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Biodiversity and the natural history museum - issues and opportunities.

Peter Davis

Wilson (1992) defines biodiversity as "The variety of organisms considered at all levels, from genetic variants belonging to the same species through arrays of species to arrays of genera, families and still higher taxonomic levels; includes the variety of ecosystems, which comprise both the communities of organisms within particular habitats and the physical conditions under which they live". In essence it is the variety of life which has sustained and fascinated humankind; the variety of life which has been collected so avidly to stock museums and of which museums have taken stock.

The acceptance and usage of the term "biodiversity" is a product of the late 1980s, (and more widely used since the Earth Summit), but the threat to habitats and individual species is one of the major causes which has exercised the mind and energies of the environmental lobby since the 1960s. There is now widespread concern for the loss of species, and "the academic community of biology now sees the biodiversity crisis as a very real phenomenon meriting our closest scrutiny." (Eldredge, 1992).

The current biodiversity crisis differs from the previous five extinctions recorded in geological time in being caused by the unthinking actions of one species. Humans have been cited as a causal factor of the extinction of species (mammoth and ground sloths for example) as far back as the Pleistocene; there is strong circumstantial evidence to link the collapse of diversity of late-Pleistocene faunas with the influx of man in North America, Madagascar and New Zealand. The first Maoris, colonising New Zealand around 1000 A.D. found about thirteen species of large flightless birds - the moas - which had evolved to fill the niches normally taken by mammals, which were absent on these remote islands. All moa species had been hunted to extinction by about 1300. This is just one well-known example of species extinction - other notable fatalities include the Dodo, Great Auk, Passenger Pigeon, Carolina Parakeet and Quagga - specimens of which are now treasured by many museums. Although all these species were hunted to extinction, other factors equally culpable were habitat destruction, the introduction of exotic, competitive species, and the spread of disease carried by such exotics - the effect was dramatic, on the landscape and on habitats, as well as on species. If hunting was the primary cause of extinctions up until the end of the 19th century, there can be little doubt that habitat destruction has taken its place as the root cause of the biodiversity crisis - not through human malevolence, but simply the growing demands for living space and natural resources. Much of the loss of habitat is recent - Wilson (1992) cites a number of examples including that of Madagascar. With its spectacular endemic animals, including 30 primates, (all lemurs), and two thirds of the world's chameleons and an estimated 10,000 plant species about 80% of which are endemic - "In 1985 the forest remaining intact was down to a third of the cover encountered by the first colonists fifteen centuries ago. The destruction is accelerating along with population growth, with most of the loss having occurred since 1950." It is inevitable that the greatest loss of species will be felt in parts of the world, like Madagascar, with greatest diversity of species - the so-called "hot-spots" - it is here that biodiversity research and conservation efforts must be concentrated. Natural history museums should be playing a major role in these localities.

Biodiversity - a global political issue.

The "Earth Summit" in Rio brought together well over 100 heads of state and government, and involved no less than 178 countries. The end result was five major agreements - *Forest Principles* (a failed attempt to negotiate a forest convention), *The Rio Declaration* (covering environment and development), *Agenda 21* (an action plan for sustainable development), the *Framework Convention on Climate Change* (seeking to reduce the emission of "greenhouse" gases) and the

Convention on Biological Diversity, which focuses on the preservation of species diversity and seeks to establish guidelines for the use of biological resources and biotechnology. Biological diversity has been the focus of natural history museums from the 18th century; consequently the Biodiversity Convention is of immense importance to museum biologists, especially those engaged in taxonomic research. Particularly relevant is the fact that making biodiversity a political issue, and providing international legislation, may release funds for the urgent taxonomic work which is required in order to document the world's biological resources. It is clear that in the UK much progress has been made since Rio, with increased collaborative effort and (in some quarters) greater recognition of the value of natural history collections.

The Biodiversity Convention preamble stresses the "ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic " values of maintaining species diversity. One might apply the same values to natural history collections. Under Article 7, each country is required " ... as far as possible and as appropriate" to "identify components of biological diversity important for its conservation and sustainable use" whilst "paying particular attention to those requiring urgent conservation measures and those which offer the greatest potential for sustainable use". There is a prerequisite for producing inventories of species and to assess which are rare or endangered; from this data appropriate conservation strategies can be formulated. Museums, and museum biologists, must be at the cutting edge of such taxonomic and biogeographical studies; the science of systematics and taxonomy carried out in the world's great natural history museums now has increased relevance and purpose.

Biological collections - some inherited problems and the consequences for the museum's role in sustaining biodiversity.

a) Recognising that environmentalism is important

Interestingly, within the museum world of the 1960s little reference was made to the loss of species, or to the museum role in conservation (e.g. Oliver, 1969); taxonomic research took centre stage, with only passing reference to the potential benefits of that research for environmental protection (Netting, 1962). Yet the impact of environmentalism was such that in the United States a major review of the nation's biological collections carried out in the early 1970s pivoted around the theme of biological conservation - "the very cornerstones to studying, understanding and managing natural ecosystems are the systematic collections of the plant and animal species of the world ... the major systematic collections are essential complementary components of a system which catalogs the world biota, and which deserves strong support by this nation to assure our gaining essential insights into our own relationship to that tortured biota" (Conference of Directors of Systematic Collections, 1971). This emotive statement is itself a strong reflection of the mood of the times, a statement of the impact that environmentalism had made. The realisation of the central role of biological collections in biodiversity studies has continued to gain ground since the 1970s, and many museum directors (especially in the USA) have publicly stated their institutions' commitment to the role of preserving the Earth's biological diversity (e.g. Nicholson, 1991; Novacek, 1990).

But how well-equipped are museums in the mid-1990s to become involved in the fight to save the planet's plants and animals? It is salutary to compare the readiness of larger institutions in North America to adopt the environmental cause to the situation in Britain, where despite the best efforts of museum biologists, progress is constantly hampered by funding crises and conflicting priorities. The legacy of past collecting policies, the perceived low status of natural history collections (especially in multi-disciplinary museums), pose many problems which need to be solved if museums are to become key players in maintaining biodiversity. The downgrading of systematics as an academic discipline, and a lack of understanding of the significance of its role, is of equal concern.

b) The scale and nature of collections

The urge to collect natural history specimens has resulted in collections of tremendous scale and diversity in the museums of the world's developed countries, which we can identify as a strength and a weakness. Large-scale natural history collections were made for two main reasons - firstly to provide education and enjoyment for the general public (often focusing on large and attractive organisms, especially birds and mammals) and second, for taxonomic and biogeographic research. The latter frequently had little or nothing to do with any educational or conservationist aim - it was scientific research for its own sake. Past collecting efforts in both these categories, despite their often seemingly random nature, can only now be appreciated, as the collections begin to realise new meaning and significance - for example, the well-documented use of biological collections in determining the increase in pollutants in the environment (e.g. Johnels, 1973). In this, and many other ways, (see Pettitt, 1991 and 1994, Danks, 1991, Wiggins et al, 1991) historical collections housed in museums and other institutions chart our understanding of the earth's fauna and flora and its past distribution - our collections and their associated data give us a unique view of past worlds, and a yardstick with which to measure change. But – and here is the weakness – these collections can only be useful if they are well-documented and the data readily accessible. And when we know what our collection strengths are, should we be re-assessing the material, and even contemplating disposal?

c) Where are the named and significant collections?

Some specialist private collections rivalled those of the national museums - the shell collection of Hugh Cuming (1791-1865) was estimated to contain 52,789 specimens, including many types in 1846 (Barber, 1980); Walter Rothschild (1868-1937) used his fortune to establish his personal museum at Tring in Hertfordshire, the largest collection in natural history ever assembled by one man. Rothschild employed more than 400 collectors throughout the world - the resulting collections being used to describe more than 5,000 new species and subspecies (Purcell and Gould,1992). These (and many other) great collections are well-known, and made an enormous contribution to our understanding of the diversity of life, yet throughout Britain, and much of the world, other individuals were making collections on a smaller scale - most of the important individual collections found their way into museums. The number of such "named" 19th and early 20th century collections held in museums is still not yet known, but the preparation of individual catalogues of natural history collections held in museums and other institutions in the various regions of Britain (e.g. Davis and Brewer, 1988) have done much to reveal their size, strengths and diversity. There is no doubt that it is an enormous resource for the understanding of biodiversity; collections of international significance can be found in the most unsuspected institutions, and even the smallest local museum may hold collections which help to reveal the status of species and the significance of biological and geological sites in its area - the most important prerequisite to any conservation effort. We, as curators, need to be able to recognise the significance of this material and make such information widely known.

d) The geographical component in collections

Often led by charismatic and individual directors, there can be little doubt that personal, civic, national and institutional pride fuelled by a sense of competition, spurred museums to finance substantial collecting expeditions (as in the United States) or encourage the purchase and donation of collections (as in the U.K.). There were few thoughts of collaboration between museums on collecting policies in the 19th and early 20th centuries, no "National Plans" for systematic collections and collecting emerged until the 1970s (see Irwin *et. al.*, 1973). As a consequence there has been little specialisation by individual institutions, and every major museum has collections which cover "popular" taxa such as Lepidoptera, Mollusca or Mammalia. Similarly, geographical boundaries of collecting activity received only lip-service, and hence

collections in most major museums reflect a haphazard and sometimes bizarre geographical distribution pattern. The lack of a clearly defined collecting policy has meant that provincial museums have frequently accepted as donations material which lies well beyond their geographic sphere of influence and which they frequently have neither the expertise nor funding to curate and conserve, let alone actively research. This might, to the outsider, seem an unprofessional approach. However, as donations frequently come from nearby research institutions or individuals who have some association with the museum, but whose collecting area (geographically and taxonomically) falls well outside that of the museum, they are difficult if not impossible to refuse - curators are regularly compromised by such links. The Hancock Museum in Newcastle upon Tyne, perfectly illustrates the wayward nature of past collecting, holding, for example, a collection of Australian land-shell (including type specimens) collected by George French Angas (1822-1886), the C. H. E. Adamson (d. 1930) collection of Burmese butterflies, and a worldwide collection of micro-crustacea of international significance made by George Stewardson Brady (1832-1921). There seems to be little logic in such collections being curated in the north of England, but the reason is simply that all three collectors had strong links with the city of Newcastle and its Natural History Society, which ran the museum.

This situation is repeated worldwide; for example, in France's 187 provincial natural history museums " ... sont conservées plusiers dizaines de millions d'echantillons et de spécimens. Ils sont des temoins non seulement de l'histoire naturelle de notre pays mais aussi du monde entier ... " (Leclaire, 1989). This worldwide scatter of collections has prompted some individuals (e.g. Haas, 1993) and organisations to suggest repatriation as a solution, in particular when collections are poorly-curated or under-utilised. The Royal Society in its evidence to the Dainton enquiry (Dainton, 1991, 6.23) suggested the cost of curation might be mitigated by "relocating specific collections via long-term loan to relevant user groups in other countries ..." Some evidence of this actually occurring is the transfer of a collection of Irish Lepidoptera to the Ulster Museum, Belfast, from the Smithsonian (John Wilson, *pers. comm.*). The arguments for maintaining the integrity of the UK collections (the ability to compare material, concerns about repatriation to developing countries) are much stronger, yet there is little doubt that as a consequence of historical collecting a huge amount of information vital to the biodiversity cause is locked away, seemingly inaccessible, and is another challenge to us as curators. However, the increasing number of collections databases compiled by museums, and their availability on line over the internet has revolutionised this situation, and the numerous biodiversity servers indicate the progress that has been made.

e) Conservation needs of collections

However, according to Howie (1993) the priceless archive (an estimated 2 billion specimens) has "... been slowly deteriorating over the past two centuries. The extent and understanding of the processes involved are as yet largely undocumented and unknown ... recent surveys ... reveal that some areas are at crisis point through the unchecked growth of collections, poor training in conservation and collection management procedures, and pure indifference." The condition of many natural history collections prompts Howie to the conclude that "... a third of the world's natural history collections is in an extremely poor state with possibly as many as thirty million specimens per year deteriorating to the extent that they are of no future benefit."

Clearly there is a real problem here if the collections held in museums are to be of any value to the needs of the biodiversity crisis. There is a real need for better collections management and improved conservation facilities, for funding which would enable research on conservation problems and techniques, and above all a commitment of management to the preservation of collections. The formation of specific organisations such as the National Institute for the Conservation of Cultural Property (NIC) (1973) , the Society for the Preservation of Natural History Collections (SPNHC) (1985) in the USA and

the Natural Sciences Division of the United Kingdom Institute for Conservation (UKIC) (1993) has meant a growing voice for the needs of collections, and a focus for improving standards of collection care.

f) Patterns of biodiversity and the distribution of natural history museums

A simplified view of the pattern of biological diversity is that it is greatest in the equatorial regions, especially in areas of tropical forest, becoming less diverse with increasing latitude. This pattern seems to hold true for larger vertebrates and higher plants, but has been questioned for some invertebrate groups, for example, spiders Platnick (1992). This generalised pattern of distribution suggests that as a consequence the greatest loss of biodiversity is occurring in equatorial, often developing countries, and it is here that systematic collecting of biological material is most urgently required in order to determine which areas are of greatest significance and to promote active conservation policies for them.

Those developing countries are facing a real dilemma as a result - many lack the systematics skills required, many do not have a national museum of natural history of any standing. The very real economic pressures such countries face mean that insufficient resources can be put into scientific education, museums or environmental protection. If biodiversity is to be considered as a global resource, as the Rio declaration has suggested, then equally the global scientific community has an obligation to work with developing countries, to develop scientific research programmes and to implement systematics training. Natural history museums are well-placed to guide and conduct research and to influence public opinion in developing countries. There is a real need to promote museum developments, and to ensure that staff are trained in systematics and collections management.

Mares (1993) has made a comparative study of the development of museums in the United States and in the countries of South America; he notes that by 1992 "there were 1500 natural history related organizations in the United States (1176 actual natural history museums) compared with only 412 organizations in all of Latin America (326 actual museums) and that "... without the prodigious efforts of thousands of research biologists from throughout the world, there is little doubt that the taxonomic and ecological information available on the biota of the Americas would be poor indeed." However, the end result of this scientific (often museum-based) activity in developing countries is that the majority of the material evidence of their biodiversity is now housed in remote institutions in the 'north' and information vital to the conservationists on the ground is inaccessible.

Perhaps the natural history museum community's greatest challenge is to assist the growth of natural history museums in developing countries. The disproportionate distribution of the 6294 natural history museums in the world in 1992 has been described by Mares (1993), who states " The number of museums located within any country is a function of the economic well-being of that country ... there are more museums in the United States than in all other American countries combined. In the Old World, the pattern is similar. Indeed, countries with high per capita incomes have 2.5 times as many museums as countries with low per capita incomes, although there are only twenty-seven developed countries versus 137 developing nations." He has demonstrated convincingly that not only is there is a direct relationship between the number of natural history museums and per capita income within a country, but also a significant relationship between population size and number of museums once a threshold of personal income has been passed.

g) The lack of networking

There is clearly a need to develop a worldwide network of natural history museums which, wherever they are, face the same essential challenges of collecting, preserving and interpreting the natural heritage. The promotion of co-operative scientific and educational programmes between institutions in developed and developing countries must be seen as a matter of some urgency, and was

recognised at the Madrid Conference, when the WCCR was mandated to "promote efforts to establish regional training centres in one or more developing countries, particularly in tropical regions, to train natural history museum collection managers and conservators to properly maintain collections in tropical regions." (Anon, 1992).

I don't know what has happened to the WCCR – no web site seems to exist for the organisation. However, in terms of biodiversity beyond the museum, it is very clear that networking has improved dramatically since publication of *Museums and the Natural Environment* (Davis, 1996). So, for example, the Biodiversity Servers website (http://darwin/eeb.uconn.edu/biodiversity.html) gives a vivid picture of active and professional biodiversity networking. But to what extent are natural history museums plugged into these systems?

h) Ethical issues - to collect or not to collect?

Tattersall (1992) commented that "in a world where both ecological communities and large numbers of systematic groups are under threat everywhere, museums will in some areas at least find it increasingly difficult, or often impossible, to continue collecting the kinds of material of which they have built up their collections over the past couple of centuries. And indeed, no responsible museum professional would wish to add to the stress upon populations already on the brink of disappearance. Thus a change of emphasis seems not only desirable but mandated." The museum biologist has always faced an ethical dilemma with regard to collecting specimens - yet if we are to document fully an area's biological diversity, there is no alternative but to collect for most taxa.

Ethical considerations are now compounded by practical problems - in many developing countries the enforcement of new laws relating to the collection and export of natural history material (usually to limit wildlife trade as a national response to the demands of CITES) is already influencing the way in which museums can collect, sometimes to the detriment of our understanding of the biodiversity of those countries. Similarly, the Biodiversity Convention has resulted in the need for greater control over the movement of specimens - botanical gardens, with their propensity to move plants and seed, have been especially affected, with many gardens using documentation rigorously to control the exchange of living material (Nelson, *pers. comm.*). It is quite probable that these activities, when compared to the impact on biodiversity of illegal (and legal) trade in animals, plants and derivatives for non-scientific purposes are trivial (Braun and Mares, 1991).

Mahan (1980) proposed an "International Ethics Code for Natural History Museums" which sets out broad guidelines for the museum curator, and explores the ethics of field collecting. It is unfortunate that this document has not been more widely circulated, as it sets practical and attainable standards, including the prerequisite for careful planning of expeditions and the disclosure of findings, as well as stressing the need for appropriate conduct when in other countries. As he notes "Being a member of a scientific team and having authority to collect, does not absolve a museum worker from observing the principles of good conservation ... nor permit him to behave in a callous or inhumane fashion." An important part of ethical collecting is being aware of wildlife legislation , particularly as it relates to endangered species, and complying with it (Saito, 1993). It is interesting to note that the Madrid Conference Resolutions called for "Rapid and *focused* surveys and inventories of the Earth's biota" (Anon, 1993), a strong indication that the international museum community has recognised the need for selective collecting, and that the conservation ethic is firmly established.

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Should local authority museums be collecting natural history?

Clare Stringer

Natural history collections in local authority museums, as for all collections in all institutions, must be able to justify their existence if they are to survive. Collecting itself is essential to the development of a collection and must be justified confidently, precisely and vigorously in order to continue. 'Collections and collecting are after all the very essence of museum practice.' [1]

Justifications for keeping natural history collections.

A major reason to collect natural history is to augment valuable collections. However, the value of natural history is a huge topic and much time and writing space has been dedicated to it. This article concentrates on the reasons for and against collecting. For more in depth analysis of the justifications for keeping natural history see: Pettit, C., 'Putting 'Bloody Mice' to Good Use', *Museums Journal*, (August 1991), 25-7; Nudds, J. R. and Pettit, C. W., eds., *The value and valuation of Natural Science Collections* (London: The Geographical Society, 1997).

Current Collecting Trends

In the summer of 2000, most Local authority museums were increasing their natural history collections (Table 1).

Whether they should be or not, local authority museums are currently collecting natural history. Of the two museums not expanding their collection in this study, Leeds Museum is currently 'static collecting,' due to space and money problems and the Yorkshire Museum's natural history department has also been forbidden to collect before its 'backlog' has been cleared. Nevertheless, they were still able to say through what means they normally collect (displaying a strong presumption to collect) suggesting that the termination of collecting is a 'pause' rather than a permanent arrangement. Table 2 shows the methods of collecting in the eight museums used in this study.

The large standard deviation is due to the small sample size as well as the variability of the data. This variation in collecting habits is a reflection of the resources available to each museum as well as the personal preferences of the curators involved.

Collecting Policies

Although the museums in this survey are collecting in a variety of different ways and at a variety of different rates their collecting policies all contain similar points e.g. geography and legality. A few discuss deeper aspects of collecting, for example the Hancock Museum's collecting policy states that 'it is the collection and its association with a particular place, time and person that is important. It is for this reason that the data that