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*From the Biological Secretary and Vice-President Professor PPG Bateson FRS*  
28 January 2002  
Our ref: JC/Syst

Dear Ms Neal

### **Response to the Science & Technology Committee's inquiry into Systematics and Biodiversity**

The Royal Society is pleased that the House of Lords Science and Technology Sub-Committee I is considering systematics and biodiversity and we welcome this opportunity to contribute to the inquiry.

Systematic Biology, which encompasses taxonomy, provides an essential framework for many areas of biological science. Taxonomy addresses questions such as what type of organisms exist, their number, how organisms are related to each other, where they occur and a systematic name allocation. Without this basic knowledge and framework biology cannot proceed in a coherent manner. Systematic biology also provides an essential common language for communication. A sound taxonomic base is a prerequisite for environmental assessment, ecological research, pest management, conservation of biological diversity and managing biological resources within a framework of sustainable development.

The understanding of biodiversity is integrally associated with systematics. Taxonomic knowledge is required to address at least four basic issues under the remit of the Convention of Biological Diversity. These issues are identification of areas of high diversity, taxa under threat, taxa that are or may be of value to mankind and improving the understanding of ecosystem functioning.

Detailed answers to the questions put in the inquiry are attached to this letter. In summary there is a belief that beta-taxonomy has been reinvigorated over the past decade and is healthy. However much concern was expressed about the state of alpha-taxonomy with evidence of a decline in core funding. We feel that there is a strong case for a thorough analysis to provide quantitative data on the state of systematic biology in the UK. In addition the difficulty of accessing information held in biological collections is a major issue. We recommend that core funding to support alpha-taxonomy is increased. This funding is required not only for maintenance of biological collections and expertise in this field but also for teaching and access

to data. We support the idea put forward by Professor Charles Godfray FRS that the systematics community should be encouraged to consider radical changes in the way descriptive taxonomy is undertaken to turn it into a 21<sup>st</sup> century information science.

Please do not hesitate to contact us if you require further information.

## **Response from the Royal Society to the House of Lords Inquiry into Systematics and Biodiversity**

This response has been prepared by Professor Patrick Bateson, Biological Secretary and Vice-President of the Royal Society, in consultation with the following Fellows of the Royal Society: Prof Michael Akam, Prof Peter Crane, Dr Richard Fortey, Prof Charles Godfray, Prof Paul Harvey and Sir David Smith. We are aware that some of our Fellows have also submitted evidence to this inquiry in a professional or individual capacity.

### **Summary**

Previous studies on the status of systematics in the UK identified three priority areas for future investment: beta-taxonomy (phylogenetic studies); alpha-taxonomy (descriptive systematics) and increasing access to the information held in collections or generated through systematic research. Of these, we believe that that beta-taxonomy has been reinvigorated over the past decade and is healthy. However there is still much concern about the state of alpha-taxonomy with evidence of a reduction in core funding. The difficulty of accessing information held in biological collections is also still a major issue of concern. We recommend that the reduction in core funding should be reversed. This funding is required not only for maintenance of biological collections and expertise in this field but also for teaching and access to data. We also support the idea put forward by Professor Charles Godfray FRS that the systematics community should be encouraged to consider changes in the way descriptive taxonomy is undertaken to turn it into a 21<sup>st</sup> century information science. Before any additional funding is allocated we feel that there is a strong case for a thorough analysis to provide quantitative data on the state of systematic biology in the UK.

### **How has the organisation of and funding for systematic biology in the United Kingdom changed since 1992?**

The 1992 House of Lords report on Systematic Biology Research has clearly influenced the funding and organisation of systematic biology in the UK. In addition two further reports, the Natural Environment Research Council (NERC) review and the Strategy for Systematic Biology in the UK produced by the UK Systematics Forum, have also had an impact. These reports identified three priority areas for future investment:

- alpha-taxonomy (or descriptive systematics) focusing on poorly known groups and contributing to the taxonomic inventory of life
- beta-taxonomy (or phylogenetic studies) that aims to discover the patterns of evolutionary relationships in groups where the current state of knowledge is inadequate
- increasing access to the information held in biological collections and generated by research in systematics

Various funding initiatives have been launched since the publication of the House of Lords report on Systematic Biology Research including the NERC Taxonomy Initiative and the Wellcome Trust Biodiversity Initiative. All these initiatives have had a positive effect on the state of systematics research, primarily in the area of beta-taxonomy. Both the NERC and the Wellcome Trust initiatives have recently ended and similar initiatives are not likely to be forthcoming in the foreseeable future. The Darwin Initiative for the Survival of Species was launched by the UK government at the 1992 Rio Summit and has committed £24m to over 200 projects in more than 80 countries. This has led to real benefits in conservation and sustainable use, as well as for the UK systematics institutions and their partners in the richly biodiverse countries.

Of the three priority areas identified for future investment beta-taxonomy appears to have been invigorated. The two other areas of systematics research, alpha-taxonomy (especially focusing on poorly known groups) and increasing access to the information held in biological collections and generated by research in systematics, have fared much less well over the last decade. We examine these areas in more detail below.

#### *i) Beta-taxonomy*

Beta-taxonomy has been reinvigorated within the last decade by the widespread application of comparative data derived from molecular biology to phylogenetic problems, further helped by the development (led mainly by the US and UK) of sophisticated statistical methods for using such data. This area of research has gained momentum and benefited from funding initiatives such as those described above. The use of molecular techniques has led to major revisions in our understanding of high level systematics, raised the profile of this subject and made it more attractive. The UK has played an important role in increasing the international interest in this kind of work.

Research on beta-taxonomy is supported by Research Councils in the form of competitive grants, providing that phylogenies are used to explore questions in wider areas of biology. However it should be noted that funding is still scarce (as is true of most ecological and evolutionary subjects) and is unevenly distributed among taxa with most funding being targeted at developments of methodology and in the taxonomy of groups of potential medical interest.

#### *ii) Alpha-taxonomy*

The funding of research into baseline systematic biology (alpha-taxonomy) has deteriorated compared to all other areas of biology. Contrary to a key recommendation in the 1992 House of Lords report core funding for research and curation in the major systematics institutions have continued to decline. Information presented to us by Professor Peter Crane FRS (Director of Royal Botanic Gardens Kew) shows that core funding from government (Grant-in-Aid) has declined in real terms over the past decade. This baseline research has now largely disappeared from universities and is concentrated in the three major systematics institutions in the UK (Natural History Museum, Royal Botanic Gardens Edinburgh and Royal Botanic Gardens Kew). However hi-tech and exciting the molecular level analyses that can be applied to a new species,

and despite the increased use of parataxonomists<sup>1</sup>, the collection of such specimens in the field remains a rate-limiting step. Concern was expressed to us that the pool of taxonomists in UK and elsewhere is diminishing and that little has been done to alleviate a growing shortage of taxonomic specialists capable of identifying field collected specimens, essential for biodiversity studies. This is exacerbated by the decline in the extent and importance of teaching of this subject in both schools and universities. Where funding has been made available (e.g. NERC Initiative in Taxonomy Research and Training) this has strongly bolstered the volume and standing of taxonomic research. For example, Imperial College was a recipient of one of the NERC programmes and through this has consolidated its undergraduate teaching of whole organism biology, and has set up (with the Natural History Museum) an MSc in Systematics and Biodiversity, demand for which has exceeded expectations.

We have gained a strong impression that the number of taxonomists in the UK has fallen and that there are now fewer university courses or masters courses teaching this subject. There is a need to quantify the extent of this decline.

*iii) Accessibility of taxonomic information*

With regard to making the results of systematics research more accessible, the increasing and widespread use of the World Wide Web over the last decade has created exciting new possibilities for the effective dissemination of data. There have been some real successes in the area of electronic dissemination led by UK institutions, for example, the International Plant Names Index. The funding for electronic databases has been mainly technology driven and the information to populate these databases is sparse. Greater investment will be needed not only in the baseline work highlighted above but also for the basic data entry of information about collections. There has also been international interest in this objective through the establishment of the Global Biodiversity Information Facility (GBIF). In the case of international initiatives such as GBIF and equivalent national initiatives, there is a need to ensure that common protocols and standards for basic data entry and synthesis are implemented.

We support the idea put forward by Professor Charles Godfray FRS that the systematics community should be encouraged to consider substantial changes in the way descriptive taxonomy is undertaken in order to turn it into a 21<sup>st</sup> century information science<sup>2</sup>. Professor Godfray outlines a mechanism by which the existing but largely scattered taxonomic information can be synthesised into a coherent and more useful form for presentation through the web. Such a website could also be linked to websites such as the *Tree of Life*<sup>3</sup> that aims to build a phylogeny of all living organisms. This is task that requires collaboration within the taxonomic research community at an international level. Such a project is likely to require additional funding.

## **What, if any, are the changes required in this area to enable the United Kingdom to meet its policy aims on biodiversity?**

The Convention for Biological Diversity Conference of the Parties Decision IV/1: Report and Recommendations of the Third Meeting of the Subsidiary Body on Scientific, Technical and Technological Advice asks that “Parties should: ensure that institutions responsible for biological diversity inventories and taxonomic activities are financially and administratively stable; so as to have potential for continued and growing training and employment opportunities”. The major UK taxonomic institutions have a particular international responsibility to support alpha-taxonomy in the richly biodiverse parts of the world, through capacity building, collaborative research and access to collections. However, core funding for research at, and the curation of the collections in, the UK major systematics institutions has not been maintained in real terms over the past decade. If the UK is to continue to contribute significantly in baseline biodiversity research and in making that information widely available electronically and thus more accessible, this pattern of declining core funding must be reversed. This funding is required not only for maintenance of biological collections and expertise in this field but also for teaching and access to data.

If the information held in biological collections and generated by research in systematics is to be widely available a new approach is required. As outlined previously, we recommend that consideration should be given to the transition of alpha taxonomy to a web-based information science (idea put forward by Professor Charles Godfray FRS). Such a move can only be driven from within international community of taxonomists and will require substantial changes in museums and herbaria. We believe this is necessary both to revitalise alpha-taxonomy and to enable the UK to meet its policy aims on biodiversity.

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<sup>1</sup> Parataxonomists are normally local people who have received a general introductory training (in scientific method of inquiry, biology, ecology, computing), complemented by training for particular research jobs as needed. They collect specimens, mount them and perform a preliminary sorting to species, as well as performing simple field and laboratory experiments and observations.

<sup>2</sup> Reference: Godfray (2002). *Antenna* 26:11-17.  
[http://www.cpb.bio.ic.ac.uk/staff/godfray/antenna\\_article.pdf](http://www.cpb.bio.ic.ac.uk/staff/godfray/antenna_article.pdf)

<sup>3</sup> Further information can be found at <http://phylogeny.arizona.edu/tree/phylogeny.html>