MARINE ORNITHOLOGY
Vol. 29 No. 1 2001

FORUM

TAXONOMY AND CONSERVATION: THOUGHTS ON THE LATEST BIRDLIFE INTERNATIONAL LISTINGS FOR SEABIRDS

A.J. (TONY) GASTON

Canadian Wildlife Service, National Wildlife Research Centre, 100 Gamelin Blvd., Hull, Quebec, K1A 0H3 Canada (tony.gaston@ec.gc.ca)

Received 31 January 2001, accepted 15 May 2001

SUMMARY

GASTON, A.J. 2001. Taxonomy and conservation: thoughts on the latest BirdLife International listings for seabirds. *Marine Ornithology* 29: 1–6.

A review of the seabirds included in the recent BirdLife International compilation, *Threatened birds of the world*, shows that the number of species considered threatened or near-threatened increased from 45 in 1988 to 123 in 2000. Recent taxonomic changes have been responsible for some of this increase, with most of the taxa involved being recognized previously as subspecies. I discuss the role of taxonomy in making conservation decisions and suggest that we may be becoming too dependent on critical taxonomic assessments and that we should be considering a broader mix of taxonomic and ecological criteria.

Key words: Seabirds, taxonomy, conservation

The publication of *Threatened birds of the world* (BirdLife International 2000), the latest incarnation of BirdLife International's assessment of rare and endangered birds, is a landmark achievement and embodies a vast amount of data and debate regarding the way in which we should assess conservation priorities for birds. The implications of such a volume will take time to digest, but in comparison with earlier versions (*Birds to Watch I* and *II*, Collar & Andrew 1988, Collar *et al.* 1994) some changes are immediately clear. One of these is the considerable impact of taxonomic evaluations on conservation priorities, especially at the level of species.

In this article, I review the seabird species included in *Threatened birds of the world* as a catalyst for examining the interaction between taxonomy and conservation priorities. As those of us in North America are currently involved in planning exercises aimed at prioritizing species for conservation (e.g. North American Waterbird Conservation Plan) and as our approach is basically similar to that of BirdLife International, the need to consider the role of taxonomy in conservation priorities is particularly timely.

Threatened birds of the World includes 91 species of seabirds (penguins, albatrosses, petrels, pelicaniforms, gulls, terns, auks and skuas/jaegers) considered 'threatened' and another 32 considered 'near threatened'. These constitute approximately 38% of extant species of those families (see below): a much greater proportion than for non-marine birds. They include two species almost certainly extinct (the Guadalupe Storm Petrel *Oceanodroma macrodactyla* and the Jamaica Petrel *Pterodroma caribbea*).

Threatened species are divided into three categories:

1. 'Critical' (could go extinct next year, e.g. Amsterdam Albatross *Diomedea amsterdamensis*, with a world population of below 100 birds);

2. 'Endangered' (likely to go extinct very soon, e.g. the Peruvian Diving Petrel *Pelecanoides garnoti*, declining, currently with less than 30 000 birds, and threatened by numerous human activities);

3. 'Vulnerable' (could soon be extinct if luck runs against them, e.g. Campbell Island Cormorant *Phalacrocorax campbelli*, with a population of only 8000, all on Campbell Island and associated islets, although currently facing few threats).

'Near-threatened' species are those where, either the population is large and widespread, but decreasing (e.g. Magellanic Penguin *Spheniscus magellanicus*), or rather small but believed to be stable

TABLE 1

Breeding ranges of threatened and near-threatened seabirds (after BirdLife International 2000)

Family	Total spp. [a]	Southern Ocean	Tropical oceans	Caribbean	Arabian Sea	Mediterranean	California/Mexico	North Atlantic	North Pacific	Japan	South Africa	China	Non-marine	Total	% species
Penguins Spheniscidae	17	11	1											12	64
Albatrosses Diomedeidae	14 (25)[b]	17	2						1					20	95
Petrels Procellariidae	79	17	20	2	1	1	2	2						45	57
Storm Petrels Hydrobatidae	21		1				2		1	1				5	24
Tropicbirds Phaethontidae	3													0	0
Pelicans Pelecanidae	5												2	2	40
Gannets & Boobies Sulidae	7	1	1											2	29
Cormorants Phalacrocoracidae	34	7	1		2						3		1	14	41
Darters Anhingidae	2												1	1	50
Frigatebirds Fregatidae	5		2											2	40
Skuas & Jaegers Stercorariini	8													0	0
Skimmers Rhynchopini	3												2	2	67
Gulls Larini	50	1	1		1	1	1		1			2	1	9	18
Terns Sternini	44	2					1				1	1	2	7	16
Auks Alcini	23[c]						2		1	1				4	17
Totals	**322[b,c]**	**56**	**28**	**2**	**4**	**2**	**8**	**2**	**4**	**2**	**4**	**3**	**8**	**123**	**38**

[a] from Sibley & Monroe (1990) unless otherwise indicated,
[b] numbers from Tickell (2000),
[c] includes the Long-billed Murrelet *Brachyramphus perdix* (Friesen *et al.* 1996).

and breeding in an area where it can be readily protected (e.g. Black Storm Petrel *O. melania*) with a population of 5000–10 000 breeding on islands off California). There is an implicit assumption that our concern should be determined primarily by the likelihood of species extinction within a given time span. This is the paradigm under which conservation currently operates.

REGIONAL COMPARISONS

Several things stand out about the species listed. First, northern hemisphere species are generally better off than those in the southern hemisphere. Fifty-six threatened and near-threatened species occur in the southern oceans, 36 in tropical oceans, eight in southern California and on the Pacific coast of Mexico, four in southwest Africa and three in China. Only four species breed in the cold oceans of the northern hemisphere (Table 1).

Is this distribution a tribute to the conservation skills of northern nations? Probably not. Seabird distributions in the northern hemisphere were subject to enormous and frequent rearrangements due to the rise and fall of sea level during the Pleistocene. Consequently, there was little scope for the sort of prolonged isolation among populations that would have led to the formation of island endemics, such as the gadfly petrels *Pterodroma* spp. of the Mascarene islands, the Galapagos Penguin *Spheniscus mendiculus*, the Amsterdam Albatross, or the Pitt Island Cormorant *Phalacrocorax featherstoni*. Very few cold-ocean seabirds of the northern hemisphere are restricted to a few colony sites, and the most obvious exception, the Red-legged Kittiwake *Rissa brevirostris*, is considered Vulnerable. Moreover two recent seabird extinctions, the Great Auk *Pinguinus impennis* and the Spectacled Cormorant *Phalacrocorax spectabilis*, were both confined to cold waters of the northern hemisphere.

Most threatened species are found mainly or exclusively in the southern or tropical oceans: their threatened status is usually the result of very restricted breeding grounds being invaded by alien predators or otherwise perturbed by human activities. Alien species introductions are cited as being an important factor in the status of 28 of the 36 threatened tropical seabirds, half of the eight species in southern California and Mexico and all of the three species breeding on the Juan Fernandez Islands. The two tropical species for which breeding grounds are currently unknown (Jouanin's Petrel *Bulweria fallax* and Markham's Storm Petrel *O. markhami*) are probably menaced by introduced predators as well. Nearly all of the species threatened by introduced mammals are gadfly petrels, shearwaters, or storm petrels. Some species are considered threatened simply because of their very small range and population size, in the absence of evident threats (e.g. several of the New Zealand cormorants or shags).

A second striking feature of the list is the uneven distribution among families and sub-families. Most threatened species in the southern circumpolar region are penguins (64% of extant spp.), albatrosses (95%) and large petrels *Procellaria* (four out of five spp.). The primary threat to albatrosses and large petrels currently is the proliferation of longline fishing for a wide variety of fish, not only in the southern oceans, but in tropical and subtropical areas where they may forage while away from the colony, or spend the non-breeding period. In contrast, the gulls and terns, with many species in the northern hemisphere, contain fewer threatened species (18% and 16%, respectively), whereas among the auks, entirely confined to the northern hemisphere, 17% are threatened, of which three out of four belong to one genus of murrelets *Synthliboramphus*.

CHANGES FROM EARLIER LISTS

The 123 species listed in *Threatened birds of the world* (91 threatened, 32 near-threatened) compare with 45 species listed as threatened (includes two listed as 'data deficient') by Collar & Andrew (1988) and 95 species (62 threatened, 28 near-threatened and five data deficient) listed by Collar *et al.* (1994). Table 2 shows a taxonomic breakdown of the species listed in the three volumes. Some changes in status, such as those that have occurred for many penguins and albatrosses and for some large petrels, are clearly based on new data concerning population trends or imminent threats. However, others clearly relate to taxonomic revisions.

THE ROLE OF TAXONOMY

It is evident that there are many cases where the level of conservation concern depends heavily on taxonomic decisions. The albatrosses have been subject to recent taxonomic re-evaluation that has raised several populations previously considered subspecies to the rank of species. Comparing the rather conservative species list of Warham (1990) for the albatrosses with those of Sibley & Monroe (1990) and Nunn *et al.* (1996), we find that Warham's 13 species in two genera become 14 species in Sibley & Monroe and 25 species of four genera in Nunn *et al.* All of the new species created by Nunn *et al.* were listed by Warham as subspecies.

Warham (1990) also listed 28 species of gadfly petrels (*Lugensa* and *Pterodroma*; he treats *Bulweria* separately), whereas Sibley & Monroe (1990) listed 34 species, raising a number of subspecies to species. For the shearwaters, Warham listed 17 species in two genera (*Puffinus* and *Calonectris*), whereas Sibley & Monroe listed 21. *Threatened birds of the world* does not give a full listing of albatrosses and petrels, but treats a further two gadfly petrels listed as subspecies by Sibley & Monroe as full species, while recognizing another genus and also raising two subspecies of shearwaters to species.

Turning to cormorants, 28 species were listed by Harrison (1983), whereas Siegel-Causey (1988) listed 36 species, most additions being the result of splitting up the island races of the New Zealand King Cormorant *Phalacrocorax [Euleucocarbo] carunculatus*. With small variations, this arrangement was accepted by Johnsgard (1993) (34 spp.) and by Sibley & Monroe (1990). All of the species added to the threatened and near-threatened list between Collar & Andrew (1988) and Collar *et al.* (1994) qualified on the basis of the taxonomic re-evaluation that raised subspecies of the Campbell Island and New Zealand King Cormorants to the level of species, in the process taking the cormorants from a group with a relatively low proportion of threatened species to one with a relatively high proportion.

The level of splitting inevitably affects the size of individual populations, and their geographic spread, changing the likelihood that they will be classified as threatened. At the same time, a correct taxonomic re-evaluation recognizes that only a small amount of genetic exchange has been possible between the populations involved: a useful clue to the likelihood of re-establishment in the wake of local extirpation.

The importance of taxonomy in deciding whether to list a species has encouraged people to think that increased taxonomic work, and especially molecular genetic analysis, are important conservation tools. We can look at this in two ways. First, if we consider that saving species is the primary goal of conservation (and a lot of conservation literature can be read that way) then we should define species as rigorously as possible and concentrate our efforts wherever a species, so defined, is at risk. We can look on BirdLife International's adoption of a 'splitter's' approach (relative to other recent taxonomy) as an expression of the precautionary principle, which says if we are not sure about things we should assume the worst until proven otherwise.

Another way to view the problem is that local genetic discontinuities, which are what species represent, indicate either low rates of interbreeding with other populations, or high rates of local adaptation. Low interbreeding means low immigration and hence a limited probability that the population could re-establish itself if extirpated. Hence, if the population becomes extinct, colonization of the same islands by close relatives might take a very long time. Local adaptation means the development of unique genotypes that are best suited to local conditions. This is the sort of genetic diversity that we particularly want to protect, because it encompasses the type of diversity that may help in responding to changes in environmental conditions. The taxonomic status of the population hence provides us with an indication of how lengthy the processes of recolonization, or re-adaptation might be, if local or global extinction was to occur. Crudely, numbers and population trends indicate time to extinction, taxonomic status, time to repair.

SOME PROBLEMS WITH THE CURRENT APPROACH

There are several problems with an approach to conservation that is built around the prevention of species extinction. One of the most obvious is the need to rely on contentious taxonomic assignments. Certainly, it is possible to argue about numbers and trends, but taxonomy, even when armed with the sharp weapons of molecular genetics, seems especially susceptible to subjective judgment.

In addition, most molecular genetic work addressing taxonomic problems deals deliberately with DNA that is believed to be under little or no selection. Changes in non-coding DNA are useful in determining phylogeny, because they tell us about the approximate age at which different populations became genetically isolated and hence help to determine the relative age of different lineages. However, they tell us nothing about local adaptation. A second problem is that there is no universally accepted genetic definition of a species. When genetics are applied to defining species, the evidence cited is generally that differences in DNA are equivalent to those normally seen between 'good' biological species (i.e. those species that taxonomists are agreed on). The circular element in this argument is obvious.

TABLE 2

Threatened and near-threatened seabirds (Collar & Andrew 1988, Collar *et al*. 1994, BirdLife International 2000)

Family	**Total species**[a]	**Collar & Andrew 1988**	**Collar *et al.* 1994**	**BirdLife International 2000**	**% spp.**
Penguins Spheniscidae	17	3	4	12	64
Albatrosses Diomedeidae	14 (21)[b]	2	8	20	95
Petrels Procellariidae	79	19	29	45	57
Storm Petrels Hydrobatidae	21	3	5	5	24
Tropicbirds Phaethontidae	3	0	0	0	0
Pelicans Pelecanidae	5	2	2	2	40
Gannets & Boobies Sulidae	7	1	2	2	29
Cormorants Phalacrocoracidae	34	3	14	14	41
Darters Anhingidae	2	0	1	1	50
Frigatebirds Fregatidae	5	2	2	2	40
Skuas & Jaegers Stercorariini	8	0	0	0	0
Skimmers Rhynchopini	3	0	1	2	67
Gulls Larini	50	5	7	9	18
Terns Sternini	44	4	8	7	16
Auks Alcini	23[c]	1	4	4	17
Totals	**322**[b,c]	**45**	**87**	**123**	**38**

[a] from Sibley & Monroe (1990) unless otherwise indicated,
[b] numbers from Tickell (2000),
[c] includes the Long-billed Murrelet *Brachyramphus perdix* (Friesen *et al.* 1996).

ALTERNATIVE APPROACHES

We need to recognize that prioritization on the basis of the likelihood of species extinction is not the only possible method. Another approach is to take a more ecological view. If we have a geographical area that supports a variety of seabirds, we could strive to maintain the integrity and ecological function of that community, irrespective of the taxonomic status of the populations involved. If we took this view, we might be just as concerned about the small population of Manx Shearwaters *Puffinus puffinus* breeding off the south coast of Newfoundland (the main New World outpost), as about the small population of the Manx-like Balearic Shearwater *P. mauretanicus* breeding in the Mediterranean. We might consider the re-establishment of frigatebirds on St Helena more important than saving the Chatham Island Taiko *Pterodroma axillaris*, a gadfly petrel in an area that supports many gadfly petrels (although presumably the diversity of gadfly petrels relates to some partitioning of resources among them: an interesting topic in itself).

If we begin to think about ecosystems, we might be more concerned about Magellanic Penguins in Argentina, where the species is numerous but declining (currently rated as 'near-threatened' by BirdLife International), than about the Endangered Galapagos Penguin *S. mendiculus*, which even before recent setbacks was never numerous enough to have been an important element in the marine ecosystem around the Galapagos. Or we might consider protection of the Westland Black Petrel *Procellaria westlandica*, a bird that may have been very abundant in the past (now rated Vulnerable) more important than protecting the Chatham Island Cormorant *Phalacrocorax onslowi*, a species never likely to be of more than very local significance (currently Endangered).

In fact, from a perspective of maintaining ecosystem integrity, we should be more concerned about reductions in numbers of common species, such as Great and Sooty Shearwaters *Puffinus gravis* and *P. griseus* and Dovekies or Little Auks *Alle alle* than about declines in small populations of island endemics, such as MacGillivray's Petrel *Pterodroma macgillivrayi*, or the Christmas Island Frigatebird *Fregata andrewsi*. Millions of Sooty Shearwaters formerly present as non-breeding visitors in the California Current system have disappeared during the last decade (Veit *et al.* 1997), but there is no mention of this in *Threatened birds of the world*. This disappearance seems to me to be of greater global concern than the fate of the Snares Island Penguin *Eudyptes robustus* (currently 4000 pairs), or the Chatham Island Albatross *Thalassarche eremita* (*c.* 10 000 pairs). Perhaps we should consider that keeping common birds common is as important as saving rare species.

TAXONOMIC LEVELS

There is another argument to consider. If we do take a taxonomic approach that bases our concern at the level of the species, should we not extend this approach to higher taxonomic levels, treating the fate of genera as more important than that of species, and the fate of tribes as more important still? In the past, it has been possible to argue that taxa above the level of the species are purely artificial constructs, setting arbitrary boundaries within a spectrum of continuous genetic variation. However, molecular methods allow us to be far more precise in defining higher taxa now than was possible when we were reliant on phenotypic variation. In any case, there are many examples that no one is likely to argue with (e.g. that aberrant genera like *Creagrus* and *Rodostethia* are further from the other gulls than typical *Larus* species are from one another).

A hierarchical approach based on taxonomic levels has been applied to conservation prioritization for birds by Daniels *et al.* (1991), Fjeldsa (1994) and Padmanabhan & Gadgil (2000). However, to my knowledge, this approach has not been applied to seabirds. It might, for example, put greater emphasis on the conservation of genera such as *Diomedea*, where practically all species are threatened, *Procellaria* with four of five species threatened and *Synthliboramphus* (three of four species threatened), compared with species of *Puffinus* or *Sterna*. Likewise, the single species in a monotypic genus, such as *Eudyptula*, *Nesofregatta* or *Garrodia*, would rank more highly in conservation priorities than any individual *Oceanodroma*, *Pachyptila* or *Larus* species.

Likewise, the taxonomic approach can be applied below the level of species, to subspecies, or to isolated populations. In fact, the North American Waterfowl Management Plan takes this approach, by dividing many continental populations into 'flyways' and treating each flyway population as a unit of concern. This means that the Atlantic Canada Goose *Branta canadensis canadensis* is receiving much attention from managers in the light of recent declines (Dickson 2000), despite being unarguably a member of one of the most abundant waterfowl species on the planet.

Modern molecular genetic techniques can be especially helpful in telling us the degree to which populations are isolated from one another. For instance, we now know that Common Murres or Guillemots *Uria aalge* in Oregon and Washington experience little interchange with those in Alaska (K. Warheit pers. comm.). On the other hand Ancient Murrelets *Synthliboramphus antiquus* appear to be panmictic across the entire northern Pacific (Pierce *et al*. in press). In view of the isolation of the California–Washington murre population, should it be of any less concern than the fate of any other allopatric population of a widespread genus, such as the Least Tern *Sterna antillarum*?

WHY WE CLEAVE TO SPECIES AS THE BASIS FOR CONSERVATION PRIORITIES

There are probably many reasons why our concerns have coalesced at the level of the species and why we tend to prioritize based on the likelihood of extinction. Some are probably emotional, cultural and historical and hence are marginal to the domain of science. However, I would suggest that there are some good practical reasons for the current choice:

1. Prioritization in terms of the likelihood of species extinction is preferred over a more ecosystem approach because it is easier to apply clear-cut guidelines at the level of the species. The total population and the range size are readily quantified variables; with the appropriate molecular techniques the phylogenetic relationships also can be clarified. In contrast, the role of seabirds in particular ecosystems is an area where we may never have sufficient information to develop rigorous criteria.

2. Species extinction is an apparently irreversible process, whereas species declines or range contractions are something that, at least in theory, could be addressed at some future date.

3. Problems confronting small populations are often, though not always, local – introduced predators are a case in point. These problems are inherently more easily solved than those, such as global warming, the increasing load of toxic chemicals in the oceans, or the planet-wide problem of fishing down the food chain that are chronic and pervasive. Not to say that eradicating introduced organisms is easy, but it involves specific and well-understood actions and once fixed it may remain fixed for a long time.

I present these arguments, not to suggest that our priorities must necessarily be re-examined, but to demonstrate that there are other ways to look at the situation and that exact species definitions, though they may be useful, should not become an over-riding concern. In particular, I would suggest that becoming dependent on taxonomic criteria in ordering our priorities forces us to place heavy emphasis on an area of research where uncertainties and contentions abound, as the changes in taxonomy over recent decades illustrate. Certainly, we shall continue to deal with many conservation issues at the level of species, but we need to shake off the stranglehold that this particular taxonomic category has placed on our conservation thinking and consider populations and ecosystems, perhaps also higher and lower taxonomic categories, as well as just the probability of species extinction.

More importantly, I believe that our current species-based approach to conservation prioritization tends to direct our energies at what are, on a planetary scale, relatively trivial conservation goals (making nest boxes for rare petrels, writing endless management plans for Marbled Murrelets) while the large-scale threats, not just to individual species, but to whole communities and ecosystems, consequent on the unsustainable use of natural resources in most parts of the globe, become the concern of non-biologists and those with political agendas to promote. It causes professional conservation biologists to become fragmented into specialist groups, each concerned with problems specific to their group, when instead we should all be shouting with one voice that it is not the Madeira Petrel or the Giant Panda, the Amsterdam Albatross or the Bactrian Camel that are under threat, but the whole biosphere.

ACKNOWLEDGEMENTS

I would like to thank Sandy Bartle, Hugh Boyd and Alan Tennyson for feedback on earlier drafts and Bill Sydeman for acting as guest editor for the piece.

REFERENCES

BIRDLIFE INTERNATIONAL. 2000. Threatened birds of the world. Barcelona & Cambridge: Lynx Edicions & BirdLife International.

COLLAR, N.J. & ANDREW, P. 1988. Birds to watch: the ICBP world checklist of threatened birds. ICBP Technical Publication, No. 8. Cambridge: International Council for Bird Preservation.

COLLAR, N.J., CROSBY, M.J. & STATTERSFIELD, A.J. 1994. Birds to watch 2: the world list of threatened birds. Cambridge: BirdLife International.

DANIELS, R.J.R., HEGDE, M., JOSHI, N.V. & GADGIL, M. 1991. Assigning conservation value: a case study from India. *Conservation Biology* 5: 464–475.

DICKSON, K.M. (Ed.) 2000. Towards conservation of the diversity of Canada Geese (*Branta canadensis*). Canadian Wildlife Service Occasional Paper No. 103. Ottawa, Canada.

FJELDSA, J. 1994. Geographical patterns for relict and young species of birds in Africa and South America and applications for conservation priorities. *Biodiversity and Conservation* 3: 207–226.

FRIESEN, V., BAKER, A.J. & PIATT, J.F. 1996. Evidence from allozymes and cytochrome-b sequences for a new species of alcid, the Long-billed Murrelet (*Brachyramphus perdix*). *Condor* 98: 681–690.

HARRISON, P. 1983. Seabirds: an identification guide. Boston: Houghton Mifflin.

JOHNSGARD, P.A. 1993. Cormorants, darters and pelicans of the world. Washington: Smithsonian Institute Press.

NUNN, G.B., COOPER, J., JOUVENTIN, P., ROBERTSON, C.J.R. & ROBERTSON, G.G. 1996. Evolutionary relationships among extant albatrosses (Procellariiformes: Diomedeidae) established from complete cytochrome-b gene sequences. *Auk* 113: 784–801.

PADMANABHAN, P. & GADGIL, M. 2000. What to conserve: an objective and participatory method. In: Singh, S., Sastry, A.R.K, Mehta, R. & Uppal, V. (Eds). Setting biodiverity conservation priorities for India. New Delhi: World Wide Fund for Nature – India. pp. 426–444.

PIERCE, R.L., WOOD, J.J., ARTUKHIN, Y., BIRT, T.P., DAMUS, M. & FRIESEN, V. in press. Mitochondrial DNA suggests high trans-Pacific gene flow in Ancient Murrelets. *Condor*.

SIBLEY, C.G. & MONROE, Jr., B.L. 1990. Distibution and taxonomy of birds of the world. New Haven: Yale University Press.

SIEGEL-CAUSEY, D. 1988. Phylogeny of the Phalacrocoracidae. *Condor* 90: 885–905.

TICKELL, W.L.N. 2000. Albatrosses. Mountfield: Pica Press.

VEIT, R.R., McGOWAN, J.A., AINLEY, D.G., WAHL, T.R. & PYLE, P. 1997. Apex marine predator declines ninety percent in association with changing oceanic climate. *Global Change Biology* 3: 23–28.

WARHAM, J. 1990. The petrels: their ecology and breeding systems. London: Academic Press.