The Royal Society of Edinburgh

The Role of the BBSRC in Biodiversity Research

The Royal Society of Edinburgh (RSE) is pleased to respond to the Biotechnology and Biological Sciences Research Council (BBSRC) consultation on the role of the BBSRC in biodiversity research. This response has been compiled by the General Secretary, Professor Andrew Miller and the Policy Officer, Dr Marc Rands, with the assistance of a number of Fellows with considerable experience in this area.

In general, we welcome the BBSRC's broadly based statement on Biodiversity research, an area funded by several other Research Councils, Government Departments and Agencies. There is clearly a need for all of these to work together on biodiversity issues and it would be useful if other major funders were to produce similar papers setting out where they see their areas of influence. In addition, the scientific community would benefit considerably from a clear statement of the distinctions between the research areas, which areas are common to more than one funding body, and the ways in which they can or will collaborate to enable funding at the interfaces, the funding of common goals, or approaches. For example, the document highlights, but does not describe, duplication with NERC funding of biodiversity. One useful way forward for the effective funding of major research in biodiversity would be to establish a joint committee of all those organizations presently funding research, or a joint Research Council committee, to develop a coordinated approach, and in order to identify if there are any gaps in the research being supported. In this context, the dimension of devolution should not be forgotten since, for example The Scottish Executive Environment and Rural Affairs Department is also, potentially, a major funder of biodiversity, primarily in Scotland.

Many bodies, including the House of Lords, have stressed the importance of taxonomy and this is especially so in the context of biodiversity research of all kinds. Reliable progress in all of the themes described in the BBSRC's paper depends upon the organisms studied being correctly identified and based on reliable and sound taxonomy.

In addition, perhaps reflecting the BBSCR's remit, the document expresses rather an anthropocentric view of biodiversity, with an over-emphasis on exploitation and no reference to stewardship of the natural environment. In fact the Introduction of the Statement goes so far as to say "The option for preserving biodiversity has passed". This needs more discussion and it would be tragic if we were to replace natural diversity with an artificial array of animal breeds and plant crops designed for our current needs, or fashions, as human beings, and, furthermore, with invasive species and new pathogens consequent upon human action.

The consultation paper helpfully organises themes for research according to four different levels of diversity, and our comments on these are outlined below:

Molecular Diversity

While the main locus of BBSRC activity is in the molecular diversity and gene and genome diversity levels, it is focused perhaps too narrowly on species of industrial and medical use, and on crops. There would be merit in widening this activity to include some species of wildlife which at the moment are not too easily characterised as being of economic or social importance. For example a lot of research, with positive outcomes, has been done on wild species such as *Arabidopsis*. This is a tiny little weed of no economic importance at present, but which has been important in the development of much biological thinking. Flies of the genus Drosophila (especially *D. melanogaster*) would be another example.

Gene and Genome Diversity

There could be greater emphasis on the importance of gene diversity for physiological diversity. For example, what is the range of diversity of particular, individual functional genes and how does this relate to the range of physiologies, and hence ecosystem functions? To what extent is physiological diversity driven by diversity of individual genes, as opposed to genes controlling their regulation and interaction with other functional genes, which will themselves exhibit diversity?

Comparative studies of genome structure in groups of closely related or cryptic species is likely to provide information concerning evolutionary change at this level and coupled with the kinds of studies described in the previous paragraph could help to elucidate fundamental aspects of the effects of natural selection.

Organismal Diversity

We welcome the priority given to systematic (including taxonomic) studies relating to changes in organismal diversity, although we would question whether this has to be justified in terms of hypothesis-driven research. There is still a great need for observation, identification and description, before we can readily quantify changes in biodiversity and suggest causal factors. It needs to be recognized that the majority of such information both at present and probably in the future, is provided by voluntary observations made by members of national societies and recording schemes. The continuation of such work is jeopardized both by the general decline in taxonomy and lack of appropriate training schemes for observers and the inadequate and somewhat haphazard funding available for major national and regional surveys. Moreover, because the bulk of the recording is done by volunteers there is an almost complete lack of information about less popular or more obscure groups of organisms such as many invertebrate groups and microorganisms. Indeed, critical taxonomic research is need in many of these groups also. Without support in all these areas the development of reliable inventories of organisms of all kinds at regional or national level will be impossible.There is an increasing awareness that faunal and floral inventories are a prerequisite in assessing the vulnerability – or resilience - of particular ecosystems. An example of a programme of this nature is the international "Census of Marine Life", the results of which are expected *inter alia* to help in the setting of priorities for research into ecosystem structure and function.

In addition, much of the discussion on organismal and habitat diversity refers to species, which are the basic units by which diversity of plants and animals is measured. For prokaryotes, there is no consistent or universal species concept or measure. Research priorities might, therefore, include definition and standardisation of ways for measuring prokaryotic diversity, to investigate the potential for universal concepts and theories to be applied across all biological groups. This would provide a link between organismal and genomic diversity, in that genomic studies provide a new means of investigating prokaryotic evolution.

Habitat and Ecosystem Diversity

The focus in this section is on agro-ecosystems, and while they might cover up to 70% of the land area of the UK, the second major land use, forestry, is not mentioned, and neither are the uses of our fresh water or marine environments. There should be some recognition of forest ecosystems and aquatic ecosystems in the document.

We also welcome the mention of soil at this level of biodiversity, as there is a need to characterise the biodiversity for this understudied ecosystem and to determine the specific functions of individual species. Overall, there is also a need to look at the effect of the environment on diversity, and of the influence of diversity on the ecosystem. In addition, reliable taxonomy is still lacking for many groups of soil organisms and their distribution is often poorly understood.

In the section on conservation of habitat and ecosystem diversity, there would be merit in broadening out the focus of the impacts of pollution, beyond that of nitrogen, including other chemicals such as phosphates and other forms of pollution.

Biodiversity Informatics and e-science

Most of the basic biodiversity data for the UK, such as species sites and associated metadata, is not readily available being largely held on paper by voluntary organizations or as museum/herbarium collections. Some of this information is now being computerized but there is a great need for it to be digitised and made accessible as inventories and databases. Such schemes as exist are often developed locally and consequently are often incompatible. Digitization and the development of appropriate software are essential if national and regional inventories are to be developed. One database, the National Biodiversity Network Trust's Gateway website has brought together about 18.6 million such records (of which about 16 million are available on the Global Biodiversity Information Facility) using a cumbersome 'warehousing' technique but there is an urgent need for better and more efficient means of combining dispersed datasets in the biodiversity field as a whole. Collaboration between those responsible for molecular datasets and other biodiversity workers is most desirable to promote effective biodiversity informatics but the whole field badly needs to be reviewed if progress of major scientific value is to be achieved.

Additional Information

In responding to this consultation the Society would like to draw attention to the following Royal Society of Edinburgh response which is of relevance to this subject: *Government Response to the House of Lords' Select Committee on Science and Technology Report "What on Earth? The Threat to Science Underpinning Conservation"* (April 2003). Copies of this response, and the above publication, are available from the Policy Officer, Dr Marc Rands (email: mrands@royalsoced.org.uk) and from the RSE web site (www.royalsoced.org.uk).

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