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Taxonomy *is* important in conservation: a preliminary reassessment of Philippine species-level bird taxonomy

A. TOWNSEND PETERSON

Summary

Alpha taxonomy involves delineation of the basic unit of biology: the species. The concepts by which we define species, however, have been controversial, with several alternatives competing at present, some creating fewer and some more species units, depending on interpretation of species limits. Although it is tempting to assume that species concepts would have little interaction with the geographic foci of species richness and endemism — and some have so argued — this assumption does not withstand careful analysis. In this paper, I develop a first-pass assessment of Philippine bird taxonomy under an alternative species concept, and compare the results with the traditional biological species concept lists. Differences between the two lists were dramatic, but not just in numbers of species; rather, new, previously unrecognized or previously underappreciated foci of endemism were noted. A thorough understanding of the taxonomic basis of species lists is therefore critical to conservation planning.

Introduction

Recent taxonomic studies have pointed out conservation implications of their results for several parts of the world (Boon *et al.* 2000; Lovette *et al.* 1999; Ortíz-Pulido *et al.* 2002): new viewpoints on species limits led to new priorities for conservation action, mainly via recognition of 'new' (although not necessarily undescribed) species-level taxa. What is more, recent reviews have indicated broader-scale effects of taxonomic treatments on conservation priorities, in that taxonomic viewpoints underlying suites of species used as bases for conservation priority-setting affect the results of those priority-setting exercises, often dramatically (Danielson and Treadaway 2004; Hazevoet 1996; Meijaard and Nijman 2003; Peterson and Navarro-Sigüenza 1999, 2000a; Sangster 2000). Hence, the picture appears clear: efforts to prioritize areas for conservation action based on biodiversity considerations should take into account the taxonomic viewpoint underlying the 'authority list' of species involved, otherwise unforeseen and unwanted biases resulting from inconsistencies among taxa may creep into the results.

Nonetheless, biodiversity considerations such as species' distributions continue to be used in numerous current conservation priority-setting exercises (Amori and Gippoliti 2001; Balmford 2003; Bibby *et al.* 1992; Bonn *et al.* 2002; Brooks *et al.* 2001; Brooks and Thompson 2001; Cowling *et al.* 2003; Mittermeier *et al.* 1998; Seymour *et al.* 2001), and even mention — much less careful consideration — of taxonomic considerations is rare. What is more, the early commentary of Hazevoet (1996) arguing for the need for careful attention to species concepts in developing conservation assessments received strong rebuttal from the conservation 'establishment' (Collar 1996), suggesting that the message has not been appreciated broadly. Finally, a recent paper (Fjeldså 2003) carried the provocative title "How much does taxonomy matter?" and arrived at the conclusion that 'species concepts' did not affect the conservation priorities resulting from detailed analysis.

In this paper, my aim is to address this question yet again. In my previous analyses along these lines (Navarro-Sigüenza and Peterson 2004; Peterson 1998; Peterson and Navarro-Sigüenza 1999, 2000b), colleagues and I have focused on the example of the birds of Mexico. However, the Mexican example is but a single region, and is representative only of continental avifaunas. As a consequence, I have now taken first steps towards development of a second regional example of an alternative species concept taxonomy — the Philippine avifauna — that provides a new view from the standpoint of insular and archipelagic avifaunas. Although the formal taxonomic and nomenclatural issues are only beginning to be addressed, I have nonetheless attempted to identify discrete species units based on at least a preliminary review of essentially all the Philippine avifauna. Perhaps more importantly, in parallel with the 'before' (biological species concept) and 'after' (evolutionary species concept) of the Mexican studies (Escalante-Pliego *et al.* 1993; Peterson and Navarro-Sigüenza 1999), this new review can be compared directly with results of a previous compendium developed under a biological species taxonomy (Peterson *et al.* 2000) to see how alternative species concepts will function in insular regions (Philippines) as compared with continental regions (Mexico).

Philippine birds

A recent summary of the Philippine avifauna (Dickinson *et al.* 1991) indicated the presence of 556 biological species, of which about 395 breed in the country and 169 are endemic (Peterson *et al.* 2000). However, many of these species vary dramatically from island to island. These differentiated forms are frequently described as subspecies of biological species, and as such may be confused with other ('minor') subspecies that are not genuinely distinct. The resulting confusions between genuinely distinct forms and forms that are only subtly distinct (or not distinct!) lead to neglect of the distinct forms in conservation planning (Peterson *et al.* 2000).

Several recent studies have re-evaluated species limits in Philippine birds, and have led to the recognition of additional species taxa (Collar *et al.* 1999; Kennedy *et al.* 1997, 2001). As in other regions (Navarro-Sigüenza *et al.* 2002, 2003), however, much more alpha taxonomic work is necessary to achieve a genuinely comparative treatment of species limits, both in reassessing species limits under the biological species concept and in outlining species limits under alternative concepts. In this paper, I offer a first-pass summary of such species that show discrete among-population phenotypic variation. This list will eventually evolve into a full alternative taxonomy for the Philippine avifauna under the evolutionary species concept (Wiley 1978), a concept operationally similar to the phylogenetic species concept (at least in applications to birds) but that presents several distinct advantages, reviewed elsewhere (Navarro-Sigüenza and Peterson 2004).

Methods

Specimens of almost all named taxa of Philippine birds (Dickinson *et al.* 1991) were inspected in most major systematic collections from the Philippines, as well as in several smaller collections: Field Museum of Natural History, American Museum of Natural History, British Museum (Natural History), Academy of Natural Sciences of Philadelphia, Yale Peabody Museum, Museum of Vertebrate Zoology, University of Kansas Natural History Museum, Museum Mensch und Natur (Munich) and the Naturmuseum Senckenberg (Frankfurt).

For each taxon, I compared skin specimens of males and females from each named population. Wherever feasible, I also made comparisons among potentially distinct populations within named populations (e.g. among mountain ranges within Mindanao, among islands inhabited by the same subspecies) to detect any potentially unnamed distinct populations. Differences sought included variation in coloration, size or shape.

To be considered for inclusion in my lists, I used the following criteria: (1) Differences among populations had to be discrete, permitting easy separation of essentially 100% of individuals of that age/sex class from the two populations. (2) Whenever possible, differences were confirmed based on independent series of specimens housed at other scientific collections to avoid problems with specimen conservation or treatment (Peterson and Navarro-Sigüenza 2000a). As discussed elsewhere (Navarro-Sigüenza and Peterson 2004), this operational approach can be taken as a first pass towards a taxonomic treatment under the evolutionary species concept, and certainly would qualify as a phylogenetic species concept treatment as well. Results are summarized in terms of present-day endemism, and in terms of endemism at the level of Pleistocene islands, that is, the larger and more inclusive units that remained separated by sea channels at the Last Glacial Maximum (Heaney 1991; Peterson and Heaney 1993).

Results

In all, 108 of the 556 or so bird species known to occur in the Philippines were found to constitute examples of discrete interpopulation differentiation (see summary in Appendix). These examples ranged from differences between Philippine populations and populations further to the south and west (e.g. Buff-banded Rail *Gallirallus philippensis*, Barred Rail *G. torquatus*, Slaty-legged Crake *Rallina eurizonoides*) in Indonesia and South-East Asia to taxa representing complexes of many distinct forms. These latter complexes included, for example, Tarictic Hornbill *Penelopides panini*, Greater Flameback *Chrysocolaptes lucidus* and Philippine Hanging Parrot *Loriculus philippensis*, each of which appears divisible into five distinct forms, and Island Thrush *Turdus poliocephalus*, which appears divisible into seven distinct forms, including three on Mindanao alone. These populations, in each case, are clearly distinguishable, separation among well-prepared specimens of appropriate age/sex classes being essentially 100%.

Geographic divisions among the 'new' distinct forms (Figure 1) generally follow divisions among islands that existed and were maintained through periods of lower sea level in the Pleistocene (Heaney *et al.* 2002; Peterson and Heaney 1993).

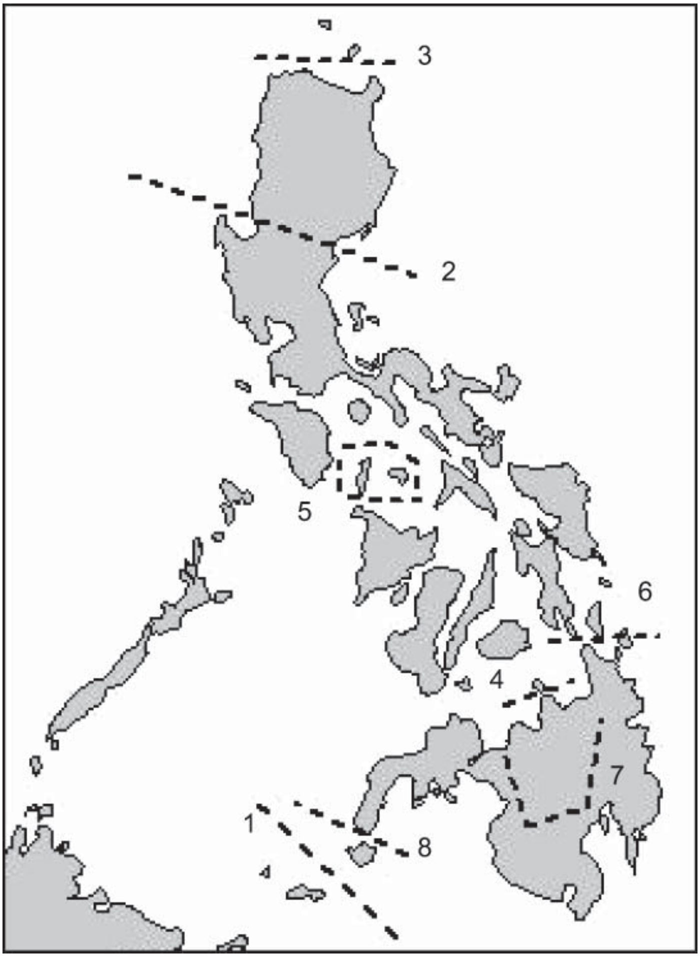

Figure 1. Summary of sets of coincident boundaries found among the differentiated populations summarized herein. Apart from well-known breaks between Pleistocene islands, the following additional zones of turnover of species were noted: (1) the Sulu Archipelago versus the remainder of the Philippines; (2) northern versus southern Luzon; (3) the Batanes and Babuyan islands versus the remainder of the Philippines; (4) Camiguin Sur versus Mindanao; (5) Tablas, Romblon and Sibuyan versus the remainder of the Philippines; (6) northern islands versus southern islands within Greater Mindanao; (7) subdivisions within Mindanao proper; and (8) Basilan versus Mindanao.

Pleistocene islands showing greater differentiation of bird populations than has been appreciated in present taxonomic treatments included, in particular, the Sulu Archipelago (e.g. forms of Dark-eared Brown Dove *Phapitreron cinereiceps*, *Loriculus philippensis*, White-bellied Woodpecker *Dryocopus javensis* and Brown Tit Babbler *Macronous striaticeps*); the Batanes and Babuyan islands (e.g. forms of Black-chinned Fruit Dove *Ptilinopus leclancheri*, Brown Cuckoo Dove *Macropygia phasianella* and Yellow-bellied Whistler *Pachycephala philippinensis*); Tablas, Romblon and/ or Sibuyan (e.g. forms of Philippine Hawk Owl *Ninox philippensis*, Streak-breasted

Bulbul *Hypsipetes siquijorensis*, Spangled Drongo *Dicrurus hottentottus*); and tiny Camiguin Sur (e.g. forms of *Loriculus philippensis*, Golden-green White-eye *Zosterops nigrorum* and Yellowish Bulbul *Hypsipetes everetti*) (Table 1; Figure 1).

Differentiation among present-day islands within single Pleistocene islands was observed principally in Greater Mindanao (Table 1; Figure 1). (1) Populations of the northern islands (e.g. Samar, Leyte, Bohol) differed from those of Mindanao proper (e.g. *Penelopides panini*, *Dryocopus javensis*, *Chrysocolaptes lucidus*); and (2) Basilan populations were distinct from those of Mindanao and islands to the north (e.g. Philippine Fairy Bluebird *Irena cyanogaster*, *Zosterops everetti*). Additional examples of within-island differentiation were observed within both Luzon (e.g. *Turdus*

Table 1. Summary of biological species concept (BSC) and evolutionary species concept (ESC) perspectives on distribution of bird species endemic to single islands and single Pleistocene islands in the Philippine archipelago.

	Single Pleistocene island endemics			Single island endemics		
Island	BSC	ESC	% increase	BSC	ESC	% increase
Greater Mindanao	31	73	235.5	15	30	200.0
Mindanao	30	65	216.7	15	27	180.0
Samar	11	37	336.4	0	0	–
Leyte	11	37	336.4	0	0	–
Bohol	7	32	457.1	0	1	+
Basilan	10	33	330.0	0	2	+
Greater Luzon	19	44	231.6	1	24	184.6
Luzon	19	44	231.6	13	24	184.6
Greater Negros	9	23	255.6	8	11	137.5
Negros	6	20	333.3	5	8	160.0
Panay	2	11	550.0	1	1	100.0
Cebu	2	9	450.0	2	2	100.0
Greater Palawan	16	25	156.3	8	12	150.0
Greater Sulu	3	12	400.0	2	4	200.0
Greater Romblon	0	3	+	0	0	–
Romblon	0	2	+	0	0	–
Tablas	0	3	+	0	1	+
Mindoro	5	11	220.0	5	10	200.0
Siquijor	0	1	+	0	1	+
Cagayan Group	0	1	+	0	1	+
Batan and Babuyan Groups	0	4	+	0	1	+
Camiguin Sur	0	3	+	0	3	+

BSC figures are simplified from a previous paper on the subject (Peterson *et al.* 2000), based on a previous monographic treatment (Dickinson *et al.* 1991); ESC figures are drawn from a first-pass summary of individual cases listed in the Appendix.

Pleistocene islands are listed in italics, and component islands (if any) for which data were available are listed beneath each Pleistocene island. Plus signs (+) indicate an increase from zero and minus signs (–) indicate no change from zero.

poliocephalus, Lemon-throated Leaf Warbler *Phylloscopus cebuensis* and Green Imperial Pigeon *Ducula aenea*) and Mindanao (e.g. Mindanao Wattled Broadbill *Eurylaimus steerei*, *Turdus poliocephalus*, Purple-throated Sunbird *Nectarinia sperata*).

Discussion

Philippine bird taxonomy

One important impediment encountered in the course of this study was the paucity of bird specimens from parts of the Philippines. Although important and extensive series were assembled in decades past, particularly by D. S. Rabor and colleagues, these series frequently include few or no representatives of key taxa, such as *Dicrurus hottentottus* from Tablas or *Turdus poliocephalus* from Sibuyan. Not only are new collections needed for further progress in establishing species limits based on phenotypic characters, but modern series including associated tapes of vocalizations and frozen tissue material are critical to permitting more in-depth study. Such incomplete representation prevented this broad survey from resulting in a complete, checked and verified list including final decisions regarding synonymy and priority. Hence, targeted new collections are key to progress with understanding Philippine bird taxonomy.

The existence of heretofore unrecognized distinct populations within currently recognized species taxa is, of course, quite common (Escalante-Pliego and Peterson 1992; Navarro-Sigüenza *et al.* 2001; Pitman and Jehl 1998; Thompson 1991; Zink 1994). Indeed, recent studies in the Philippines have also indicated that avian diversity is greater than appreciated under current taxonomic treatments, showing the existence of distinct, species-level taxa (Kennedy *et al.* 1997, 2001). Detailed studies of mammal species have indicated even more impressive increases in numbers of distinct forms in the country (Heaney 2002; Heaney and Mallari 2002; Heaney *et al.* 2002; Peterson and Heaney 1993). Clearly, though, the often-partial treatments offered in this paper beg the need for distribution-wide reassessments rather than treatments of Philippine populations only.

The degree to which the forms identified herein should be considered as valid species taxa is a considerably more difficult question; clearly, though, full appreciation of avian diversity will depend on reassessment of species limits within currently recognized bird species (Peterson 1998). The Philippines provide a particularly difficult challenge, as these differentiated forms are almost universally disjunct in nature. Disjunct differentiated populations have represented a serious challenge for the biological species concept from its first applications (Mayr 1942). Although the forms listed below would clearly qualify as species taxa under the phylogenetic (Davis and Nixon 1992; De Queiroz and Donoghue 1988; McKitrick and Zink 1988) or evolutionary (Wiley 1978) species concepts, their consideration as species under the biological species concept will depend on the evolving reinterpretation of that concept that has characterized recent taxonomic treatments, such as the American Ornithologists' Union's check-list of North American birds (AOU 1983, 1998).

The hope in development of the lists presented herein is that they will aid in spurring development of a truly comparable species taxonomy for the Philippine avifauna. If this taxonomy is to be developed under alternative species concepts, then the distinct populations listed herein would all qualify as candidate species taxa, and unresolved issues would be largely nomenclatural in nature. If, on the other hand, the taxonomy is to be developed under the biological species concept, continuing the excellent start provided by previous summaries (Dickinson *et al.* 1991), then the principal challenge will be that of making *parallel* decisions across taxa. For instance, the *Penelopides* hornbills have been treated recently as one (Dickinson *et al.* 1991), four (Kemp 1988) or five (Sibley and Monroe 1990) species under the biological species concept, with no particular stability in the decision. Decisions regarding *other* disjunct differentiated populations of these and other complexes and their representatives elsewhere in South-East Asia will have to follow parallel criteria in setting new species limits in order to achieve a genuinely comparable species taxonomy for the country's avifauna.

Taxonomy and conservation priorities

Returning to Fjeldså's (2003) provocative question, in the analyses presented herein, the answer is clear: taxonomy *does* matter. First, different regions are emphasized more or less under the alternative species concept (here ESC, for evolutionary species concept) as opposed to the biological species concept (BSC) viewpoints: for example, Greater Palawan was seen to hold 56% more single-Pleistocene-island species under the ESC than under the BSC, whereas the Greater Sulu Islands increased in single-Pleistocene-island species richness by 400%. These differences appear to be related to the relative isolation of particular islands in relation to neighbouring islands, although causes are not completely clear.

Second, the ESC identifies several other Pleistocene island groups as having endemic species when few or none were known or prioritized previously. The Greater Sulu Islands (although their unity through the Pleistocene is somewhat uncertain) rose in single-Pleistocene-island species richness from three to 12 species; Greater Romblon was seen to hold three ESC species when it previously was known to hold none, and similarly for the Batanes and Babuyan islands (four species now appreciated), Camiguin Sur (three species now appreciated) and the Cagayan Group and Siquijor (one species each now appreciated). These islands or island groups were previously unappreciated or underappreciated as conservation priorities, and are now 'visible' as holding endemic species.

Finally, and perhaps most interesting, in three cases, the ESC lists have permitted further appreciation (Mallari *et al.* 2001; Stattersfield *et al.* 1999) of centres of speciation and differentiation *within* Pleistocene islands: (1) differentiation of populations (even in species of lowland forests) between northern and southern Luzon, (2) differentiation of populations in the northern islands of Greater Mindanao (Samar, Leyte, Bohol) from those of Mindanao, and (3) differentiation of populations *within* Mindanao (in addition to a few already known; Kennedy *et al.* 1997). Many of the broad-brush-stroke patterns had, of course, been appreciated by even the earliest workers in the region (Dickerson 1928). Although a previous prioritization of Philippine regions on the basis of bird diversity (Stattersfield *et al.* 1999) suggested that elevation of many subspecific taxa to species status would not affect areas of endemism identified, this paper and others (Peterson and Navarro-Sigüenza 1999) indicate the contrary. Consideration of endemic subspecies as units of conservation action (Mallari *et al*. 2001) would be misleading as well, as many subspecies reviewed in this effort were *not* distinct, thus once again clouding the picture. Put simply, new conservation priorities were revealed or known areas of importance were emphasized thanks to an alternative species taxonomy.

So why did Fjeldså (2003) arrive at such a different conclusion from that found here and in other such analyses (Peterson and Navarro-Sigüenza 1999)? Either the African system on which his analyses were based is qualitatively different from Mexico and the Philippines, or his analyses are somehow biased against such a conclusion. As regards the former, I see no reason why Africa should not also prove to be a rich store of ESC species taxa, with its complex biogeography and long-appreciated intricacies of bird taxonomy. Indeed, given the greater attention to alpha-systematics of the birds of the Neotropics over the past half-century than to those of the Afrotropics, I suspect that even more BSC species will prove to constitute 'complexes' in need of revision and splitting, and that these changes will have geographic biases that will affect conservation priorities.

Rather, I believe that the explanation for these differences lies in Fjeldså's (2003) methodology. His 'alternative' species list was based on taxonomic splits suggested in the literature since the excellent atlases of speciation in the African birds (Hall and Moreau 1970; Snow 1978), and not on a comprehensive (if preliminary) reanalysis as my colleagues and I have developed in our examples. I suspect that the African 'reanalysis' was simply not sensitive enough, and probably omitted numerous key centres of repeated differentiation and speciation, at least under alternative species concepts.

Conclusions

A recent study (Danielson and Treadaway 2004) of Philippine butterfly species distributions under different species concepts arrived at the same conclusions as I have here. Their conclusions could easily be those of this paper: 'We demonstrate that a better resolved species level classification could reveal numerous "new" priority areas. In tropical island and mountain regions where the distinctiveness of butterfly subspecies is high, significant evolutionary units may be lost unless fine-scale conservation planning pays attention to well-defined subspecies.'

Put quite simply, taxonomy does matter in establishing conservation priorities. A recent review of species limits and criteria used in describing bird species (Watson 2005) pointed out the impressive degree to which bird species are defined by ornithological taxonomists based on 'field marks', in marked contrast to those characters used by other vertebrate zoologists. This focus on identifiable species has clearly simplified the view of bird diversity, but runs the risk of obscuring important, independent evolutionary lineages. Taxonomy is taxonomy, and can always be fixed, but conservation is particularly unforgiving — once a species or lineage is lost, it is lost forever. Workers in bird conservation should therefore pay close attention to the taxonomic basis of the species lists on which they base their conservation assessments.

Appendix. Summary of Philippine bird species within which among-population heterogeneity was detected via inspection of a series of natural history museum specimens. When divisions involve populations that would have micro-scale distributions (e.g. part of a large island, or total restriction to a single small island) the 'microendemics' column is checked. Note that a full synonymy is not provided owing to the preliminary nature of the summary, and given the woefully small samples and unavailability of many of the key taxa.

Taxon	Microendemics	Comments
Aviceda jerdoni		Philippine populations with whitish chest (not brown as in SE Asian forms) and white base colour to throat (not buff)
Spilornis holospilus		Palawan populations with white-spotted breast, but lightly barred on upper chest; populations from the rest of the Philippines with entire underparts spotted white
Accipiter virgatus		Philippine population with solid brown wash on chest (not barred)
Accipiter trivirgatus		Populations in Borneo and Palawan have chest white with long brown streaks, whereas populations from the rest of the Philippines have chest almost solid brown
Microhierax erythrogenys		Populations from Greater Luzon, Mindoro and Negros have small body size; populations from Greater Mindanao are large (Bohol populations are a possible exception)
Gallirallus philippensis		Philippine populations smaller in body size than other populations; possible difference in back colour
Gallirallus torquatus		Philippine populations have brown chest band not present in other populations
Rallina eurizonoides		Philippine populations have cinnamon throat (not white)
Porzana cinerea		Philippine populations larger in body size
Amaurornis olivacea		Philippine populations larger in body size (not small) and with darker plumage overall
Porphyrio porphyrio		Philippine populations with brown (not blue) midback, belly blue as chest grading into it (not purple, distinct from chest)
Himantopus himantopus		Two distinct wintering populations (*himantopus*, *leucocephalus*) present (one with white nape, the other with nape white with a black patch)
Phapitreron amethystina		Populations from Greater Luzon and Greater Mindanao have underparts dusky olive-brown; populations from Negros have underparts blue-grey and faintly streaked
Phapitreron cinereiceps	X	Populations from Tawitawi distinct from those of Mindanao and Basilan in head coloration
Ptilinopus merrilli	X	Populations from Cagayan, Isabella and Quirinon provinces, Luzon have a purple-red crown patch; populations from the rest of Luzon and associated islands lack the crown patch
Ptilinopus leclancheri	X	Populations from Batan, Calayan, Camiguin Norte of large body size; populations from the rest of the Philippines of small size
Ducula aenea	X	Populations from northern Luzon have a purple crescent on hindneck, not present in other populations

Taxon	Microendemics	Comments
Macropygia phasianella	X	Populations from Batan, Lanyu (Taiwan), Itbayat and Calayan are of large size and are purplish-brown overall; populations from rest of Philippines are smaller and are brown overall
Prioniturus discurus		Populations from Luzon, Negros and Mindoro with blue forehead; populations from Greater Mindanao with forehead green
Prioniturus montanus	X	Populations from northern Luzon with red nuchal patch; populations from rest of Philippines lack patch
Loriculus philippensis	X	Populations from the Sulus differ from all others in having bill and legs black; populations from most of the Philippines have crown and nape green, forehead orange and an orange breast patch; populations from Camiguin Sur lack the orange breast patch (Tello *et al.* pers. comm.); populations from Greater Mindanao lack the orange forehead; populations from Negros have crown golden and nape green
Chrysococcyx xanthorhynchus		Philippine populations have rusty wash on throat and upper breast lacking in other populations
Eudynamys scolopacea	X	Populations from Calayan and Fuga may be larger in body size, and with different coloration of female, as compared with populations from the rest of the Philippines
Centropus viridis		Populations in Mindoro have blackish wings; wings rusty in rest of Philippines
Ninox philippensis	X	Complex variation in coloration of crown and back: solid dull brown in much of the Philippines, barred or spotted on Greater Mindanao, barred in the small islands in the central Philippines (e.g. Tablas, Romblon) and lightly barred (and belly barred on buff base colour) on Mindoro
Strix seloputo		Philippine populations with brown bars on buff (not white) below, small (not large) white spots on crown and back
Hemiprocne comata		Philippine populations with large body size as compared with other populations
Alcedo cyanopectus		Populations of Greater Luzon and nearby islands (Masbate, Sibuyan, Ticao) and Mindoro with yellow bill and extensive blue-green on belly; populations from Cebu, Negros and Panay with bill black, and blue-green on belly restricted
Halcyon capensis		Philippine populations in general differ from other populations in having the cap orange (not grey); populations from Palawan have underparts medium orange, whereas those of the rest of the Philippines have underparts light orange
Halcyon smyrnesis		Philippine populations have white on throat restricted (not extending to lower breast)
Halcyon winchelli		Populations of most of the Philippines have buff underparts and slender bill; populations of the Sulus have white underparts and stout bill
Actenoides lindsayi		Populations of Greater Luzon have back and breast green and white throat in female; populations of Negros have back and breast black and buff throat in female

Taxon	Microendemics	Comments
Merops viridis		Philippine populations with throat light green (not sky blue)
Penelopides panini		Complex variation in bill pattern; also, rufous tail band is restricted (Greater Luzon) versus broad (remaining populations) and dark (Mindoro) versus light (remaining populations) in colour; populations from the Visayas are of large body size (remaining populations small); rump is black, except for in the Visayas, Bohol, Leyte and Samar (where it is beige); belly is cream, except for in the Visayas (rusty); hence, distinct populations are found on Greater Luzon, Greater Mindanao, Visayas and Mindoro
Aceros leucocephalus		Populations of Greater Negros with upper breast dark rufous; populations of Mindanao, Dinagat and apparently Camiguin Sur with upper breast light cream
Buceros hydrocorax		Populations of Greater Luzon with bill red (not yellow with red at base, as in populations of Greater Mindanao)
Megalaima haemacephala		Populations of Greater Mindanao, Greater Luzon and Mindoro with throat yellow; populations of Cebu, Negros and Guimaras with red throat
Dinopium javanense	X	Populations of Palawan and Culion with reduced black on face and underparts reduced, and with buff-grey patch in middle of chest, as compared with several populations farther west
Mulleripicus funebris		Populations of Luzon blackish; those of Greater Mindanao medium grey
Dryocopus javensis	X	Populations of the Sulus with black bib, throat lightly speckled with white, and of small body size; populations of Bohol, Leyte, Samar and Panaon with entire bib speckled white, and of small body size; populations of Luzon, Mindanao, Basilan, the Visayas and Mindoro with bib black, throat broadly speckled white, and of large body size
Dendrocopos maculatus	X	Complex variation among four sets of populations: those of the Sulus have back solid brown, some white in midback, tail dusky brown without spots, throat white, two brown moustaches, caudal border brown, breast yellow and brown streaked; populations of Greater Luzon and Mindoro have dark grey overall, breast streaked, spots on throat reduced, back strongly black and white, tail mostly black; populations of Greater Mindanao have black overall, throat and upper breast spotted, belly streaked, back strongly black and white, tail mostly white or grey; and populations of the Visayas have dark grey overall, throat with two thick streaks on sides, streaking on breast reduced, back mostly dark grey, tail mostly blackish
Chrysocolaptes lucidus		Complex variation among five sets of populations: populations of Greater Luzon have the back mostly red, buffy face, and diffusely barred belly; populations of Mindanao and Basilan have the back tinged red, face buffy and belly scalloped black; populations of Bohol, Leyte, Panaon and Samar have the back solid red, face

Taxon	Microendemics	Comments
		buffy tinged red and belly scalloped black; populations of Greater Palawan have the back light green, face buffy tinged with red and the belly strongly barred; and populations of Guimaras, Negros, Panay, Masbate and Ticao have the back mostly red, face yellow and belly clear yellow
Eurylaimus steerii	X	Populations of Basilan and the Zamboanga Peninsula of Mindanao have a bright yellow patch in the white on the wing; remaining populations lack yellow
Pitta erythrogaster		Variation in coloration of breast is complex in this species, but coloration in Philippine populations (including Palawan) is unique
Pitta sordida		Black belly patch is prominent (not reduced) in Philippine populations
Coracina striata		Populations of Greater Luzon have male solid grey and female with grey throat and barred belly; populations of Greater Palawan are similar but overall light grey in colour; populations of the Visayas and Greater Mindanao have both sexes barred (male with grey throat); and populations of Mindoro, Tablas and Libagao have both sexes solid grey
Lalage melanoleuca		Populations of Greater Luzon and Mindoro have female underparts white barred with light grey; populations of Greater Mindanao have female underparts medium grey barred with white
Pericrocotus flammeus		Complex variation and few specimens, but Philippine populations show distinct combinations of plumage characters
Pycnonotus plumosus		Philippine (Greater Palawan) populations have primaries medium grey-olive (not green)
Hypsipetes philippinus		Populations of Mindoro and Semirara have the throat grey-olive; remaining populations have throat warm rusty colour
Hypsipetes siquijorensis	X	Populations of Romblon and Tablas have olive streaks on breast and crown grey tinged blackish; populations of Siquijor have olive breast streaking reduced and crown black
Hypsipetes everetti	X	Populations of Camiguin Sur have the throat and upper breast green strongly washed with dark cinnamon; populations from Greater Mindanao have the throat and upper breast light cinnamon
Dicrurus balicassius		Populations of Greater Luzon and Mindoro have belly black; populations of Visayas (Bantayan, Cebu, Guimaras, Masbate, Negros, Panay, Ticao) have belly white
Dicrurus hottentottus	X	Complex variation that requires more specimen material to elucidate; unique specimen from Tablas has tail elongated and splayed laterally, quite different from remaining populations
Oriolus xanthonotus		Populations of Greater Palawan have bib dark grey (not black)
Oriolus steerii		Populations of Greater Mindanao and the Visayas with lores black, underparts with grey bib and belly white striped black; populations of Greater Luzon have lores white and underparts yellow striped with grey

Taxon	Microendemics	Comments
Irena cyanogaster	X	Populations of Basilan duller and less glossy overall
Corvus enca		Philippine populations of small body size
Parus elegans		Populations of Greater Mindanao have cream-yellow wing spots; remaining populations with white spots
Sitta frontalis		Populations of Greater Luzon and Greater Negros with nape light lilac and belly brown; populations of Greater Palawan with nape blue and belly brown; populations of Greater Mindanao with nape light lilac and belly washed violet; no Philippine populations present the white throat of mainland populations
Rhabdornis mystacalis		Populations of Greater Mindanao with a short bill; remaining populations with long bills
Rhabdornis inornatus		Populations of Greater Mindanao with light grey on throat restricted and dull streaking; populations of Negros have throat more broadly light grey and streaking pronounced
Napothera rabori	X	Populations of southern Luzon with throat white; populations of northern Luzon with throat dark
Stachyris plateni		Populations of Mindanao with crown and throat rusty, forming a distinct bib; populations of Leyte and Samar with crown and throat grey-olive, with an indistinct caudal border
Stachyris nigrocapitata		Populations of Luzon with throat all-over rusty over yellow; populations of Leyte, Samar and Bohol with throat yellow and rusty moustaches
Macronous gularis		Philippine populations with throat cream-yellow and breast with indistinct throat streaks (not yellow with distinct stripes)
Macronous striaticeps	X	Populations of Greater Mindanao with crown black and streaked boldly with white; populations of the Sulus with crown brown streaked lightly with white
Brachypteryx montana	X	Philippine populations have some blue in females (not brown); females of populations of Luzon, Negros and Mindoro with blue-black body and brown head; females of populations of Mt Malindang have females overall dark blue (almost as male); remaining populations of Mindanao require inspection
Copsychus luzoniensis		Populations of Greater Luzon have white spots in wing and rump rusty; populations of the Visayas have wing without white and rump black
Turdus poliocephalus	X	Complex variation: populations of Luzon with male black and dark brown bib, and female overall grey-brown (northern Luzon) or blackish (southern Luzon, also Sibuyan); populations of Negros have both sexes all-over dusky grey-brown; populations of Mindoro have both sexes with a grey hood, brick belly and white ventral midline; populations of Mt Malindang (Mindanao) have both sexes medium brown, with a grey bib and white belly; populations of Mt Kitanglad (Mindanao) have both sexes blackish, with grey bib, brown flanks and white belly; and populations of the rest of Mindanao have both sexes all-over dark grey-brown, with a medium grey-brown bib

Taxon	Microendemics	Comments
Phylloscopus cebuensis	X	Populations of northern and central Luzon have reduced lemon yellow on throat and almost no yellow under tail; populations of southern Luzon, Cebu and Negros have ample lemon yellow in both areas
Phylloscopus trivirgatus	X	Populations of Mt Kitanglad (Mindanao) have belly whitish-yellow tinged green and back dull olive green; remaining populations have belly lemon yellow tinged green and back bright olive green
Megalurus timoriensis		Philippine populations are large with large bills
Orthotomus castaneiceps		Populations of Greater Mindanao have brown on crown restricted to lores (rest grey), belly black with white stripes, and small size; populations of Luzon have crown brown, throat black, belly black with white stripes, and large size; populations of the Visayas have crown brown, throat with black strips, belly white, and large size
Orthotomus cucullatus		All Philippine populations have heavy bills as compared with other populations; populations of Luzon have crown brown, nuchal area and cheeks grey, throat white; populations of Mindanao have entire head brown, including throat
Cistocola exilis		Philippine populations have cinnamon crown (not striped), browner underparts
Eumyias panayensis		Philippine populations differ from remaining populations in several respects; populations of Luzon and Mindoro have a black mask and white belly; populations of Mindanao have black only on the lores and belly tinged orange; populations of Negros and Panay have black only on the lores and belly white
Ficedula hyperythra		Philippine populations have white in crown restricted to the eyeline (not forehead)
Cyanoptila cyanomelana		Two migratory populations occur in the Philippines: one (*cyanomelana*) with throat and breast black and warm blue back, and the other (*cumatilis*) with throat and breast dark grey and back dull light blue
Culicicapa helianthea		Philippine populations of small body size
Rhipidura cyaniceps		Populations of Greater Luzon and Tablas have belly cinnamon; populations of the rest of the Visayas have belly white
Rhipidura javanica		Philippine populations of large body size
Terpsiphone atrocaudata		Philippine populations have belly black, back black, and white restricted to near vent
Pachycephala grisola		Philippine (Palawan) populations have breast washed grey (not olive-buff)
Pachycephala philippinensis	X	Populations of Calayan very different from remainder of populations: chest light olive (not bright yellow washed with olive), belly light creamy yellow (not bright yellow)
Lanius schach		Philippine populations have black crown and nape (not mask only) sharply (not graded) defined from grey back
Sarcops calvus	X	Populations of the Sulus have back light grey; remaining populations have back black

Taxon	Microendemics	Comments
Nectarinia sperata		Populations of much of the Philippines have upper back orange red and breast red; populations of northern Luzon have upper back black and breast orange-red; populations of central Mindanao have upper back shining purple and breast red; populations of southern Mindanao, Basilan and the Sulus have upper back orange-red and breast yellow
Nectarinia jugularis		Philippine birds have crown dull grey (not iridescent blue); populations of Palawan have yellow breast tinged with orange; remaining populations have breast yellow
Aethopyga flagrans		Populations of Luzon have bill large, throat orange, belly dull yellow and upper back green; populations of Guimaras, Panay and Negros have bill small, throat dull orange, belly bright yellow and upper back maroon
Aethopyga pulcherrima		Populations of Greater Luzon have bill large and orange-red chest spot; populations of Greater Mindanao (except Bohol) have bill small and orange-red chest spot; populations of Bohol have bill small and lack chest spot
Aethopyga shelleyi		Complex variation in need of careful study
Aethopyga siparaja		Philippine populations of large body size, with long and strong bill
Arachnothera longirostra		Populations of Greater Mindanao with lower belly yellow and short bill; populations of Palawan with lower belly dirty white and bill long
Prionochilus olivaceus		Populations of Greater Mindanao with sides of throat grey and bill small; populations of Luzon with sides of throat black and bill large
Dicaeum anthonyi		Populations of Luzon and Mindanao differ in coloration of crown, belly and undertail coverts (red versus yellow)
Dicaeum australe		Most Philippine populations have throat grey and breast grey with red spot; populations of Guimaras, Negros and Panay have throat white, and black on breast around red spot
Dicaeum trigonostigma	X	Populations of Greater Luzon, Mindoro and the Visayas with throat and belly orange; populations of Greater Mindanao and Camiguin Sur with throat grey and belly orange; populations of Romblon and Sibuyan with belly yellow or light orange; populations of Sibutu have throat almost black and belly orange
Dicaeum hypoleucum	X	Populations of Greater Luzon with belly light olive grey; populations of Greater Mindanao (except southern portion) have back dark brown and belly light grey; populations of the Zamboanga Peninsula, Basilan and the Sulus have back black (slightly iridescent) and belly off-white
Dicaeum pygmaeum		Populations of most of the Philippines with sides of throat medium grey, and back and rump light green; populations of (at least parts of) Mindanao with sides of throat black, and back and rump black
Dicaeum ignipectus		Philippine populations with throat red (not beige) and lacking red chest spot

Taxon	Microendemics	Comments
Zosterops everetti	X	Most populations with large, thick bill; populations of the Sulus have smaller and more slender bill; populations of Basilan differ in aspects of coloration
Zosterops nigrorum	X	Most populations have bill small, green forehead and lores, belly yellow-green, small body size; populations of Camiguin Sur differ in having bill large; populations of Cagayan differ in having bill large, forehead yellow, large body size; populations of Mindoro have bill small, forehead green, lores yellow, belly yellow-green, and small body size
Zosterops montanus		Most populations (including outside of the Philippines have belly tinged yellow; populations of northern Luzon have the belly greyish white, with yellow only on crissum
Lophozosterops goodfellowi	X	Populations of Mt Apo and Mt Kitanglad (Mindanao) have crown medium green; populations of Mt Hilong Hilong and Mt Malindang have crown grey
Lonchura punctulata		Philippine populations have scaling on underparts less well defined than other populations
Loxia curvirostra		Philippine populations with small body size and small bills
Pyrrhula leucogenis		Populations of Mindanao with base of mandible black and dusky underparts; populations of Luzon with base of mandible yellow and light underparts

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A. TOWNSEND PETERSON
Natural History Museum and Biodiversity Research Center, The University of Kansas, Lawrence, KS 66045, U.S.A.

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