Bird Conservation International (2000) 10:1–15. © BirdLife International 2000

Opinion
Collecting and conservation: cause and effect

N. J. COLLAR

Introduction

The killing of birds for scientific reference causes debate and dispute whose intensity is in inverse proportion to its relevance as a conservation issue, with similar degrees of heat being generated only by such momentous things as the standardization of vernacular bird names. Doubtless this is because these are seemingly simple, black-and-white issues over which many people feel they have sufficient personal clarity and power to achieve a resolution. Really important matters – global warming, intransigent debt arrangements for developing nations, exponential human population growth, obliteration of habitats for short-term human gain, scandalous abuses of biocide in agriculture, saturation-level corruption and incompetence in state conservation agencies, all of which are poised to degrade the ornithological environment beyond recognition – belong to another dimension altogether in which most of us are simply sleepwalking towards doomsday. It is important, then, to get the collecting issue into reasonable perspective as soon as humanly possible.

In recent years museum-based ornithologists and their sympathizers, particularly in North America, have published a series of papers setting forth the case for the defence of scientific collecting, many if not all of which are listed in the comprehensive affirmation and review by Remsen (1995). One of the curiosities of the situation, however, is that this body of material is in no way matched by a similar body of anti-collecting writing. Indeed, it may be the very dearth of published opposition that has driven the museum community and its supporters to their repeated protestations of innocence: for there is nothing more disconcerting than trial by rumour and insinuation, emanating from sources that steadfastly fail to identify themselves. If there was just once a full, clear-headed and calmly stated case for the prosecution, then a single point-by-point rebuttal might be furnished, and the matter settled on its merits.

In fact, it seems to me that Remsen (1995) has performed an important service to both sides by marshalling virtually all the ''anti'' arguments and dealing with them in turn: certainly the value of research collections to conservation, and the minimal impact of their creation and extension, could hardly have been more strongly conveyed. Nevertheless, I feel he still overlooked or underplayed certain areas which fuel much anti-collecting sentiment and which, unless addressed, will continue to inflame feelings and hence distract (and possibly even obstruct) scientific collectors from their mission. There has already been a brief exchange

on the real ethical problem of causing suffering by collecting (Bekoff and Elzanowski 1997, Remsen 1997), and some fieldworkers may yet seek to respond to Remsen's section ''*Can't the data be obtained without harming the birds*'', since the data he discusses are of a type most biologists would not need in order to implement scientifically sound conservation. Both these issues merit further debate not least because a large proportion of the world's nature-lovers and birdwatchers (the people on whom national and international conservation movements, and indeed even natural history museums, ultimately depend) have feelings and views on these matters that need to be heard and developed and accommodated. In this essay, however, I wish to address a further issue not fully considered by Remsen and which bears on an acute problem in conservation, namely the impact of collecting on known small populations of globally, nationally and even locally threatened species, and on unknown but possibly small populations of such birds, including species new to science.

The notion of ''judicious'' collecting

A tacit admission that collecting *might* inflict damage of some sorts has been evident ever since the word ''judicious'' made its blushing debut on the strong arm of ''collecting'' as a temper to the latter's rogue image, at least 30 years ago (the phrase is, for example, in Allen *et al.* 1968). Clearly what lies behind the pair-off is the notion that activities should be sufficiently restrained for a sampled population to experience only short-term, negligible disadvantage; conversely, injudicious or indiscriminate collecting must be that which to some degree compromises the long-term viability of a population. LeCroy and Vuilleumier (1992) referred to the need for ''judicious sampling of populations'' and the ''availability of discerningly collected specimens'', but went no further in indicating what thresholds might be represented by these concepts. They were certainly correct, however, in indicating that the issue is indeed as much the *availability* of collected specimens as how discerningly they were taken (this point is covered in proposal 5 of the draft protocol below).

It was only with Remsen (1995) that a formal articulation of what might be considered judicious collecting was attempted. He suggested the appropriate number of specimens to be taken per collecting locality (defined as an area of about 1 km^2) as: 25 for species with body mass under 100 g, 15 for those at 100–250 g, six for those over 250 g, and four ''for species whose populations are potentially sensitive, such as raptors and large galliforms''. This passage in his paper is confused (as its editor I take responsibility for this), since these values are first indicated as recommended *minima* when of course, as the context shows, they are intended to stand as guideline *maxima*.

One immediate concern here must be the continuing uncertainty over the relationship between body mass and abundance (Blackburn and Gaston 1997): large species do not always occur at lower densities than small ones, and same-sized species can occur at dramatically different densities from one another. For this reason in particular, and because the highly territorial nature of some species theoretically might result in the removal of a population from an area much larger than 1 km^2, as neighbouring birds prospect the locality following the loss of its resident pair, Remsen's guideline numbers seem a little too high for com-

fort. Moreover, there is the consideration that not all specimens are recovered – describing the luxuriant foothill vegetation in what its rulers now call Myanmar, E. W. Oates in Hume (1875) wrote that ''in such jungle the collector may consider himself fortunate if he retrieves *one bird out of five shot*'' (my italics) – so that under a collecting regime using shotguns and seeking to attain Remsen's maxima (unless his numbers included lost specimens) many more birds might have to be killed than are salvaged.

A further concern is the nature of the collecting locality. If it is a site defined by collector activity around a central point within habitat extending uniformly for miles in several directions, then Remsen's numbers – notwithstanding my doubts – may well be tenable. If, however, it is a site whose characteristics in some way bias the numbers and densities of species present – an aggregation of flowering or fruiting trees, even perhaps an antswarm, a well-watered site at which vegetation is particularly luxuriant, a restricted habitat within a broader habitat type, a piece of primary habitat in a patch of disturbed land, and, worst of all, an entirely isolated small plot offering no dispersal or immigration potential for many of its inmates – then some serious rethinking may be needed. To be fair, Remsen acknowledged that isolated pockets are separate cases, but whether (unless they are about to be destroyed) they would be treated as collecting no-go areas, or ones where the collectable number of birds in different weight classes would be scaled down, is not discussed; nor is it suggested what the minimum distance should be between collecting localities, although I would assume one of 5 km might be appropriate, at least in continuous and similar habitat.

The most crucial point of all, however, must concern the status of the species to be collected. Whether judged globally, regionally, nationally, provincially or locally, individual species may possess a formally assigned conservation status, not necessarily backed by law but nonetheless demanding sensitivity on the part of a prospective collector. There must be some system to which he or she can refer in order to gauge the appropriateness of collecting such species; yet at present there is none.

Valuable therefore as Remsen's guidelines are, they do not discriminate between quality and type of collecting site, nor do they elaborate, with appropriate advice and numerical adjustments, on the problems posed by ''rare'' species, threatened species, new species or conserved species (i.e. birds in reserves). As a result, judiciousness continues to lack definition beyond individual context and discretion; and until this problem can be addressed it must remain a defensive weakness on which anti-collecting arguments will legitimately continue to concentrate. Before attempting to develop a further set of guidelines, however, it is worth considering some of the things that have been said and thought about the dangers of collecting over the past century or so, if only as a frame to the conclusions that such guidelines represent.

A brief history of blame

Among the first species considered likely to be exterminated by collecting – at a time when the commercial and scientific dimensions of that activity greatly overlapped – was the Blue Chaffinch *Fringilla teydea*, for which the market in specimens (for the plume trade) was so great in the 1880s that its days then

seemed numbered (Meade-Waldo 1889, Koenig 1890); so when von Thanner (1910) disclosed that over a period of years he had procured (for museums) 76 specimens on Gran Canaria and 122 on Tenerife, there was a strong reaction (the word ''butchery'' was used) in British ornithological circles (Ogilvie-Grant 1910, Bannerman 1912). In fact von Thanner had already stirred feelings (''atrocity'') in 1907 by collecting, for Alexander Koenig in Bonn, 53 Azores Bullfinches *Pyrrhula (pyrrhula) murina*, a species which four years earlier had been thought ''practically extinct'' (Lowe 1908). Twenty years later – by which time the era of the bounty collector, and indeed the dealer who paid him, must have been over – the taking of a further five bullfinches for the American Museum of Natural History led to a protest again involving Lowe and Bannerman (1930), both of whom were committed museum men (the former by then being Curator of Birds at the British Museum), but from which their American respondents, Murphy and Chapin (1930a,b), making several points which link directly with Remsen's current line of reasoning, emerged with full dignity and credit.

It is difficult to know how deep the feelings might have run at this time; I suspect not very. Despite Lowe being a founder, in 1922, of what was to become BirdLife International, the bulletins of the International Council for Bird Preservation (ICBP) throughout the 1920s and 1930s made no reference to scientific collecting as a bird protection issue; and, apart from Whistler (1930), neither *Ibis* nor *Auk* appears to have made further allusion to the subject. Whistler's contribution was important, however, in being an open appeal to museums to moderate the scale of their collecting, which he regarded as having become a means of acquiring exchange material rather than real knowledge of birds and their natural history. He declared that

> there is undoubtedly need for ornithologists to set their house in order so far as the unnecessary collection of birds is concerned, or there is danger that others will take the matter in hand for them, and legitimate scientific collecting will be unduly hampered all over the world.

He may here have had in mind the Whitney South Seas Expedition, which in 1923 had received an unexpected setback: an exhibition of its extensive material in Tahiti was greeted with such dismay by the governor that he promptly banned the collection of further specimens in French territories under his jurisdiction, an action which caused New Zealand in turn to block the expedition's planned visit to the Cook Islands (J.-C. Thibault verbally 1997). At any rate, it may well have been around the time of Whistler's intervention that the notion of judiciousness in collecting began to have wide currency. If subsequently there appear to have been no public expressions of disquiet over the volumes in which birds were collected, this was presumably because such volumes had by then been widely acknowledged as things of the past. Indeed Murphy and Chapin (1930a,b), while robustly defending the taking of five Azores Bullfinches, had readily joined in the condemnation of the earlier collection of 53, referring to it as ''quite outrageous'' and a ''holocaust''.

It is notable, however, that even in the great era of museum expansion when some collecting might be thought to have been excessive, there is no documented instance of an extinction directly resulting (see also Mearns and Mearns 1998: 18). Jackson (in press) has identified collecting, albeit not just by museum workers, as

a major but by no means the sole factor in the demise of the Ivory-billed Woodpecker *Campephilus principalis* (there are as many as 400 specimens in collections around the world!). Zonfrillo (1994) attributed the loss of the Canarian Black Oystercatcher *Haematopus meadewaldoi* to – of all people – David Bannerman, but this accusation seriously confused proximate and ultimate influences on the species (Collar 1994). Greenway (1958) mentioned that overcollecting might have significantly affected the Huia *Heteralocha acutirostris*, but provided reasons why the notion is untenable. Taylor (1998) did the same with the Chatham Islands Rail *Gallirallus modestus*. Olsen (1996) catalogued the taking of 30 specimens of the Norfolk Island Boobook *Ninox novaeseelandiae undulata* in one season (the licence was for six) at a time when, from the context she gave, there were fewer than 8 km^2 of forest cover remaining; yet the owl survived.

Even in this last case, however, where a haul of 30 birds must appear culpably injudicious to most people (the infraction of the permit clearly was), it transpires that this corresponds to the proceeds from just two sites and 25% of available habitat, based on Remsen's guidelines for birds weighing 200 g, and I simply do not know either how museum collectors today would regard such a number, or whether the population experienced any permanent damage as a result. The same goes for the Blue Chaffinch and even the Azores Bullfinch. The extent of pine on Tenerife at the start of the twentieth century could almost certainly have supported five collecting stations each 5 km apart, which would putatively have yielded 125 Blue Chaffinches in a ''sampling'' of the island sanctioned by Remsen's guidelines (and von Thanner's 122 were obtained over several years, not in one season). The ''holocaust'' of 53 bullfinches were only three over Remsen's guideline maxima for two collecting sites, and a century ago there may well have been sufficient forest on São Miguel to accommodate two such sites in the eyes of a present-day collector. Thus even the widely condemned excesses of a bygone age appear in a rather different light when set against modern criteria.

Whatever the case, the Second World War seems to me to mark the terminus of the era of large-scale museum collecting, so it is perhaps hardly surprising that for a decade after Whistler's letter and another two after Pearl Harbor the issue of collecting as a conservation problem remained in abeyance. It was only likely to be revived by anxiety over the effect that even small-scale collecting might have on populations of rarer species, and consequently it took until the ground-breaking study by Greenway (1958) – progenitor of the Red Data Book listings of the 1960s – for the world to have a first glimpse of which those species might be. Thus it was that, some four years later, when Amadon (1962) named a new species and genus of bird, the tiny but glorious Miniature Tit-babbler *Micromacronus leytensis*, the British popular science journal *New Scientist* carried the story not for the immense biological interest of the find but in order to make the observation that ''it was just as well'' that collecting efforts had yielded only four specimens:

> To what extent the collecting of birds for museums is responsible for the rarity of certain species is a very delicate point and one not often discussed by professional ornithologists . . . [James] Fisher's list [of over a hundred bird species in danger of extinction] should be hung up in the bird room of every museum in the world, especially those where collectors are paid without any questions asked (Anon. 1962).

Eight years later *NS* was at it again. In a leader addressing ''the ethics of killing almost extinct animals'', the magazine pilloried C. W. Benson and M. J. Penny for having ''as they put it, 'collected''' a single pair of Aldabra Warblers *Nesillas aldabranus* and their nest and eggs for description in ''one of the technical bulletins of the British Ornithologists' Club, an offspring of a learned society'' (Anon. 1969). A robust defence was promptly furnished (Thorpe and Stoddart 1969), but this was also a time when collecting as a means of identifying regionally rare species was under discussion in *Ibis* (Allen *et al.* 1968, Benson *et al.* 1968, Harwin 1969, Spencer *et al.* 1969), and since then the subject has never fallen dormant for very long. Within a few years, for example, the long-suffering Benson was pursued to Madagascar by a small posse of fellow ornithologists despatched by representatives of ICBP in the mistaken belief that some very rare species were to be his targets. None of this is in the public record, of course (and some of the reasons for the scare, not pertaining to Benson, do not even exist on private files), but an echo of the affair survives at the end of the paper by Keith *et al.* (1974) where they express concern that the behaviour of many Malagasy birds makes them ''vulnerable to indiscriminate collecting'', which ''is a problem to be controlled''.

In fact, one of the most effective modern controls on collecting is money. Late twentieth century affluence does not, by and large, extend to natural history museums, and the costs of collecting today are many times greater than those of a hundred years ago. As G. R. Graves (verbally 1996) has observed, every skin has its price – the expense in time and/or dollars of the travel, arranging of permits, cartridge/netting, preparation, cataloguing and storage – so it is hardly surprising that modern collecting increasingly exhibits its own in-built judiciousness. Paradoxically, however, these considerable costs also explain why skins can be conceived more as ends in themselves – *possessions* – than as means to other ends. This in turn tends to support the (albeit minority) notion of collecting as a right sanctioned by the greater cause of science, analogous to the medieval *droit de seigneur*, by which local feelings and strict adherence to written or unwritten protocols become subordinate to the acquisition of material or knowledge. Evidence of this mindset are the illegal traffic in eggs (the subplot of a quest for egg-white proteins) uncovered in the early 1970s (Hudson 1974), the killing in 1979 of a Red Goshawk *Erythrotriorchis radiatus* merely to identify it (Debus *et al.* 1993), and the taking a decade ago of a pair of ringed Regent Honeyeaters *Xanthomyza phrygia* – Endangered in Collar *et al.* (1994) – from a population under active study, an incident which caused a question to be asked in the Australian parliament (*Senate Hansard*, 6 December 1989: 3988). Rogue (if rare) events like these have helped keep public suspicion of collecting – and of the values of those who undertake such work – alive and occasionally kicking.

Principles and perceptions

There is a characteristic human trait of underestimating population sizes when using mainly qualitative field assessments and/or reviews of published sources, and this commonly results in overpessimistic evaluations of the status of species. For example, Collar and Stuart (1985), having scrutinized every item of available evidence, described the White-breasted Guineafowl *Agelastes meleagrides* as ''one

of the most threatened birds in continental Africa'', yet studies (undertaken in response to this remark) fairly soon resulted in a population calculated at 30,000–40,000 individuals in Taï National Park, Côte d'Ivoire (Francis *et al.* 1992). Prior to this fieldwork the collection of even a few specimens would have seemed perversely risky; now by contrast it might seem perversely cautious for an authority to disallow such a sampling (although this instance is complicated by the population's presence within a national park).

There are many other such cases, not all involving birds, that should now warn conservationists against unreasonable pessimism in status assessment (though I should say that the research and enquiries made before the guineafowl judgement were as exhaustive as resources allowed, and I stand by the inference made, wrong as it proved to be). Even so, and even if it can be shown that scientific collecting has never caused the extinction of a bird species, it must always be a little unsafe to assume that species are *necessarily* commoner than we perceive them to be. Moreover, as the habitats and populations of so many birds shrink to small fractions of their original size, public discomfort over anything resembling ''indiscriminate collecting'' can only intensify. The last quarter of the twentieth century has seen a dramatic increase in both habitat destruction (resulting in smaller populations) and ornithological exploration (resulting in larger-than-believed populations), but the perceptual gains (grateful as we may be for them) are scant compensation for the real-world losses. Prospective collectors are, therefore, obliged to observe the precautionary principle, which requires the assumption of rarity until clear evidence to the contrary is encountered. This is certainly the case where species evaluated as globally threatened are concerned, and there are some notable instances of compliance. When Butynski and Koster (1989) discovered the Grey-necked Picathartes *Picathartes oreas* on Bioko in 1986, they speculated on its possible subspecific identity but declined to take a specimen ''until the status of this population is determined''. When Haney *et al.* (1993) reported a probable Fea's Petrel *Pterodroma feae* in North American waters, they too excluded the option of future voucher specimens on the grounds that this species is numerically weak and its lookalike sister taxon, Zino's Petrel *P. madeira*, very much (two orders of magnitude) weaker still and possibly also to be found in the same waters.

Small, geographically or politically isolated populations of species pose very similar problems. The situation is clearly more delicate where the population in question has taxonomic standing, such as the Cinnamon Teal *Anas cyanoptera borreroi* of Colombia, Helmeted Guineafowl *Numida meleagris sabyi* in Morocco or White-bellied Woodpecker *Dryocopus javensis richardsi* on the Korean peninsula. It may be somewhat less so when it does not, as in the cases of Magnificent Frigatebird *Fregata magnificens* in the western Palearctic, Glossy Ibis *Plegadis falcinellus* on Agalega Atoll, Arabian Bustard *Ardeotis arabs* in Arabia, Eared Trogon *Euptilotis neoxenus* in the southernmost U.S.A. or White-winged Apalis *Apalis chariessa* in Malawi. However, all such situations represent challenges that cannot be negotiated by reference to Remsen's guidelines; and the problem persists even when the scale is reduced to local dimensions (sometimes merely by the effect of administrative boundaries) involving no taxonomically identifiable entities, particularly in the tropics where there may be some tiny, long-isolated populations in valleys and on peaks. Indeed, if the pressure to adopt a phylogenetic

species concept (Cracraft 1997, Zink 1997) prevails, there will be ever-increasing interest in sampling any small isolated populations (not always but certainly sometimes involving the collection of animals rather than just biochemical samples). Restraint in all these contexts is clearly important, so that diversity at local and national levels remains unimpaired.

However, if such restraint is broadly judged sensible, the question immediately arises of how the situation is to be handled when entirely new species are at stake. There ought, of course, to be no difference: but although the putative new species might be at risk, the pressure for specimen evidence would, almost always justifiably, be decisive. The same kind of considerations apply as those related to the nature of the collecting locality: new species found in previously unexplored, continuous habitat – Rondônia Bushbird *Clytoctantes atrogularis* is a good recent example, as indeed (*pace New Scientist*) is *Micromacronus leytensis* – cannot be expected to be on the brink of extinction, vanishingly rare as they appear to be (of course it is unsafe to assume that *no* risk exists); new species found in a patch of fragmented habitat far from any other – there is no better example than the Bulo Burti Bush-shrike *Laniarius liberatus* – represent a very different circumstance. Distinguished representatives of the museum community were quick to identify the specimen-free description of the Bulo Burti Bush-shrike (although not mentioned by name) as a ''disservice to ornithology'' (Banks *et al.* 1993), but, in accepting the possibility of the species's population being so small that every individual matters, I take the opposite view (Collar 1999).

Certainly the collection of material of new or threatened species is a matter to which hundreds of thousands of birdwatchers and nature-lovers are now sensitized. New species very often *are* threatened species: Mayr and Vuilleumier's (1983) explanation of why new species continue to be discovered – that some ''have exceedingly small ranges'' – conforms with the finding that range size in Neotropical oscines is negatively correlated with date of description (Blackburn and Gaston 1995), and is precisely the reason why many of them are defined as species at risk. Table 1 shows an overall though small increase in the percentage of threatened species from among those described as new in the period 1938-1990, but with a notable increase in the proportion of those qualifying as threatened under the restricted-range components (B, D2) of the new IUCN criteria for evaluating threat status (see Collar *et al.* 1994: 14–21; also Table 2). There is therefore good reason why the collection of material of putative new species should proceed with caution (which is not to say it should not proceed), and with every effort to ascertain their conservation status through fieldwork beforehand. In the case of species already known to be threatened, while the collection of new material may often remain important (as in the case of unsampled populations that may be subspecifically distinct), the need for caution and restraint is all the stronger, chiefly for conservation but also for what one might call cosmetic reasons.

There is at any rate another principle than the precautionary which needs to be applied in modern collecting, relating to another type of discrimination: one which recognizes that the public perception (local, national, international) of collecting really matters, and needs constantly to be considered. Even if collecting has no lasting impact on species or populations, the normal response in many sectors of human society to the deliberate killing of wild creatures by scientists

Table 1. The number of new species now listed as threatened, by period in which they were described (AMNH review papers: see last sentence of this caption), by range-size criteria under which they qualified as threatened (B and D2: see Table 2), and as percentages. Species in Collar *et al.* (1994) are counted even if the AMNH reviews treat them as subspecies; new species relegated to races of species treated in earlier AMNH reviews are counted only once, while those relegated to races of species described prior to the AMNH reviews are not counted at all. Species that qualified at risk on both B and D2 range criteria (see Table 2) are counted once. Columns 1–6 are based, respectively, on: (1) Zimmer and Mayr (1943), (2) Mayr (1957), (3) Mayr (1971), (4) Mayr and Vuilleumier (1983), (5) Vuilleumier and Mayr (1987) and (6) Vuilleumier *et al.* (1992) supplemented by Bahr (1995)

AMNH review paper	1	2	3	4	5	6
Number of new species	53	74	51	48	19	50
Number of new species also threatened	14	18	23	17	6	23
% new also threatened	26.4	24.3	47.9	35.4	31.6	46.0
Number qualifying at risk on range	8	18	12	13	6	21
% qualifying at risk on range	15.1	24.3	23.5	27.0	31.6	42.0

Table 2. The IUCN categories of threat, greatly simplified. The three main columns are for the three main categories. The six main rows are for the criteria that trigger the categories. Criterion A reflects rate of decline (Vulnerable indicates over 50% in 20 years or five generations, whichever is the longer, etc.). B (eo) is for species restricted to and in some way (range, numbers, habitat) declining in an *extent of occurrence* (i.e. area expressed by the shortest boundary encompassing all known or inferred sites) less than that indicated. B (ao) is for species restricted to and in some way declining in an *area of occupancy* (i.e. measurable area actually used within the extent of occurrence) less than that indicated. C is the number of mature individuals in a total population that must be in significant decline. D1 is a population threshold stand-alone, with no decline needed. D2 is a range-size or locality number stand-alone, with no decline needed and application only to the category Vulnerable. Bold highlights those circumstances where all collecting might be prohibited; italic highlights those where collecting might only be under sufferance of a committee of, say, IOC.

	Vulnerable	Endangered	Critical
A	> 50% in 20 years/ 5 generations	*> 50% in 10 years/ 3 generations*	*> 80% in 10 years/ 3 generations*
B (eo)	< 20,000 km^2	*< 5,000 km^2*	**< 100 km^2**
B (ao)	< 2,000 km^2	*< 500 km^2*	**< 10 km^2**
C	< 10,000	*< 2,500*	**< 250**
D1	*< 1,000*	**< 250**	**< 50**
D2	< 100 km^2 or 5 sites	—	—

is one of distaste and hostility, and this only increases the rarer a species is perceived to be. However just their cause, museum scientists cannot easily ameliorate this effect; but it is well within their grasp to make it no worse, by continuing to maintain and promote the highest standards of conduct in both field and institution.

A draft protocol for the scientific collecting of new, rare and threatened species

The problem of new and threatened species ought now to be subject to careful consideration by taxonomists and conservationists working jointly towards a protocol that both sides can support and help implement. The International Ornithological Congress could perhaps take a neutral lead on this. Thirty years of silence have passed since Snow's (1972) initiative in the matter and ICBP's

resulting World Conference resolution (*ICBP Bull. XI* [1971]: 51), although the issue was soon afterwards complicated by the establishment of CITES as a check on the international transfer of animal material. The new IUCN system of status evaluation, as interpreted in Collar *et al.* (1994), offers the chance to identify a suite of species, according to their particular category and the criteria they meet, which should by common consent have further collection of material prohibited or strictly regulated (whether international transfer of that material is intended or not); and similar principles could be invoked to prohibit or regulate the collection of threatened subspecies and locally threatened populations of commoner species.

The new IUCN criteria for the assessment of threat status were long in the making and broad in the consultation process (as tokens of which see Mace 1994, Mace and Stuart 1994). There are three categories of threat: Vulnerable, Endangered and Critical, each reflecting several separate numerical criteria, which are designed to be nested (see Table 2). When these criteria were first applied to birds, 1,111 species were judged to meet them, of which 704 were deemed Vulnerable, 235 Endangered and 168 Critical, with four Extinct in the Wild (Collar *et al.* 1994). These classifications were reached through another process of broad consultation and, while they may legitimately be challenged and are in any case under continual revision, they represent a standard which has never previously been sought in any objective evaluation of globally threatened species, and which therefore must currently serve as the best available reference point for bringing consensus and coherence to an otherwise constantly debatable area.

Accordingly, I submit for consideration the following 10–point set of proposals, in which ''collection'' means deliberate killing, not salvaging of already dead material, and which of course concede that national and international laws relating to individual species override any general sanctions suggested herewith. I should stress that these are no more than personal ideas to open a debate rather than institutional prescriptions to foreclose one.

1. All Critical species (except those qualifying only under Criterion A), and species that qualify as Endangered under Criterion D1, should be prohibited from collection at all times.
2. All Endangered species, plus species that are Critical under Criterion A and Vulnerable under Criterion D1, should be prohibited from collection except by consent of an international committee (perhaps of IOC, but in any case composed of representatives of the museum and conservation communities, and judging each species separately), with a maximum of 10 specimens per year.
3. All other Vulnerable species may be collected, with a maximum of 25 specimens per year, on condition that they are declared to the said committee within six months, so that their existence can be publicized and duplication discouraged.
4. The said committee should initiate a worldwide inventory of museum specimens of species threatened with extinction *sensu* IUCN, starting with those that are Extinct in the Wild and Critical, and moving through Endangered, Vulnerable, Data Deficient and Conservation Dependent (for which see Collar *et al.* 1994).

5. Access to material in the above inventory should be maximized, all data concerning such material made available, and exchanges between museums increased, enabling workers to locate specimens they might otherwise seek to collect, so that resources can be considered on a global rather than merely an institutional basis (posting biometric data and images on the internet may be one consequence here).
6. The collection of taxa apparently new to science should wherever possible proceed only when it has been established either (a) that the taxon in question is present in sufficient numbers to tolerate the offtake of a small number of individuals (generally not more than five), or (b) that the continuity of the habitat (equivalent altitudes, general facies, specific plant composition, and so on) makes it reasonable to assume the taxon's presence over a wide area; and either way the evidence should be presented in the original description.
7. The collection of nationally threatened species should be conducted by matching the known or estimated population with the global numerical criteria for Critical, Endangered and Vulnerable (see Table 2, row C), and the decision whether to collect taken on the basis of proposals 1–3.
8. The collection of locally threatened or otherwise susceptible species (e.g. those with poor dispersive ability in highly fragmented habitats) should have a ceiling of a reasonably estimated 10% of the population present at any one collecting site.
9. The collection of species in protected areas should as a general rule be avoided, even when permitted by the authorities, but otherwise should be undertaken with the utmost discretion (including the minimal use of shotguns) and only after full consultation of all local staff and education workers.
10. Active collecting museums should form a worldwide federation where membership is conditional on acceptance of the above limitations plus the code of ethics laid out by AOU (1975), and where the power to exclude transgressors has the effect of retaining public confidence (including conservation support) in the institutions that police themselves thus.

Although there is evidence that body mass very broadly correlates with threat status – parrots over 500 g are three times as likely to be at risk as parrots under 50 g (Collar 1998) – the relationship between weight and abundance, as already noted, remains too unpredictable to be used as a decisive rule here. This presents a real difficulty, and it is compounded by the fact that species often occur, often for entirely obscure reasons, at different abundances in different locations. It would therefore be preferable to undertake collecting at any given site on the basis of actual encounter rates, although in most cases the resources (chiefly time) needed to make such evaluations are unlikely to be available. It might, however, be practicable to develop a crude index of general abundance for every species, based on the accumulated body of evidence, and on this basis allocate it to one of four classes to substitute for Remsen's weight classes: ''very frequent'', ''frequent'', ''infrequent'', and ''scarce''. Definitions for these terms might respectively be >100 individuals per km^2, 25–100 per km^2, 5–25 per km^2 and <5 per km^2. If these values were adopted, I would suggest (and these are merely best–guessed figures, open to debate; see the summary in Table 3) that the maximum

Table 3. Summary of suggested maxima of birds of any species to be collected at a given locality (normally representing an area of 1 km^2), depending (first two columns) on their weight (Remsen 1995) or (last five columns) on their broadly calculated abundance levels (this paper). Numbers represent maxima of non-threatened (column A) and threatened (B) birds at a site where the habitat continues in several or all directions beyond the site, and of non-threatened birds at isolated sites where habitat does not extend beyond the site (C). Further details are in the text.

Weight level	Maximum	Index level	Number/km^2	A	B	C
<100 g	25	Very frequent	>100/km^2	15	5	5
100–250 g	15	Frequent	25–100/km^2	5	3	3
>250 g	6	Infrequent	5–25/km^2	3	1	0
Sensitive	4	Scarce	<5/km^2	2	1	0

number of birds collected at any one site (*including* unretrieved specimens) might, respectively, be 15, five, three and two; that they drop to five, three, one and one for all globally threatened species (*sensu* IUCN) whose collection is sanctioned by the above proposals; and to five, three, zero and zero for non–threatened species in isolated patches which are small enough to be treated as an entire collecting site (no threatened species should be taken at such sites). Each collecting site inside continuous habitat is here conceived as having a radius of 500 m, with its circumference at least 5 km from that of any other site in the same habitat.

Moreover, there is scope for far greater cooperation among museums themselves over their activities, and between museums and conservation organizations, about priorities for further work. Many parts of even a seemingly well–covered nation such as Mexico remain poorly sampled for birds, and spatiotemporal representativeness is even weaker (Peterson *et al.* 1998); by extension, the entire world is still in need of a great deal of sampling (although conservation purposes alone certainly do not automatically require the death of the specimens sampled). Deciding where the priorities lie might better be done through carefully considered planning rather than through more arbitrary means, and this would certainly further the integration of museum studies with broader conservation agendas. Here is the true cause and effect of collecting – the cause is knowledge, and the effect is the ability to conserve. For this reason, conservationists should be seeking to help direct museum studies towards areas where taxonomic clarity is most needed and where ''judicious'' collecting, governed by the principles suggested above, is welcomed by local and national representatives. A forum is needed in which this issue can be addressed, and once again IOC looks appropriate for the part.

In conclusion

Conservation is not just icing on the cake of biological science: it is, ultimately, the mechanism by which biological science, in its zoological and botanical aspects, will have a basis for its own future, in all those areas which Remsen identifies as of value (including, be it noted, human health). Ultimately a great deal of biological research material on this planet will survive, if at all, owing to the endeavours and enterprise of conservationists. It is of course true that in many cases they will have been pointed in the right direction by research

museums, or through the integration of museum scientists in exploration programmes, such as Field Museum (Chicago) staff leadership of Conservation International's Rapid Assessment Program (RAP). It needs to be remembered, however, that rapid assessment – indeed, any type of field survey – is the relatively easy and assuredly more glamorous part of it, involving credit, profile and often, in due course, public reward; but that once the research team has moved on, there falls to another, no less important community, with no less an interest in the preservation of biological diversity, the altogether more exacting proposition of saving *for all time* what it took a research team *a few months* to identify. It is not just extinction that is forever: so too is conservation.

In other words, conservation no less than museum science is suffering severe constraint in the millenial period, and the way forward for both may best be through mutual support. If conservation seeks the backing of good science for the identification of critical target areas, it needs, among other things, the evidence provided by research collections in museums, and on this basis conservation bodies need to support museums to the hilt as major continuing contributors to the endeavour to save the biological diversity of the planet. Equally, however, if the museums of the world, as representatives of good science, wish to have study material drawn sustainably over time from living populations of birds, and not simply the ''crumbling'' remains (Winker 1996) of lost and irreplaceable populations, then they must in turn gain and maintain the complete confidence of conservationists, so that the latter can help promote their work in the face of unreasonable opposition wherever it may occur. Inevitably therefore museums have to do everything within their power to prevent the conditions in which anti–collecting sentiment can take root or by which anti–collecting prejudice can find itself an excuse, and among the things that would enormously promote their cause is the adoption of a protocol such as that outlined above.

Acknowledgements

I am particularly grateful to R. G. Creshkoff, C. F. Mason and two referees, one of them J. V. Remsen, one of them anonymous, for their detailed and very helpful commentaries on the submitted draft, now much revised. Remarks on and/or information for earlier drafts were kindly provided by P. Andrew, I. Dawson, L. D. C. Fishpool, K. J. Gaston, J. C. Lowen, R. P. Prys–Jones, P. C. Rasmussen, A. J. Stattersfield and J.–C. Thibault. The ideas in this essay are personal, and do not constitute policy of BirdLife International.

References

Allen, F. G. H., Barclay–Smith, P., Bourne, W. R. P., Campbell, B., Conder, P., Cramp, S., Evans, P. R., Ferguson–Lees, I. J., Fisher, J., Fitter, R. S. R., Hollom, P. A. D., Hosking, E., Hudson, R., Hurcomb, Huxley, J., Lea, D., Mead, C. J., Mountfort, G., Nisbet, I. C. T., Scott, P., Spencer, R., Thompson, A. L., Valverde, J. A., Wells, D. R. and Williamson, K. (1968) The collecting of rare birds. *Ibis* 110: 211–212.

Amadon, D. (1962) A new genus and species of Philippine bird. *Condor* 64: 3–5.

Anon. (1962) A new genus of birds – and old species in danger. *New Scientist* 15 March: 606.

Anon. (1969) Editorial: collectors' pieces. *New Scientist* 6 March: 493.

AOU (1975) Report of the *ad hoc* Committee on Scientific and Educational Use of Wild Birds. *Auk* 92 (3, Suppl.): 1A–27A.
Bahr, N. (1995) Additions to the list of new species of birds described from 1981 to 1990. *Bull. Brit. Orn. Club* 115: 114–116.
Banks, R. C., Goodman, S. M., Lanyon, S. M. and Schulenberg, T. S. (1993) Type specimens and basic principles of avian taxonomy. *Auk* 110: 413–414.
Bannerman, D. A. (1912) The birds of Gran Canaria. *Ibis* (9)6: 557–627.
Bekoff, M. and Elzanowski, A. (1997) Collecting birds: the importance of moral debate. *Bird Conserv. Internatn.* 7: 357–361.
Benson, C. W., Brooke, R. K., Irwin, M. P. S. and Steyn, P. (1968) White-rumped Swifts in Spain. *Ibis* 110: 106.
Blackburn, T. M. & Gaston, K. J. (1995) What determines the probability of discovering a species?: a study of South American oscine passerine birds. *J. Biogeogr.* 22: 7–14.
Blackburn, T. M. and Gaston, K. J. (1997) A critical assessment of the form of the interspecific relationship between abundance and body size in animals. *J. Anim. Ecol.* 66: 233–249.
Butynski, T. M. and Koster, S. H. (1989) Grey–necked Picathartes *Picathartes oreas* found on Bioko Island (Fernando Po). *Tauraco* 1: 186–189.
Collar, N. J. (1994) Bannerman and the Black Oystercatcher. *Brit. Birds* 87: 492.
Collar, N. J. (1998) Information and ignorance concerning the world's parrots: an index for twenty-first century research and conservation. *Papageienkunde* 2: 201–235.
Collar, N. J. (1999) New species, high standards and the case of *Laniarius liberatus*. *Ibis* 141: 358–367.
Collar, N. J. and Stuart, S. N. (1985) *Threatened birds of Africa and related islands: the ICBP/IUCN Red Data Book*. Third edition, part 1. Cambridge, U.K.: International Council for Bird Preservation, and International Union for Conservation of Nature and Natural Resources.
Collar, N. J., Crosby, M. J. and Stattersfield, A. J. (1994) *Birds to watch 2: the world list of threatened birds*. Cambridge, U.K.: BirdLife International (BirdLife Conservation Series 4).
Cracraft, J. A. (1997) Species concepts in systematics and conservation biology – an ornithological viewpoint. Pp. 325–339 in M. F. Claridge, H. A. Dawah and M. R. Wilson, eds. *Species – the units of biodiversity*. London: Chapman and Hall (Systematics Association Spec. Vol. Ser. 54).
Debus, S. J. S., McAllan, I. A. W. and Mead, D. A. (1993) Museum specimens of the Red Goshawk *Erythrotriorchis radiatus*. II. Morphology, biology and conservation status in eastern Australia. *Sunbird* 23: 75–89.
Francis, I. S., Penford, N., Gartshore, M. E. and Jaramillo, A. (1992) The White-breasted Guineafowl *Agelastes meleagrides* in Taï National Park, Côte d'Ivoire. *Bird Conserv. Internatn.* 2: 25–60.
Greenway, J. C. (1958) *Extinct and vanishing birds of the world*. New York: American Committee for International Wild Life Protection (Spec. Publ. 13).
Haney, J. C., Faanes, C. A. and Bourne, W. R. P. (1993) An observation of Fea's Petrel, *Pterodroma feae* (Procellariiformes: Procellariidae), off the southeastern United States, with comments on the taxonomy and conservation of soft-plumaged and related petrels in the Atlantic Ocean. *Brimleyana* 18: 115–123.
Harwin, R. M. (1969) The collecting of rare birds. *Ibis* 111: 113.
Hudson, R. (1974) Egg on their faces. *Brit. Birds* 67: 304–305.
Hume, A. O. (1875) A first list of the birds of Upper Pegu. *Stray Feathers* 3: 1–194.
Jackson, J. D. (in press) *The Ivory–billed Woodpecker, a natural and unnatural history*. Washington, D.C.: Smithsonian Institution Press.
Keith, G. S., Forbes-Watson, A. D. and Turner, D. A. (1974) The Madagascar Crested Ibis, a threatened species in an endemic and endangered avifauna. *Wilson Bull.* 86: 197–199.
Koenig, A. 1890. Ornithologische Forschungsergebnisse einer Reise nach Madeira und den Canarischen Inseln. *J. Orn.* 38: 257–488.

LeCroy, M. and Vuilleumier, F. (1992) Guidelines for the description of new species in ornithology. *Bull. Brit. Orn. Club* 112A: 191–198.
Lowe, P. R. (1908) Letter. *Ibis* (9)2: 198–199.
Lowe, P. R. and Bannerman, D. A. (1930) The extermination of the Azorean Bullfinch. *Auk* 47: 297–300, and *Ibis* (12)6: 374–379.
Mace, G. M. (1994) Classifying threatened species: means and ends. *Phil. Trans. R. Soc. Lond.* B 344: 91–97.
Mace, G. and Stuart, S. (1994) Draft IUCN Red List categories, version 2.2. *Species* 21–22: 13–24.
Mayr, E. (1957) New species of birds described from 1941 to 1955. *J. Orn.* 98: 22–35.
Mayr, E. (1971) New species of birds described from 1956 to 1965. *J. Orn.* 112: 302–316.
Mayr, E. and Vuilleumier, F. (1983) New species of birds described from 1966 to 1975. *J. Orn.* 124: 217–232.
Meade–Waldo, E. G. (1889) Notes on some birds of the Canary Islands. *Ibis* 6(1): 1–13.
Mearns, B. and Mearns, R. (1998) *The bird collectors*. San Diego: Academic Press.
Murphy, R. C. and Chapin, J. P. (1930a) Letter. *Auk* 47: 300–301.
Murphy, R. C. and Chapin, J. P. (1930b) The bullfinch of the Azores. *Ibis* (12)6: 537–539.
Ogilvie–Grant, W. R. (1910) [Record of remarks.] *Bull. Brit. Orn. Club* 25: 119.
Olsen, P. D. (1996) Re-establishment of an endangered subspecies: the Norfolk Island Boobook Owl *Ninox novaeseelandiae undulata*. *Bird Conserv. Internatn.* 6: 63–80.
Peterson, A. T., Navarro-Sigüenza, A. G. and Benítez-Díaz, H. (1998) The need for continued scientific collecting: a geographic analysis of Mexican bird specimens. *Ibis* 140: 288–294.
Remsen, J. V. (1995) The importance of continued collecting of bird specimens to ornithology and bird conservation. *Bird Conserv. Internatn.* 5: 145–180.
Remsen, J. V. (1997) Museum specimens: science, conservation and morality. *Bird Conserv. Internatn.* 7: 363–366.
Snow, D. W. (1972) A recommendation for cooperative action by museums and private ornithological collectors, with the aim of preventing the overcollecting of rare and threatened species. *Proc. XV Internatn. Orn. Congr.* 21–22.
Spencer, R., Hudson, R. and Mead, C. J. (1969) The collecting of rare birds. *Ibis* 111: 258.
Taylor, P. B. (1998) *Rails: a guide to the rails, crakes, gallinules and coots of the world*. Robertsbridge, East Sussex: Pica Press.
von Thanner, R. (1910) Beiträge zur Ornis Gran Canaria's. *Orn. Jahrb.* 21: 81–101.
Thorpe, W. H. and Stoddart, D. R. (1969) Letter: the Aldabra warblers. *New Scientist* 20 March: 649.
Vuilleumier, F. and Mayr, E. (1987) New species of birds described from 1976 to 1980. *J. Orn.* 128: 137–150.
Vuilleumier, F., LeCroy, M. and Mayr, E. (1992) New species of birds described from 1981 to 1990. *Bull. Brit. Orn. Club* 112A: 267–309.
Whistler, H. (1930) Bird protection and museums. *Ibis* (12)6: 548–551.
Winker, K. (1996) The crumbling infrastructure of biodiversity: the avian example. *Conserv. Biol.* 10: 703–707.
Zimmer, J. T. and Mayr, E. (1943) New species of birds described from 1938 to 1941. *Auk* 60: 249–262.
Zink, R. M. (1997) Species concepts. *Bull. Brit. Orn. Club* 117: 97–109.
Zonfrillo, B. (1994) In memoriam: Garefowl or Great Auk *Pinguinus impennis*. *Brit. Birds* 87: 269–270.

N. J. COLLAR
BirdLife International, Wellbrook Court, Girton Road, Cambridge CB3 oNA, U.K.