

# UK Taxonomy & Systematics Review

## Consultation document

### *Background*

The recent House of Lords Science & Technology Committee report on Systematics and Taxonomy<sup>1</sup> highlighted a series of concerns about the health of the discipline in the UK and its ability to support the needs of its user communities. In response NERC (the Natural Environment Research Council), acting on behalf of all research funders in this area, has set up the UK Taxonomy & Systematics Review. Its remit is:

- To review the current status of and trends in UK taxonomy and systematics, including the nature of current funding and the size of the workforce.
- To assess the current and anticipated future needs for the outputs of taxonomy and systematics by the full range of its user communities.
- To produce recommendations for a future UK Taxonomy & Systematics Strategy.

The Review will cover all aspects of taxonomy (including phylogenetics, revisionary taxonomy and identification) and both living and fossil organisms. It will consider professional taxonomy wherever conducted in the UK, and also the role of volunteer taxonomists. Though focused on the UK, it will be aware of the international context within which taxonomic research in the UK operates. It will consider research, national capability in taxonomy and training (though only at tertiary levels).

The Review will be undertaken by an Expert Working Group (EWG) supported by a Project Team that will collect data and information, and provide a secretariat. After an open competition the Natural History Museum, acting in the capacity of a consultancy, won the contract to provide the Project Team. Membership of the EWG and further details are available on the NERC website<sup>2</sup>.

The EWG is aware that taxonomy and systematics in the UK has been reviewed before, that initiatives have come and gone, and that there may be some skepticism about the need for further strategizing. The Group is keen to learn from past successes and failures and to propose a transparent mechanism that will allow the state of the subject in the UK to be monitored without the need for further one-off initiatives and reports.

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<sup>1</sup> <http://www.publications.parliament.uk/pa/ld200708/ldselect/ldsctech/162/16202.htm>

<sup>2</sup> <http://www.nerc.ac.uk/research/programmes/taxonomy/events/review.asp>

## ***Consultation***

To help “produce recommendations for a future UK Taxonomy & Systematics Strategy” the EWG is seeking input from taxonomists and users of taxonomy in the UK. This will be done in two ways: first, by inviting written comments and, second, at an open event in London on April 23<sup>rd</sup> (details on our website [www.uktaxonomy.co.uk](http://www.uktaxonomy.co.uk)).

All comments are welcome but in this document we list a variety of questions and issues that have come up in initial discussions amongst the EWG and the Project Team. We do this both to encourage responses to these topics and so that relevant areas to the development of a national strategy that we might have overlooked can be identified. We stress that we expect most contributors to comment on only a limited number of issues.

The EWG will make use of material submitted to the House of Lords Inquiry, and also information given to the Linnean Society as part of their current exploration of critical gaps and needs in UK taxonomy. There is thus no need to duplicate evidence provided to these bodies.

In providing responses to issues discussed in this document it would be helpful to us for contributors to quote the paragraph numbers below. Comments that include referenced, evidence-based statements will be particularly helpful. We do not intend to publish submissions, but would like the opportunity to quote from them; please indicate if you would not like us to do this.

We shall need to receive submissions by May 15<sup>th</sup> for them to influence our report which we are intending to complete in July. Please email submissions to: [responses@uktaxonomy.co.uk](mailto:responses@uktaxonomy.co.uk).

We believe that taxonomy and systematics is at a critical stage in its history, and that the development of a UK strategy is very important for the subject to continue and flourish in this country. We thank in advance everyone who helps us to contribute to this process.

## ***Issues for discussion***

1. In our review we are making a series of basic assumptions about modern taxonomy: are they useful and appropriate?
  - 1.1. Modern taxonomy requires the integration of morphological and molecular data and needs integration and analysis using modern information technology and bioinformatics
  - 1.2. Over the next few decades taxonomy will change radically as high through-put sequence data becomes increasingly available and the web becomes ever more important in engaging in and communicating scientific research
  - 1.3. Taxonomy and systematics remains one of the few areas of science where volunteers or “citizen scientists” (if suitably supported) can make a genuine contribution to the advancement of knowledge and delivery of policy objectives, given that adequate and sensitive quality control is implemented
  - 1.4. The UK “punches above its weight” in taxonomy because of its collections of international scope and importance, because it is home to some of the leading

taxonomy research institutes in the world, and because of its long-term and excellent track record in research

2. We are considering defining four funding categories of UK taxonomy and systematics (using a terminology for public funding developed by NERC); does this capture the support for the field from its multitude of different funders
  - 2.1. *National Capability*. Core long-term funding for taxonomy including for (i) collection and other resource maintenance and care; (ii) the UK's contribution to the global taxonomic enterprise; (iii) taxonomy to support UK environmental science; (iv) training of the next generation of taxonomists
  - 2.2. *Research Programmes*. Time-limited major programmes to address strategic priorities requiring funding above baseline
  - 2.3. *Responsive Mode*. Research projects instigated by individual PIs where science excellence is the major criterion for funding
  - 2.4. *Commissioned Research*. Specific goal-directed research projects funded by contracts from industry, government or other bodies
  
3. We are tasked with making recommendations for a future UK Taxonomy & Systematics Strategy
  - 3.1. Are the following the main advantages of having a National Strategy?
    - 3.1.1. Funding is distributed across different Departments (Defra, DCMS, BIS), research councils, non-governmental bodies (Wellcome, Linnean Society), as well as regional and local government. Currently there is no co-ordinating mechanism to identify key resources and promote key investments and hence risk of duplication and omissions
    - 3.1.2. In the absence of a national strategy, there is a risk that the subject will have low visibility and suffer resource attrition
    - 3.1.3. It offers the opportunity for the subject to speak with one voice
  - 3.2. Are the following the main risks of setting up a National Strategy?
    - 3.2.1. Waste of time if there are no implementation methods
    - 3.2.2. It would add another tier of bureaucracy
    - 3.2.3. Risk of loss of autonomy of major taxonomic institutions
    - 3.2.4. Minority interests and opinions may be drowned out and not represented
  - 3.3. How wide should the remit of a National Strategy be?
    - 3.3.1. Should it include prokaryotes and viruses, and extinct organisms?
    - 3.3.2. Should it consider biodiversity below the species level?
    - 3.3.3. What other dimensions need to be considered?
  - 3.4. Should there be a standing committee to monitor the application and development of the national strategy? If so:

- 3.4.1. Who should convene (and fund) it (e.g. a government department, research council, society or institution)?
  - 3.4.2. Should it be made up largely of taxonomists or a broader range of scientists and stakeholders?
  - 3.4.3. How should the major taxonomy institutions be represented?
  - 3.4.4. What should be the role of research funders?
  - 3.4.5. Are there alternatives to setting up a committee?
  - 3.5. Research Councils operate throughout the United Kingdom whilst government funds taxonomic research through Whitehall departments and the devolved administrations. How should a National Strategy incorporate input from the different regions of the United Kingdom?
4. National capability – care of physical collections and other resources. The UK houses some of the most significant taxonomic collections on the planet. How can they be better and more efficiently preserved, used for research, and made more accessible to users?
- 4.1. How should the scope of the “national collection” be determined (or should it just be left to individual institutions)?
  - 4.2. Collections can be made more accessible by digitization (imaging and databasing); what should be the priority given to digitization compared to other activities in collection maintenance and ITC; what should be digitised first and what shouldn’t be digitised?
  - 4.3. Should there be UK policy on access to collections (visits, loans, payment for web resources; level of access to data) or is this a matter for individual institutions?
  - 4.4. Are there special issues concerning collections held outside major taxonomic institutions (universities, local museums, and societies)?
  - 4.5. Could efficiencies be made in the distribution and management of collections that would free resources for other taxonomic activities?
  - 4.6. How will the role of taxonomic libraries change as more literature is available on the web?
  - 4.7. Should culture collections of microbial organisms be considered as part of the UK collection base?
5. National capability – contribution of the UK to the global taxonomic enterprise. The UK has traditionally made a major contribution to the systematics and taxonomy of organisms on a global scale. We take it as given that the UK will continue to be a significant player on the global stage.
- 5.1. In the past individual institutions and organisations have contributed to taxonomic and systematic knowledge by publishing research papers, monographs and flora; some institutions have strategically concentrated on specific groups or regions; is this model of research organisation appropriate today?

- 5.2. Should the UK taxonomic community take “leadership” of large taxonomic groups; for example to commit over the long term to maintain a critical research mass in Phylum X or Class Y, and to provide the collection, molecular and web resources to facilitate research in the group throughout the world? If so, should the choice of group be made by individual institutions or by a national body (such as the National Strategy standing committee); how should such decisions be co-ordinated with international partners?
  - 5.3. Is there a role for taxonomic “grand challenges” equivalent to projects in other fields such as the Human Genome project; for example the “completion” of a taxonomic or phylogenetic treatment of a major taxon? Might this generate support and funding from novel sources?
6. National capability - taxonomy to support UK environmental science. The UK environmental science community are consumers of the products of taxonomy and systematics
- 6.1. Does this community currently have access to the resources it require
    - 6.1.1. Are there currently significant taxonomic impediments, and how could they be removed?
  - 6.2. How will the community’s resource needs change in the future and will they be met; for example will there be a greater need for:
    - 6.2.1. Molecular identification tools (DNA barcodes etc.)
    - 6.2.2. Phylogenies of groups of organisms
    - 6.2.3. Web-based taxonomic treatments?
  - 6.3. A UK National Strategy for Taxonomy and Systematics might include the goal of providing identification resources (for different groups they might be traditional morphological, molecular or a combination) for all taxa found in the UK: is this a good use of resources?
    - 6.3.1. Where should the resources come to achieve this goal; for example from current support for major taxonomic organisations, or from time-limited research programmes (q.v.)
  - 6.4. No organisation (institute, society etc.) is currently formally charged with providing taxonomic resources for different UK groups of organisms (though some do an extraordinarily good job informally); should part of a National Strategy for Taxonomy and Systematics be the allocation of responsibility for different groups to different organisations?
    - 6.4.1. How would the funded (taxonomic institutes) and unfunded (societies etc.) sectors interact to produce such resources?
  - 6.5. Surveying the distribution of organisms is a major part of environmental studies in the UK involving volunteer recording schemes, biodiversity monitoring, and commercial environmental impact assessments; much of this data is co-ordinated by the National Biodiversity Network and the Biological Records Centre; are these communities adequately supported and linked (institutionally and electronically) with the taxonomic community and its research and results?

- 6.6. Is there evidence that the fulfilment of the UK's statutory duties or obligations (for example to the Convention on Biological Diversity or the Water Framework Directive) is being put at risk by lack of taxonomic skills or resources?
  - 6.7. Is lack of taxonomic expertise in palaeontology and palynology hindering the reconstruction of past climates, to the detriment of climate research?
  - 6.8. How should a National Strategy take account of the UK's special responsibilities to its Overseas Territories (which include several areas of very high biodiversity importance)?
7. National capability – training the next generation of taxonomists. [Note: our review is primarily restricted to issues of post-graduate training]
- 7.1. How should the UK determine the optimum number of MSc and PhDs in taxonomy, systematics and cognate areas to train?
  - 7.2. What is the best way of training taxonomists?
    - 7.2.1. For example courses and projects based primarily in major taxonomic institutes, in Higher Education Institutes (HEI), or a mixed model?
    - 7.2.2. Should training courses focus on taxonomy or be more multidisciplinary?
    - 7.2.3. Should training be taxon-based or technique-based?
    - 7.2.4. How can examples of best practice be identified and disseminated?
  - 7.3. Are there particular issues concerning training in palaeontology?
    - 7.3.1. Is infrastructure in HEIs adequate to teach palynology and micropalaeontology?
    - 7.3.2. Is it important to retain expertise on all fossil groups, or if not which groups should be emphasised?
    - 7.3.3. HEI taxonomic palaeontology has been traditionally housed in geology/earth science rather than biology departments in universities. Is this still appropriate?
  - 7.4. Is the pipeline of students interested in taxonomy being threatened by the reduced attention paid to the subject in Biology and Earth Science Departments in HEIs? If so, how might this be addressed taking into account current pressures on the curriculum?
  - 7.5. Who should fund the training of taxonomists?
8. National capability – taxonomy in support of private enterprise. Is there evidence for shortages of taxonomists in the private sector?
- 8.1.1. For biodiversity surveys and environmental monitoring
  - 8.1.2. In the agricultural, forestry, biotech and pharmaceutical sectors
  - 8.1.3. In the extraction industries and in other sectors that use biostratigraphy

9. National capability – governance. UK national capability in taxonomy and systematics, as defined here, is supported through a very wide variety of funding organisations
  - 9.1. Assuming flat funding should resources be channelled through fewer organisations?
  - 9.2. Where institutions receive support for a variety of purposes (taxonomic research, public exhibitions, education, buildings upkeep) should they be asked to declare formally what fraction is devoted to taxonomic research?
    - 9.2.1. If so should this be broken down further into sub-categories of taxonomic research?
    - 9.2.2. It has been argued that professional taxonomists in our major institutions now spend less time doing descriptive taxonomy than in the past; if true (we are collecting data on this) is it a bad thing?
  
10. The role of the volunteer taxonomy community (that is people who produce new taxonomic information but are not paid as taxonomists)
  - 10.1. Are there ways in which the productivity of this community could be enhanced; for example by
    - 10.1.1. Easier access to information (paper and web)
    - 10.1.2. Easier access to reference and research collections
    - 10.1.3. Training opportunities
    - 10.1.4. Facilities for publishing or otherwise making available their data
    - 10.1.5. Creating “teams” composed of professional and volunteer taxonomists?
  - 10.2. What is the role of taxon-based societies in facilitating these activities (note: this issue is also being explored currently by the Linnean Society and the conclusions of their study will feed into our report)?
  - 10.3. What priority should this be given in competition with other resource demands?
  - 10.4. If more taxonomy is done by volunteer and “para-” taxonomists how can quality control be assured?
  
11. Research programmes. Research Councils and other funders group together to fund major initiatives. Recent examples (with a biological bent) include the Insect Pollinator Initiative (£10M funded by Wellcome, BBSRC, Defra & NERC); Ecosystems Services for Poverty Alleviation (£40M funded by NERC, DfID, ESRC) and the emerging Food Security Programme being led by BBSRC. NERC in the 1990s sponsored a “Initiative in Taxonomy Research and Training” and the NSF in the USA has operated programmes such as PEET (Partnerships for Enhancing Expertise in Taxonomy), PBI (Planetary Biodiversity Inventory) and AToL (Assembling the Tree of Life). The programmes are time-limited and are aimed at addressing major issues of national strategic importance
  - 11.1. Should there be a mechanism by which the taxonomic community can come together and put forward ideas about research programmes and, if so, what should that mechanism be?

- 11.1.1. For example, the astrophysicist community in the US meet periodically and agree a costed, prioritised list of major projects
  - 11.1.2. Might a National Strategy standing committee have a role here?
  - 11.2. How should the taxonomic community engage with the different research funders in exploring possible major research programmes?
    - 11.2.1. Might the Environment Research Funders' Forum have a role here?
  - 11.3. Where research programmes produce a taxonomic resource (a web resource for example), how can their long-term sustainability be assured?
    - 11.3.1. How are research programmes linked to national (or international) capability?
  - 11.4. How can international programmes be developed and the funding co-ordinated?
    - 11.4.1. Within the EU
    - 11.4.2. Globally?
12. New infrastructure to support taxonomy. The major taxonomic collections and libraries constitute the traditional infrastructure for taxonomic research.
- 12.1. Is there a need for new infrastructure to support taxonomy?
    - 12.1.1. Molecular (especially sequencing) facilities
    - 12.1.2. Morphological digitisation and storage facilities
    - 12.1.3. High-throughput phenotyping
    - 12.1.4. Information technology and bioinformatics
  - 12.2. Increasingly, the large museums and herbaria are investing in such infrastructure; should such investment decisions be left to individual organisations or would there be advantages in a national strategy for taxonomic infrastructure support?
  - 12.3. Is the UK sufficiently integrated in global initiatives that provide ITC and bioinformatic infrastructure to support taxonomy?
  - 12.4. What should be the role of the National Strategy and any committee supporting it in this area?
13. Responsive mode. Currently taxonomists working at HEIs and other accredited organisations can apply for “responsive mode” research grants where the primary criterion for success may be, for different funders, scientific excellence, or economic, societal or medical impact.
- 13.1. Do the committees that award these grants have sufficient expertise in taxonomy and systematics to judge their excellence or relevance (bearing in mind they are informed by specialist referees)?
  - 13.2. In the US the NSF has panels devoted to taxonomy and systematics; should this be introduced in one or more UK research councils and, assuming flat funding, from where should the resources be redirected?
    - 13.2.1. From other areas of biology and the environmental sciences?

- 13.2.2. From funds currently given to major museums and herbaria?
- 13.3. Is there sufficient clarity about which research council has responsibility for responsive funding of which part of the subject?

#### 14. Performance metrics.

- 14.1. Citation counts and related bibliometrics are commonly used to judge the quality and quantity of scientific outputs in the UK
  - 14.1.1. Is this a fair way to judge all or part of taxonomic research?
  - 14.1.2. What, if any, alternative metrics or review mechanisms would do a better job?
  - 14.1.3. How might REF or whatever replaces the RAE provide a fair assessment of taxonomic research quality?
- 14.2. What metrics or review mechanisms (if any) could be used to assess the volume of UK taxonomic work?
- 14.3. What metrics or review mechanisms (if any) would be required to judge the success of a UK Strategy in Taxonomy and Systematics?

#### 15. Sequence-based taxonomy.

- 15.1. The taxonomy of prokaryotes and viruses is now almost wholly molecular with sequence information the basis of any new taxon description with morphology, physiology and biochemistry having at most a supporting role. Trends to a similar model of taxonomy are occurring in some eukaryotes, in particular single-celled organisms, interstitial fauna, some fungal groups etc. What are the consequences of these trends for investment in taxonomic research in the UK?
  - 15.1.1. Should the UK cease investment in the morphological taxonomy of some groups?
- 15.2. Over the next decade new-generation high-throughput sequencing is likely to advance rapidly, making it feasible to obtain massive quantities of sequence information from individual specimens and even whole ecosystems. What might be the consequences of this for UK taxonomy?
- 15.3. Is the involvement of the UK in current international DNA barcoding programmes appropriate and co-ordinated?
- 15.4. Is the involvement of the UK in current international phylogeny programmes (for example the “Assembling the Tree of Life”) appropriate and co-ordinated?
- 15.5. Is there a risk that the molecular and non-molecular sides of taxonomy become separated; does this matter; and if it does how can it be prevented?
- 15.6. How should the UK initiate or become involved in international effort to coordinate microbial taxonomy and bioinformatics?

## 16. Web-based taxonomy

- 16.1. Are the major taxonomic institutions in the UK responding appropriately to the opportunities afforded to the subject by the web? If not how might this be improved?
- 16.2. Arguments have been put forward that descriptive taxonomy should become purely a web-based activity; is this desirable, and if it were how would this affect a purely UK taxonomic strategy?
- 16.3. Is the involvement of the UK in current international digital taxonomy and biodiversity initiatives (for example the Encyclopaedia of Life and GBIF) appropriate and co-ordinated?

## 17. Previous Initiatives in Taxonomy.

- 17.1. What can we learn from the successes and failures of previous and current initiatives to support taxonomy and systematics in the UK? For example:
  - 17.1.1. The House of Lords Science and Technology Committee Reports (1992, 2002, 2008)
  - 17.1.2. The UK Systematics Forum (1996-1998)
  - 17.1.3. The NERC Initiative in Taxonomy Research and Training (1994-2000)
  - 17.1.4. BBSRC & NERC's current SynTax scheme and its predecessors<sup>3</sup>
- 17.2. Are there equivalent overseas initiatives we can learn from?

## 18. Are there issues not touched on here we should be considering?

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<sup>3</sup> <http://www.nerc.ac.uk/research/programmes/taxonomy/events/syntax.asp>