 20 years of work to produce the *Handbook of the Birds of the World* (HBW), and from over 30 years engaged in evaluating the conservation status of all bird species, our two organizations, Lynx Edicions and BirdLife International, albeit from rather different perspectives, have become acutely sensitized to the issues and problems surrounding modern species-level taxonomy. Given that conservation very largely takes the species as its unit of concern, and that the future of



Figure 1 – Ever since the introduction of a trinomial system in Ridgway's list of North American birds (1880), and particularly since Mayr's formulation of the Biological Species Concept (1942), reproductive isolation has been the decisive criterion in the human classification of birds into different species. This has the advantage of accounting for not just how we humans see birds but also how they see each other. Even so, processes in nature are always under varying evolutionary pressures, and avian recognition systems can sometimes malfunction, as when Western Capercaillies *Tetrao urogallus*, pictured here at a lek, cross-breed with Black Grouse *Lyrurus tetrix*.

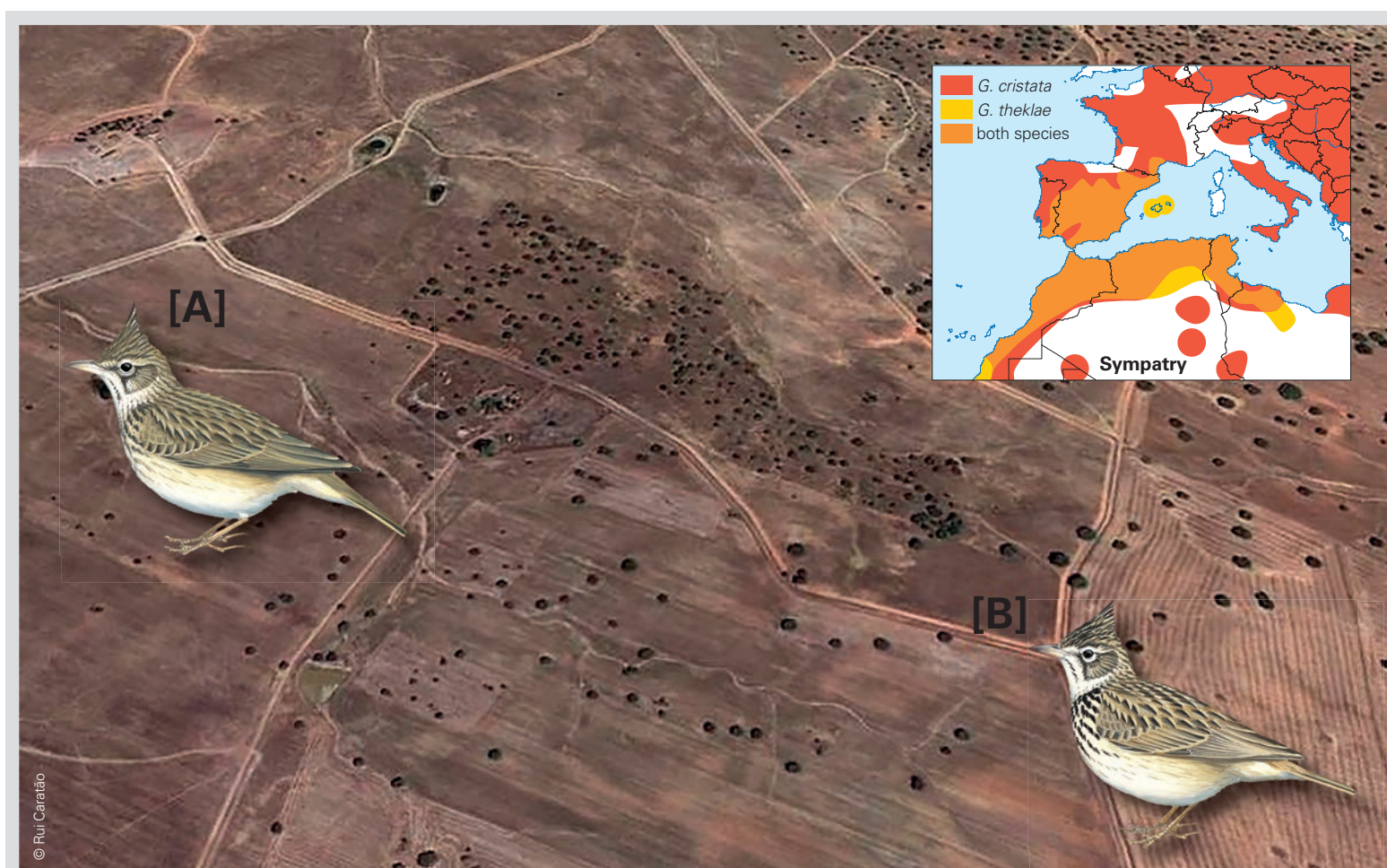


Figure 2 – Reproductive isolation is easy to prove when two species live side by side, i.e. in sympatry. Usually such species possess characters that are relatively obvious to the human eye, as they must be to the birds themselves. Rarely, however, the differences are disarmingly subtle, as in the case illustrated by this photograph of the Alentejo, Portugal, involving Crested *Galerida cristata* (with territory at A) and Thekla Larks *G. theklae* (territory at B). There are no known genetically proven hybrids between these two taxa and their differences remain constant: thus we can say with confidence that, on the basis of current knowledge and according to the BSC, they are two species.

many taxa might in part depend on their recognition or not as species (but see the subsection *Subspecies, populations and conservation* below), it has become increasingly frustrating to have to wait—frequently in vain—for authoritative decisions from other sources over whether form A or form B is a species or subspecies. Taxonomy proceeds through the endeavours of individual biologists working on whatever interests them, for whatever reason, rather than to any all-embracing plan; and the resulting piecemeal patchwork has been, and remains, what the compilers of world lists have had to cope with as best they can.

Lynx on its own or BirdLife on its own could not conceivably have attempted a project that seeks to be proactive in addressing a significant number of the more salient issues in species-level taxonomy at the global scale. However, by pooling our various resources we felt we might generate a synergy which could serve our common interests and needs. We began discussions in 2009, and it has taken five years to reach this seeming half-way stage, although in fact we plan to issue the passerine volume as soon as possible, in 2016 (since the size of the book would require two volumes, and since the non-passerines and passerines form two roughly equal groups in terms of species numbers, we long ago decided that a two-step approach to publication was appropriate). In briefest outline this is the story behind the *HBW–BirdLife Checklist*; however, we feel it incumbent to go into considerably more detail in order to justify our venture more fully, although to do so we have to go back to the very beginning.

The speciation process and the species problem

Evolutionary theory holds that all life on earth can be traced back to an ill-defined moment in time when certain compounds (methane, ammonia, phosphate), under certain influences (heat, electricity, radiation), began to form self-replicating acids. From a biogenesis so far back in the history of the planet that dozens of ideas have been put forward concerning its

nature, the “tree of life” eventually arose, branched and budded into all the dazzlingly intricate forms we know today—and into many others, we can be sure, that we have yet to come to know.

Blind adaptation to environmental conditions in this self-replication process is the driver of the variation in this unimaginably giant tree. Adaptation itself, like the first life on earth, results from entirely random circumstances. Biotic and abiotic conditions in one part of an organism’s range encourage a particular slight variation in that organism where conditions in another part of the range do not; both variants thus adapt to—increase their resource-use efficiency in—their individual circumstances, and in the process begin their slow trajectory towards independent existence. But because conditions are always changing at a great range of scales from global to local, these organisms remain under constant (and constantly changing) pressure to adapt further in order to survive and self-replicate, and the process—which, because it involves advantages and therefore disadvantages, is necessarily conceived as a competition, a struggle for existence—thus never ends. It can be seen in life-forms separated by the splitting of continents under tectonic effects; but it can be seen, too, in life-forms separated by a few metres and by a few hours every day in rock-pools along a sea-shore.

At a certain point in the divergence of the organisms that make up animal life (the life of plants is considerably more complicated) their differences—their degrees of adaptation to their environment—reach the point at which recombination with their closest relatives represents a disadvantage to their ability to survive and self-perpetuate. These disadvantages mean that recombining populations are outperformed by those that stay separate. This “natural selection” of the separate populations (abetted by “sexual selection”, in which males compete with males and females choose among them on the basis of traits that are not necessarily adaptive) also drives the evolution of mechanisms such as colour patterns, sounds and shapes that help block any further wasteful co-mingling between them. This is the point—complete reproductive isolation—at which biologists

can judge with certainty that a species has been born (Figure 1): a new and distinctive leaf on the tree of life has unfurled.

Unfortunately, in reality the situation is not always so clear-cut. Populations of apparent species *do* sometimes merge without apparent disadvantage. Other populations may behave like species in one part of their range but merge without disadvantage in another. Hybridizations occur, sometimes with fertile offspring, sometimes not. Owing to such inconvenient truths some evolutionary biologists make the points that life on earth is a continuum, that life-forms are continuously evolving, and that their division into “classes”, “orders”, “families”, “genera”, “species” and “subspecies” is simply a human artefact, made for our convenience (see, e.g., Mallet 2006). Such pronouncements are certainly a timely reminder that these distinctions are subject to constant revision; moreover, if speciation is a continuous process, then determining species limits must to some extent be arbitrary (although of course arbitrariness is not the same as random: it is, rather, the result of the best subjective attempt to evaluate a case by reference to similar cases, within the framework of contemporary opinion—informed inference rather than pure guesswork). Nevertheless, as working hypotheses our hierarchical classifications of animals and plants commonly work well: nobody need doubt that Greater and Lesser Flamingos *Phoenicopterus roseus* and *Phoeniconaias minor* are two species or that they clearly group together with several other flamingos into one highly recognizable family.

But what about the populations of flamingo that live on opposite sides of the Atlantic Ocean—American *Phoenicopterus ruber* in the New World and Greater *P. roseus* in the Old? They differ in certain respects, but they are far more like each other than either is like Lesser Flamingo. So are they one species or two? Are the differences that have evolved between them large enough to prevent them from interbreeding, or at least interbreeding successfully? Unfortunately we cannot tell by reference to nature alone, since their populations live in allopatry, never naturally coming into contact. The obvious basic test of species status involves populations that live alongside each other through their use of the same localities (sympatry) and habitats (syntopy), as in the case of the Greater and Lesser Flamingos in the lakes of the Great Rift Valley: because they do not interbreed, *de facto* they are species (Figures 2 and 3). This is the basis of the Biological Species Concept (BSC): any population that retains its phenotypic and genetic integrity when in direct contact with another population must, necessarily, represent a species (if it did not, it would not exist).

However, populations of similar-looking taxa that do not come into contact present a problem for the BSC. Separated by geographical barriers such as mountains, seas, rivers and other kinds of unsuitable habitat, such populations are not and cannot be subject to the test of reproductive incompatibility. Experiments in captivity may be indicative but never conclusive, because animals are unavoidably but unquantifiably modified by *ex situ* conditions (Frankham 2008); and, in any case, the great majority of species cannot easily be maintained in captivity for the sake of such studies. Faced with many thousands of cases of allopatric taxa, taxonomists have been thrown back on their informed inference to judge what taxonomic status two populations should have, based on the degree of difference they perceive between them and subjectively assess as evidence. In an attempt at greater rigour (although it rarely if ever appears to have been practised), they were enjoined to apply a criterion that involves measuring the differences between two allopatric populations and comparing their magnitude with the differences between two closely related sympatric species that are also the closest relatives of the taxa under review (Mayr 1969, Mayr & Ashlock 1991). If the magnitude of the difference between the allopatric taxa is more than that between the sympatric taxa, then the allopatric taxa are species; if not, not.

This criterion may have some general appeal and applicability (it was adopted in this century, for example, by Helbig *et al.* 2002), but it has several significant although not always obvious drawbacks. The first is that there may be no close relatives with which to make the comparison. The second is that, even if there are such relatives, the result may not be helpful. Are the very similar Lattice-tailed and Choco Trogons *Trogon clathratus* and *T. comptus* (Figure 4) two species or one? Pairs of sympatric trogons exist to compare the levels of differentiation—Green-backed and Violaceous *T. viridis* and *T. violaceus*, Mountain and Elegant *T. mexicanus* and *T. elegans*, Slaty-tailed and Black-tailed *T. massena* and *T. melanurus*—but in each of these cases the two trogons constituting the pair are more obviously distinct from each other than *clathratus* is from *comptus*. The two transatlantic Greater Flamingo populations are another case in point: all other flamingo species are more distinct from them than they are from each other, but *P. [ruber] ruber* and *P. [ruber] roseus* are still strongly distinct, to the point where some taxonomists treat them as two species while others continue to consider them one.

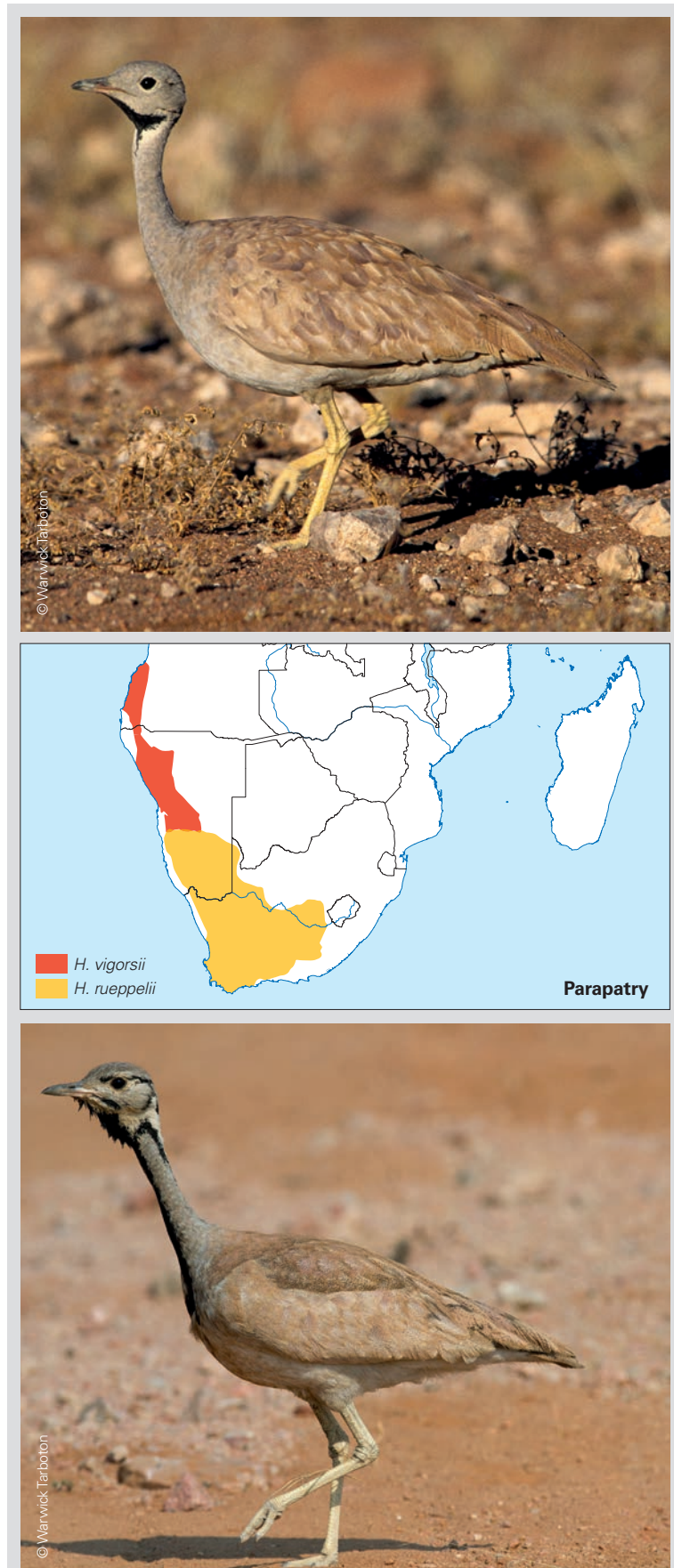


Figure 3 – Karoo *Heterotetrax vigorsii* (above) and Rüppell's Bustards *H. rueppellii* (below) were often considered conspecific in past taxonomies, because their level of morphological differentiation is not strikingly high. However, their ranges meet in southern Namibia and there are no definite records of hybridization or intergradation between them. Parapatric arrangements of this kind indicate a high degree of reproductive isolation and strongly support treatment of the two forms as biological species.

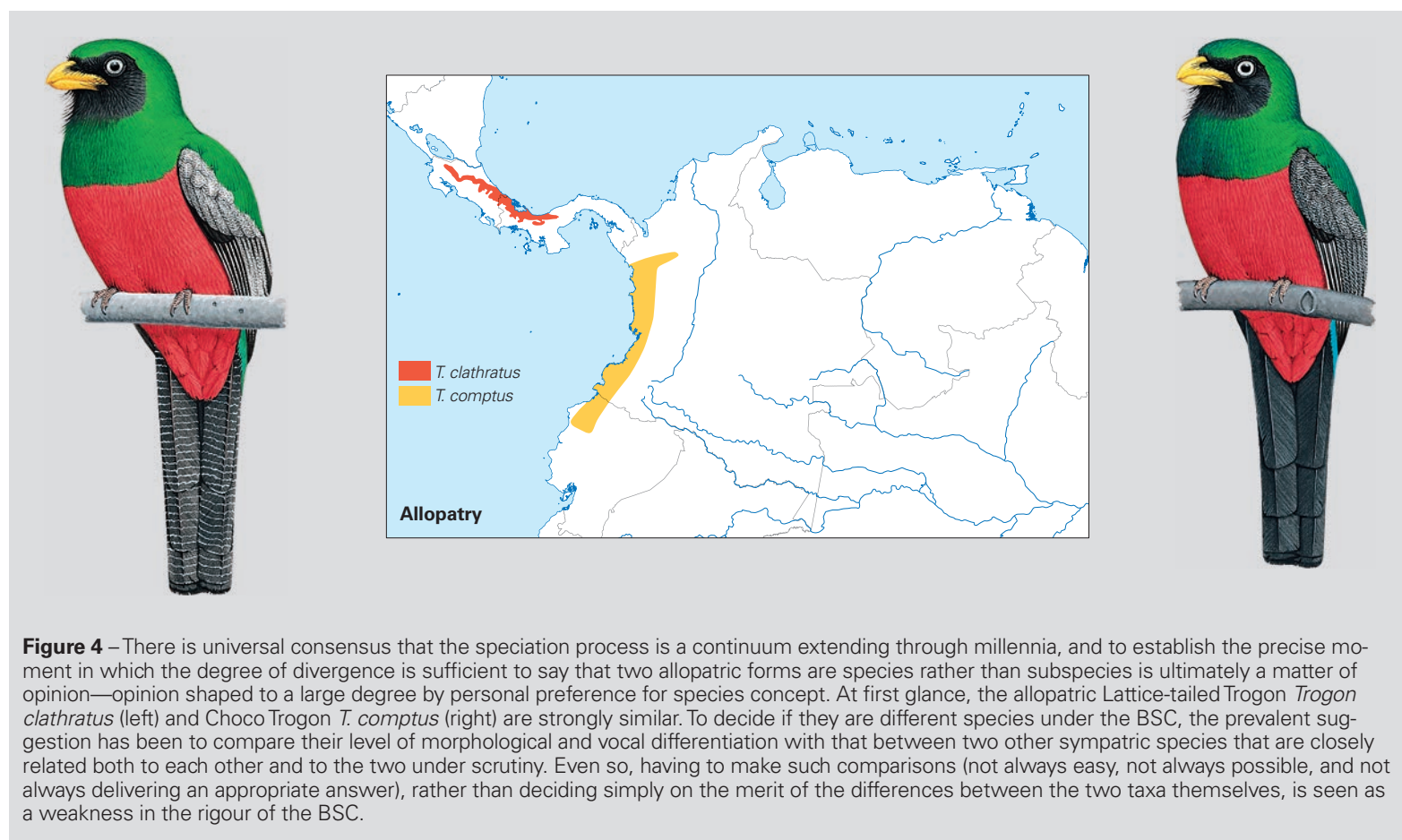


Figure 4 – There is universal consensus that the speciation process is a continuum extending through millennia, and to establish the precise moment in which the degree of divergence is sufficient to say that two allopatric forms are species rather than subspecies is ultimately a matter of opinion—opinion shaped to a large degree by personal preference for species concept. At first glance, the allopatric Lattice-tailed Trogon *Trogon clathratus* (left) and Choco Trogon *T. comptus* (right) are strongly similar. To decide if they are different species under the BSC, the prevalent suggestion has been to compare their level of morphological and vocal differentiation with that between two other sympatric species that are closely related both to each other and to the two under scrutiny. Even so, having to make such comparisons (not always easy, not always possible, and not always delivering an appropriate answer), rather than deciding simply on the merit of the differences between the two taxa themselves, is seen as a weakness in the rigour of the BSC.

This is the nature of the species problem: it is not just the degree of variation in the taxa that creates it—it is also variation in the preferences and perceptions of the taxonomists. Up in the canopy of the tree of life, the highest primates have long found it difficult to agree! Moreover, it is not just allopatric taxa that create a problem for them: it is also taxa that hybridize along the zones where they come into contact. For many decades following Mayr (1942), reproductive isolation was the critical arbiter of species limits in birds: “species are groups of actually (or potentially) interbreeding populations that are reproductively isolated in nature from other such groups” (that parenthetical phrase “or potentially” catering for the allopatric populations so many species possess). However, while very rare events could be dismissed as accidents, considerable dissatisfaction remained over the seemingly counter-intuitive relegation to conspecificity of, for example, Bullock’s Oriole *Icterus bullockii* with Baltimore Oriole *I. galbula* and of Golden-winged Warbler *Vermivora chrysoptera* with Blue-winged Warbler *V. cyanoptera*, the members of these pairs being far too distinct from each other to be easily credited as subspecies (Figure 5).

In the 150-year period between the epoch-making tenth edition of Linnaeus’s *Systema Naturae* (1758–1759) and Sharpe’s monumental *Hand-list of the Genera and Species of Birds* (1899–1909), when the great majority of avian taxa were described, these problems did not exist. Linnaeus is most celebrated for introducing the binomial system into biology, whereby every species must possess both a generic (*Otis*) and a specific (*tarda*) name (the generic name can sometimes be changed according to new perceptions of the species’ relationships with other species; the specific name can be changed only in exceptional circumstances). Sharpe was in a sense the last in Linnaeus’s ornithological line, taking a narrow, typological view that treated each described taxon as binomial irrespective of its similarity to another taxon; so by his own reckoning the number of bird species known on earth in 1909 ran to 18,939.

However, towards the end of the nineteenth century, with the steady accumulation of material allowing ever-greater sampling power, certain ornithologists, notably the Americans Elliott Coues and Robert Ridgway (Birkhead *et al.* 2014) and the German Ernst Hartert, based at Tring alongside his fellow countryman and like-minded taxonomist Karl Jordan in the employ of Lord Walter Rothschild (Johnson 2012), began to develop the use of trinomials as a means of indicating the very close relationship of certain taxa, when these appeared to differ in only trivial characters. In the thirty or so years after Sharpe’s death in 1910 the trinomial system—transfer-

ring many described taxa from the status of species to that of subspecies (*Otis dybowskii* becoming *Otis tarda dybowskii*) in a process now universally referred to as “lumping”—was imported into ornithology with astonishing speed, cutting his number of species by over 10,000 (i.e. more than half).

Whenever today one of these subspecies is restored to the level at which Sharpe left it (a process now universally referred to as “splitting”), it has become commonplace to deprecate the ornithologists who pursued this taxonomic synthesis—Peters pre-eminent among them as a consequence of his pioneering and monumental *Check-list* (1931–1986), which ran to 15 volumes and over 6,000 pages—for their failure to provide evidence or explanation for their decisions, rendering the process seemingly arbitrary and unaccountable. This failure can of course be particularly distressing in cases where the newly split taxon, whose conservation status when a subspecies was given no attention, proves to be threatened with extinction or even conceivably extinct (e.g. Blue-bearded Helmetcrest *Oxyphaps cyanolaemus*; Collar & Salaman 2013). Nevertheless, in reality this work of synthesis was a vitally important stage in establishing both the geographical and biological relationships between taxa, while at the same time clarifying the pattern of avian diversity across the planet. The great majority of these decisions would certainly appear to have been accepted by the global community of ornithologists: as Haffer (1997) noted, the number of bird species reckoned in 1946 was 8,616, in 1980 it was 9,021 and in 1990 it was 9,672, so that, although very roughly a thousand subspecies were reinstated as species during the second half of the twentieth century, another nine thousand—using Sharpe’s 18,939 as a baseline—remained unchanged and unchallenged. What instead we witnessed in this period was a slow but steady unpicking of species limits throughout the global avifauna as new information came to light (and since 1990 several hundred more splits have been proposed, bringing the total close to, if not over, the 10,000 mark).

Even so, “what is a species, and what is not?”, as Mayr (1996) portentously phrased it (and which these days can equally be re-cast as “what is a subspecies, and what is not?”), has become an increasingly live issue in ornithology over the past two or three decades. This is attributable to three interacting developments. First, dissatisfaction with the performance of the BSC in relation to allopatric taxa led to a proliferation of alternatives, of which by far the most important, influential and intelligible has been the Phylogenetic Species Concept (PSC), introduced into ornithology by Cracraft (1983). The key criterion in the PSC is diagnosability: if a population can be consistently discriminated by one or more unique characters,

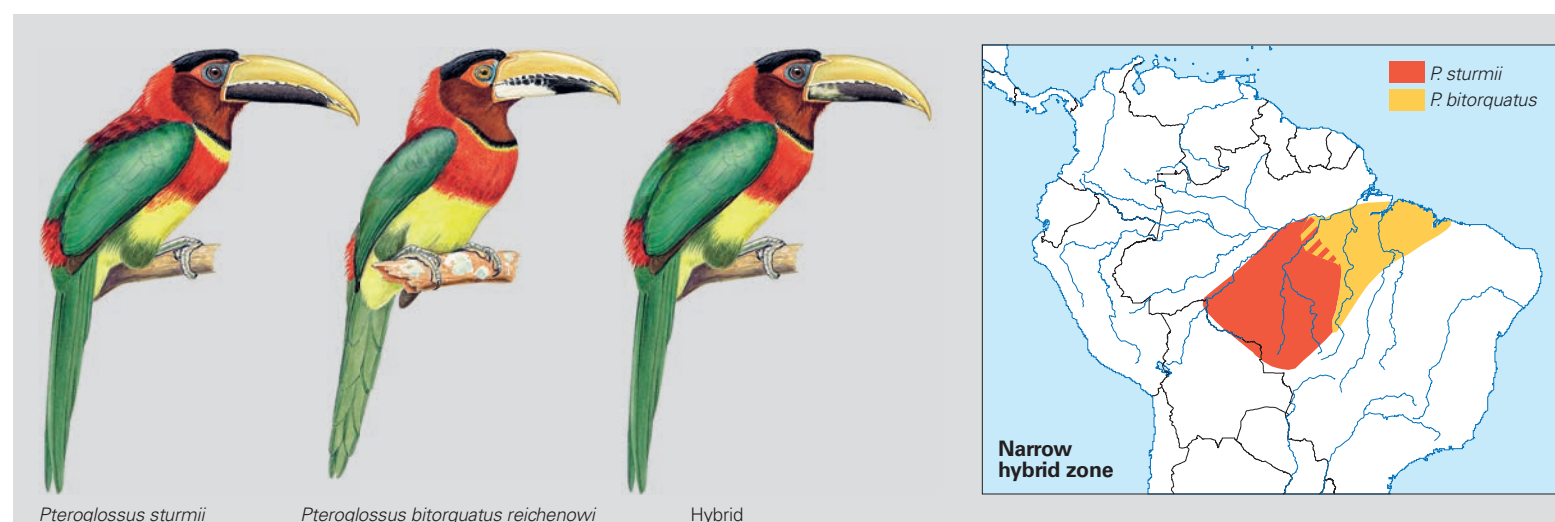


Figure 5a – Although two taxa can possess characters that strongly differentiate them from each other, as in the case of many pairs of toucans in the Amazon and elsewhere, where they come into secondary contact they may commonly hybridize. This happens, for example, in the upper reaches of the Rio Tapajós, Brazil, where intermediates between the Western and Eastern Red-necked Araçaris *Pteroglossus sturmii* and *P. bitorquatus* are found. Until recently, strict adherence to the BSC required that these forms be treated as conspecific, as the existence of intermediate birds was considered proof that reproductive isolation had not yet been achieved. Now the reverse is considered more appropriate: the failure of the genomes of the parent taxa to merge is strong evidence that full reproductive compatibility between the taxa has not occurred.

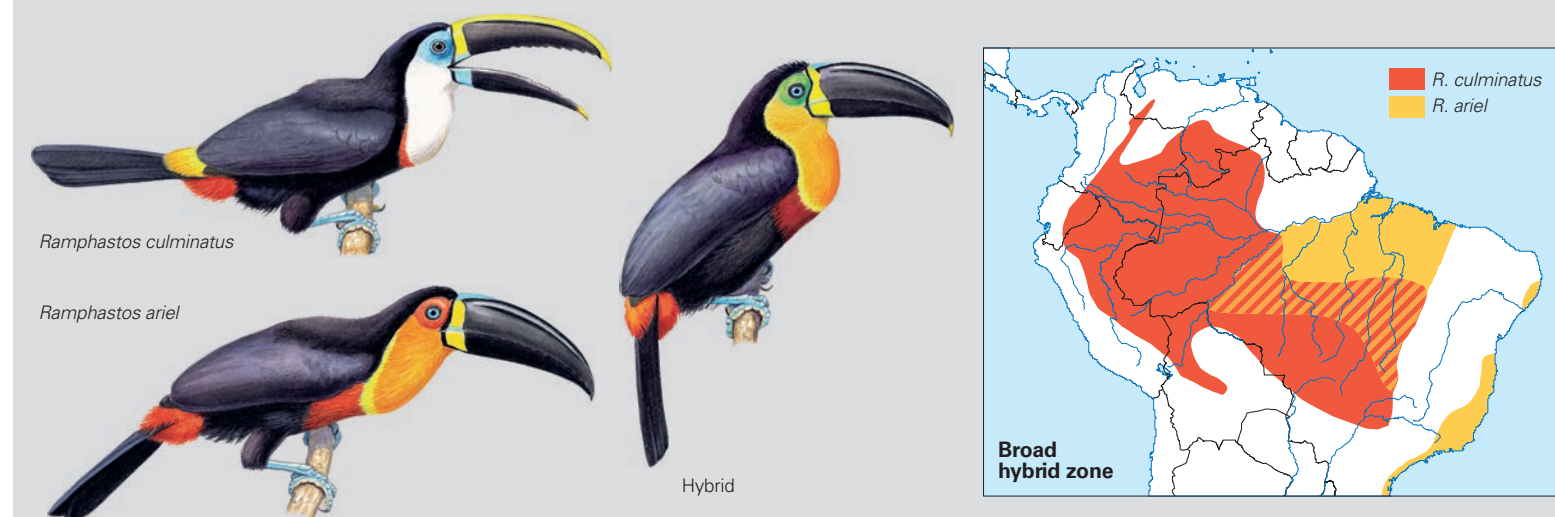


Figure 5b – Yellow-ridged and Ariel Toucans *Ramphastos culminatus* and *R. ariel* differ strongly in bill and underparts pattern, rump, bare skin and iris colours, as well as in morphometrics, yet the hybrid zone they form is a broad one, indicating an even lesser degree of reproductive isolation than in the case of the araçaris in Figure 5a (above). Consequently, in most recent handbooks, monographs and checklists, these taxa have been treated as subspecies of the same species. For many, the subsuming of such distinct forms into one species is a source of frustration with the BSC (although hybridization causes similar problems for other species concepts too). However, while hybridization could be taken to indicate that the two taxa are on course eventually to become one, it is equally valid to argue that the failure of the parent taxa to have lost their identities (yet) indicates that hybridization carries a significant biological disadvantage. Indeed, the breeding success of pairs involving hybrid birds was recently shown to be significantly lower than between pure ones (Harr & Price 2012), suggesting that incomplete reproductive isolation still has important selective consequences.



Figure 5c – Other examples of distinctive forms that for similar reasons have commonly appeared merged in the plates and texts of field guides until recently include Baltimore and Bullock's Orioles *Icterus galbula* and *I. bullockii*, as Northern Oriole, in North America (left-hand pair); Brown-faced and White-faced Barbets *Pogonornis minor* and *P. macclounii*, as Black-backed Barbet, in Africa (central pair); and Rufous-throated and Black-throated Thrushes *Turdus ruficollis* and *T. atrogularis*, as Dark-throated Thrush, in Asia (right-hand pair).

it is assumed to represent a monophyletic “terminal taxon” (a monotypic entity with a single ancestral lineage). Under this concept all subspecies that are disjunct populations (as on islands or mountaintops) are terminal taxa and therefore species; and all subspecies that are arbitrary segments of clines (in which a character such as size or shade changes fractionally but continuously across a geographical range) cannot be diagnosed and thus acquire the status of populations within a monotypic species (Figures 6 and 14). By this means, subspecies (which are integral to the BSC as natural and necessary phases in the evolution of species) are rendered obsolete, and the world reverts to a list of species very much as Sharpe knew it.

Second, from the mid-1980s the growth in scope and ease of international travel, and the concomitant growth of the nature-tour industry and its associated equipment, have produced a wealth of new knowledge of many avian taxa. Field guides and handbooks have made use of this knowledge, and in some cases have proceeded to make splits less on PSC grounds than on evidence compatible with BSC criteria, with perhaps the prime example being Rasmussen & Anderton (2005), which made extensive use of vocal evidence to inform often radical taxonomic decisions on the birds of the Indian subcontinent; Ridgely & Greenfield (2001) for Ecuador and Sinclair & Ryan (2003) for sub-Saharan Africa are other authors who also made significant innovations based on their judgements and preferences. There is even, to some degree and in some quarters, a certain pressure from birdwatchers, especially the more widely travelling ones, to split species as a means of maintaining the upward momentum of their life-lists (although this may be kept in check by the uncertainty and ambiguity of many resulting records: Figure 8).

Third, genetic studies came of age in the 1980s and have, as with individual human growth, developed in maturity and authority with each passing decade. Laboratories for molecular analyses have proliferated in many museums and universities, resulting in a breathtaking number of papers in recent years that offer, on a monthly basis, new phylogenetic insights

and unexpected connections and disconnections between taxa (the verb “reveal” commonly features in their titles). Many of these papers address, either directly or indirectly, the issue of species limits and make recommendations based on the genetic distances that the analyses disclose. Almost all such proposals have substance, but here too, in rare instances, there may be an unacknowledged and indeed unconscious pressure to split species, if only because to do so represents a somewhat more momentous scientific conclusion, a correspondingly more publishable result, and a more demonstrable return on the often very considerable investment of both time and money that such work represents (a view wryly espoused, for example, by Pyle 2012).

These three factors have loosely combined to create a new democracy in taxonomy in which several different kinds of expert have felt able to participate, largely supplanting the traditional museum taxonomist, into whose quotidian remit this kind of work fell for the previous two and a half centuries. Moreover, the constituency is now much greater than it was in past eras: an array of “stakeholders”, from birdwatchers through professional ornithologists, biologists, systematists and collection managers to legislators, conservation planners and funding agencies, have legitimate interests in wishing for greater clarity and confidence over the taxonomic entities they are dealing with. However, what taxonomy thereby indubitably gains in terms of rejuvenation and openness it risks losing in terms of stability and coherence, since different authors give different weight to such elements as morphology, voice, genetic distinctiveness and even conservation status. At any rate, the clear trend in modern avian taxonomy is to split species on increasingly narrow margins of differentiation, involving sometimes PSC principles (turning the Golden-green Woodpecker *Piculus chrysochlorus* into six species: Del-Rio *et al.* 2013); sometimes variations in vocal and other behavioural characters in morphologically similar taxa (turning two sirystes *Sirystes* into four: Donegan 2013); sometimes degree of molecular distance (establishing New Caledonian Parakeet *Cyanoram-*

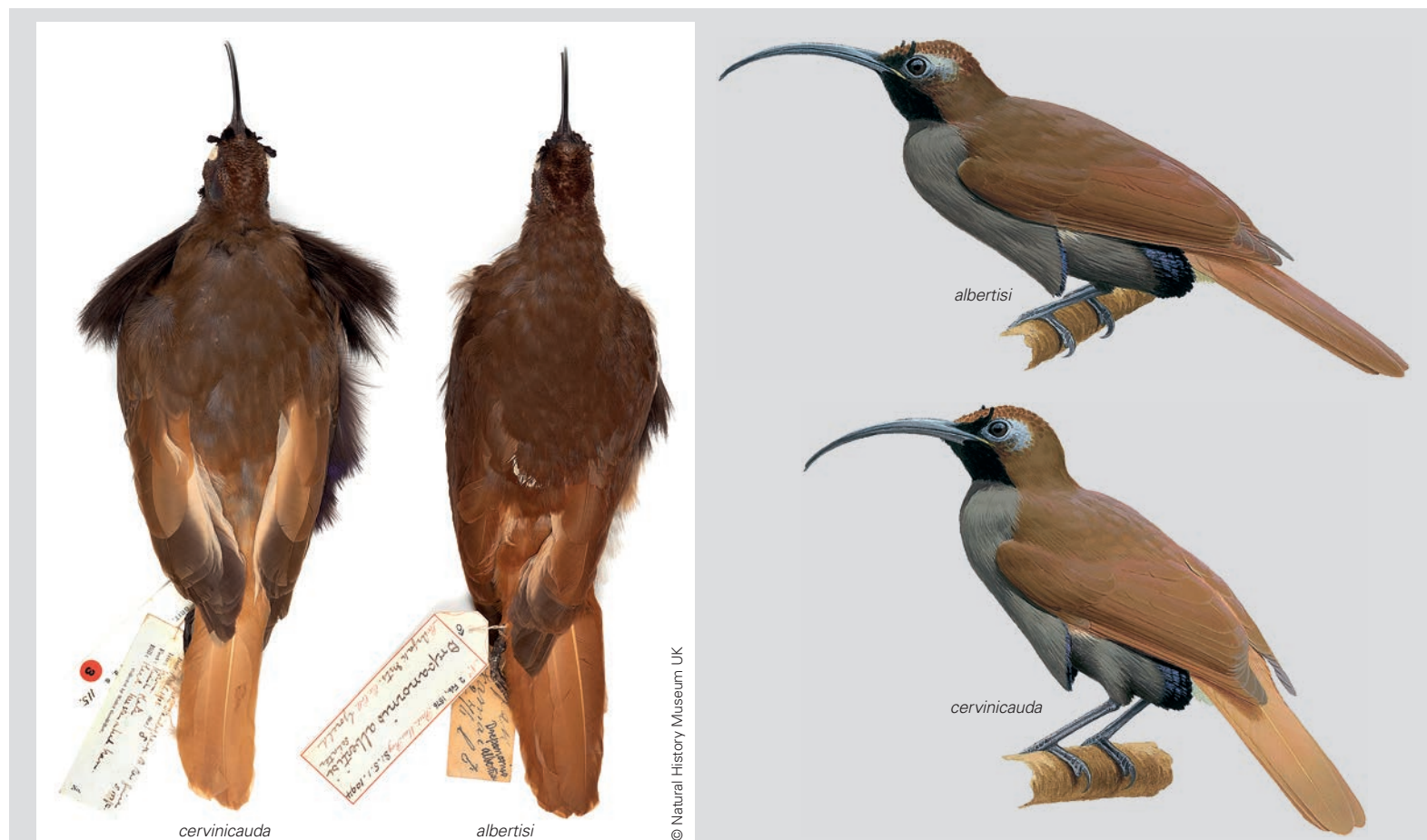


Figure 6 – Dissatisfaction with the inherent difficulty of the Biological Species Concept in dealing with the taxonomic rank of allopatric forms was a driving force behind the proliferation in the late twentieth century of alternative species concepts, many of them seemingly minor adjustments of other formulations. The Phylogenetic Species Concept (PSC) appears to have been by far the most successful in terms of appeal to and understanding by those undertaking taxonomic revisions. Under the PSC diagnosability alone is the key criterion: all taxa that are diagnosably distinct rank as species. Accordingly, for example, the form *cervinicauda* of the Black-billed Sicklebill *Drepanornis albertisi*, although usually considered a weakly marked subspecies, rises to species level under the PSC (Cracraft 1992) because it is diagnosable from the nominate form on the basis of its slightly paler upperparts with little chestnut tinge.



Figure 7 – Of course the PSC itself is not exempt from criticism. A common objection is that, with ever more refined human technologies, diagnosability is a dynamic rather than a stable concept. At the start of the present century the New Caledonian Parakeet *Cyanoramphus saisseti* (right) was proposed as a different species from the Red-fronted Parakeet *C. novaezelandiae* (left), through explicit invoking of the PSC criterion of diagnosability—not on grounds of the morphological characters by which the subspecies was originally established but, rather, solely on its “mtDNA control region data” (Boon *et al.* 2001). Nevertheless, the study found a degree of structure within *C. novaezelandiae* itself, such that further research might provide new molecular evidence for more PSC splittings in this complex. Moreover, while the same study found no evidence to split the subspecies *C. n. chathamensis*, this form is still widely regarded as a valid taxon, presumably because it can be diagnosed on morphological grounds. Thus questions remain over the number of diagnosable units (i.e. PSC species) that exist within the *C. novaezelandiae* complex. This is not to deny that the molecular study was potentially of great help, not only in understanding the evolutionary history of these populations but also in providing pointers for their optimal management from a conservation perspective (nor is it to imply that the conservation of subspecies and island populations is of no importance). Indeed, probably under the influence of the trend towards splitting that has dominated ornithological classifications in the last two decades, this split has been extensively adopted by workers and institutions (including BirdLife International) which are not consciously following the PSC.

phus [novaezelandiae] saisseti and Norfolk Parakeet *C. [n.] cookii*: Boon *et al.* 2001; Figure 7); and sometimes through different combinations of these factors (breaking the Clapper/King Rail *Rallus longirostris* complex down into five: Maley & Brumfield 2013).

A further trend is for these splits to pass largely unchallenged into the literature, by virtue of a domino effect involving one uncritical acceptance after another, each exerting an ever-increasing peer pressure to conform (if two or three lists accept the split, it looks increasingly perverse or out of touch for a new list to stand against it). This trend towards taxonomy by default may indeed promote a greater homogenization in world lists, but this is not the same as creating stability, since new insights, particularly emerging from the welter of modern genetic studies, frequently promote further changes and combinations, so that the life-span of a split can sometimes be rather short, as in the case of, for example, Cape Verde Kite *Mikrus fasciinucha* (1995–2005), Southern Grey Shrike *Lanius meridionalis* (in the polytypic sense in which it was always treated; 1993–2010) and Fuerteventura Blue Tit *Cyanistes degener* (1996–2008) (Collar 2013). That this phenomenon has considerable ramifications for ornithology in general and conservation in particular—in its various managerial and legislative guises—goes without saying.

But the taxonomic genie is out of its little museum bottle, and it shows no sign of intending ever to go back. This is not something simply to be

accepted with good grace but to be welcomed with unpatronizing if cautious enthusiasm. On the one hand, increasing numbers of bird taxa are being documented through photographs and video- and sound-recording, producing a major new body of behavioural and morphological evidence (AVoCet, the Internet Bird Collection, the Macaulay Library and Xeno-canto are manifestations of this); and on the other, increasing numbers of bird taxa are being DNA-sampled, both dead and alive, with ever-greater sophistication and confidence. These two factors in particular, abetted by the world wide web and perhaps even, through its illustration of every distinctive subspecies, by HBW, have created a new era in global ornithology. If the species problem is still part of that new era, we perhaps need new ways of addressing it.

Convergence and criteria in species-level avian taxonomy

Recent steep rises in the numbers of species being recognized, particularly among vertebrates, has led to concerns that “taxonomic inflation” may be devaluing the currency of the species and increasing the costs, complexities and choices that must be faced by conservationists (Isaac



Greater Snow Petrel
Pagodroma nivea major



Lesser Snow Petrel
Pagodroma nivea nivea

Figure 8 – The recent tendency to split species has, in general, been well received by field ornithologists, as a means of elevating the profile of the subjects of their research, and by birdwatchers, who enjoy the prospect of a longer list of species to see in their lives. But in cases of extreme splitting, the consequences may not always be so positive. For instance, the Greater and Lesser Snow Petrels (treated here as *Pagodroma nivea major* and *P. n. nivea*) can be separated only by size (when seen side by side at sea) or by geography (when at their respective breeding colonies), but otherwise they are unidentifiable. This means that the great majority of observations of these two “species” (for followers of the more radical taxonomy) cannot be attributed to one or the other.

et al. 2004, Parham *et al.* 2006, Zachos & Lovari 2013). The robust alternative view is that many of these changes represent real and hard-won progress resulting from the advent of better taxonomic tools and greater theoretical clarity in their application, and they neither should nor do have implications for conservation (Padial & de la Riva 2006, Sangster 2009, 2014, Morrison *et al.* 2011). To at least one observer, the truth lies somewhere between (Tattersall 2007), and a synthesis of sorts may indeed offer the firmest basis for a reasonably stable consensus. The writings of recent advocates—Johnson *et al.* (1999) for the BSC, Sangster (2014) for the PSC—suggest that, while polarization is still in evidence, there is nevertheless in general a degree of movement from both camps towards a middle ground (Figures 9 and 14). The former authors offered the following definition under what they call the “Comprehensive Biological Species Concept”:

An avian species is a system of populations representing an essentially monophyletic, genetically cohesive, and genealogically concordant lineage of individuals that share a common fertilisation system through time and space, represent an independent evolutionary trajectory, and demonstrate essential but not necessarily complete reproductive isolation from other such systems.

The clarification encapsulated here (in those words “not necessarily complete”) that hybridization is not an automatic block on species recognition moves the BSC to a more accommodating position. Similarly, the criteria formulated by the British Ornithologists’ Union (BOU) stipulate the need for species limits to be determined on “multiple characters” (Helbig *et al.* 2002), shifting at least a little from the PSC, which readily defines species on the basis of a single character. Moreover, analysis by Sangster (2014) suggests that “avian species-level taxonomy has become increasingly pluralistic and eclectic”, meaning that “taxonomists consider different criteria as complementary rather than as rival approaches to species delimitation”. This observation is supported by the notable trend in recent (post-2000) papers splitting species or establishing new ones to assess the taxa under review against both PSC and BSC.

All the same, the fact that a thousand species were “created”, mostly through splitting (of course a percentage were new discoveries) in the second half of the twentieth century, in reaction to the trinomial consolidations of the post-Sharpe decades, is a clear sign that species limits in birds are by no means settled, and that world lists continue to abide by taxonomic decisions from 70–80 years ago, many of which are incompatible with modern treatments and indeed modern evidence. These world lists are to varying degrees dependent on regional or national lists, on family and other taxonomic monographs, or on both, and inevitably this patchwork dependence results in inequalities and imbalances of treatment owing to differing judgements and possibly different levels of competence in the authorities used. A notable dimension to this problem is the geographical bias in the scope and intensity of taxonomic investigations, which is generally high in regions and continents where western institutions have long been active (the Americas, Europe, the Middle East, Africa and Australia), but rather lower where they have not (Asia, Papuasia and parts of the Pacific). For example, ten years ago the birds of Asia were very crudely judged to be undersplit by 8% compared with the Neotropics, resulting in an even cruder estimate that a level of scrutiny on a par with that given to the New World avifauna might increase the Asian species complement by over 500 (Collar 2003).

One of the strongest ambitions of HBW (1992–2013) was to illustrate all well-marked subspecies; accounting properly for geographical variation is, after all, a central *raison d’être* of any zoological handbook. Consequently, in the first ten years of the project visits were made to the world’s most important museums as well as over 80 zoos and aviaries in order to build up a photographic reference collection of all distinctive avian taxa, resulting in a body of some 30,000 slides. Naturally, therefore, the two decades of editorial scrutiny, part of them spent in carefully checking plates against text against photographs, prompted many reflections about the status of the taxa in question; indeed, although this was never the primary intention, the entire venture constituted a unique opportunity to review the distinctive subspecies of the world through fresh eyes. Moreover, as HBW approached its conclusion, it was very obvious that—irrespective of any perceptions about the true status of distinctive subspecies—the list of species it treats (total 9,903) was significantly out of date.

In parallel with this, the small science team at BirdLife International was coming under increasing pressure from the sheer volume of taxonomic changes being put forward not just in the technical peer-reviewed literature but also in popular magazines, field guides and handbooks

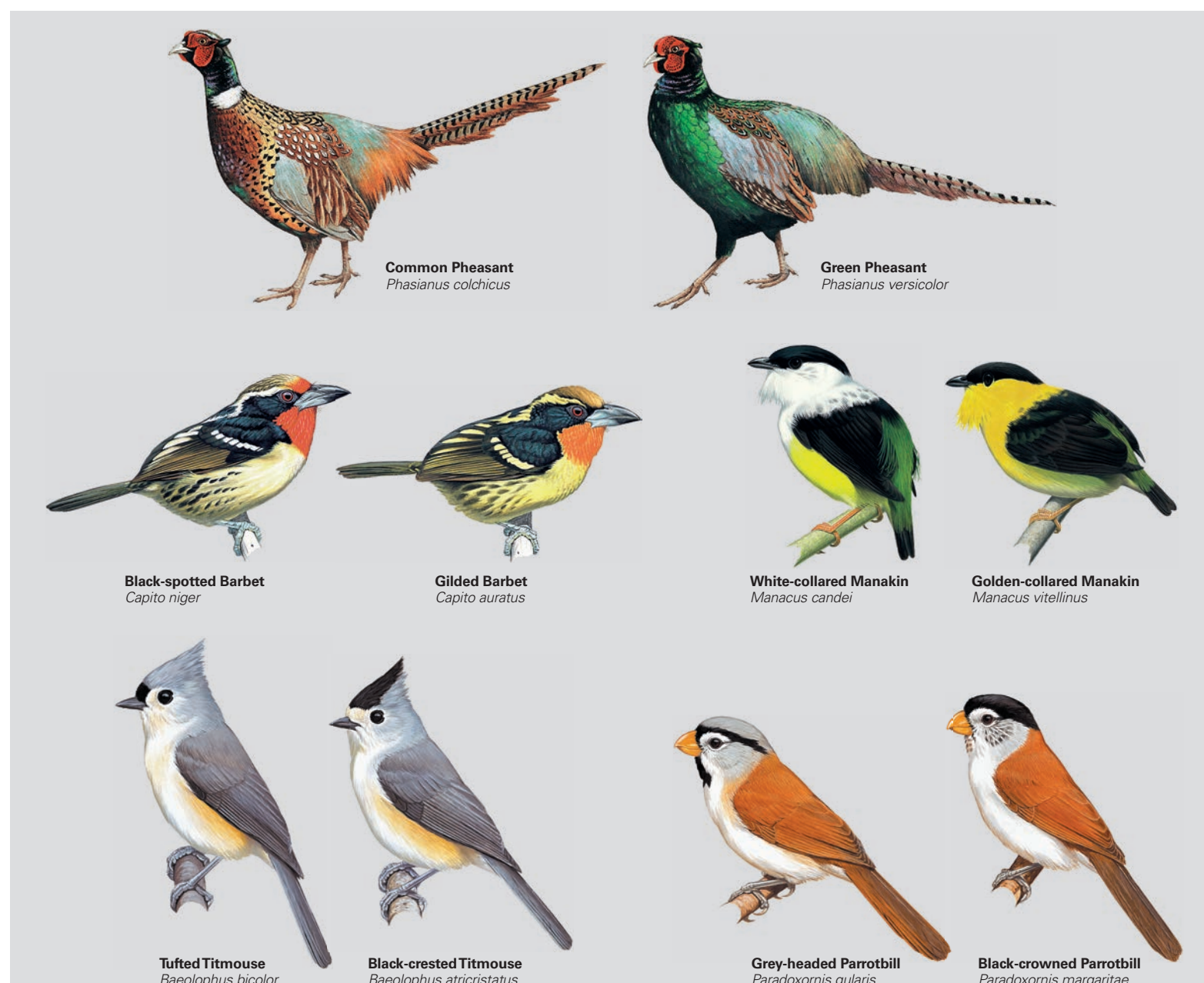


Figure 9 – Criticism of the BSC is mainly directed at its most restrictive version (disallowing species status for taxa that hybridize), but in reality for a number of years now almost nobody has applied it in this way. Taxonomists who prefer to relate species rank to reproductive isolation tend to accept a looser, more liberal interpretation of the BSC, several of which have been formulated over recent years (see, e.g., Haffer 1997). Perhaps the most salient of them is the Comprehensive Biological Species Concept (Johnson *et al.* 1999), under which taxa are species if they “demonstrate essential but not necessarily complete reproductive isolation” (see previous page). Thus these modern formulations of the BSC no longer place hybrids, which indicate that breeding incompatibility has not been fully reached, as an impediment to species status of clearly distinct forms previously ranked as subspecies. This is the case with all the taxa shown in this figure, which are today more or less unanimously accepted as species.

(including, sometimes, HBW). Given the need to document and, more importantly, conserve any “new” species that might be emerging from these sources, the work of assessing the validity of these changes against some sort of standard relating to the BSC (the only species concept used in world lists and indeed in virtually all avifaunal and taxonomic lists) was and remains imperative. Moreover, fieldworkers with both experience of taxa in the wild and some feeling for their conservation status would increasingly often suggest that certain of them be scrutinized for an urgent taxonomic upgrade. Independently, the science team’s own work in museums, connected with the search for distributional and ecological data on specimen labels, commonly brought them face to face with species-level issues that needed to be addressed by someone sometime soon. At the back of the BirdLife team’s mind was always the question: how many taxa that most modern taxonomists would regard as species are going extinct unnoticed because they are currently treated as subspecies?

Clearly, then, Lynx and BirdLife had convergent interests in a thoroughgoing review of avian taxa across the world, and to a degree they had

complementary resources with which to tackle such a venture. Lynx’s list derived from the treatments of the many HBW authors, most of them acknowledged world experts in the families whose accounts they wrote; BirdLife’s list derived from a conflation of regional checklists, with Sibley & Monroe (1990) as the default authority (BirdLife International 2014) but with a succession of annual revisions produced by a small committee that reviewed (and continues to review) new taxonomic proposals. The new vision was for a list that carefully takes into account everything that other authors have produced in recent years, but which also evaluates in a consistent way all the prospective cases that present themselves within the pages of HBW, the drawers of museums and the messages of concerned correspondents. HBW’s extensive collection of plates and BirdLife’s ambitions to update and improve its dataset of maps for all bird species were further persuasive considerations for a collaboration. But was there also common ground on the small matter of the criteria to use in making this new global assessment? From all points of view the dominant need was for consistency, for equality of treatment; so what were the options?

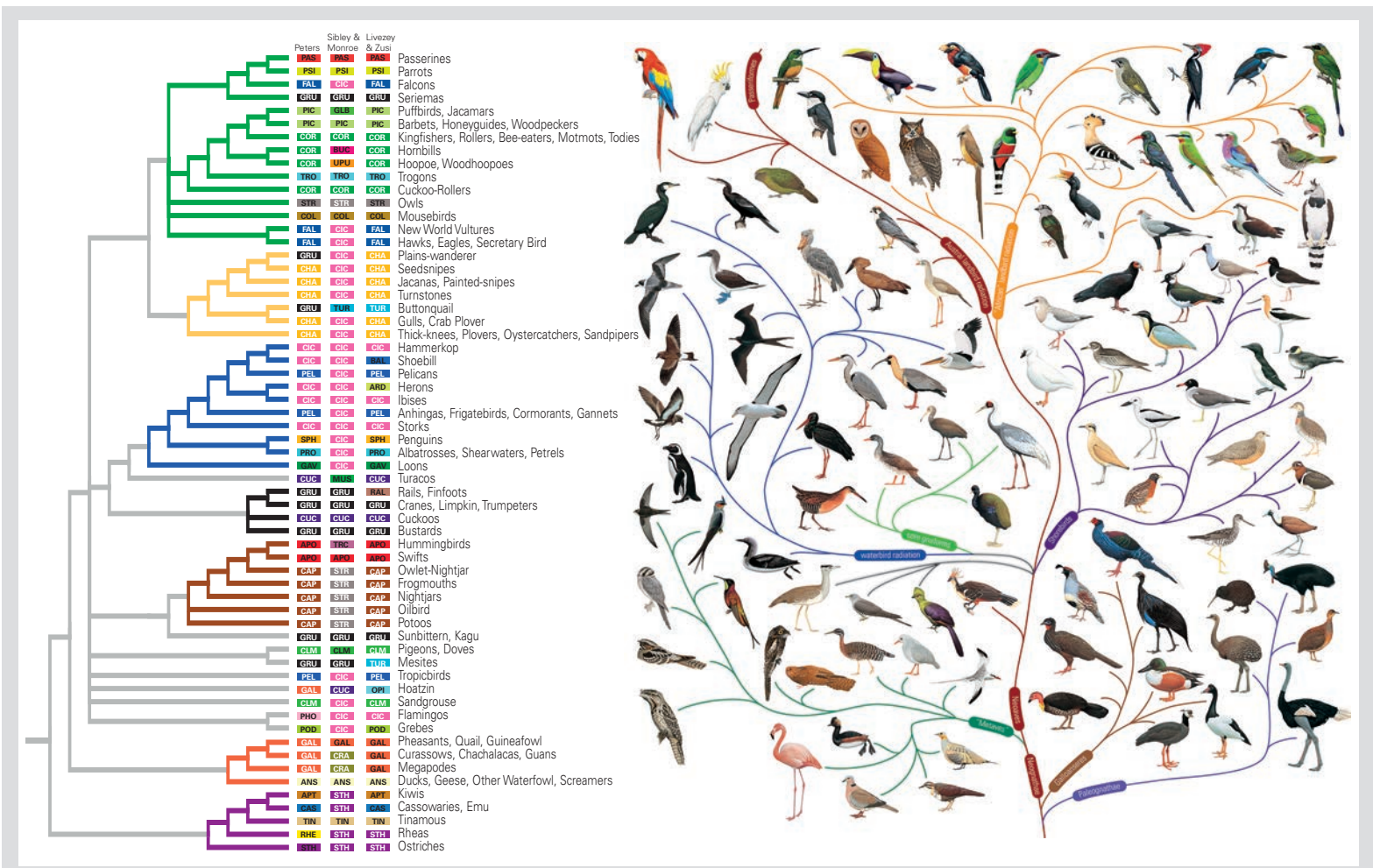


Figure 10 – The arrival of genetic studies in systematic ornithology produced a major upheaval. The pioneering work of C. Sibley and colleagues in the early 1990s, mainly seeking to clarify the relationships between the higher groups of birds, had a marked influence. While some of their findings are still considered valid, others were later contradicted by more advanced research techniques, with much more comprehensive samples, and in recent years results have reached a level of reliability that is regarded as very high. Perhaps the most notable example is the work of S. Hackett and collaborators, published in *Science* in 2008, after which there has been a high degree of consensus about the orders and families into which the class Aves can be divided (Winkler *et al.* in prep.).

A PSC-based approach to the issue was never likely to be practical to adopt. Whatever the attractions of a world list that might stretch to 25,000 species—and number of species has never been a reason, on its own, to reject the PSC, despite claims to the contrary—the PSC rejection of subspecies runs counter both to evidence and to intuition. Both HBW and BirdLife have long acknowledged the legitimacy of subspecies, and the case for retaining this taxonomic rank is, we judge, compelling (see, e.g., Remsen 2010). No less compelling is the fundamental difficulty that exists with the PSC dependence on diagnosability: with increasing scrutiny, populations can frequently be divided into new “terminal taxa” based on very minor but consistent (and therefore diagnosable) differences, with the consequence that PSC species lists are, of their very nature, impractically volatile (Figure 7). The difficulty remains even in the case of multiple (i.e. at least two) characters, as proposed by Helbig *et al.* (2002), if those characters are weak enough: a case in point might be the recently described race *wirthi* of the Blue-winged Siva *Siva cyanouroptera*, the only known material of which lay undiscriminated in museum drawers for 80 years, but which differs from *S. c. orientalis* in two unobtrusive characters—a warmer rump colour and slightly smaller size (Collar 2011)—on which basis it could qualify as a species under the BOU criteria. A further consideration is the circumstance in which the central section of a cline becomes extinct: under the BSC the two end-points normally remain subspecies, but under the PSC they become diagnosable and therefore species, creating the paradox whereby a decrease in actual biological diversity produces an increase in measured biological diversity (Collar 1997). For these and other reasons, some conservation biologists are electing not to work with the PSC (e.g. Frankham *et al.* 2012).

What, then, of genetics? Taxonomists have, of course, always used phenotypic evidence as a surrogate for genetic evidence, and the general assumption is naturally that large and small phenotypic differences correspond

to large and small genetic differences. That this is not always the case has been one of the most striking features of the discoveries made by molecular workers in recent years. Nevertheless, an exclusively genetic solution to the challenge of a world list of bird species is, at least currently, no more practicable than one involving the PSC because, although molecular research is making extraordinary strides in the exploration of avian relationships, the number of taxa to be sampled and assessed remains defiantly large, and the coverage of taxa to date is patchy and uneven. One day—and it is difficult to predict how soon it might come (as early as 2022 *vide* Harr & Price 2012)—genetic work may entirely underpin all avian species-level taxonomy, as it is rapidly managing to do at higher phylogenetic levels.

In sympatry, two near-identical forms that demonstrate clear molecular differences must qualify as species. In allopatry, however, one long-standing obstacle to the use of genetics is the difficulty taxonomists currently have in determining or agreeing what degree of differentiation is enough to warrant considering a taxon a species. A first step ought to be to ensure that the most appropriate method of calculating genetic distance (“best-fit evolutionary model”) is always used, so as not to bias comparisons (Fregin *et al.* 2012); but in any case, as Collinson (2001) observed, “there will never be a fixed degree of genetic divergence which defines a speciation event”. Molecular work has thrown up some remarkable evidence to support this proposition in recent years. On the one hand, Common Swift *Apus apus* and Pallid Swift *A. pallidus*, which have different colours, somewhat different breeding regimes and overlapping ranges (and therefore have long been recognized as biological species), are “genetically indistinguishable” (Päckert *et al.* 2012); and Cyprus Wheatear *Oenanthe cyprica* has a behavioural repertoire which preserves its independence even though it is virtually identical in molecular phylogeny to two congeners (Randler *et al.* 2012). On the other, certain populations of a species, even if not recognized with a formal taxonomic (subspecific) name, may pos-

sess deep clades (with 4–5% differences) without any evidence of discrimination or disadvantage where they co-exist (e.g. Common Raven *Corvus corax* and Common Redstart *Phoenicurus phoenicurus*; Johnsen *et al.* 2010, Webb *et al.* 2011; Figure 12). Indeed, drawing on the Common Redstart evidence, Hogner *et al.* (2012) expressed the view that the existence of sympatric mtDNA divergences in birds “argues against the use of threshold mtDNA divergences in species delineation”.

This comes on top of evidence that the study of mtDNA is in any case not the most dependable means of investigating relationships—being rather, in one stark assessment, “perhaps intrinsically the worst population genetic and phylogenetic molecular marker we can think of” (Galtier *et al.* 2009). It is certainly fair to say that molecular workers have sometimes found their results in conflict with those of their colleagues or of their earlier selves, leaving non-molecular taxonomists in a state of mystified irresolution. A recent case in point concerns Black-backed Oriole *Icterus abeillei*, which until 1999 was considered most closely related to Bullock’s Oriole *I. bullockii*, but then in three successive mtDNA studies was claimed instead to be closest to Baltimore Oriole *I. galbula* (Omeland *et al.* 1999, Kondo *et al.* 2004, Kondo *et al.* 2008) before once again emerging, after nuclear DNA analysis, as sister to Bullock’s (Jacobsen *et al.* 2010, Jacobsen & Omeland 2011, 2012). Other salutary studies have found that nuclear DNA and mtDNA revealed divergent patterns of relationships in *Pterodroma* petrels in the north-east Atlantic (Gangloff *et al.* 2013) and in the Yellow-fronted White-eye *Zosterops flavifrons* (Phillimore *et al.* 2008). In the latter case morphology was incongruent with both nuclear DNA and mtDNA evidence, which indicates how natural selection might produce morphological change without leaving a detectable signature in the sampled genes—but what does this tell the taxonomically curious bystander about choosing between lines of evidence? What are we to make of a morphological study which concludes that Archer’s Buzzard *Buteo archeri* is merely a colour morph of Augur Buzzard *B. augur* and therefore has no taxonomic status at all (Clark 2003) and a genetic analysis which suggests that it is basal to all Afrotropical buzzards and not even closely related to *B. augur* (Riesing *et al.* 2003)? The taxonomic notes in this checklist under Antipodean, Amsterdam and White-capped Albatrosses *Diomedea antipodensis*, *D. amsterdamensis* and *Thalassarche steadi* carry further evidence of the contradictory findings that molecular work can bring to the taxonomic table. For the moment, therefore, insights from such work are, we strugglingly conclude, best used to prompt and consolidate splitting and lumping decisions based on other evidence, but not to be their sole arbiter.

Could the peer-review process, however, be the sole arbiter? This is a stance that has sometimes been taken in the past by compilers of species lists. Indeed, a recent comparison of two world checklists praised one over the other for being “more progressive in terms of adopting splits published in the literature” (Rostron 2011). The advantage here is that

a seemingly neutral system of assessment, by which papers proposing species-level changes are independently refereed for their scientific rigour, takes sole responsibility for what does or does not get incorporated into a checklist. However, a moment’s reflection reveals that such a strategy clearly will not serve the interests of consistency. First, some papers that pass the peer-review process are still poor enough in quality for their findings to be challenged. Second, some papers are perfectly good but openly use criteria relating to the PSC rather than the BSC. Third, ignoring a proposed or potential split because it has not been sanctioned in a peer-reviewed journal only perpetuates the patchiness of treatment that the HBW–BirdLife list in particular seeks to overcome (Figure 13).

Throughout the 2000s, in order to make rapid, consistent judgements in cases where the literature was claiming a split, BirdLife experimented with some simple criteria that sought to approximate to the levels of distinctiveness shown by species as defined under the BSC. Eventually, with the participation of evolutionary biologists from the University of Oxford, these grew into a system of assessing the level of difference between allopatric taxa based on scoring particular characters for their strength (Tobias *et al.* 2010). This system takes into account morphology, vocalizations, other behaviours and ecology as well as degree of hybridization, which, as determined by Johnson *et al.* (1999), is not fatal to species status under the BSC. Molecular data are used so far as possible to establish evolutionary history, to inform and support decisions made on other characters, and to cue research into taxa for other evidence, as in the case of the Raiatea Fruit-dove *Ptilinopus chrysogaster* which, concordant with molecular findings, proved to show characters aligning it with Rarotonga Fruit-dove *P. rarotongensis*. However, molecular differences between taxa are not assigned a score, because, as noted above, degree of genetic distance does not *per se* reflect degree of reproductive incompatibility, given that bigger distances can be found within some populations of what everyone regards as one species—as noted above for Common Raven and Common Redstart—than exist between many forms that are universally regarded as two, leaving us with no way of determining an appropriate score threshold for a given distance.

On the other hand, and crucial to its validation irrespective of its capacity to incorporate genetic information, the system was calibrated experimentally: when it was trialled on 58 pairs of closely related sympatric or parapatric bird species, in 95% of cases species status was reflected in a total score of 7. It was then applied, with 7 as the threshold, to 23 pairs of European subspecies, resulting in 21 (91%) remaining as subspecies and only two (both of them already considered by some to merit the higher rank) rising to species (Tobias *et al.* 2010). This sample suggests that the system coincides well with species limits as broadly agreed within the taxonomically well-worked and relatively stable avifauna of Europe, and that consequently it can be applied to other avifaunas with a reasonable

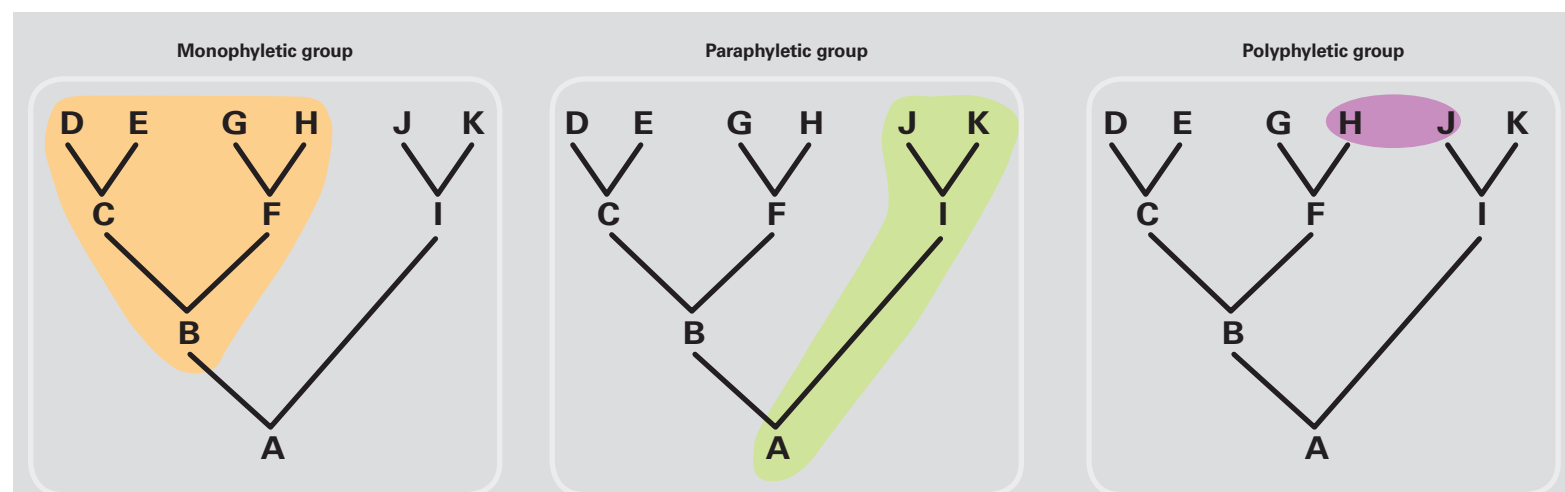


Figure 11 – The guiding principle in avian DNA studies that reconstruct evolutionary history is monophyly: each rank in any classification of birds, from subspecies to the highest groups, including of course the species, needs to represent an independent evolutionary lineage, i.e. one that is monophyletic as opposed to paraphyletic (one that includes the most recent common ancestor but not all of its descendants) or polyphyletic (one that does not include the common ancestor of all members of the taxon). This insight has had major repercussions at the genus level, resulting for instance in the disappearance of well-known genera (such as *Nyctea* for the monotypic Snowy Owl and *Megalaima* for the Asian barbets), the resurrection of others long forgotten (*Rupornis* for the Roadside Hawk, *Clanga* for the Spotted Eagles), and the establishment of entirely new ones (*Parkesia* and *Agraphospiza*). While perhaps less consistent than those concerning the higher categories of birds, the results obtained by workers focusing at the genus level are nevertheless usually compatible and convergent, with only minor differences related to sampling. Occasionally, however, the disparity is more striking, as in the case of two studies of the gulls (Laridae) (Pons *et al.* 2005, Sternkopf 2011; also Liebers-Helbig 2013), which caused first the resurrection and then the re-subsuming of the genera *Chroicocephalus*, *Leucophaeus* and *Ichthyophaga*.

degree of confidence that any score of 7 or more will reflect a high level of reproductive isolation (i.e. species rank) in the taxon in question.

This is not to say that the system, which does not pretend to be truly objective but simply to serve as a tool to help assess, consistently and transparently, degrees of difference between taxa, is infallible: 91% is encouraging but not perfect (although it is perhaps arguable that the original evaluations of the 9% were not perfect), and subjectivity, while contained to a degree by the way the scores are defined and capped, is certainly not eliminated. In any case there are significant issues, discussed below, relating to the constraints on human perception and judgement that the birds themselves do not share. Moreover, further calibration using taxa outside Europe may in future produce rather different results. Nevertheless, over and above its seemingly strong performance as a measure of reproductive isolation, the system possesses certain virtues in terms of consistency (all taxa treated to the one standard), rigour (all taxa required to meet the criteria via a series of options) and transparency (all evidence and judgements open to scrutiny). We therefore considered it appropriate to adopt it for use in this new global checklist.

The Tobias criteria: an outline

As indicated above, in assessing the overall degree of difference between taxa the key threshold under the Tobias criteria is a total score of 7: any taxon at or above this score is adjudged to possess species status. This total score can be reached by combinations of smaller scores generated by two types of criteria: phenotypic and distributional.

Phenotypic criteria

Phenotypic differentiation between taxa (involving plumage colour, pattern and structure, morphometric evidence and vocal characters) is scored according to four categories of magnitude, each so far as possible defined by quantitative thresholds; some smaller allowance is also made for differences in ecology and behaviour. Morphometric differences are quantified by using effect sizes (a measure of the magnitude of a relationship based on the spread of individual data-points) for the largest degree of difference computed from means and standard deviations (which show the degree of variation from the mean) and presented as the Cohen's *d* statistic; characters in a taxon that evidently co-vary (e.g. longer wing and longer tail) can be scored only once against another taxon, but characters that evidently do not co-vary (e.g. longer wing and shorter tail) can both be scored, involving the strongest increase and strongest decrease in effect size. Vocal characters are scored through spectrographic analysis based on the strongest temporal and strongest spectral effect size in analogous vocalizations in two taxa.

The four categories of magnitude in the phenotypic criteria are minor, which scores 1, medium 2, major 3 and exceptional 4 (Figure 15).

- A *minor* difference involves weak divergence in a plumage or morphometric character, in the form of a slightly different wash or suffusion on an area of feathering or on a bare part (although minor differences in bare part coloration are either not common or infrequently detected). A minor morphometric or vocal character is one in which the effect size is 0.2–1.99.

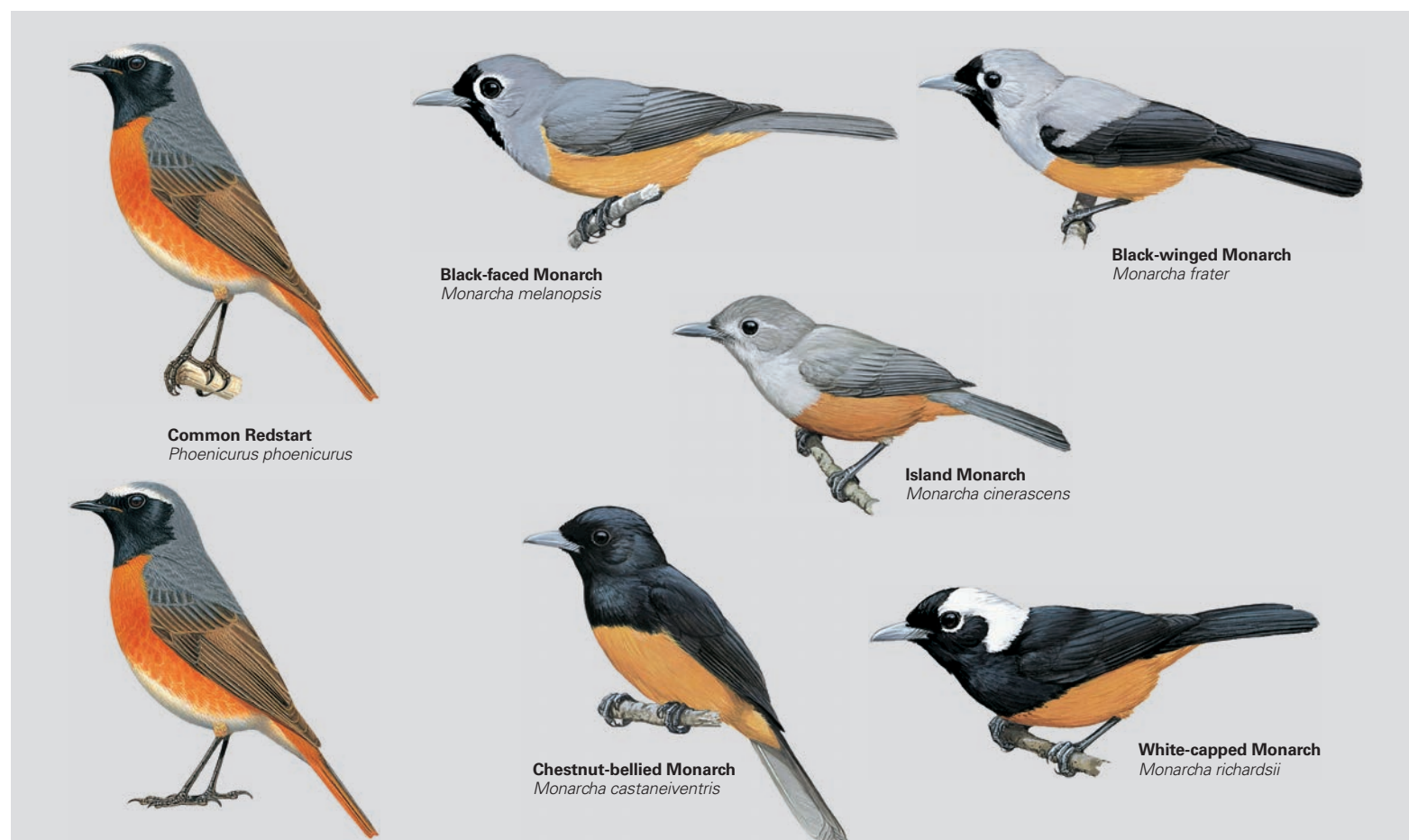
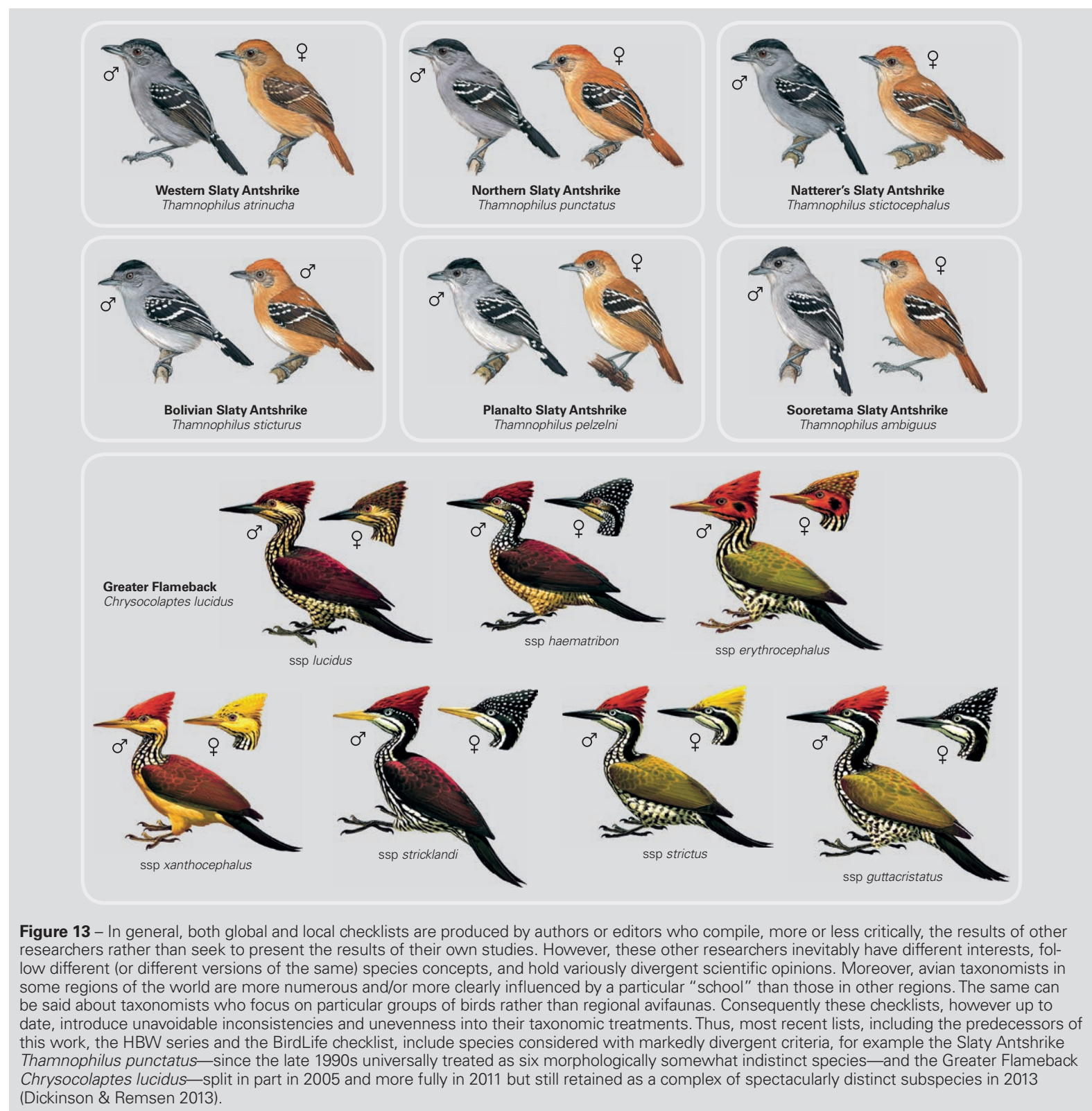


Figure 12 – In contrast to those at the macrosystematic and generic levels, molecular results at the species level are often much more difficult to interpret and use for taxonomic purposes. For instance, two populations of the Common Redstart *Phoenicurus phoenicurus* from different parts of Germany possess a difference in their mitochondrial DNA of as much as 5% without showing any obvious phenotypic distinction or any evidence of reproductive incompatibility where they meet (Johnsen *et al.* 2010, Hogner *et al.* 2012). On the other hand, several forms of monarch, normally recognized as independent species and highly distinctive in morphology, differ by less than 2% (Filardi & Smith 2005). To date, perhaps because of such seemingly contradictory evidence, nobody has proposed a species concept based on the amount of genetic difference between taxa, but more and more studies are splitting almost indistinguishable forms based on a similar percentage of genetic differentiation found between another pair of congeneric species. It is predictable that in the not too distant future, with the use of larger and more representative samples of DNA, much more conclusive results will be obtained and criteria developed for using them to help determine species limits; but for the present, given the lack of consensus about what genetic distances really mean in species-level taxonomy, the results of these studies need to be treated with respectful caution.

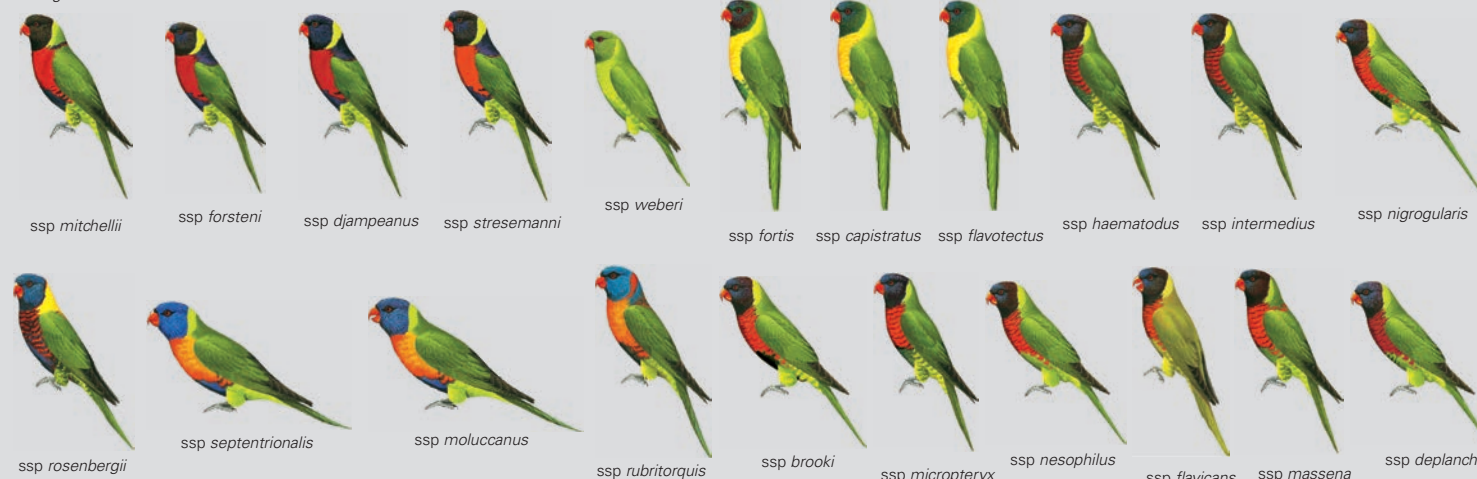
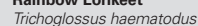


- A *medium* difference involves a distinctly different tone (shade: light yellow *vs* dusky yellow, etc.) on an area of feathering or bare part. A medium morphometric or vocal character is one in which the effect size is 2–4.99.
- A *major* difference involves a contrastingly different hue (colour: e.g. white *vs* yellow) on an area of feathering or bare part, and/or the presence of an entirely different patterning (such as strong spotting *vs* strong stripes). A strong morphometric or vocal character is one in which the effect size is 5–9.99.
- An *exceptional* difference involves a radically different coloration or pattern (a striking contrast in colours or shapes) applying to the majority of the plumage area, or any trait directly involved in courtship and mate choice. An exceptional morphometric or vocal character is one in which the effect size is 10 or more.

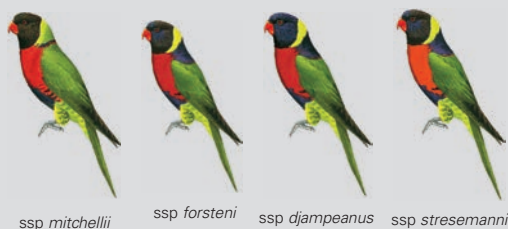
Obviously it is the highest-scoring characters that must be used in the assessment of species rank. However, to constrain the effects of interdependence in phenotypic characters, several conditions apply. The number of characters relating to differences in plumage and bare-part colours and patterns is capped at *three*. The number of morphometric and vocal characters is capped at *two*. Differences in ecology and behaviour can be scored only *once*, and except for non-overlapping differences in courtship display (allowed a score of 2) all such differences are limited to a score of 1.

Distributional criteria

These involve five conditions of geographical relationship: allopatry, broad hybrid zone, narrow hybrid zone, parapatry and sympatry. Of



Scarlet-breasted Lorikeet



Flores Lorikeet



Marigold Lorikeet



Coconut Lorikeet



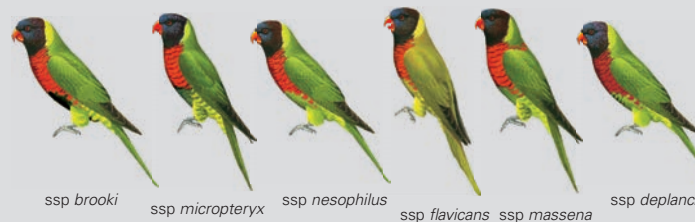
Biak Lorikeet



Rainbow Lorikeet



Red-collared



T. forsteni

T. diamproanus

Tetrasemmi;

T. weberi

T. fortis

T. canistratus

T. flavotectus

T. haematodus

T. intermedius

T. nigrogularis

T. rosenbergii

T. septentrionalis

T. moluccanus

T. rubritorquis

T. brooki

T. micropteryx

T. nesophilus

*T. flavicarpa**T. massena**T. deplanchii*

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these, allopatry scores 0, because it cannot be quantified and supplies no evidence of evolutionary separation, while sympatry automatically scores 7 since the taxa in question are behaving demonstrably as species. The three intermediate conditions, however, can be allowed scores which reflect the approximate degree of the resistance of the taxa to phenotypic merging.

- A *broad hybrid zone* is one in which hybridization between two taxa occurs over a range more than 200 km wide at its maximum point. The breadth of the zone suggests a relatively low resistance, thus allowing a “minor” score of 1.
- A *narrow hybrid zone* is one in which hybridization between two taxa occurs over a range less than 200 km wide at its maximum point. The narrowness of the zone suggests relatively high resistance, reflected in a “medium” score of 2.
- *Parapatry* involves an extremely narrow line along which the boundaries of two taxa abut with no or minimal hybridization. The taxa are not dissimilar enough ecologically to coexist in sympatry, but appear to exclude each other (i.e. there is no assistance from a geographical barrier such as a broad river), suggesting strong resistance worthy of a “major” score of 3.

Obviously, these three conditions exclude each other: a taxon can be scored only once on distributional criteria.

In contrast, a score of 7 can be reached purely on phenotypic characters, but combinations of phenotypic characters and a particular distributional condition can also make up the necessary total. However, scores of 7 that are achieved on minor characters only (which here include a broad hybrid zone) are disallowed as triggering species status.

The fact that hybridization is treated in these criteria as a positive rather than a negative characteristic in determining species rank must appear counterintuitive to many people who, perhaps for many decades, have assumed that almost any serious degree of hybridization between two taxa is evidence of their reproductive compatibility and hence of their conspecificity. The fact that at least 9% of all bird species have interbred in the wild (Grant & Grant 1992) tends, however, to suggest that hybridization is on the one hand a widespread and common phenomenon and on the other very rarely capable of producing significant changes in parent taxa (mostly on oceanic islands and only as a result of anthropogenic interference). So if taxa—lineages—meet and hybridize on a regular basis but their genomes have not merged (as judged by molecular or phenotypic evidence), then there is every reason to consider them species (Johnson *et al.* 1999, Helbig *et al.* 2002, Carling & Brumfield 2009, Harr & Price 2012). If Icterine Warblers *Hippolais icterina* and Melodious Warblers *H. polyglotta* were allopatric, the relatively low levels of differentiation between them would form an arguable case for their conspecificity; but, precisely because they slightly overlap and hybridize without merging into one another, this possibility is quashed outright. Thus, in this checklist, we accept the specific status of a suite of taxa which previously had been considered subspecies because of their hybridizations—Franklin’s Grouse *Falcipennis franklinii*, White-faced Barbet *Pogonornis macclounii*, Iberian Green Woodpecker *Picus sharpei*, various *Colaptes* flickers and, perhaps most notably, a suite of *Pteroglossus* and *Ramphastos* toucans from Amazonia.

The key point is that, in evolutionary terms, hybrids are less fit (Harr & Price 2012). If hybrids were fully viable, genomes fully compatible and signals not reproductively isolating, then the contact zone between two hybridizing taxa would be a broad cline, and in this case the taxa would be conspecific—and indeed there is an increasing trend not to give any taxonomic recognition to components (even the two ends) of a cline, which thus become (part of) the range of a single taxon. (One might then add “cline” to “allopatry” in the list of distribution conditions above, and allow them both no score.) Between the cline and the line of parapatry lie the two types of hybrid zone determined by their width, on the reasonable assumption that fitness decreases with decreasing width of zone; hence a narrow hybrid zone provides evidence of greater genomic integrity and should be scored accordingly. (The inevitable corollary is, of course, that

very broad hybrid zones reflect relatively high levels of hybrid fitness, and we acknowledge that these pose challenges that deserve thought and reflection, for example in the cases of Masked and Black-shouldered Lapwings *Vanellus miles* and *V. novaehollandiae* and of Campo and Pampas Flickers *Colaptes campestris* and *C. campestroides*, both pairs of which we split, with some uncertainty; indeed in one case, involving the Oriental Dwarf-kingfisher *Ceyx erithaca*, the hybrid zone between northern nominate *erithaca* and southern *rufidorsa* is so wide—far wider than the range of pure *rufidorsa*—that logic and practicality militate altogether against establishing the taxa as species.)

A further important point made but not discussed in any detail by Tobias *et al.* (2010) is that, although it may play a part in the speciation process, *disjunction is not a taxonomic character*. In recent years several splits have been proposed on the basis of the existence of a great distance between one taxonomically distinct population and another (and indeed distance between islands forms part of a system for determining taxonomic rank proposed in Pratt 2010). Paradoxically it is also sometimes remarked that two taxa separated by only a short distance could also be judged two species because, in spite of their proximity, they have managed to maintain the integrity of their characters. In both cases, however, it needs to be recognized that the distance between the ranges of taxa, whether very small or very large in size, has no taxonomic value *per se*. Disjunction is simply the circumstance that triggers the need for criteria to gauge the differences in character between the taxa involved. It cannot then also be invoked as one of the factors on which the degree of difference is assessed.

It is perhaps also worth noting that broad rivers render the ranges of understorey birds disjunct, since such species cannot cross them; but this means that these rivers do not represent a line of parapatry. On the other hand, the same rivers should not pose a barrier to larger canopy species such as parrots and toucans, so for these kinds of bird rivers may indeed be considered, potentially, as forming lines of parapatry.





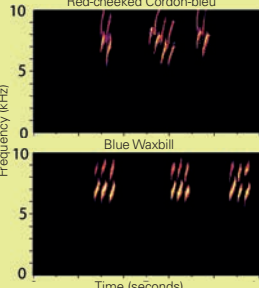
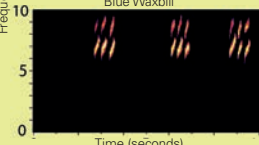
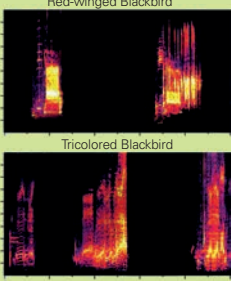
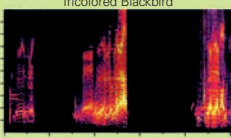
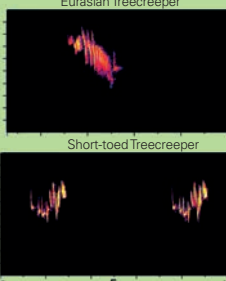
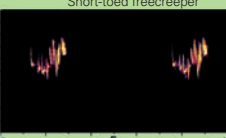
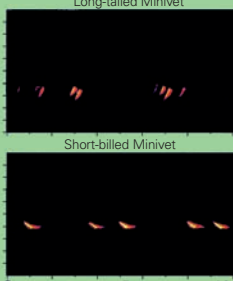





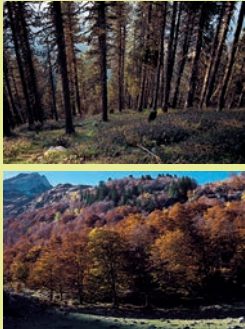


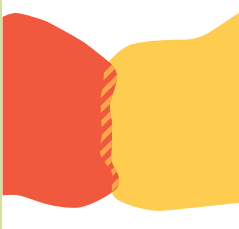
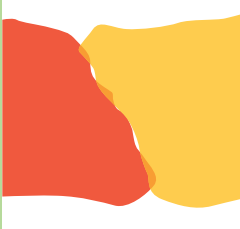
The Tobias criteria: in practice

Although received with two thoughtful, positive commentaries (Winker 2010, Brooks & Helgen 2010), the Tobias criteria have not been rapidly adopted in published species-level taxonomic revisions. Five papers with one common author (Collar 2011, Collar & Bird 2011, Rasmussen *et al.* 2012, Collar & Salaman 2013, Collar *et al.* 2013) have resulted in the elevation of some 40 taxa to species level, and a number of other papers (Rheinhardt *et al.* 2011, Shirihai *et al.* 2011, Donegan 2012, Donegan & Salaman 2012, Leader & Carey 2012, Praveen & Nameer 2012, van Balen *et al.* 2013, Leader *et al.* 2013, Mahood *et al.* 2013) have used the criteria to explore and in some cases decide the status of taxa. (It should be noted that taxonomic revisions using what may now be seen as prototypes of the Tobias criteria will need to be reworked in the light of various changes that were introduced when the criteria were finally, formally published.) However, their wide use by BirdLife International in its evaluations has been steadily generating decisions in response to the many proposed splits in the recent literature, and providing a partial basis for a more proactive evaluation of the global avifauna such as envisioned by this checklist.

Identifying candidate taxa

Our ambition therefore has been to apply the Tobias criteria as fully as possible to the global avifauna, not only for splitting but also—to be even-handed and consistent—for lumping. However, within the constraints of a relatively tight time-frame it was clearly not practicable to evaluate every taxon—this would be more the work of half a lifetime. The assumption had to be made that the great majority of subspecies are distinguished by one or two characters with a low to medium strength. With this acknowledged limitation, we prepared candidate lists for taxonomic inquiry based on evidence trawled from the peer-reviewed literature (not always easy,

Figure 14 – Different species concepts produce markedly different classifications, and their usefulness depends on what sort of information we need. The traditional BSC has restricted the highly polytypic Rainbow Lorikeet *Trichoglossus haematodus* to a single species. On the other hand, since the 21 subspecies are all diagnosably distinct, a strict application of the PSC would produce at least 21 species. Both these classifications have value—the BSC in indicating the close relationships of all taxa to each other, the PSC in highlighting the spread of taxa involved—so they do not need to be considered automatically in conflict. However, in recent years those with greater allegiances or inclinations to the BSC or the PSC have moved away from stricter interpretations of these concepts to the edges of what may be considered middle ground (Johnson *et al.* 1999, Helbig *et al.* 2002, Sangster 2014), and it is perhaps the case that the results of the analyses in this checklist, using a system which quantifies diagnostic characters against a standard threshold for biological species, will in time be seen as a further step on the path to the heart of this middle ground.

Type of taxonomic character	Frequency of scoring	Magnitude (score)			
		Minor (1)	Medium (2)	Major (3)	Exceptional (4)
(1) Biometrics	2 (strongest increase and strongest decrease only)	Effect size: 0.2–2 	Effect size: 2–5 	Effect size: 5–10 	Effect size: >10 
(2) Acoustics	2 (strongest increase and strongest decrease only)	Effect size: 0.2–2 Red-cheeked Cordon-bleu  Blue Waxbill 	Effect size: 2–5 Red-winged Blackbird  Tricolored Blackbird 	Effect size: 5–10 Eurasian Treecreeper  Short-toed Treecreeper 	Effect size: >10 Long-tailed Minivet  Short-billed Minivet 
(3) Plumage and bare parts	3 (three strongest characters)	A slightly different wash or suffusion to all or part of any area 	Distinctly different tone/shade to all or part of a significant area 	Contrastingly different hue/colour to all or part of a significant area 	Radically different coloration or pattern to most of plumage (striking contrast in colour, shade, shape) 
(4) Ecology and behaviour	1 (once)	Non-overlapping differences in (a) foraging/breeding habitat; (b) adaptations related to foraging/breeding; or (c) an innate habit 	Non-overlapping differences in an innate courtship display 	not applicable	not applicable
(5) Geographical relationship	1 (once)	Broad hybrid zone 	Narrow hybrid zone 	Parapatry 	not applicable

owing to the increasing number of—sometimes rather arcane—journals catering for molecular biology), field guides, monographs and handbooks; information supplied by correspondents; insights of our own from work in museums and the field; and a review of the distinctive subspecies used in illustrations in HBW (which, as mentioned above, were particularly targeted for inclusion in the series). By scrutiny of the HBW plates and other sources we also listed out species whose distinctiveness appeared sufficiently low to call in question their taxonomic rank.

That this process is far from exhaustive may be gauged by the case of the Australian Painted-snipe *Rostratula australis*, which was treated in HBW as a subspecies of Greater Painted-snipe *R. benghalensis* with the words “averages considerably longer-winged; no significant plumage differences”, and hence was not even illustrated. In this case other sources suggested a split, prompting our own assessment; but even the key “splitting” paper (Baker *et al.* 2007) failed to account for the full morphological distinctiveness of the form, which is only now in these pages indicated for what we believe may be the first time. This case could easily have been missed, and serves as a warning that other equally distinctive taxa may have escaped scrutiny in this exercise.

The same may be true of the exercise to evaluate the possible conspecificity of forms long treated as separate species (Figure 23). This targeted a wide sweep of taxa, including for example (although scores in these cases are not always provided) the *Spheniscus* penguins, *Ardeola* herons, *Threskiornis* ibises, *Levinia* rails, *Ardeotis* bustards, the two smallest *Numenius* and a significant number of pigeons, nightbirds, hummingbirds and woodpeckers, although we should again stress that we were unable, from lack of time, specimen material and other evidence, to undertake a full review of taxa, thus leaving certain intriguing complexes (for example the *Macropygia* cuckoo-doves, *Ducula bicolor* imperial-pigeon complex, *Tanyptera* paradise-kingfishers, various gulls and skuas) unexplored. Only a very small proportion of cases of those we considered resulted in the lumping of taxa, but we again acknowledge that some of these may be challenged in due course. Nonetheless we consider it a cardinal obligation in this major exercise to use the Tobias criteria dispassionately both for splitting and for lumping.

Sources of information

Every reasonable effort has been made to ensure that all publications relevant to this work have been traced, procured and considered. The number of taxonomic and distributional papers consulted runs to over 9,000. Nevertheless, we will obviously have missed some material (as noted above, the appearance of many ornithological studies in the proliferating body of molecular journals is a particular challenge), and we apologise in advance to authors for such oversights, hoping to make up for them in subsequent editions. We specified no absolute cut-off date for new material, and have sought as far as possible to incorporate findings that appeared in the early part of 2014, working to a set of unofficial, staggered cut-off dates established by the logistics of producing a work of this scale and complexity. This means that the later the taxa appear in the volume the greater the chance is that new material has been incorporated or alluded to; conversely, taxa earlier in the sequence may have lost the chance for last-minute revisions, as regrettably in the case of the New World nightjars (for new perspectives on which, already rendering our classification out of date, see Sigurdsson & Cracraft 2014). Again, later editions will seek to accommodate such material.

So far as possible the candidate taxa were considered by direct reference to specimen material in museums (see Acknowledgements). When no such material could be accessed, a taxonomic evaluation could sometimes be taken by reference to photographs of living and indeed of

preserved birds. Photographs from the wild can, of course, sometimes provide evidence that museum material cannot, since the colours of the “bare parts” of a living bird—bill, bare skin around the eye, iris and legs—can fade or be absent in the preserved specimen. A notable example was the discovery through recent photographs, prompted by our research, of a pale iris and strong red pre- and post-ocular patches in Seram Mountain-pigeon *Gymnophaps stalkerii* but not in Buru Mountain-pigeon *G. mada*, something no specimen or specimen label conveyed. A similar discovery of a red face in living male Hainan Peacock-pheasants *Polyplectron katsu-matae*, something completely missed from previous diagnoses using museum material (Davison *et al.* 2012), significantly increased the confidence with which this form could be split.

In the absence of either specimens or photographs, in a very small number of cases use was made of written descriptions and, if judged to be clear enough, these were accepted as a basis for taxonomic decisions. A case of some interest involves the detailed and meticulous split by Stiles (1996)—not accepted by HBW but supported by the Tobias criteria—of Blue-tailed Emerald *Chlorostilbon mellisugus* into as many as eight species, when even Stiles himself was unable to access specimens of every taxon under review; inevitably, then, information on character differences has had to be taken on trust. Occasionally, published morphometric differences between taxa lacked the standard deviations needed to apply a Cohen’s *d* test; in these cases—see, e.g., under American Comb Duck *Sarkidiornis sylvicola* and Andean Teal *Anas andium*—the available data are presented and an estimate was made of the likely score, prefixed by the word “allow”.

In outlining these sources of information we must pay tribute to the various global and regional checklists on whose giant shoulders this work dares to stand (although we do not presume to see any further than they, but merely to have an alternative perspective). The American Ornithologists’ Union, British Ornithologists’ Union and South American Checklist Committee all publish updates to their respective lists and include varying levels of explanation for their taxonomic decisions, and this transparency is a particular virtue which we seek to emulate. Annotated checklists such as Dickinson (2003), Dickinson & Remsen (2013) and Dowsett & Forbes-Watson (1993) (as interpreted by Dowsett & Dowsett-Lemaire 1993) represent an indispensable resource in the pursuit of taxonomic understanding; so too do major scholarly compilations typified by the eight-volume *Birds of Africa* series (1982–2013), Wells (1999, 2007) and Ridgely & Greenfield (2001), not to mention the multitude of bird family monographs that have been appeared in the past two or three decades. Last but not least we should mention HBW itself, whose many authors contributed taxonomic information which this checklist often extensively reproduces and on which it directly builds.

Characters not specified in the Tobias criteria

A series of characters emerged during this review that are not mentioned in the Tobias criteria. Number of tarsal scutes (Puna Rhea *Rhea tarapacensis*, Northern Brown Kiwi *Apteryx mantelli*), feather stiffness and facial-bristle length (Northern Brown Kiwi), feather-loose endemism (Northern Brown and Okarito Kiwi *A. rowi*), casque shape (Sira Curassow *Pauxi koepckeae*), comb shape (American Comb Duck *Sarkidiornis sylvicola*), femur structure (Laysan Duck *Anas laysanensis*), shape of bill (Siberian Scoter *Melanitta stejnegeri*, Australian Gull-billed Tern *Gelochelidon macro-tarsa*), “osteological morphology” (Grey-faced Petrel *Pterodroma gouldi*), presence of polymorphism (Papuan Harrier *Circus spilothorax*), number and structure of coronal plumes (Ouvea Parakeet *Eunymphicus uvaensis*) and egg colour (Grey Nightjar *Caprimulgus jotaka*) required some thought as to the appropriate level of scoring in the absence of guidelines (the scores given indicate our conclusions in these cases, but a review of these

Figure 15 – Under a recently proposed system of quantitative criteria for species delimitation (Tobias *et al.* 2010) phenotypic differences (i.e. differences in plumage, morphology, measurements and vocalizations) are scored as minor (1), medium (2), major (3) and exceptional (4), depending on their perceived degree of strength. Co-varying differences (e.g. longer wing length and proportionately longer bill size) can be scored only once, and (to avoid maximizing the value of minor differences) only three morphological, two morphometric and two vocal differences may be scored. Molecular differences between taxa are not given quantitative scores because genetic and phenotypic differences have no consistent correlation (see Figure 12); although this omission has drawn criticism, genetic information is repeatedly used to illuminate or infer evolutionary history, and in some cases molecular evidence has been central to the way species have been arranged and their limits drawn. Ecological and behavioural differences are also taken into account and, if present, they receive an extra score of 1 (with 2 allowed for “non-overlapping differences in courtship display”). Finally, distributional data are also incorporated, and, while allopatric (no matter how disjunct) ranges do not score, parapatry scores 3, a narrow zone of hybridization 2 and a broad zone of hybridization 1 (see text for details and reasoning). Taxa scoring a total of 7 or more are considered distinct enough to be accorded full species status (based on scores achieved by similar species living in sympatry and compared with lower scores for taxa widely considered to be subspecies). The “Tobias criteria” were not introduced as a new species concept or a truly objective method, but rather as a practical tool to help assess the degree of difference between non-sympatric taxa, in as consistent and transparent a way as possible.

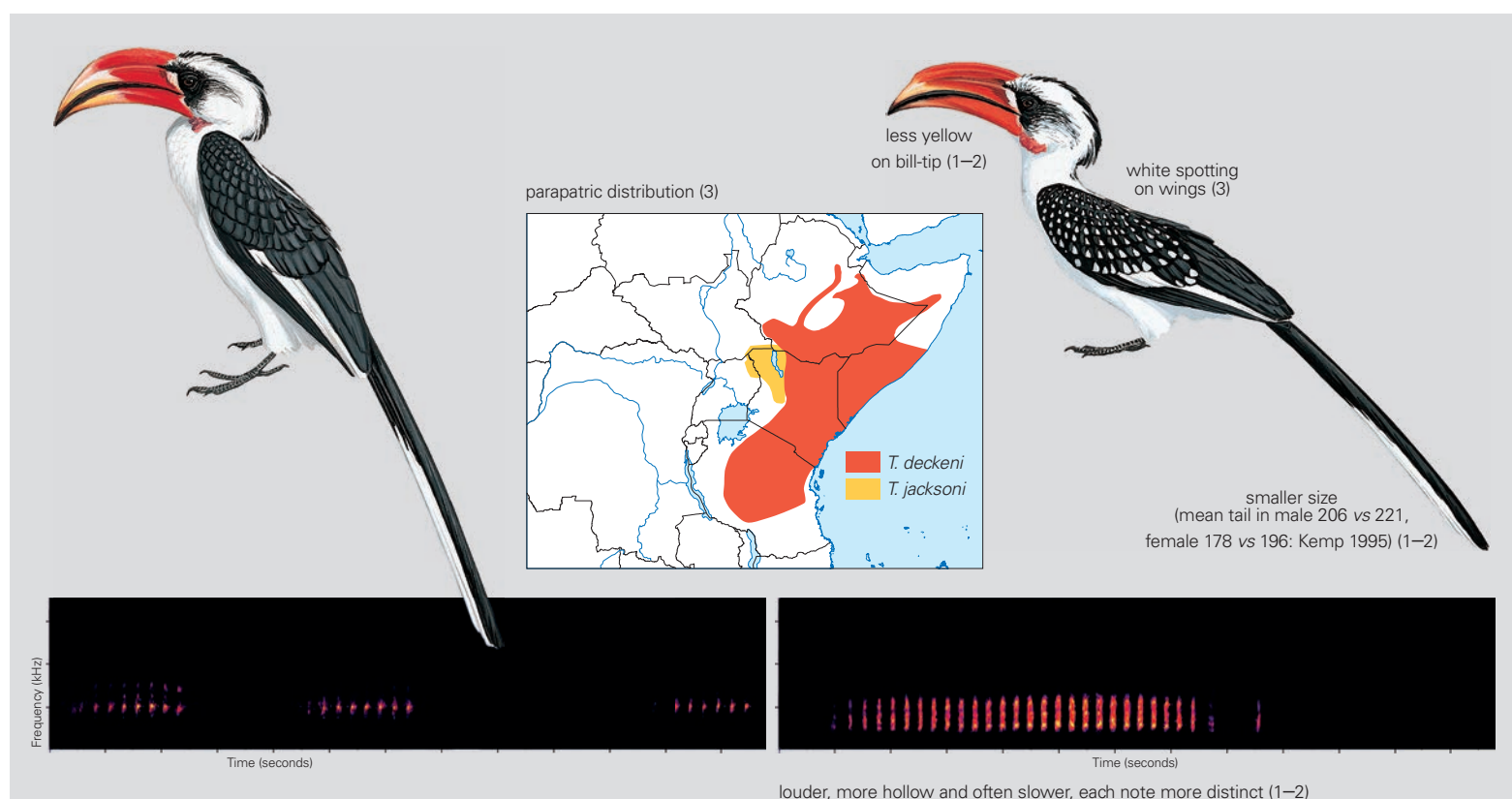


Figure 16 – In many cases, the results of applying the Tobias criteria are clear-cut. For example, the differences between Von der Decken's *Tockus deckeni* (left) and Jackson's Hornbills *T. jacksoni* (right), hitherto predominantly considered conspecific and still so in very recent works (Dickinson & Remsen 2013), reach a total scoring of 9–12, well above the threshold of 7 for species status. Of course, some level of subjectivity inevitably enters the scoring process depending on the individual judgement of the scorer (whose uncertainty is expressed here by three “1–2” scores), but at least in easy cases like this one the result is unaffected. In more borderline cases another advantage of this method, according to its proponents, is its transparency, as the scores are explained, meaning that other, perhaps more sceptical, workers have the opportunity to repeat the scoring process and judge the conclusions for themselves.

issues may form an addendum in any future revision of the criteria). There is also the problem of difference in breeding season, which notably affects two seabirds in the north-east Atlantic: Desertas Petrel *Pterodroma deserta* and Monteiro's Storm-petrel *Hydrobates monteiroi*; a score of 1 for a behavioural/ecological difference is arguably inappropriate in these cases.

And how taxonomically informative are differences in juvenile plumage? Although these are clearly unrelated to signalling in the reproductive process, they must nevertheless be assumed to represent distinct adaptations with particular survival value, and therefore be not entirely irrelevant to taxonomic processes. Pattern of downy young proved decisive in the split of Grey Teal *Anas gracilis*, and colour of soft parts and plumage of juveniles in the split of Common Gallinule *Gallinula galeata*, while relatively distinct juvenile plumages help to maintain the specific identity of, for example, the Spanish Imperial Eagle *Aquila adalberti*, Philippine Drongocuckoo *Surniculus velutinus* and São Tomé Kingfisher *Corythornis thomensis* and may, in future, bear on the taxonomic status of “Cabot's Tern” *Sterna sandwichensis acutiflavia*.

Acoustic evidence

The Tobias criteria stipulate precise thresholds for quantifying vocal differences through the analysis of recorded elements. However, for this non-passerine volume, with relatively few groups for which vocalizations were critical, such specialized research was for the most part felt to be unnecessary. To begin with, partly from considerations of time, we felt it superfluous (although theoretically desirable) to revisit and reconfirm long-established splits that are based in large part on voice (ten examples: White-winged Dove *Zenaida asiatica*, Brown-backed Dove *Leptotila baltii*, Madagascar Coucal *Centropus toulou*, Livingstone's Turaco *Tauraco livingstonii*, Yellow-footed Gull *Larus livens*, Himalayan Owl *Strix nivicolium*, Southern Yellow-billed Hornbill *Tockus leucomelas*, Rufous Motmot *Baryphthengus martii*, White-bellied Piculet *Picumnus spilogaster*, Choco Woodpecker *Veniliornis chocoensis*).

Moreover, although the past decade has witnessed a remarkable growth in the accessibility, number and scope of bird recordings available, with

rapidly developing online sites such as Xeno-canto, AVoCet, Cornell Laboratory of Ornithology and the Internet Bird Collection, most of the taxa assessed in this checklist for their taxonomic status are not well represented. In any case, vocal evidence was often not essential to clinch the taxonomic change, even when it was available (ten examples: Western Crested Guineafowl *Guttera verreauxi*, Purple Quail-dove *Geotrygon purpurata*, Olive-capped Coua *Coua olivaceiceps*, Asian Houbara *Chlamydotis macqueeni*, Lesser Sooty-owl *Tyto multipunctata*, Jackson's Hornbill *Tockus jacksoni*, Highland Motmot *Momotus aequatorialis*, Malabar Barbet *Psilopogon malabaricus*, Freckle-breasted Woodpecker *Dendrocopos analis*, Splendid Woodpecker *Campephilus splendens*).

In a good number of cases, however, acoustic differences were decisive in making a split (ten examples: Comoro Green-pigeon *Treeron griveaudi*, Ecuadorian Hermit *Phaethornis baroni*, Whistling Yellowbill *Ceuthmochares australis*, Eastern Water Rail *Rallus indicus*, Plumbed Egret *Ardea plumifera*, Snowy Plover *Charadrius nivosus*, Guadalcanal Boobook *Ninox granti*, Palau Kingfisher *Todiramphus peleuensis*, Annam Barbet *Psilopogon annamensis*, Bronze-winged Woodpecker *Colaptes aeruginosus*). Some of these differences are well documented via recordings on the internet, or via detailed written descriptions and sonagrams, and for these we often provide a transcription of our own or a copy of a pre-existing description, adding a score based on our sense of degree of difference. Some, however, are blunt unsupported assertions in publications with little or no descriptive information, so that in the absence of accessible material to confirm them they had to be taken on trust; such cases are particularly difficult to score, and our tendency was to treat such evidence as a minor character only.

There are, of course, notable instances where voice is the dominant character in determining species status. In the case of Least Tern *Sterna antillarum*, various hawk-cuckoos *Hierococcyx*, Australian Little Bittern *Ixobrychus dubius* and Madagascar Hoopoe *Upupa marginata* this is sufficiently well documented to allow a confident evaluation against the Tobias criteria, the general rule being that a large vocal difference is supported by two or three relatively minor morphological characters. However, this is not always so, and one or two cases present interesting and important challenges to the premises that sit behind the Tobias criteria. The most

notable is Mees's Nightjar *Caprimulgus meesi*, which is in plumage “exceedingly similar to and not diagnosably different from *C. macrurus schlegeli*”, the form of Large-tailed Nightjar with which it was previously lumped, but highly distinct in its song, to which playback experiments repeatedly demonstrated species-specific responses (Sangster & Rozendaal 2004). This circumstance is extremely rare and conceivably unique among non-passerines, although something very similar appears to happen in Costa Rica, where Northern Potoo *Nyctibius jamaicensis* and Common Potoo *N. griseus* are supposedly inseparable except on voice (although here the taxa appear to be sympatric). However, the Tobias criteria are not necessarily invalidated in this case: they allow for a song to be scored on the strongest of both temporal and spectral characters, so that structure of delivery and pitch of note can be assessed. In the absence of the data required to make a formal evaluation, the evidence on Xeno-canto strongly suggests high scores for both, and it is entirely plausible that other elements in the vocal repertoire of *C. meesi* will also, in due course, prove distinct from those of its closest relatives.

A similar expectation underpins our tentative recognition of species status in certain other nocturnal birds, namely the burrow-nesting procellariiforms (Figure 22). The recent discovery of Monteiro's Storm-petrel *Hydrobates monteiroi*, which differs in barely significant proportions from Band-rumped Storm-petrel *H. castro* but has a somewhat different song in its burrow (and does not respond to the song of *H. castro*), provides evidence that highly philopatric oceanic seabirds have evolved precise acoustic signals by which to discriminate their own kind over relatively short distances, in the seclusion of their night-time nest-sites. This possibility makes it easier to accept multiple species in the intractably difficult Little/Audubon's Shearwater complex (dealt with in this checklist under the entry for Subantarctic Shearwater *Puffinus elegans*), all of which are borderline cases with the Tobias criteria.

A note of caution is perhaps worth sounding here. It was proposed that the Comoro Thrush *Turdus bewsheri* be split from *T. comorensis* (with race *moheliensis*) on the basis mainly of vocal differences (Herremans 1988), but “further study of voice has shown the differences to be less marked than first thought” (Safford & Hawkins 2013). While the issue of sample size is particularly relevant to birds that at least in part learn vocalizations from their environment (true in non-passerines only of hummingbirds and parrots), it is probably worth stressing that multiple vocal sampling of any taxon across the spatial and temporal spectrum provides a far stronger basis for taxonomic evaluation. In the same way, playback experiments will be all the more informative when they are conducted and presented with the kind of rigour invested in the case of *Caprimulgus meesi*.

Difficult groups and special problems

Taxonomic decision-making tends to be much easier when it involves only two taxa. There have been many such situations in the course of this exercise, resulting in some straightforward outcomes such as the splits of Taiwan Bamboo-partridge *Bambusicola sonorivox*, Puerto Rican Mango

Anthracothonax aurentus, and Black-faced Go-away-bird *Corythaixoides leopoldi*, with among the more striking cases two parrots, Mustard-capped Lorikeet *Trichoglossus meyeri* and Cordilleran Parakeet *Psittacara frontatus* (see also Figure 16). However, the process need be no less straightforward in three- or four-way comparisons if the taxa involved are all easily discriminated, as appears to be the case with the *Guttera* guinea fowl, *Otidiphaps* pheasant-pigeons and *Oxygogon* helmetcrests. The bright plumages of these birds signal their identity: distinctions between them are generally easily detected in museum specimens or photographs, rendering the taxonomic evaluation process relatively undemanding.

Unfortunately, these clean, clear-cut conditions tend to be less frequently encountered than their opposite. To start with, particular groups represent significant challenges to the Tobias criteria: birds, that is, whose environments and life histories constrain their coloration and structure, for example seabirds, swifts, nightbirds, tapaculos. These are cases in which for fairly obvious reasons bright colours and patterns have not evolved, but this does not mean that their capacity to signal their identities is any less developed. Rather, the context in which these signals are made is much more constrained, and human ability to perceive them is correspondingly limited. The danger of assuming that human proficiency in perception is equal to that of the birds themselves has been highlighted in recent years by studies of the degree to which birds make use of ultraviolet reflectance (Eaton & Lanyon 2003, Stoddard & Prum 2011), although to date there has been no evidence of its value in species recognition.

One notable characteristic of procellariiform seabirds is their ability to detect “chum”, the bait commonly made of fish offal used by birdwatchers to attract petrels and shearwaters close to ships, even seemingly from beyond the horizon. It is tempting to imagine that this hypertrophied olfactory sense might also find a role in determining the identity of potential mates, although it is perhaps more likely that—as noted in the previous section—the key means of communicating identity is through vocalizations at the breeding colony, to which these burrow-nesting birds possess an extraordinary degree of fidelity. At any rate, this large group of species poses age-old taxonomic problems to which there have been many proposed solutions, none of them definitive, and we recognize that conservatively plumaged seabirds (along with swifts!), for which other ecological and behavioural characters may play a far more significant role in mate choice and speciation, represent an interesting challenge to the Tobias criteria. Advances towards a coherent classification of taxa will require the dedication of substantial resources and, even so, a degree of stability is unlikely for many years. We have sought to make an independent assessment of as many taxa as possible, but in the case of the *Puffinus assimilis*/*P. lherminieri* complex we elect simply to follow the taxonomy of a recent authority (Onley & Scofield 2007) without attempting to apply the Tobias criteria to the taxa involved; and with albatrosses we do the same, “provisionally and precautionarily” accepting the largely phylogenetic taxonomy of the Agreement on the Conservation of Albatrosses and Petrels (ACAP), which benefits from the force of international law and the advice of an expert taxonomic panel.

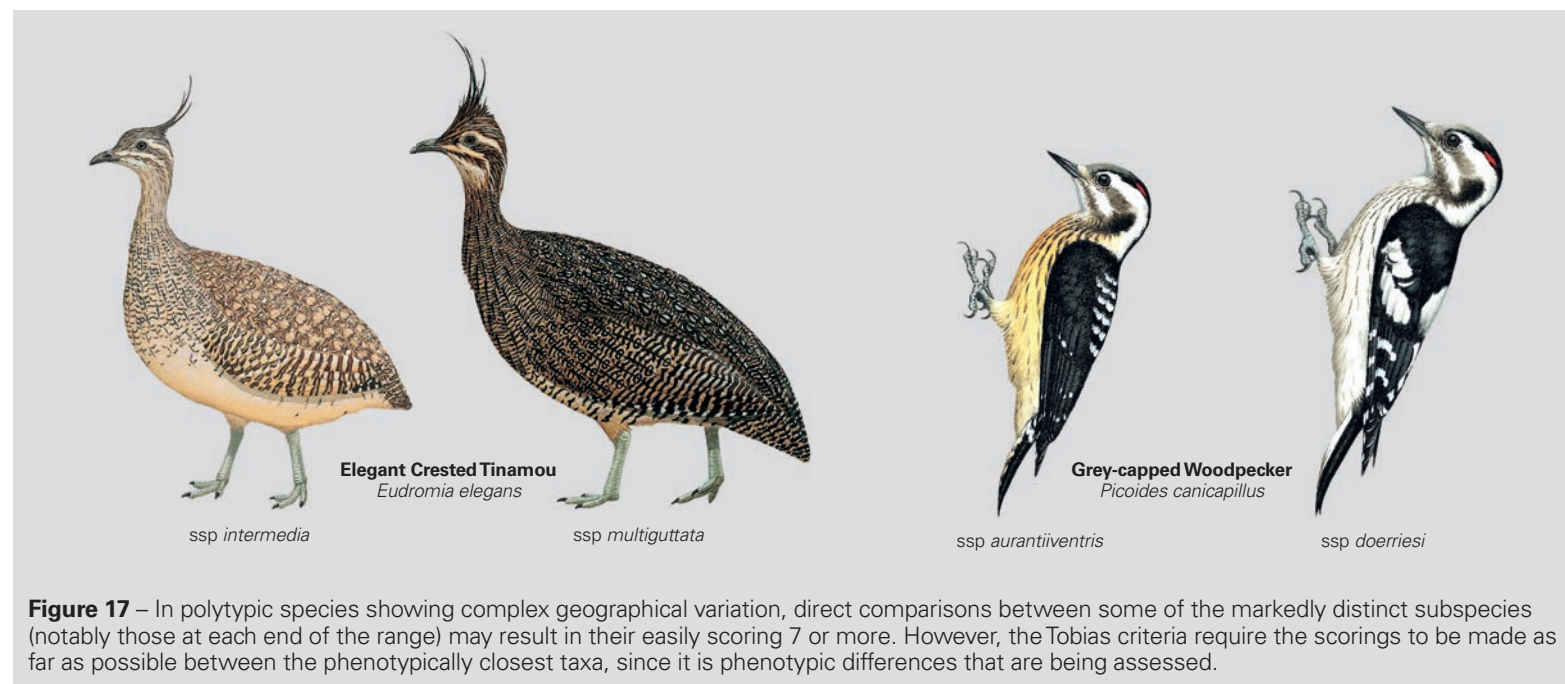


Figure 17 – In polytypic species showing complex geographical variation, direct comparisons between some of the markedly distinct subspecies (notably those at each end of the range) may result in their easily scoring 7 or more. However, the Tobias criteria require the scorings to be made as far as possible between the phenotypically closest taxa, since it is phenotypic differences that are being assessed.

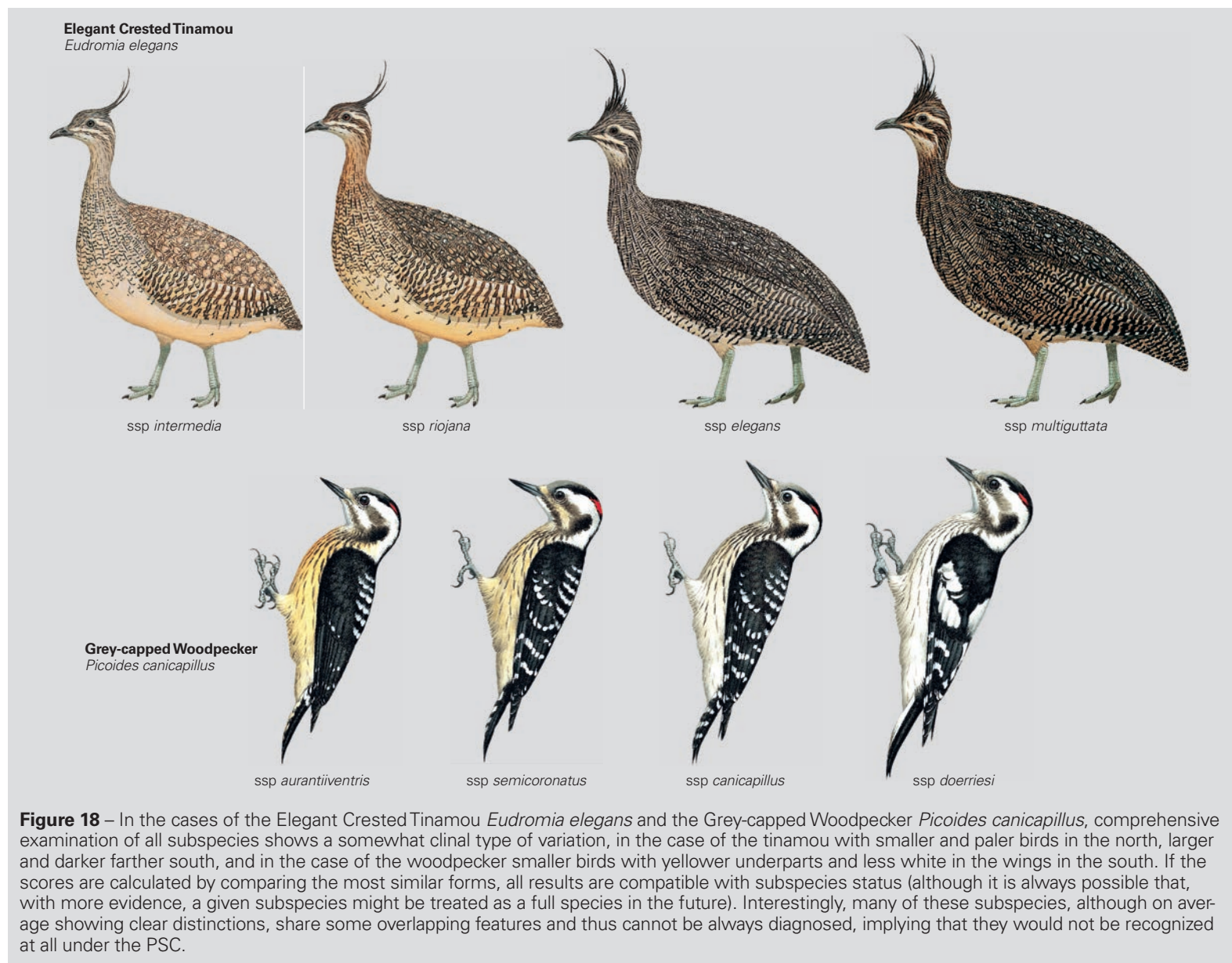


Figure 18 – In the cases of the Elegant Crested Tinamou *Eudromia elegans* and the Grey-capped Woodpecker *Picoides canicapillus*, comprehensive examination of all subspecies shows a somewhat clinal type of variation, in the case of the tinamou with smaller and paler birds in the north, larger and darker farther south, and in the case of the woodpecker smaller birds with yellower underparts and less white in the wings in the south. If the scores are calculated by comparing the most similar forms, all results are compatible with subspecies status (although it is always possible that, with more evidence, a given subspecies might be treated as a full species in the future). Interestingly, many of these subspecies, although on average showing clear distinctions, share some overlapping features and thus cannot be always diagnosed, implying that they would not be recognized at all under the PSC.

If the acceptance of these species is precautionary as well as provisional, this simply acknowledges our sensitivity to the desperate plight of the world's albatrosses, which have the highest proportion of threatened species of any family of birds (Butchart *et al.* 2010, Croxall *et al.* 2012), and to the good work that ACAP is seeking to do on their behalf. However, we should stress that conservation interests exert no influence over taxonomy in this checklist. The peculiar vulnerability of seabirds to introduced predators, combined with their highly localized breeding sites, renders them particularly susceptible to the invocation of what might be called the “conservation species concept”, under which a split is proposed on weak taxonomic grounds in order to improve the chances of the resulting species receiving research funding and management attention. Despite the stake BirdLife International has in this checklist, we have rigorously sought to disallow any bias in taxonomic decisions resulting from conservation interests.

There are, however, a few other instances—Desert Petrel *Pterodroma deserta*, Grey Noddy *Procelsterna albivitta* and Arctic Herring Gull *Larus smithsonianus*—where species status is accepted for a seabird without its reaching the Tobias threshold, but these decisions are explained in the text and are not taken from conservation interests. The gull is recognized as a consequence entirely of several molecular studies rendering it, somewhat surprisingly, paraphyletic with the near-identical European Herring Gull *L. argentatus*, and with the caveat that this is, owing to the very small genetic distances involved in most of the “herring gull complex”, not a very satisfactory (and probably not a very stable) arrangement. Similarly incomplete evidence informs our recognition of Wilson's Snipe *Gallinago delicata*, Fernando Po Swift *Apus sladeniae* and Madagascar Swift *A. balstoni*; indeed, for the most part the *status quo* for all members of the Apodidae is accepted uncritically. In contrast, we proceed with the split of Yellow-headed Amazon

Amazona oratrix, Yellow-naped Amazon *A. auropalliata* and Yellow-crowned Amazon *A. ochrocephala* despite the facts that (a) two molecular studies (Eberhard & Bermingham 2004, Russello & Amato 2004) are inclined to support their original HBW 4 treatment as a single species and (b) the subspecies *xantholaema*, from the isolated easternmost end of the range of *ochrocephala*, resembles one of the *oratrix* subspecies: we do so in part because subsequent molecular work (Ribas *et al.* 2007) indicates that the genetic evidence is far from settled, and in part because application of the Tobias criteria supports the split so long as the anomalous *xantholaema* is set aside, an uncomfortable decision which further research (including into the behaviour and ecology of *xantholaema*) will, we hope, help to justify.

Elsewhere, we do not disturb the taxonomic *status quo* of Dwarf Ibis *Bostrychia bocagei* and Narcondam Hornbill *Rhyticeros narcondami*, although on present knowledge the latter in particular cannot be justified as a species by use of the Tobias criteria, seemingly (discounting, for reasons given above, its extraordinary and inexplicable disjunction) being a miniature Papuan Hornbill *R. plicatus*; rather than overhastily lumping these two taxa, we judge that further research, including into behavioural and ecological factors, is needed. We also make a leap of faith—arguably a leap of logic—with three nightbirds: Allied Owlet-nightjar *Aegotheles affinis*, which genetic analysis, combined with a significant size difference and the geographical position of the taxa involved, strongly implies is a full species; and Northern and Chocolate Boobooks *Ninox japonica* and *N. randi*, in both of which significant vocal and some morphometric distinctiveness have been indicated such that we confidently anticipate further evidence to be assembled in due course. In addition, we have chosen to accept the findings of a very recent molecular study of the King Rail *Rallus elegans* complex (Maley & Brumfield 2013) which, combined with a degree of

morphological evaluation (which we have had no time to confirm and extend), has drawn species limits in a way that appear at least as plausible and satisfactory as any previous arrangement.

In the great majority of species-level cases, however, this checklist makes use of species-level genetic evidence as additional corroboration rather than as an integral part of the decision-making process. Naturally it is encouraging when genetic evidence and phenotypic evidence coincide, as when “Crimson”, “Yellow” and “Adelaide” Rosellas *Platycercus elegans*, *P. flaveolus* and *P. adelaidae* (as given in HBW 4), which application of the Tobias criteria cannot maintain apart, prove by genetic analysis to be better understood as forms (subspecies, hybrid populations) of a single species (Joseph *et al.* 2008); or when a molecular paper (den Tex & Leonard 2013) suggested that *Psilopogon asiaticus chersonesus*, known from a single mountain in peninsular Thailand, is a full species, and the (very scarce) specimen material shows that on plumage alone this much-neglected taxon meets the threshold for species status under the Tobias criteria. It is far less satisfactory, however, when a molecular paper makes such a claim and the specimen material provides relatively weak support for it, as with the splits of “American Three-toed Woodpecker” *Picoides (tridactylus) dorsalis* (Zink *et al.* 2002), “New Caledonian Parakeet” *Cyanoramphus (novaezelandiae) saisseti* and “Norfolk Parakeet” *C. (n.) cookii* (Boon *et al.* 2001) and “Western Ground Parrot” *Pezoporus (wallicus) flaviventris* (Murphy *et al.* 2011)—this last being particularly distressing to discount when only a few hundred individuals may survive (but see comments above).

Our preference to set such claims aside is, we emphasize, absolutely not out of indifference or hostility to genetic evidence; it is, we repeat, simply because genetic distance between taxa, however great, is as yet impossible to assign to categories whose thresholds invariably reflect a speciation event. There are, incidentally, at least five instances in this checklist—apart from the *Amazona ochrocephala* example above—where morphological distinctiveness has led us to override molecular results that call for a lump rather than a split: White-faced Plover *Charadrius dealbatus*, Little White Tern *Cygis microhyncha*, Sanford’s Sea-eagle *Haliaeetus sanfordi*, Moorea Kingfisher *Todiramphus youngi* and Yellow-billed Toucanet *Aulacorhynchus calorhynchus*. In such cases, as Rheindt *et al.* (2011) observed, “diagnostic phenotypic characters may be encoded by few genes that are difficult to detect”.

Tobias *et al.* (2010) recommended that in cases of highly polytypic species the comparisons should be made between phenotypically rather than geographically closest taxa, but they admitted a degree of flexibility in such situations (Figure 17). We found this freedom helpful in two cases where we were dependent on a published source which had reviewed the specimen evidence (and where our own review of this evidence was impracticable), namely the Blue-tailed Emerald *Chlorostilbon mellisugus* complex (Stiles 1996) and the White-eared/Painted Parakeet *Pyrhura leucotis/picta* complex (Arndt 2008). Particularly in this second case comparisons between all taxa represent a dizzying challenge, and the only feasible way forward (if only for space reasons!) was to restrict considerations to adjacent taxa. In other cases, we were fortunate enough to find high levels

of representation in museums of taxa in difficult complexes, so that comparisons could be multiple, for example Variable Dwarf-kingfisher *Ceyx lepidus*, Emerald Toucanet *Aulacorhynchus prasinus* and Rainbow Lorikeet *Trichoglossus haematodus*. In the case of the first two of these complexes our findings, worked out in parallel, proved largely but not exactly concordant with published molecular phylogenies (respectively Andersen *et al.* 2013, Puebla-Olivares *et al.* 2008).

However, many complexes that appear in need of revision proved too difficult—largely in terms of time required to assemble and consider the evidence—to evaluate in this review, and are priorities for future work (Figure 20). In a minority of cases, for example the species closest to Pied Imperial-pigeon *Ducula bicolor* and to Long-tailed Sylph *Agelaiocercus kingi*, the question is whether lumping would not be more appropriate. In the majority, of course, it is the opposite—how and by how much to split. The list is long, but we would mention here, as cases in particular need of further work, Kalij/Silver Pheasant *Lophura leucomelanos/nycthemera*, Common Pheasant *Phasianus colchicus*, Tyrian Metaltail *Metallura tyrianthina*, Little Bronze-cuckoo *Chalcites minutillus*, Green-backed Heron *Butorides striata*, Black-winged Stilt *Himantopus himantopus*, Eurasian Buzzard *Buteo buteo*, Red-billed Hornbill *Tockus erythrorhynchus* and Eclectus Parrot *Eclectus roratus*. Some such complexes have “budded off” very similar-looking forms that now live in sympatry with them—for example, Great Nicobar Serpent-eagle *Spilornis klossi* from Crested Serpent-eagle *S. cheela*, Little Paradise-kingfisher *Tanysiptera hydrocharis* from Common Paradise-kingfisher *T. galatea*, and Talaud Kingfisher *Todiramphus enigma* from Collared Kingfisher *T. chloris*—and from this we can infer that well-marked taxa in other complexes may in fact merit a higher taxonomic rank than subspecies.

Even so, circumstances can be obstinately uncooperative. It has been argued that the Purple Swampphen *Porphyrio porphyrio* is actually six species, with “Western” *P. porphyrio* in Europe, “African” *P. madagascariensis* in Africa, “Grey-headed” *P. poliocephalus* from the Caspian to southern China south through central Thailand, “Black-headed” *P. viridis* from southern China through Indochina and Sundaland to Sulawesi, “Philippine” *P. pulverulentus* in the Philippines, and “Australian” *P. melanotus* from Lombok east to Australia and the western Pacific islands (Sangster 1998). Ostensibly the various combinations of colours and shades on the back and face in these taxa, plus various proportional changes and differences in frontal shield, support this view. However, when the necessary diagnostic characters for each taxon are critically examined (including internet photographs reliably assigned to locality), confidence in this arrangement begins to evaporate. Birds in Turkey appear intermediate between *P. porphyrio* and *P. poliocephalus*, but since the populations are so discontinuous this suggests an ancient clinal pattern rather than the product of a hybrid zone. Meanwhile birds in eastern mainland Asia (*P. viridis*) possess grey faces and strongly resemble Indian birds (*P. poliocephalus*) in this character, while their upperparts are generally midway between those of *P. poliocephalus* to the west and those of the supposedly conspecific dark-faced (and confusingly named) *P. v. indicus* of Sundaland. Thus, while there seems little doubt that Purple

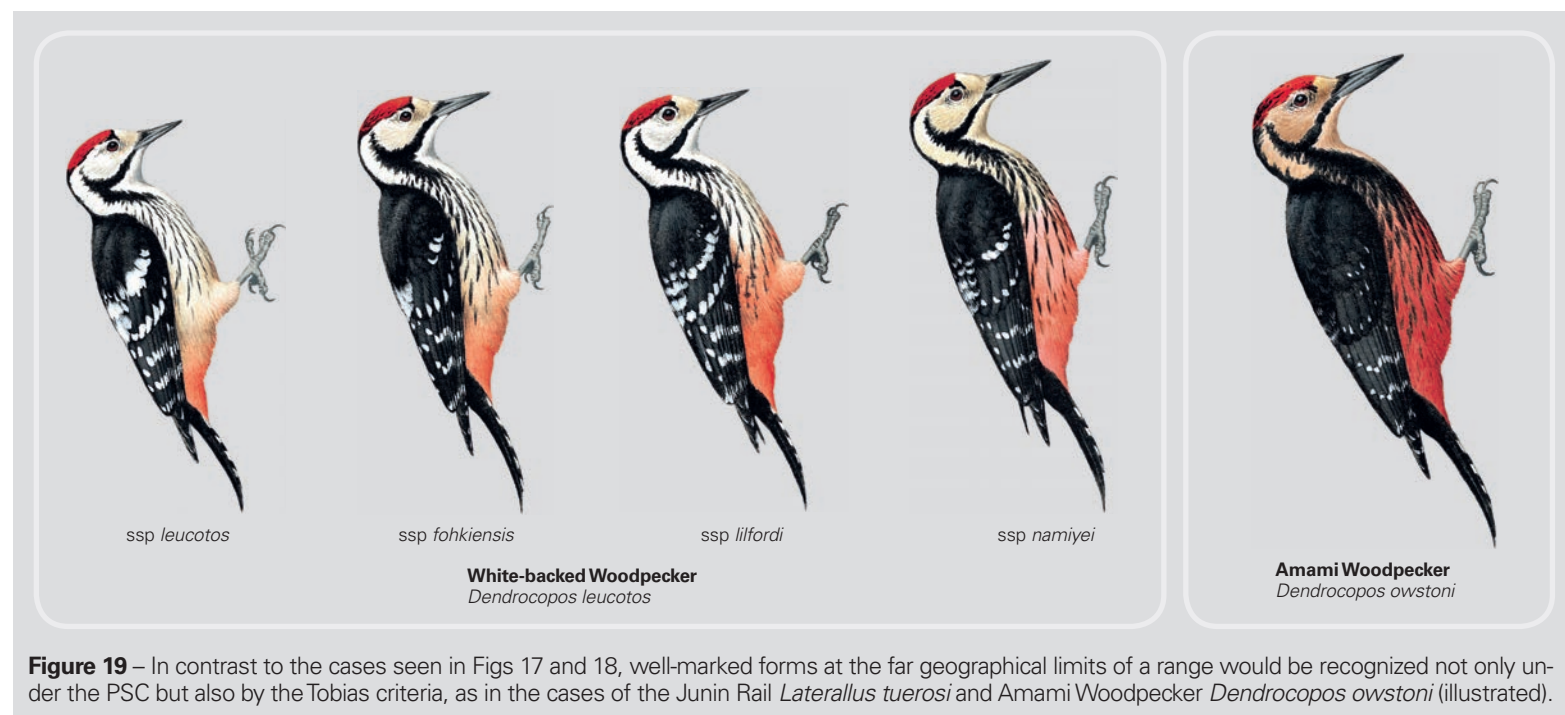


Figure 19 – In contrast to the cases seen in Figs 17 and 18, well-marked forms at the far geographical limits of a range would be recognized not only under the PSC but also by the Tobias criteria, as in the cases of the Junin Rail *Laterallus tuerosi* and Amami Woodpecker *Dendrocopos owstoni* (illustrated).

Swamphen is indeed a complex of species, as Sangster’s title runs, it is by no means clear what these species are or where and how to draw the lines and distinctions between them. The best course of action seems therefore to leave the whole group lumped until a more rigorous and comprehensive analysis of characters and ranges can be undertaken (Figure 21).

This conclusion derives from our general inclination not to attempt or accept solutions that deal only partially with the evidence, or at least which do not explore existing evidence as fully as possible. The separation of “São Tomé Lemon-dove” *Columba* [here *Aplopelia*] *simplex* from “African Lemon-dove” *C. larvata* in HBW 4 was posited on the important and notable finding that the voices of the two taxa are very different, and this arrangement may indeed eventually prove to be appropriate. However, the plumages of the various continental forms grouped under *larvata* are remarkably divergent (far more so than *simplex* is from the unsplit form *principalis* on adjacent Príncipe), while knowledge of their voices appears to be scant: in this instance, therefore, we think that a comprehensive review of taxa and their many characters might be a more helpful way forward than comparisons based on very few data points, which can appear piecemeal or opportunistic and risk missing some crucial patterns. As a perspective on this particular case, the “Amami Thrush” *Zoothera major* was originally accorded species status because its song was different from that of White’s Thrush *Z. (dauma) aurea*, but subsequently this song was found to be very similar to that of the Scaly Thrush *Z. (d.) dauma*, and the status of *major* as a species was accordingly revoked (see HBW 10).

The consideration of all taxa in a complex is, of course, a fairly obvious taxonomic requirement, and one which for example prevents this checklist from splitting the form *hubbardi* from Coqui Francolin *Pelipendix coqui* because, although it reaches a score of 7 against the nominate, *P. coqui* possesses other subspecies which, owing to specimen diaspora, we have as yet been unable to evaluate. A salutary case in this regard is that of “Siamese Partridge” *Arborophila diversa*, which Robson (2000) split from Chestnut-headed Partridge *A. cambodiana*, only for Eames *et al.* (2002) to discover and describe a precisely intermediate form, *chandamonyi*, resulting in the relumping of *diversa* within two years of its split (although of course the splitter could not have been expected to foresee this). This is the inverse of the situation referred to earlier in which the ends of a cline are so distinct that they might easily be considered two species if the linking populations disappeared; good examples of that circumstance in non-passerine birds are Elegant Crested Tinamou *Eudromia elegans* (Figure 18) and Red Spurfowl *Galloperdix spadicea*. There are, however, a couple of instances of clines, both involving the same family and a range from western Europe to eastern Asia, where the eastern (insular) extremes are so sharply differentiated from the others that they emerge as separate (if obviously derived) species: Amami Woodpecker *Dendrocopos oostoni* (from White-backed *D. leucotis*; Figure 19) and Sumatran Woodpecker *Picus dedemi* (from Grey-faced *P. canus*—although in this case an intervening group of taxa is also split off).

Just as consideration of all relevant taxa matters in taxonomy, so also does achieving a reasonable sample size in the consideration of specimen evidence. The Tobias criteria set 10 as a working minimum, and in our measurements and assessments we have always sought to meet this requirement. Inevitably, however, there are taxa for which such numbers are practically (in terms of access to holding institutions) or absolutely impossible. When sample sizes fall short of 10 in revisions given in the taxonomic notes, this is indicated; but in most cases, if the evidence is consistent, we make use of it as appropriately as possible. For taxa described and still known only from single specimens, the issue of sample size spreads beyond statistics (again, owing to diaspora we have been able to examine and measure only a small proportion of such material) to include doubts over their validity (as hybrids, morphs or aberrations). Many nineteenth-century hummingbird taxa fall into this category, apparently the result of artefacts or hybridization (perhaps anthropogenic in some cases), and, while many have now been determined as such, some still remain to be clarified. That such taxa should not be lightly discounted is demonstrated by the rediscovery in 2004 of the (in reality very distinctive) Glittering Starfrontlet *Coeligena orina*, which was relegated to a subspecies of Golden-bellied Starfrontlet *C. bonapartei* in HBW 5 (and there described as “doubtful” and perhaps “even... some melanistic plumage” and hence not illustrated).

Twelve non-passerine taxa still known from a single specimen (see Figure 25) and no other evidence but recognized as species in this checklist are Negros Fruit-dove *Ptilinopus arcanus*, New Caledonian Nightjar *Eurostopodus exul*, Cayenne Nightjar *Setopagis maculosa*, Vaurie’s Nightjar *Caprimulgus centralasicus*, Nechisar Nightjar *C. solala*, Prigogine’s Nightjar *C. prigoginei*, New Caledonian Owlet-nightjar *Aegotheles savesi*, Bogota Sunangel *Helianthus zusii*, New Caledonian Buttonquail *Turnix novaecaledoniae*, Siau Scops-owl *Otus siaoensis*, Guadalcanal Moustached Kingfisher *Actenoides*

excelsus and White-chested Tinkerbird *Pogoniulus makawai*. Seven (almost 60%) are nightbirds, which strongly implies that their continuing absence from the record is a function of human diurnal adaptations, but none can be common and the chances of being able to confirm their taxonomic identity must accordingly be limited. Most other taxonomies recognize these taxa as species, but *E. exul*, *T. novaecaledoniae* and *A. excelsus* are not usually given species status and, consequently, were scored here against the Tobias criteria, in all cases during an examination of the specimens themselves. The score for size was decisive in the cases of the nightjar and the buttonquail, and since it was impossible to calculate an effect size this was an estimate based on (a) the assumption that the specimen is fully adult and not aberrant and (b) the experience of comparing effect sizes in other parts of this project. (In one other case, Belem Curassow *Crax pinima*, where the number of specimens is extremely low and only one was available for review, this single specimen was used and again the morphometric score was decisive.)

But how dependable, how objective, can such scoring ever be? Because Tobias scores for degree of difference have clear thresholds for morphometric data and reasonably clear guidelines for plumages, in theory the scoring of character differences ought to be very consistent between one practitioner of the system and another. As yet, however, there is very little evidence to demonstrate the truth or falsehood of this assumption. We know of one case, the White-faced Plover *Charadrius dealbatus*, where we applied Tobias scores to a taxon independently of another set of practitioners. The table here compares the characters selected and the scores given (“–” means character not selected for consideration).

character	Checklist	Rheindt
bill depth at ‘nail’ = 3.8 ± 0.24 vs 3.6 ± 0.57, effect size 0.46	1	–
longer wing, effect size 0.448	–	1
longer tarsus, effect size 0.922	–	0
longer bill, effect size 0.34	–	0
white, not black, lores	2	3
more extensively white forehead, with black of crown usually reduced	2	1
brighter and paler upperparts	2	2
more dark on lower ear-coverts	–	0
much reduced black lateral breast-patches	(ns[1])	0
more vivid orange crown	–	0
rufous-brown of crown does not reach over nape sometimes to divide hindcollar	(ns[1])	–
more white in wingbar	(ns[1])	–
generally sandier, less muddy substrates	1	1
more active foraging behaviour	–	0
more upright stance	–	0
Total	8	8

Intriguingly, the final scores of these two assessments are the same, but they agreed on only two out of the four scores that they both applied to the same character; however, the differently scored characters are adjacent on the bird’s face and could be said to form one character, for which both practitioners scored 4. We do not know how many people contributed to the scoring of *dealbatus* in the Rheindt analysis; for this checklist most scoring was done by one individual examining the specimen evidence itself (N. J. Collar), but all scores were critically scrutinized by at least one other individual (J. del Hoyo) and commonly by a second (L. D. C. Fishpool) before any taxonomic decision was finalized.

As a final note here, it needs to be mentioned that, in addition to the taxa that are split and lumped in this checklist, scores for distinctiveness are often (but not always) given also in cases where taxa have been tested for possible splitting or because they have been split by others but maintained lumped here.

Subspecies, populations and conservation

The bird listings on major legal instruments such as CITES (Convention on International Trade in Endangered Species), CMS (Convention on the

Conservation of Migratory Species) and Ramsar (Convention on Wetlands of International Importance) very largely or exclusively comprise species rather than subspecies. Moreover, while the first and second editions of the international bird Red Data Book (Vincent 1966–1971, King 1978–1979) treated subspecies as well as species, the third edition did not. A full explanation for this change of policy was given in the first volume of that edition (Collar & Stuart 1985: xvi–xviii), emphasizing that national conservation organizations should certainly not disengage from subspecies conservation, and that “the environmental crisis of our planet is now so great that to focus merely on species is to fail to recognise the considerable loss of genetic diversity we are about to sustain (and doubtless are sustaining) at the subspecific level”.

A substantial part of the reason for this focus on species lies simply with the level of uncertainty that attaches to the taxonomic status of many subspecies—a circumstance that takes us back to the fundamental difficulty with the PSC. This fact, combined with the sheer number of subspecies and the failure of global conservation in any case to achieve any significant level of success at the species level, has contributed to the absence of subspecies from conservation agendas in many parts of the world. Still less attention is given to populations that are (so far as we know) undifferentiated taxonomically but of interest as geographical outliers (for example, the remnant breeding colonies of Dalmatian Pelican *Pelecanus crispus* in East Asia, Demoiselle Crane *Anthropoides virgo* in Turkey and formerly Morocco, Glossy Ibis *Plegadis falcinellus* on Agalega in the Indian Ocean). On top of this, conservation also has to contend with the steady loss of

species from the edges of their ranges and the inexorable thinning of populations *throughout* their ranges.

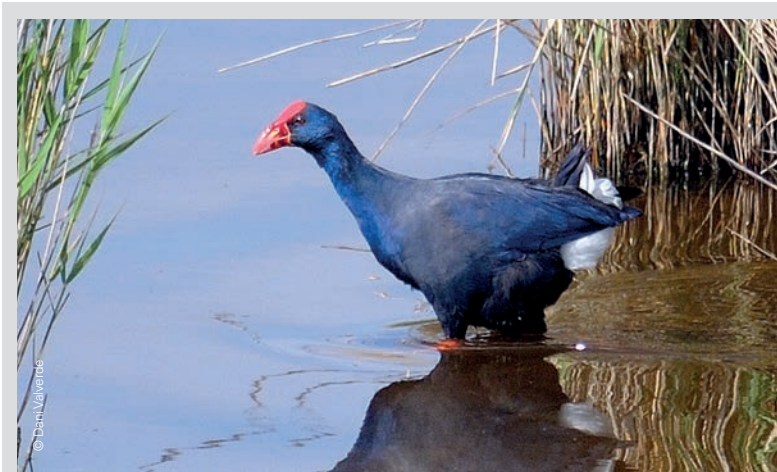
Here we simply wish to stress again that, while we firmly believe in the species as the simplest and soundest unit of biological diversity in terms of conservation attention, we acknowledge and applaud endeavours that target subspecies and populations, with the only proviso that these complement and supplement, rather than detract or distract from, endeavours that target species. If we do not judge *Cyanoramphus novaezelandiae cookii* or *Chersomanes albofasciata beesleyi* to hold species rank, we nevertheless urge those concerned for their survival to use whatever means they can to maintain these taxa into the future (for the former, see next paragraph). We certainly hope that at some stage BirdLife International will attempt the task of evaluating the global conservation status of subspecies, which may go some way to reducing the pressure we sense in some quarters to elevate subspecies to species level as a means of increasing their profiles with potential funding sources. We repeat here, however, our earlier assertion that, fully committed to conservation though we are, conservation considerations have no place in taxonomic evaluations.

Results in broad brief outline

Comparing the list of species recognized in this checklist with those published in the volumes of HBW, a total of 30 has been lumped into 22 species, all of which are now treated as Least Concern on *The IUCN Red List*.



Figure 20 – Some polytypic species consist of several well-marked subspecies that appear to be much more appropriately treated as species. Such species are sometimes referred to as “complexes”, to indicate the uncertainty of the taxonomic status of their component forms. Examples include Northern Bobwhite *Colinus virginianus*, Kalij Pheasant *Lophura leucomelanos*, Silver Pheasant *L. nycthemera* and Purple Swamphen *Porphyrio porphyrio*. Four of the most distinctive forms in the Purple Swamphen “complex” show clear differences in colour of the upperparts (dark blue, turquoise-blue, green or black!) and head (grey, blue or black), and some of them also show marked differences in body size and in the shape of the frontal scute, so it would seem that delimiting a number of species would be straightforward. In practice, however, it is not...



P. p. porphyrio (Spain)



P. p. madagascariensis (South Africa)



P. p. caspius (Turkey)



P. p. bellus (SW Australia)



P. p. poliocephalus (India)



P. p. melanotus (New Zealand)



P. p. viridis (Malaysia)



P. p. indicus (Borneo)

As noted above, however, the three taxa formerly considered threatened species, but now no longer recognized at the species level (Manus Owl *Tyto novaehollandiae manusi*, Usambara Eagle-owl *Bubo poensis vosseleri* and Socorro Parakeet *Psittacara holochlorus brevipes*) remain important conservation priorities. Moreover, *Cyanoramphus novaeseelandiae cooki* (treated as a subspecies in HBW) remains equally protected as a subspecies under Australian law (Garnett & Christidis 2007) and has its own action plan (www.birdsindanger.net).

The number of lumped taxa is outweighed 15-fold by the 462 newly split taxa (although it is important to note that very roughly half of these result from post-HBW splits proposed by others). Over 22% of these are considered threatened, falling into the categories of Critically Endangered, Endangered or Vulnerable, and a further 15% are listed as Near Threatened. These proportions are significantly higher than those for taxa that were treated as full species and remain so in this checklist (16% threatened and 11% Near Threatened), reflecting the smaller distributions and populations of the split taxa, both of which are associated with higher extinction risk and Red List category. Across all 4,471 non-passerines recognized in this checklist, 17% are considered threatened with extinction, and a further 11% are Near Threatened. Incorporating the taxonomic revisions presented in the Checklist, 13% of the world's birds are now considered threatened with extinction.

The new splits are not evenly distributed across families, with over 20 new splits documented in this volume for each of the pigeons, woodpeckers, hummingbirds, kingfishers, owls and parrots. Excluding families with fewer than ten species, those undergoing the largest proportional increase include the albatrosses, motmots, kingfishers, toucans and all three barbet families (Asian, African and New World), each growing by over one quarter. Similarly, there are geographical biases: while taxa have been split in all regions, the largest proportional increases have been in Asia (15%) and Oceania (14%), compared with the Americas, Africa, Middle East and Antarctic (each 10%), while the number of non-passerines in Europe has increased by under 9%. This would appear to accord well with the perceived “over-lumping” of the Asian avifauna discussed above.

Using the Checklist

The subsections that follow outline the technical processes, presentational conventions, sources followed and similar details relating to all aspects of this checklist. Although the volume is large in size, its structure is rather simple: following this introduction, the main body of the book—the checklist itself—comes directly; then three appendices, two of them covering the extinct species, the third comprising a set of maps to help users to interpret the distributional information; then a bibliography and index. More information on all these components follows in this section.

Macrosystematics

All species of bird belong within a higher classification, of course. The world of ornithological taxonomy has long been confronted with an intimidating array of higher order divisions—subclass, infraclass, parvclass, superorder, suborder, infraorder, parvorder, superfamily, and so on—established to provide the best approximation of the degree of relatedness of taxa on a notional evolutionary tree. However, for the purposes of this volume, these various divisions can be set aside, and in this checklist only the categories of orders and families (and subfamilies and tribes when applicable, and very occasionally suborders) are used.

These are generally good times for avian macrosystematics, as the plethora of molecular works at this level is yielding very consistent results and thus seems to be laying the foundations for what we expect will be a solid and durable higher classification of birds (Cracraft 2013, Fjeldså 2013). Recent works have been based on extensive samples of birds, both at the geographical and systematic level, which has considerably

increased the robustness of the results. Amongst these works it is essential to mention the revolutionary “A phylogenomic study of birds reveals their evolutionary history” (Hackett *et al.* 2008), which examined nuclear DNA sequences from 19 independent loci for 169 species, representing all major extant groups (see Figure 10). No subsequent study has presented any major contradiction of its findings. The practical result of all this is that, for the division and sequence of higher groups of birds, mainly orders and families, there is a welcome homogeneity in most, if not all, recently published checklists, online lists and major new ornithological works. For this checklist, however, rather than following a recently published classification, we adopt—so far as possible, although minor discrepancies may occur owing to the time lag between the three publications involved—one that will appear in due course in *Bird Families of the World: a Guide to the Spectacular Diversity of Birds* (Winkler *et al.* in prep.). Because this book will provide a comprehensive, current interpretation of systematic findings, covering each of the 35 avian orders and more than 230 avian families, we make no attempt here to offer an explanation of or commentary on macrosystematic relationships.

By contrast, from the family level downwards the options for subdivisions and their sequences multiply, so that many more classifications are possible than exist for the higher groups of birds. Consequently we follow generic arrangements and sequences largely as adopted in HBW, but naturally with a considerable number of adjustments based on more recent information, citing the individual sources under the genus headings. In similar fashion we largely adopt the subspecies and their sequences as provided in HBW, with all required updates indicated in the taxonomic notes.

Inevitably, of course, there are some groups of species whose genetic signature continues to defy a confident ascription of relationship—turacos, for example. The usual method of treatment of such groups is to place them in a separate category labelled “*incertae sedis*” (of uncertain position), but this option is avoided in this checklist (see further commentary under the subsection *Genera* below).

Genera

Despite its enormous importance as a taxonomic unit and its equal place in Linnean binomial nomenclature, the genus is a notably vague and plastic entity whose defining criteria have never been clearly codified. Every genus should have diagnosable characters, but it is increasingly apparent that these may be very subtle: when the genus *Patagioenas* was reinstated for all New World pigeons previously treated in *Columba*, the sole basis for the case was its strong monophyletic identity as revealed by molecular study (Johnson *et al.* 2001); no mention was made of any morphological, behavioural or ecological traits unique to the clade, and it is not very certain that any such traits could be found. Genetic studies are becoming increasingly important in determining generic limits, of course, resulting in the break-up of even highly uniform groups that used to be treated under one name—*Caprimulgus* is a good example—but then leaving certain other groups not yet subjected to molecular scrutiny appearing exaggeratedly heterogeneous, as in the case of *Vanellus*.

This checklist started with the generic allocations made by the many authors of HBW, checked against and conflated with the existing BirdLife list. Then of course it sought to modernize all these by reference to the many new insights provided by two decades of mostly molecular work. Nevertheless, two guiding principles in choosing genera have been, first, monophyly (where generic names define groups of species whose members are all more closely related to each other than they are to members of any other group) and, second, practicality (where opportunities have been taken, for the sake of stability and continuity, to reduce the number of changes to the *status quo*). Thus in recent years, molecular evidence has suggested a close genetic relationship between the curassow genera *Aburria* and *Pipile* (Grau *et al.* 2005), and between *Crax* and *Pauxi* (Frank-Hoeftlich *et al.* 2007), resulting in their merging respectively into *Aburria* and *Crax* alone; but each of these four genera clearly defines a monophy-

Figure 21 – A more comprehensive review of the evidence places inconvenient obstacles in the way of splitting the Purple Swampphen into several species. For instance, the geographically interposed form *caspius*, which cannot reasonably be considered a representative of a hybrid zone so much as of a cline, provides a bridge, in both coloration and scute shape, between the western Palearctic form *porphyrio* and the Indian *poliocephalus*. Even more complex are the patterns of variation in the black-backed forms: although *viridis*, from South-east Asia, and *indicus*, in most of Indonesia, have been proposed as together forming a separate species, “Black-headed Swampphen”, they share similarities in some characters with other forms much more than with each other. And when the rest of the 13 traditional forms are also considered, the difficulty in defining lines to divide the mosaic-like pattern of geographical variation, involving different characters, increases even more. In view of this, we have preferred to retain the traditional treatment until more evidence is gathered. This is a case for which an exhaustive, comprehensive genetic study, backed up by detailed morphological analysis, could clarify relationships and allow for a less frustrating treatment.

letic grouping that is diagnosably distinct in various characters including morphology, voice and/or habitat, so we have no compunction in retaining them in spite of the story their genes may be telling us. As noted in Figure 11, results of molecular studies at the generic level can sometimes be contradictory, as in the case of the *Larus* gulls, and therefore at least for the time being we prefer to balance information on genera that comes from laboratory work with evidence deriving from morphological, behavioural and other studies. In certain cases an arrangement used by an HBW author has found little acceptance (e.g. the splintering of *Amazilia* into six genera in HBW 5) and we have reverted to the original.



Bonin Petrel *Pterodroma hypoleuca*

Figure 22—Time and scientific opinion will decide how well the Tobias criteria perform as a practical tool for determining species limits in birds. It is obvious, however, that certain groups—various nightbirds, swifts and swiftlets, large gulls, certain tapaculos—present greater challenges than others when the criteria are applied. Among the non-passerines few have proved so difficult as the “tubenose” seabirds (Procellariiformes). The majority of these possess visual cues to their identities which presumably serve as signals to conspecifics at sea, but a minority, particularly among the *Puffinus* and *Calonectris* shearwaters and *Pterodroma* petrels, are lookalike puzzles to which there are no very clear answers. Given their high degree of natal philopatry, it may well be that the only place where species-specific signals matter to them is at the nest; and given that these are dark burrows visited at night it seems plausible that olfactory signals and subtle vocalizations—the first impossible for humans to detect without sophisticated technology, the second equally difficult unless at very close quarters—are the mechanisms by which the taxa tell each other apart. If information on these hypothesized phenomena were available, it might well be that the Tobias criteria would work perfectly well in analysing it. Since it is not, and since genetic sampling has been, to date, sometimes rather incomplete and sometimes rather contradictory (for instance, over the rank of *Calonectris diomedea* and *C. borealis*: see Gómez-Díaz *et al.* 2009, Genovart *et al.* 2013), the points of view of marine avian taxonomists have been particularly important and valuable in decisions over the drawing of procellariiform species limits.

All genera in this checklist are given a heading with the describer and year of description. In some cases there is also a note beneath it that provides new or notable information concerning the relationships of the genus. The category *incertae sedis* is not used; we prefer to retain a traditional position, with a note as necessary. The sequence of genera and the sequence of species within genera seek to follow the most recent published evidence (it is a frustrating aspect of many molecular projects that they fail to sequence certain taxa that are crucial to a clear definition of relationships); our default has been to follow the excellent third and fourth editions of the Howard & Moore checklists (Dickinson 2003, Dickinson & Remsen 2013), but always with exceptions when more recent evidence is available (e.g. with the hornbills and the pigeon genus *Ptilinopus*).

Species accounts

The rationale for the recognition of species in this checklist is covered in the earlier sections of this introduction.

A blue box contains first the number indicating the species' place in sequence within the family, followed by the scientific name of the species in *italic*, its English name in **bold**, a small coloured square with IUCN Red List category abbreviation, and a pointer to the volume and page on which the species is treated in HBW.

Scientific names—The great majority of scientific binomials have remained stable over many decades and from one checklist to another, but with many recent changes of genus and new assessments of the gender of these, novelties in this checklist are inevitable even if only in the agreements of specific names. For this volume on non-passerines we pay tribute to the meticulous and exhaustive work on these aspects conducted by Dickinson (2003), David & Gosselin (various papers, see below) and Dickinson & Remsen (2013), whom we generally follow on issues of nomenclature.

Several years ago, while working on HBW, we were kindly invited by Edward Dickinson and Normand David to join in their discussions concerning emendations, looking at individual cases and judging whether or not each emendation was justified, depending on individual interpretations of the Code (see Box 2). It was readily agreed that in matters purely affecting nomenclature it would be to the benefit of us all if we could reach a good level of agreement, and thus cut down discrepancies in nomenclature between our respective works. The result was almost total agreement: there was an already very high level of initial consensus, and this was followed up, after lengthy debate, by all parties ceding in a number of cases. It must be stressed that all the hard work and the merit is theirs; our contribution was limited to offering opinions. The process and the main results (non-passerines) were summarized in David & Dickinson, Appendix 8 in Dickinson & Remsen (2013). Since the publication of that work, further discussions have led us all to revise our joint opinions on two species names included in the present volume. The two names now emended herein on the basis of being correct (classical) Latin are *Microcarbo pygmaeus* and *Calidris pygmaea*. We stress that these changes have been agreed by all the parties involved, and applaud our colleagues in being prepared to reverse these decisions which they published only last year.

English names—We recognize that the English names of birds have been a matter of protracted debate, with many attempts at producing a stable, definitive set of names for worldwide usage according to particular principles. It happens, however, that HBW and BirdLife have long shared very similar views on the formulation of English names, and in this work of synthesizing their two lists we prefer to maintain continuity with them rather than seek to adopt another system. Irrespective of relationships we hyphenate compound generic names with the second element of the name in lower case, thus preferring to resist the situation, as advocated by Gill & Wright (2006) (whose comprehensive and thoughtful overall review of name formation we respectfully acknowledge), in which it is possible to have three variant combinations (e.g. “Fruit Dove”, “Eagle-Owl” and “Flycatcher-shrike”). We follow the long-standing BirdLife policy of avoiding eponyms when alternatives present themselves, preferring to associate a bird species with a place (potentially positive for its conservation) or a physical characteristic (neutral) rather than a person (sometimes with potentially negative connotations). Similarly, we seek to use modern national names where appropriate; in the case of birds recently called “Malayan” or “Malaysian” we have opted for “Malay” (“Malayan” has imperial overtones while “Malaysian” covers a political entity not necessarily coinciding with the range of the species, whereas “Malay” is, we hope, neutral and suitably imprecise in geographical terms). To

the point where it is not obtrusive, we retain spellings that are the norm for the respective English speakers in the New and Old Worlds (colored/coloured, racket/racquet, checker/chequer). For newly split species we have sought first to find an existing name that might have been used in regional guides or as a subspecies name, or otherwise to invent a name that best characterizes the bird by its geographical range or its diagnostic features. Occasionally, we chose to create a new name to replace an established one—for example, Glittering Starfrontlet for Dusky Starfrontlet, since “dusky” is a wholly inappropriate epithet for the species.

IUCN Red List categories—These were outlined for readers of HBW by Collar (1999) and the latest version was described by IUCN (2001), with various updates online. There are altogether seven categories, as follows: Extinct = **EX**; Extinct in the Wild = **EW**; Critically Endangered = **CR**, also with the tags **CR(PE)** for Critically Endangered (Possibly Extinct) and **CR(PEW)** for Critically Endangered (Possibly Extinct in the Wild); Endangered = **EN**; Vulnerable = **VU**; Near Threatened = **NT**; Least Concern = **LC**; and Data Deficient = **DD**. Definitions of these categories can be found in the sources cited above. See also additional explanatory notes given below, in the subsection *Extinct species*. In this checklist all species, including those newly split or lumped, have been evaluated by BirdLife International against the IUCN Red List criteria, and are published for the first time alongside BirdLife International’s 2014 IUCN Red List for birds.

Pointers to HBW—Readers wanting to check facts about a given species can of course use many sources, including the internet, but we offer as a first point of reference HBW, as the only published source in which every bird species is treated in some detail, providing well over 20,000 owners and probably many more users with a fast and easy way to cross-refer, whether to check name and taxonomic changes or simply to find further information on the species. If this pointer mentions only HBW volume number and page, it means that the species appears in this checklist with exactly the same scientific name as in HBW. Any change of scientific name results in the pointer indicating the former name as it appears in HBW, thereby making these pointers a simple way of detecting nomenclatural or taxonomic changes from the HBW treatment. Taxonomic changes are explained lower in the entry, as are changes in nomenclature apart, normally, from those limited to gender agreement; these are in accordance with David & Gosselin (2002a, 2002b, 2011, 2013). The final (special) volume of HBW is referred to as HBW SV.

French, German and Spanish names—For the most part these follow those given in HBW, but the same committees used by HBW (see Acknowledgements) have been consulted for updated corrections to spellings, new group-names necessitated by new phylogenetic positions, and name changes required by the splitting or lumping of species.

Other common names—This entry is discretionary, depending on whether or not alternative names exist. HBW sought to indicate as many other English names as possible when these were current or fairly recent, resulting in the need to compress them through a series of slashes and sometimes brackets, e.g. “Equatorial/Cadet Hummingbird”, “Cuvier’s (Scaly-breasted) Hummingbird”. For this checklist these names have been significantly reduced in number, retaining or adding only those found in peer checklists, monographs and field guides dating from approximately the last twenty years; consequently they are given in full. Names after semi-colons apply only to a subset of the species (typically a single subspecies) indicated by the taxonomic name in brackets; names of subspecies-groups are given in the section “Subspecies and Distribution”, discussed separately below.

Taxonomic notes—The first line of the note gives the original scientific name in *italic*, followed by the name of the describer (see Box 1), the year of description and the type locality. Where the original type locality was modified significantly, this is signalled, for example: “New Guinea; error = Cuba” would mean that the type locality given in the original description was New Guinea, but that this was subsequently corrected for Cuba; “no locality = Sumatra” means that no type locality was specified in the original description and that Sumatra was later decided upon as an appropriate locality; “Africa = Kaduna, Nigeria” means that the original, rather vague type locality of Africa was subsequently narrowed down as specified. The rest of the section may be as short as the single word “Monotypic”, but in the great majority of cases it introduces condensed, basic information on the issues that affect the taxonomic status of the species (and all taxa included in it), dealing with its relationships, former and current alternative treatments (in different genera, as subspecies, etc.), problems of



Snowy Egret
Egretta thula

Little Egret
Egretta garzetta

Figure 23 – To be consistent in treatment, taxa commonly treated as separate species but which are very close in appearance were also, as far as possible, subjected to the Tobias criteria. This exercise extended to some 150 species, but resulted in only a handful of “lumps”, by which two species were merged into one. Among the pairs of taxa considered were Snowy and Little Egrets *Egretta thula* and *E. garzetta*: non-breeding Snowy are smaller (score 1), with brighter yellow feet and a yellow stripe up the rear of the tarsus (score 2) and less feathering towards bill base (score 1), hence not at all easy to discriminate, but when breeding the ornamental crest shows a very different pattern (filamentous and bushy where Little’s consists of two long lanceolate feathers: score 3) and the back plumes are longer and very strongly recurving (“bouncing”: score 2). In contrast, taxa that were lumped include Caribbean Coot *Fulica caribaea* with American Coot *F. americana*, Usambara Eagle-owl *Bubo vosseleri* with Fraser’s Eagle-owl *B. poensis*, Green-tailed Emerald *Chlorostilbon alice* with Short-tailed Emerald *C. poortmani*, and Thick-billed Honeyguide *Indicator conirostris* with Lesser Honeyguide *I. minor*.

nomenclature, errors and options; in many cases the choices between options are fully explained. See Box 2 for a concise explanation of some of the terms used. These notes draw heavily on and in many cases simply copy the notes that appeared in the equivalent part of the section entitled Taxonomy under each species in HBW, and we gratefully acknowledge the HBW authors who contributed this material. However, all cases have been revised, and the majority of entries have been significantly modified and extended in various ways. Reference to superspecies, although given some prominence in HBW, has almost entirely been dropped, as over the years the term has been applied in various ways, not always consistent with the original concept; moreover, the concept itself has fallen out of fashion in recent decades as the use of clades to demarcate monophyletic groups has risen. Not replacing “superspecies”, but to some extent comparable,



Solomons Frogmouth
Rigidipenna inexpectata



Marbled Frogmouth
Podargus ocellatus



Gunnison Grouse
Centrocercus minimus



Sage Grouse
Centrocercus urophasianus

Figure 24 – In a sense, everything in taxonomy is hypothetical, even species. Taxonomy is no more fixed than history—both are dynamic, investigative disciplines which balance incomplete evidence and intelligent inference to generate new insights and hypotheses. Careful re-examination of the relatively few specimens of what was called *Podargus ocellatus inexpectatus*, the “Solomons Marbled Frogmouth,” revealed that its tail structure is quite unlike that of other *Podargus*, prompting osteological and genetic work that catapulted the form from subspecific status to a species in its own monotypic genus, *Rigidipenna*. This small shake-up in the biogeography of the Solomons was a remarkable event, but perhaps even more striking was the discovery of the first new species to be described in North America in over a century, the Gunnison Grouse *Centrocercus minimus*. In both cases, the discoveries were made long after specimens of the taxa had been collected, vividly demonstrating that advances in taxonomy do not necessarily depend on new field explorations.

is the phylogenetic use of the word “sister”. Although, of course, different speciation events can be in progress affecting the same “parent” species simultaneously in different parts of its range, the act of speciation unavoidably constitutes the splitting off of a single species from another. Only two entities can be involved in any one speciation event, and these two entities are considered to be each other’s sister: they are sister-species. The same principle applies right the way up the taxonomic tree so, for example, two genera may be sisters. In all such cases, it is naturally a prerequisite

that each sister group must be monophyletic, as must any two sisters when considered together. Special attention is given to account for changes between HBW and this checklist (except concerning gender agreements, for which see the subsection *Pointers to HBW* above).

Taxonomic changes involving the use of the Tobias criteria (see above) are introduced with a variety of formulaic phrases (e.g. “Usually considered...”, “Formerly treated...” and “Until recently...”) leading to a listing of characters with their scores in brackets afterwards. In these cases such

enumerations of characters, although our own, have been prompted by other taxonomic evaluations, but use of the term “Hitherto” indicates that the taxonomic change that follows is unique to the checklist and is formally being introduced here (this discounts cases where the original description a hundred or more years ago treated the form as a typological species; but otherwise we have always sought to give credit to earlier workers who have indicated, even if only in vague terms, the possibility of a split). Candidates for a change in rank between species and subspecies have always been scored against the Tobias criteria, although for various reasons (mostly relating to the weakness of the candidature) the scoring has not always been given in the text. Weaker candidates may have been judged only by reference to illustrations, photographs and texts, but so far as possible candidates that achieve the score for a change in rank have been evaluated or at least checked through the examination of museum material. As noted earlier, every reasonable attempt was made, when measuring specimens, to achieve a sample size of 10 and to ensure (where material was a constraint) an equal balance of the sexes (and preferably the use of one sex only); cases where the sample size is smaller than 10 are indicated (sometimes, e.g. when unique specimens are involved, this is very obvious). All measurements are given in millimetres. Note that what was previously the British Museum (Natural History) (BMNH) has now been renamed as the Natural History Museum (NHMUK). All references in the text use the latter form. AMNH refers to the American Museum of Natural History.

In addition to comments relating to species-level issues this section will also deal with possible nomenclatural conflicts, particularly when a name is changed. Comments may be made about the validity of both accepted and synonymized subspecies, giving, where possible, some idea of the ranges of the latter, and often providing explanations for decisions (rather than simply referring the reader to another source). Names given to hybrids, aberrants and other infraspecific forms, as well as those in invalid descriptions, are normally noted, and thus are listed in the index to make them searchable. Extinct subspecies, if any, are marked with a cross (†) but are also sometimes mentioned in the notes. The last sentence of this section always indicates either monotypy or else the number of extant subspecies accepted herein. In cases of uncertainty, or where others take a different view, the statements may be prefaced with a qualifier such as “Provisionally” or “Treated as”. We acknowledge that the validity of many avian subspecies is open to question, but the task of assessing them is so dauntingly large that for the great majority the only option is to accept them on the basis of their general currency and usage, after consulting an array of relevant sources.

Distribution/Subspecies and Distribution—Each subspecies is marked by a bullet point, except in the case of extinct races, which are marked instead by a cross (†). The generic and specific names are abbreviated and only the subspecific name is given in full, followed by the name of the describer and the year of description. As per standard usage, brackets enclose the describer and year when the currently used genus is different from that in the original description of each subspecies. The text outlines the range of each of the subspecies following a standard geographical sequence (north–south, west–east), but flexibly depending on logic and best fit, seeking a level of detail beyond simply country and cardinal points, with extensive use of provincial and regional divisions in certain countries (such additional details are supported by reference maps in Appendix 3). For migratory species the breeding and non-breeding ranges are separated; in cases where non-breeding ranges are poorly known for individual subspecies, the range may be generalized to account for all subspecies. Ranges known, or believed, no longer to be occupied are indicated, along with those where the species is known to occur but the subspecies has not been determined. The ranges of introduced populations are indicated separately. Certain country and region names (and limits) have been updated since HBW (e.g. Eritrea, South Sudan).

Subspecies-groups—These are informal taxonomic units used in several recent world checklists to highlight seemingly monophyletic groups of taxa (sometimes single subspecies) that at present appear to sit between the species and subspecies levels (although in some cases it seems likely that fuller scrutiny and better evidence will result in their being awarded species rank). Such groups are identified by their possession of one or a number of reasonably distinct characters and which therefore seem worthy of notice (but in most cases no attempt has been made to score these with the Tobias criteria, and no threshold number has been set for the recognition of such groups). They may already have been recognized as species in other lists or accorded a taxonomic status such as “megasubspecies” or “allospecies”, and may already possess English names (which we typically make use of). They may sometimes, however, result from our own work in applying the Tobias criteria, and for these groups we commonly supply our own English names. As a general rule, groups identified through the Tobias criteria were reasonably well marked; the weaker their distinctiveness became, the less likely they were to be separated as groups so that, if a name already existed for them, this was simply given in the Other Common Names section. Also, when an alternative name for a subspecies-group exists it is given under Other Common Names. In some cases a potential group could not be defined because one or more of the

Box 1 Identifying authors of scientific descriptions

Each author of scientific bird names is, theoretically, identified individually, so when the same surname crops up, one of several systems may be used for separation. In a few cases, the surname itself given in full can supply a solution (Dumont de Sainte Croix, Dumont d’Urville). Much the commonest method, however, is by the insertion of initials (J. F. Gmelin, S. G. Gmelin; P. L. Sclater, W. L. Sclater; G. R. Gray, J. E. Gray; A. H. Miller, J. F. Miller, L. Miller, W. deW. Miller; C. M. White, C. M. N. White, H. L. White, J. White, S. A. White). Full initials are often given, and sometimes serve to avoid potential or real ambiguities, such as the previously listed name “H. Blasius”, which might apply to any of A. W. H. Blasius, J. H. Blasius or R. H. P. Blasius. But full initials are not always given, normally based on common usage; thus, Emilie Snethlage appears simply as E. Snethlage rather than H. M. M. E. E. Snethlage. Occasionally, the solution can be a combination of both of the first two styles (J. G. Fischer von Waldheim vs G. A. Fischer, J. B. Fischer, J. C. H. Fischer). There are a few exceptional cases, notably that of H. Milne Edwards and his son, A. Milne-Edwards; the hyphen would distinguish their names, but as the son used it normally but not invariably, it is clearer to provide the initials. If the initials are the same, a different given name may be written in full, as with Nagamichi Kuroda and his son, Nagahisa Kuroda. When initials and names are identical, another system must be used. If those involved are father and son (as is, not surprisingly, often the case with an identical combination of names), we omit the initials and attach Sr and Jr; this occurs with the names M. Bartels, J. H. Gurney and W. H. Phelps, which become Gurney, Sr, and Gurney, Jr, etc. But if the authors involved are not father/son,

we do not use the Sr/Jr system. One particularly complicated case involves the German/Chilean R. A. Philippi and his son F. H. E. Philippi because further down the same line comes a second R. A. Philippi. To solve this one, we decided to use the Spanish custom of the second surname to separate these two, who become respectively R. A. Philippi [Krumwiede] and R. A. Philippi [Baños]. A single scientific description by a like-named person can result in a prolific author’s name having to be given initials throughout. Claudia Hartert is cited (C. Hartert) for a single subspecific name in this volume, but her formal participation in this description (and, in fact, in those of a few other bird names) means that her husband has to receive his initials each time—we prefer to give his full initials, E. J. O Hartert—each of the 272 times his name appears herein. A similar but far less extreme case is that of Annie Meinertzhagen, whose limited participation in descriptions means that her frequently named (and notorious) husband also requires an initial; interestingly, she also requires initials under her maiden name, A. C. Jackson. One last matter perhaps deserves a brief explanation. Several years ago, and after consultation with a German colleague, it was decided not to add in the “von” that is sometimes listed with some German names such as Spix, Pelzel and Berlepsch. It was decided that many of these well-known figures from the history of ornithology are better known without the “von”—in much the same way that nobody (except Vincent Price) talks about “the symphonies of van Beethoven”. We readily acknowledge that not everyone will agree with this decision. A few authors (in our subjective opinion) are better known with the “von”, and so are always listed with it, e.g. J. W. von Müller.

Box 2

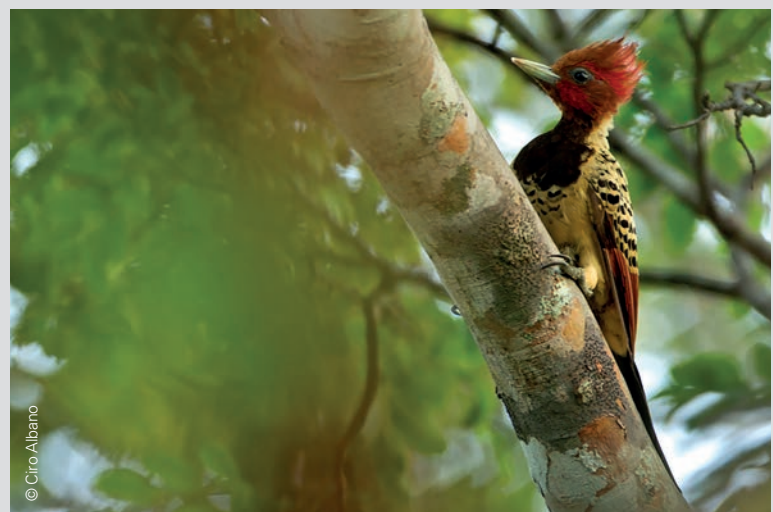
Notes on some terms used in nomenclature

The complicated business of scientific nomenclature is governed by the International Code of Zoological Nomenclature, commonly abbreviated as “**the Code**.” This is maintained by the International Commission on Zoological Nomenclature (ICZN). For any doubts in connection with this subject, readers are referred to the Code, which is available online (<http://iczn.org/iczn/index.jsp>); for a general overview, readers are warmly invited to consult the excellent and informative foreword on the subject by Richard C. Banks, HBW 9: 13–25. However, for those unfamiliar with the intricacies of the Code, and looking for a very succinct explanation of some of the potentially more obscure terms used in the text, we include some extremely brief notes on a selection here; it must be stressed that these summaries of just a few words cannot hope to encapsulate the complexities of each term, when the Code expends a good deal more space on each—in some cases several pages—so these summaries should be taken merely as general indications of what each term refers to. A **taxon** (plural “taxa”) is any taxonomic unit, with the implication that all of its members are thought to be interrelated, with no equally close relative excluded; it is broadly comparable with the phylogenetic term **clade**. It is sometimes used to refer only to species and subspecies (as, for convenience, in HBW family summary-boxes), but it can equally be applied to other ranks, such as family—or, indeed, Class Aves, although only up to family rank are these names regulated by the Code. **Taxonomy** is the science of attempting to put all relevant taxa into a meaningful order or scheme. Each species-group taxon that has been formally described has its **type specimen** (or specimens), an individual museum specimen against which the identity of any closely related taxa may be compared. Except in early works, this individual tends to be explicitly indicated by its museum specimen number in the formal scientific description and marked in the museum by a special label (usually red). If the type is a single specimen, that is the **holotype**. If it is a series of specimens, these are all **syntypes**. If the type specimen has been lost, a **neotype** may be designated, under strict rules and preconditions. If a group of syntypes proves to refer to a mixture of more than one taxon, one of the syntypes may be designated as the **lectotype**, and it thus gains the same status as a holotype. For higher ranks the system is similar: each genus has its type species; each family its type genus, upon which the name is based. For a family-group name to be valid, the genus name upon which it is based must be available, although it need not be recognized. Thus, for example, although due to merging with the older name *Psilopogon*, the genus *Megalaima* is not recognized in this checklist, the correct name for the family remains Megalaimidae, as it is the oldest available family-group name for these birds. The **type locality** is theoretically the place of collection of the type specimen. The idea of having a type locality is to have a geographical site (and population) that helps define the taxon, so that individuals observed at the same location are likely to belong to the same subspecies (if applicable) or species. However, if migrants or vagrants are involved, birds of several races may co-occur, so that it is by no means the case that all conspecifics seen at the same site need belong to the same race, as has commonly been illustrated, for example, in the case of the Yellow Wagtail *Motacilla flava*. More to the point, however, is the fact that the type locality need not even form part of a taxon’s normal range—as, for example, in the case of the American Bittern *Botaurus lentiginosus*, with a type locality in England, where the species is only a very rare vagrant—but such cases are rare, and are usually to be avoided, as their implications are misleading. Turning to the actual names themselves, a name that has been correctly introduced to the scientific literature is said to be **available**; it may or may not be in current use, or indeed it might even never be used for a valid taxon, but it complies with the requirements of the Code as a name that can be used, if and when some worker considers it appropriate. The oldest valid available name (dating from no earlier than 1758) is normally the name to be applied to a taxon through the system of **priority**. A **nomen nudum** is a name that for one of several possible reasons does not comply with the conditions of the Code, and is therefore not available; there are no implications for the taxonomic validity of the form it has been applied to—it merely refers to the name. A **nomen dubium** is a name of doubtful applica-

tion, which normally means that the name cannot reliably be applied to a particular taxon; it may be considered **unidentifiable**. A **nomen oblitum** is generally one that has not been used for over a century; this term most commonly crops up when an old, unused name is unearthed in old literature and found to refer to a taxon that is now normally known by another, more recent name—in such cases, the older, unused name loses its rights of priority, and the current name persists. If two names were correctly described for what is now judged to be the same taxon, they are synonyms; in normal circumstances, the older name has priority and is the name to be used, while the younger name becomes a **junior synonym** of the older one. **Homonyms** are identical names denoting different animal taxa. They are spelt identically (or at some taxonomic levels, they can have different suffixes) but were proposed separately, usually but not necessarily by different authors in different publications at different times. Thus, for example, the genus name *Lorius* Boddaert, 1783 (which refers to the genus now known as *Eclectus*), is a homonym of the currently valid name *Lorius* Vigors, 1825; in this particular case the later name is the valid one because the earlier name was formally suppressed by ICZN, primarily to avoid various possible forms of confusion. No two fully identical complete names for taxa can be simultaneously valid in zoology. Within any one genus no two taxa can have the same species-group name (this includes subspecies). Species-group names can be brought into **secondary homonymy** by the transfer of a taxon from one genus to another. For example, if the Whistling Dove *Chrysoena viridis* is considered to belong to the genus *Ptilinopus*, as was the case until recently in most checklists, its name becomes **preoccupied** by the name of the Claret-breasted Fruit-dove *Ptilinopus viridis*, as the latter’s name is older and thus has priority. In such a case, the Whistling Dove adopts its next-oldest available name, *P. layardi*; if no replacement name is already available, a new name must be formally established. Thus, somewhat confusingly, the same binomen (combination of generic and specific names) can occasionally end up at different times or in different classifications referring to two markedly different taxa, which may even prove not to be particularly close relatives. The **original spelling** of a name, as published in the original scientific description, is largely sacrosanct, and can only be modified in certain ways or in certain circumstances. Much the commonest and least complicated or controversial form of modification for species-group names involves mandatory gender agreement with the respective genus name, when applicable; much recent work in this field has been carried out by David & Gosselin (see main text). Any other intentional change made to the original spelling is considered an **emendation**. Emendations are either justified or unjustified, depending on what the Code specifies. The Code provides very precise rules on such issues, but in many instances there is considerable scope for personal interpretation of these rules and therefore different spellings can sometimes be found in different checklists (but see below). A **justified emendation** can only be based directly on the rules themselves and the original publication. Thus, if a name is based on the misspelling of a proper name, however well known that name may be, the scientific name cannot be emended unless there is **internal evidence** within the original publication that clearly shows the misspelling to have been unintentional. For example, the White-capped Fruit-dove *Ptilinopus dupetithouarsii* is a name undoubtedly based on that of the distinguished French naval family Dupetit Thouars, but the missing “t” cannot be added, as there is no internal evidence to justify this. Even if the same author publishes at a later date a clear statement that the original spelling was erroneous, it cannot be altered unless there is internal evidence in the original description to justify the emendation. In some instances, an original scientific description included two or even more different spellings of the same name. In such cases a single spelling must be selected as the valid one, and the first person to deal with this problem in the required fashion becomes the **First Reviser**. Nomenclature serves taxonomy by facilitating a unique system of names available for global communication and exchange of information on all animal taxa. Nomenclature does not, however, influence taxonomic decisions, whereas, as seen above, the taxonomy adopted by any author regularly influences the nomenclature.



Glittering Starfrontlet
Coeligena orina



Kaempfer's Woodpecker
Celeus obrieni

Figure 25 – One of the most intriguing aspects of taxonomy involves taxa represented by unique specimens. Are they species or subspecies? Morphs or aberrations? Hybrids or even artefacts? Could they already be extinct? Taxonomists have been generally more accepting when the specimen has a provenance and date attached, and especially if there is some corroborating evidence from the collector. Even so, some forms have had to endure years of scepticism before their validation through rediscovery: the beautiful hummingbird *Coeligena orina*—here named the Glittering Starfrontlet—was known from a specimen taken in Colombia in 1951 but, despite its distinctiveness, it was judged likely to be an immature and relegated to the status of subspecies until a concerted search in 2004 found it and proved its striking level of difference from any congener. On the other side of the South American continent, in eastern Brazil, the woodpecker *Celeus spectabilis obrieni* was described in 1973 from a single distinctive female taken in 1926, but it took until 2006 before another bird was found, and very soon shown to be sufficiently different to merit full species status. DNA studies may be particularly helpful in some of these cases: Bogota Sunangel *Heliangelus zusii* was recently shown to be a good species (but could be extinct), whereas “Bulo Burti Bush-shrike” *Laniarius liberatus* has been judged to be a morph of Somali Boubou *L. erlangeri* (Nguembock *et al.* 2008). In the absence of the rediscovery of such birds as White-chested Tinkerbird *Pogoniulus makawai* and Vaurie's Nightjar *Caprimulgus centralasicus*, genetic study to ascertain their taxonomic status will be all the more helpful.

taxa involved has or have not been sufficiently studied to determine its or their affiliation.

In this checklist the convention is that subspecies that do not separate into groups retain a black bullet point; those that do separate into groups have bullet points coloured according to group, with the English name blocked out in the same (but more subdued) colour, always with blue for the group with the nominate subspecies, and always with the next groups coloured in the same sequence: red, green, etc.; but the nominate group need not be the first in the sequence, so bullet points may also run red, blue, green, or red, green, blue, entirely depending on the appropriate sequence of the subspecies overall. In many cases the subspecies-groups do not distort the geographical order of the subspecies themselves, but particularly complex patterns of distribution sometimes require alterations to the geographical order as a means of keeping the subspecies together in the appropriate group.

Bibliographical references in the texts—For reasons of space and readability, sources are cited through superscript numbers linked to an alphabetical bibliography, although two or more consecutive citations are usually cited chronologically to allow due precedence, so that a higher number may precede a lower one. Citations occur mainly under Taxonomic notes and Distribution/Subspecies and Distribution. Although as indicated earlier the published sources used in this checklist exceed 9,000, for simplicity and clarity only those that provide significant, substantive new evidence are cited. Other information is derived from HBW or, in the case of applications of the Tobias criteria, from the authors. The main relevance of each citation is normally already summarized very briefly in the text, but there are a few situations in which it was felt that this would merely amount to an unnecessary waste of space, as the gist of the contents is already apparent. These cases almost exclusively fall into three categories: scientific name; author of original scientific description; and date of original scientific description. For the first of these, an unexplained citation with a name will mean a change in spelling, normally a relatively trivial one, although one that may need some minor justification (so not, for example, a clearly required change of gender); if the change is more substantial and the reason not obvious, an explanation is usually already supplied in the text. For the second, in recent times there may have been some disagreement regarding the correct author(s) of the taxon, and this citation explains the decision adopted. And third, when different years have commonly been cited

for the taxon, the citation provides the justification for the date followed herein. In the vast majority of these cases, the citations are to our most regular sources, such as Dickinson & Remsen (2013)⁴⁴², David & Gosselin (2002a, 2002b, 2011)^{397, 398, 399}, Zoonomen¹³⁷¹ and Dickinson *et al.* (2011)⁴⁴⁷, as well as various other papers involving these same authors.

Species illustrations and range maps

Illustration may not be essential to taxonomy, but the essence of taxa has always best been captured through their accurate depiction. HBW represented the first endeavour to provide high-quality illustrations of every bird species on the planet, as well as of (to the extent possible) their most distinctive subspecies. To judge from reviews, for many users of the series the plates have, in fact, been the primary value of the work, playing as they do an immensely important practical role in keying out the diagnostic characters of taxa. However, despite every effort to ensure the highest levels of accuracy in this regard, inevitably in some cases illustrations were felt to fall short in conveying the distinctiveness of taxa, as for example in the comments on the Oceanic Flycatcher *Myiagra oceanica* complex—four species or one?—by Pratt (2010).

Most of the artwork in this checklist comes from HBW. However, to take account of taxonomic changes, critical opinion and better information, new illustrations have been provided for a significant number of taxa, and modifications made to a much higher number of existing illustrations in order to improve their accuracy. This new post-HBW evidence derives mainly from our own museum work as well as from photographs of living birds. In cases where the text mentions a diagnostic character, every reasonable effort has been made to ensure that the plate portrays that character accurately, but it is important to recognize that practical and economic constraints relating to production schedules have limited complete matching in all cases as the strands of the project converged on its necessary deadline. Moreover, there are certain conditions that are extremely hard for an artist to convey, notably the iridescent colour in a hummingbird, which is apparent only at particular angles that are not possible to depict without compromising the rest of the illustration.

As in HBW, a single adult bird in breeding plumage is depicted for species with little or no sexual dimorphism. For sexually dimorphic species both male and female are depicted, both in breeding plumage (if a seasonal difference exists); in a few cases where the females of sexually

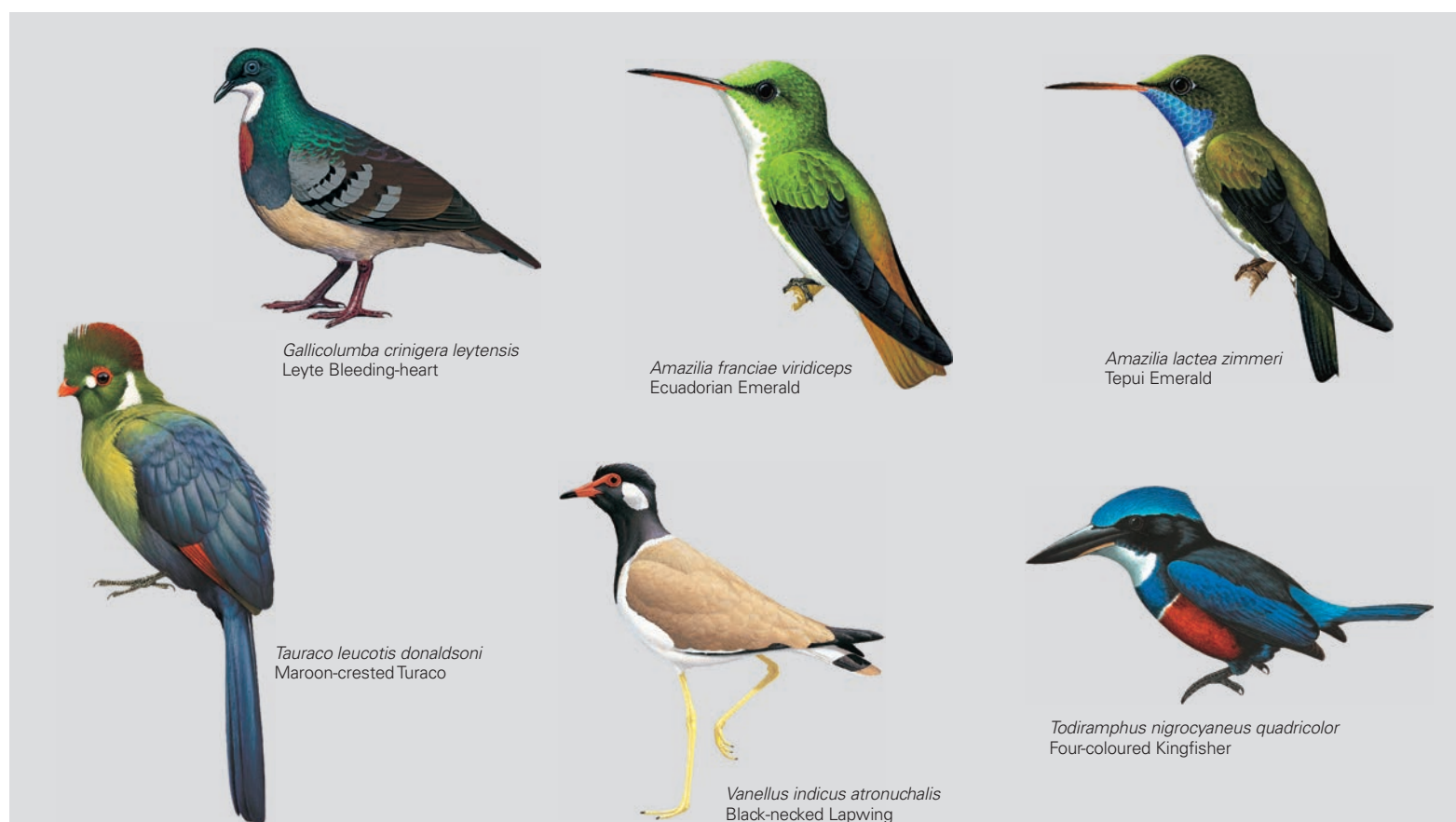


Figure 26 – Avian taxonomy has become increasingly democratized in recent years. This development coincided with and seems in part due to the advent in ornithology of the PSC and the added force of new molecular insights, providing the opportunity for those interested in national lists to begin to redefine species limits at least in their regional avifaunas. As national field guides, checklists and family monographs proliferated in the past 20 years, it became increasingly normal for authors to take their own decisions on taxonomy rather than, as in the past, defer to a particular authority. This development itself may have been the driver behind attempts to formulate and formalize guidelines and rules for species delimitation in birds (Johnson *et al.* 1999, Helbig *et al.* 2002, Tobias *et al.* 2010). Meanwhile, however, other forces behind this revolution were the parallel growth first in international air travel and ecotourism and second in technologies for the aural and visual recording of birds and their dissemination on the internet, resulting in many little-known species being documented in ways that are highly informative for taxonomic evaluations. One of the aims of this new checklist is, therefore, to invite the participation of interested ornithologists and birdwatchers in providing new information in the quest for the fuller documentation of taxa, particularly where their status is in doubt. In this volume, a number of taxa achieve a fairly high score against the Tobias criteria but still lack clinching evidence for species status, for example *Gallicolumba crinigera leytensis*, *Amazilia franciae viridiceps*, *Amazilia lactea zimmeri*, *Tauraco leucotis donaldsoni*, *Vanellus indicus atronuchalis* and *Toderamphus nigrocyaneus quadricolor*. The appearance of this first part of the *HBW–BirdLife Checklist* will coincide with the establishment of a website where observers can upload their evidence and debate their findings, thus greatly enhancing and further democratizing the process whereby future editions of the work can be updated and improved.

dimorphic species in a particular group are very similar and time has been unfavourable, the female has not been shown (but this will be rectified in future editions). Juvenile plumages, although these are occasionally used as taxonomic evidence, are not illustrated. Morphs and variants are also depicted if they are sufficiently frequent not to be considered a rarity. As in HBW, distinctive subspecies are shown, thus always including a representative of each subspecies-group recognized in this checklist, with a preference if possible for the most representative taxon in the group to be shown. All these additional illustrations are appropriately labelled.

Each species on a plate thus has (at least) one illustration, with a legend giving its number in the family sequence followed by its scientific name in italic (generic name contracted) and below this its English name in boldface, and a range map closely adjacent. The genus is given in capital letters elsewhere on the plate. The plate has a neutral background to offset the colours of the illustrations, with subtle pale lines separating each taxon (except subspecies), thinner around species, thicker around genera. A scale is given on each plate in both centimetres and inches. When birds set to different scales occur on the same plate, they are separated by a dashed line and scales for each are given. If in one plate two or more families occur, a thick straight white line is used to divide them.

Owing to shifting taxonomic arrangements and the sometimes increased number of species shown per plate, some plates contain artwork by more than one artist. Credit for each illustration is assigned on pages 16–17.

The production of the maps for this checklist has involved a major effort of research and synthesis. Many of the maps inherited from the HBW se-

ries, particularly the earlier volumes, were considerably outdated and inaccurate. BirdLife's maps (from BirdLife International & NatureServe 2013), while much more recent and with the advantages of being GIS-based with national boundaries depicted, were also far from perfect and not up to date. Resolving the discrepancies between the HBW maps and BirdLife maps, and between these maps and modern evidence, occupied two teams in the two institutions for well over a year, and of course for a significant proportion of species entirely new maps had to be generated to account for the taxonomic revisions in the present work. Range maps and distribution texts have also been checked against each other for their consistency.

Range maps are based on known records (observations, museum specimens), location of sites (particularly Important Bird and Biodiversity Areas) known to hold populations, the distribution of suitable habitat between known records, and expert information, all of which have been drawn from online data repositories, published papers, unpublished reports, field guides, family monographs and other sources. They usually exclude areas reported in the range descriptions to be "possible" parts of a species' distribution, along with records of vagrancy and places to which species have been introduced or (recently) reintroduced; but reintroduced populations are mapped where the evidence of viability and stability is good (particularly so in New Zealand). The map colour code copies that in HBW: green for present all year round (although this can cover locally or partially migratory populations), yellow for breeding range, and blue for non-breeding range. For seabirds in general, breeding colonies are depicted in yellow and their distribution at sea in blue. In the case of species Extinct in the Wild,

their former ranges are shown in grey, and, exceptionally, this colour has also been used for a few species which, while not yet officially considered extinct, are known to be absent from most, if not all, of their documented range. In the very few cases where the whole range is completely unknown, a question mark has been added in the map to indicate this. Maps zoom in much more on ranges than they did in HBW, in order to give more detail, but there is usually some attempt at leaving a recognizable geographical reference point; however, for possibly unfamiliar islands the emphasis has been on supplying detail at the expense of a general geographical locator. In cases where the distribution patterns are rather complex, larger maps are offered to allow the details to be picked out.

Extinct species

For many users a checklist is supposed to live up to its name: a list against which to check off sightings and records. Since this is not likely to happen with extinct species, there is good reason to separate them out together for reference, rather than interpolate them into a list of living forms; and since extinct birds fall roughly into two types—those that can be illustrated with confidence and those that cannot—the notion of treating them all in their rightful place in the sequence of living birds, in an *illustrated* checklist, is even less appealing. Indeed, the assembling of all extinct taxa in one place provides a better opportunity for those interested in studying extinctions to consider and compare the evidence, and for those interested in preventing extinctions to demonstrate the dimensions of anthropogenic impacts in the past half-millennium. Nevertheless, there is also real value for certain disciplines in ornithology, not least systematics and taxonomy, in keeping all (recent) species, dead or alive, in a single sequence; and this checklist is clearly intended as much for these as for anything else.

Consequently we do both. In the main checklist, the names of extinct species are included in pale grey rather than pale blue boxes, at the appropriate point in the family sequence; no family number is given, but the reader is directed to the page on which a text entry on the species appears in one of two appendices for extinct species. Appendix 1 is for species known from full specimens and/or other very strong evidence, so that they can be illustrated with confidence and given treatment practically identical to that of an extant species in the main list, but also including some information about the circumstances of their extinction; the maps show their distribution in grey. Please note that in this appendix, for obvious reasons, on any given plate the birds are not illustrated all to the same scale. Appendix 2 treats species known only from highly incomplete specimens, subfossil material and/or travellers' illustrations and reports, and these are of necessity given far briefer documentation.

Only species believed to have survived past AD1500 are included in this checklist. There is, however, a grey area in the categorization of species as extinct owing to the difficulty of proving that the last individuals have died—a particular problem in parts of the world relatively infrequently visited and relatively hard to cover comprehensively (even in a country as well worked as the USA the case of the Ivory-billed Woodpecker *Campephilus principalis* has proved highly problematic). Species that are likely to have gone extinct, but for which comprehensive searches are required to confirm that the last individual has died, are classified as "Critically Endangered (Possibly Extinct)" following a BirdLife initiative by Butchart *et al.* (2006) and IUCN (2014). Determining whether to classify a taxon as Extinct, Critically Endangered (Possibly Extinct) or Critically Endangered has to consider the time since the last record, the intensity, extensiveness and adequacy of searches, the extent, intensity and timing of threats, and the likely susceptibility of the taxon to these; experience has shown that prematurely classifying a species as extinct is potentially a threat in itself (Collar 1998). Work is currently under way to develop a more quantitative version of the BirdLife initiative, and when this is applied the list of Possibly Extinct and Extinct species will be revised more rigorously. This is likely to lead to a number of changes, including perhaps the reclassification of taxa such as Crested Shelduck *Tadorna cristata*, Pink-headed Duck *Rhodonessa caryophyllacea*, Glaucous Macaw *Anodorhynchus glaucus* and White-chested White-eye *Zosterops albogularis*. Rather than guessing the outcomes of this ongoing analysis, this checklist follows BirdLife's current classifications. A similar approach has been applied to avian subspecies by Szabo *et al.* (2012), whom we follow here (plus a few more recent updates), by marking extinct subspecies with a cross (+).

Reference maps

An important and original development in the interpretation of evidence in checklists of birds of the world was the introduction in Sibley & Monroe

(1990) of 25 political maps which marked and labelled the internal divisions of many of the larger countries, and showed some rivers and mountain ranges. These served as a valuable reference point for understanding the distributional information given in the main text of their work, and set a high standard for others to follow.

In this checklist we have sought as far as possible to extend this service by adding physical information to the political maps, outlining mountain ranges in as much detail as possible without obscuring boundaries and their labels. Although Sibley & Monroe (1990) thoughtfully added a gazetteer, this is not deemed necessary here, in part because we hope the detail of the maps in this checklist is sufficient and in part because these days the internet is a source of immediate information on even very small geographical and political entities.

Bibliography and index

All cited sources of information used in this checklist, personal and web-based as well as bibliographical, are listed alphabetically in the bibliography at the end of the book. Published references are presented in the same style as in HBW. These are numbered to match the citation number given in the main text. Names of Korean, Chinese and Indochinese authors typically consist of the surname followed by the given name, but in some publications these are reversed to conform with standard Western style, leading to great potential confusion. In the following bibliography, for clarity, the given names of such authors are retained in full, with the surname always placed in front of them.

The index is organized to allow searches for both extant and extinct taxa by scientific name of family, genus, species and subspecies and by English name of family and species (with both parts of a compound name). Also included here are all alternative English names and all synonymized and unavailable scientific genus, species and subspecies names mentioned in the text. All extant taxa (and also those only possibly extinct) are in black print, all extinct taxa are in blue, and all alternative and unaccepted names are in red (alternative and unaccepted names of extinct taxa are in blue).

The future of the Checklist

Our objective in this collaboration is to provide the most accurate evidence-based account of extant and recently (post-AD1500) extinct avian diversity at all levels of the taxonomic spectrum, but with the strongest emphasis falling on species. However, like all taxonomic studies, this checklist is a work in progress. Although it is the product of many years of work, and may—like all large books!—give the impression of being definitive and conclusive, in reality it is far from finished and is always likely to remain so, precisely because taxonomy is an investigative discipline with ever-changing insights and inferences (see Figure 24). Our inability in this volume to resolve the difficulties presented by, among others, the Purple Swamphen *Porphyrio porphyrio* (see Figure 21) is solid evidence that there is much more to be done in the world of avian species-level taxonomy—and that we cannot possibly achieve it alone. Moreover, a huge pending task which has been far beyond the scope of this work to date is the systematic, rigorous review of the validity of all subspecies, an unknown proportion of which may not be worthy of recognition at all (to adumbrate the likely scale of this task, we simply mention the exhaustive analysis that was required to determine that a single subspecies, *Perdix perdix sphagnetorum*, is invalid: Bot & Jansen 2013).

First, then, we acknowledge that we expect there to be a number of revised editions of this checklist in the coming decades. To this end—and because of BirdLife's remit to assess taxa judged as species against the IUCN Red List criteria—together our organizations plan to maintain a comprehensive review of taxonomic revisions as they appear in the literature, following developments at both the macro- and the microsystematic levels and with a particular interest in the results of new molecular studies of families, genera and species complexes. Where appropriate, this will be matched by corroborative work of our own in museums and through other sampling systems available on the internet in order to compare and contrast other forms of evidence.

Second, however, we judge that there is a major opportunity which we want to take to harness the energy, interest and goodwill of owners and users of this checklist in the taxonomic process. We see this as one of the strongest ways of maintaining the momentum of this ongoing project. In the Tobias criteria we have a system of taxonomic evaluation which has, we feel, given good service in this non-passerine volume, and certainly

we propose to continue with its use in the second volume (although we speculate that it, too, may experience adjustments and alterations in due course) and in the expected revisions of both. The application of this system in the present volume has thrown up many intriguing challenges, a good proportion of which could very probably be met by field ornithologists and birdwatchers. Video-recordings of living birds, audio-recordings of their vocalizations (especially when several individuals are sampled), records of their presence in key areas (such as suspected lines of parapatry), descriptions of their key features, behaviour and ecology—all such material, made by fieldworkers of all types, can contribute to our better understanding of the taxonomic status of what we currently rank as species and subspecies. The new evidence supplied by such endeavours can help to resolve issues such as whether the form *purpureicollis* of Australian Brush-turkey *Alectura lathamii* or the form *intermedia* of Bronze-tailed Plumeleteer *Chalybura urochrysa* would better be treated as a species (other examples among many possibilities are in Figure 26); moreover, it can be used to challenge the scores and notes provided for current splits and lumps, many of which may well not stand the test of time. All such information, made accessible to the checklist team either directly or indirectly, can be fed through the same process of evaluation as a means of maintaining, so far as possible, the consistency of treatments between taxa.

Our current proposition is for the websites of both BirdLife and HBW to host the same world list of species so far as is practical, with an internet forum where anyone can contribute information or informed opinion on the taxonomic status of the forms itemized and the evidence presented. This will be accessible at www.birdlife.org/globally-threatened-bird-forums/category/taxonomy/ as well as from the open-access pages of HBW Alive (www.hbw.com/). We intend to establish a fixed schedule for making regular updates. Depending on various factors, a new edition of the book, volume by volume, may be produced at longer intervals.

Acknowledgements

Museums and Institutions

The continuing value and relevance of natural history museums to the advancement of taxonomy cannot be overstated. The taxonomic checking, comparisons and evaluations in this checklist were undertaken at a number of museums, and we record here our enormous gratitude to all of these institutions for their unfailing welcome and encouragement. First among these is the Natural History Museum at Tring, UK (NHMUK), where collectively several months were spent in research with specimen material and library resources; we particularly thank Robert Prys-Jones, Mark Adams, Hein van Grouw, Joanne Cooper and Alison Harding for their steadfast support. At the American Museum of Natural History (AMNH) in New York, Paul Sweet, Peter Capainolo, Tom Trombone, Lydia Garetano and Mary LeCroy actively assisted our work. For their good offices (in descending order of time spent in their collections) we also warmly thank Chris Milensky and Brian Schmidt at the United States (Smithsonian Institution) National Museum of Natural History; Sylke Frahnert and Pascal Eckhoff at the Museum für Naturkunde (Zoologisches Museum), Berlin; Steven van der Mije, René Dekker and Kees Roselaar at the Naturalis Biodiversity Center (Nationaal Natuurhistorisch Museum), Leiden; and Martin Päckert at the Staatliches Museum für Tierkunde, Dresden. Nate Rice at the Philadelphia Academy of Natural Sciences also kindly provided information.

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Luther-University Halle-Wittenberg), the North Carolina Museum of Natural Sciences, the Peabody Museum (Yale University), the Royal Museum of Central Africa (Tervuren, Belgium), the Sociedad Audubon de Venezuela, the Transvaal Museum (Pretoria, South Africa), the University of Kansas Natural History Museum, the University of Michigan Museum of Zoology, and the Zoological Museum (University of Copenhagen).

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Checklist