

# **UK Taxonomy & Systematics Review**

## **Response compiled by NERC on behalf of the community of taxonomy and systematics funders**

### **Context of review**

The discipline of Taxonomy and Systematics in the UK has been the subject of a number of inquiries in recent years, including three reports by the House of Lords (1992, 2002, 2008). The most recent of these inquiries, the 2008 House of Lords Science and Technology Committee inquiry into *Systematic Biology Research and Taxonomy*, recognised the importance of the field in modern biology and environmental science but highlighted a series of substantial concerns. These included lack of effective dialogue between users and producers of taxonomy to identify national priorities; the need to stimulate recruitment in the field and encourage interest among younger generations; the need for further uptake of potentially revolutionary new technologies; ineffective communication between the taxonomic community and research councils; fragmented responsibility among government departments; and lack of leadership towards developing a national strategy. In its summary the 2008 House of Lords [report](#) concluded that the state of the field was generally unsatisfactory, in some areas to the point of crisis. In response to specific recommendations in the House of Lords report, the Natural Environment Research Council commissioned the UK Taxonomy & Systematics Review on behalf of all funders in this area (Annex 1).

The UK Taxonomy & Systematics Review covered three specific areas: (i) the current status and trends in the UK taxonomy and systematics sector, including the scale of and sources of funding, and the size and demography of the workforce; (ii) an assessment of current and future needs for taxonomy and systematics and how these relate to different user groups; and (iii) strategic recommendations for the future development of taxonomy and systematics in the UK in light of the findings of both the House of Lords inquiry and other reports. The full UK Review can be accessed [here](#).

The UK Review concluded that taxonomy and systematics, one of the oldest branches of biology, is currently undergoing a period of major transformational change that will determine its future role and structure. It also highlighted that taxonomy and systematics is a science with some unique features that make the explicit development of a national strategy advantageous. These include the role of collections, the great importance of the non-university sector, the disparate sources through which the subject is funded, and the importance of volunteer scientists. The review made 19 specific recommendations, the most fundamental of which was the creation of a UK Taxonomy Co-ordination Committee to develop a national strategy in taxonomy and systematics.

### **Response to review**

The Natural History Museum, Royal Botanic Garden Kew, Royal Botanic Garden Edinburgh, National Museum of Wales and the Linnean Society — with representation from NERC on behalf of the funder community — have agreed to drive the creation of a

UK Taxonomy Co-ordination Committee, and to actively champion the development of a national strategy. This group recognises that a broader stakeholder group will need to be fully involved to set the terms of reference for the Co-ordination Committee, develop the national strategy and take forward its implementation.

In order to assist the UK Taxonomy Co-ordination Committee to design the most appropriate co-ordinating structures to take the strategy forwards, stakeholders were approached to comment on the individual recommendations of the UK Review. Stakeholders were also asked to take an overview of all the recommendations and provide a broader vision statement, detailing how we can move forward as a collective endeavour to deliver the UK's taxonomic needs (responses are detailed in Annexes 2&3).

### **Priority areas for the Taxonomy Co-ordination Committee**

The primary objective for the Taxonomy Co-ordination Committee is to build on the recommendations of the UK Review, and associated strategy document, to fully develop a national strategy for activities, infrastructure and investment in the field of taxonomy and systematics. In order to achieve this central goal in the light of limited resources, the Committee will initially focus its efforts on the following key recommendations of the review:

- *The TCC should bring together the UK taxonomic community to list and prioritise time limited major research programmes or “grand challenges” that would advance UK taxonomy and systematics – the Committee will bring together the users and producers of taxonomy to define the key questions and priorities to advance the discipline and produce outputs relevant to major societal challenges.*
- *A study should be undertaken to determine whether the distribution of the UK’s taxonomic collections is the most efficient for today’s needs – the Committee will collate information on the current distribution, condition and curation of natural history collections and, in consultation with the organisations responsible for these collections and the user community, make a set of recommendations on how to achieve long term access to these resources. In addition to considering physical collections, this study will take into account the potential value of open, searchable collection databases and virtual collections.*
- *Moves to collection digitisation should continue with investment concentrated on priority resources – the Committee will make recommendations on where digital collections are likely to have biggest impact and how to coordinate national effort in this respect. This is an area where lessons can be learned from a number of international initiatives, including and the Biodiversity Heritage Library, the Mellon Foundation’s Plants Initiative, the Atlas of Living Australia, and the National Science Foundation’s initiative in Advancing Digitization of Biological Collections.*

- *The TCC should co-ordinate the development of a costed roadmap to provide appropriate identification tools for all UK organisms – the Committee will bring together users of taxonomic information on UK organisms to identify the types of identification tool required and the most appropriate way for these to be provided as part of a coordinated national strategy.*
- *NERC should explore whether lack of training opportunities is the reason for the difficulty in recruiting trained taxonomists by environmental consultancies and NERC should continue to support PhD training in taxonomy and assess the consequences of its recent decision to stop supporting taught masters – The Committee will collate information on the current provision of taxonomic training available to both professionals and amateurs, consult with the stakeholder community on the effectiveness of these training opportunities, and explore the various issues associated with recruitment and retention, in order to make recommendations on a national strategy for training, relevant to all funders.*

### **UKTCC reporting**

In order to maximise the effectiveness of the UK Taxonomy Co-ordination Committee, the Taxonomy & Systematics review recommended that the Committee report directly to a Government department. Potential home Departments include the Department for Business, Innovation and Skills, and the Department of Environment, Food and Rural Affairs.

## **Annex 1**

Funders that have been consulted in the process include (in alphabetical order):

Biotechnology and Biological Sciences Research Council (BBSRC)

British Ecological Society (BES)

Department for Environment, Food and Rural Affairs (Defra)

Department for Business, Innovation and Skills (BIS)

Department for Communities and Local Government (DCLG)

Department for Culture, Media and Sport (DCMS)

Higher Education Funding Council for England (HEFCE)

Higher Education Funding Council for Wales (HEFCW)

Linnean Society

Medical Research Council (MRC)

Natural Environment Research Council (NERC)

Natural History Museum (NHM)

Royal Botanic Gardens Edinburgh

Royal Botanic Gardens Kew

Royal Horticultural Society (RHS)

Scottish Funding Council (SFC)

Scottish Government (SG)

Welsh Government (WG)

## **Annex 2**

High-level visions moving forwards:

### **NERC**

The National Ecosystem Assessment describes the natural world, its biodiversity and its constituent ecosystems as critically important to our well-being and economic prosperity, underlining the importance of the findings from NERC's recent review of taxonomy & systematics. The discipline of documenting, describing and communicating that diversity requires a long-term commitment as it depends upon collections and historical data, as well as a critical mass of well-trained practitioners, and the application of the latest technological approaches. NERC recognises that taxonomy and systematics make an important contribution to environmental science, along with many other science approaches and disciplines.

NERC already makes substantial investments in long-term and large-scale research, making use of a range of taxonomic skills and provides outputs relevant to science and policy through such activities as the Biological Records Centre, the Countryside Survey, the Environmental Bioinformatics Data Centre and the National Biodiversity Network. In addition to this extensive national capability, NERC provides funding for research involving taxonomy through all of its funding modes, provided that the research in question meets the assessment criteria and funds are available.

NERC therefore sees itself as an active but equal member of a broader community of funders and users, who move forward as a collective endeavour to deliver the UK's taxonomic needs. Development of a joint strategy, with priority goals, is considered a key element of any sustained progress in this discipline.

### **RHS**

Understanding organismal diversity is fundamental not only to biological science but also conservation of biodiversity, to food security and to our responses to climate change. The discipline of documenting, describing and communicating that diversity requires a long-term commitment as it depends upon collections and historical data, as well as a cadre of well-trained practitioners, and the application of the latest technological approaches. The UK has a remarkable record in its contribution in this field and, in the opinion of the RHS, has a global responsibility to maintain it, and to make best use of the unique assets of which it is the custodian. It is not enough to depend upon disparate stakeholders to deliver their contributions when so many of them face major challenges in balancing priorities. Nationally, we need a high-level joined up approach that seeks to match resources and capacities to needs and opportunities in a comprehensive strategy that can also secure a long-term future for our collections and expertise and maintain our position as a world-leader in this field.

Going forwards we would envisage the first step, assuming that its creation is agreed, to be the formation of the Taxonomy Co-ordination Committee, with clear terms of reference and reporting lines, and with short and medium-term goals. These should be

derived from the report and from any comments from consultees. Key to its success will be a long-term commitment to funding, even if at a relatively low level. The experiment of co-ordinating UK taxonomic and systematic activity has been tried before, with the UK Systematics Forum which disbanded when the funding ceased. It is hoped that the difference this time would be that the TCC not only would be tasked with drawing up the national strategy but also with co-ordinating and monitoring its implementation. Additionally it should be asked to explore mechanisms of funding its activity in order to minimise its dependency on Government funding, if that is envisaged to be made available for its establishment.

### **BBSRC**

BBSRC is a relatively minor player in taxonomic research, with most of its needs being met through phylogenetic analysis of molecular-level taxonomic data (e.g. in genomic sequences).

BBSRC's main concern is that the document and the accompanying series of questions (below) appears to focus on (morphological) taxonomy of preserved specimens, whereas BBSRC's interests tends to focus on taxonomic and phylogenetic approaches for biotechnological application e.g. :

- detection and study of dispersion and evolution of organisms that cause diseases of plants and animals (e.g. FMDV).
- Genomic characterisation of an organism for the purposes of producing germplasm for breeding
- Genomic characterisation for the purpose of identifying particularly useful characteristics (e.g. secondary metabolism) or with specific physical properties (e.g. low lignin content willows for biomass)

### **The Linnean Society**

The Vision: A sustainable base for the disciplines of taxonomy and systematics, facilitating understanding of UK/global biodiversity and providing significant economic and social benefits.

The Mission: To secure a national capability in taxonomy and systematics (education, training, access to all relevant collections), underpinning the biological sciences and their application in biodiversity, sustainability of the environment, conservation, public health, forensics and international trade legislation.

The Fact: The natural world, its biodiversity and its constituent ecosystems are critically important to our well-being and economic prosperity (National Ecosystem Assessment, 2011). If we don't know what biodiversity we have, how can we manage it?

### **NHM; RBG Kew; RBG Edinburgh (joint response)**

We support the broad findings of the review and recommendations of the strategy document, including the recommendation that a UK Taxonomy Co-ordination Committee (TCC), made up from practitioners and stakeholders, should be established to guide the development of a national strategy, make recommendations on how such a strategy should be implemented, and highlight challenges currently faced by both

practitioners and stakeholders. Although we believe that the TCC should not have prescriptive powers and should not introduce unnecessary bureaucracy, in our view its activity would provide a useful focal point for what is currently a diffuse group of users and stakeholders. We therefore suggest that the TCC should be given responsibility for formulating a national strategy with a set of key action points through a series of workshops held in several parts of the UK. Given the broad scope of the review and strategy document we would anticipate that the TCC may decide to establish a series of working groups in focal areas of activity, with each such group including expert practitioners and stakeholders.

In order to set up a TCC, we suggest the use of an expert advisory council or task-force to draft the Terms of Reference including membership of the TCC, which could then be circulated for comment and approval by the major stakeholder groups. We suggest that an advisory group or task-force of this type should involve representatives from the major systematic/taxonomic institutions in the UK and include participation from across the devolved administrations of the UK.

#### **National Museum of Wales on behalf of CyMAL, Welsh Government**

We envisage the creation of a UK TCC as needed to recognise the diversity of the taxonomic agenda and to formulate strategies appropriate for each sector. We recognise that in some areas research councils will be the lead supporter but in other areas such as taxonomic collections the museum sector must be involved. Priorities for taxonomic research and provision of identification tools especially where relevant to UK biodiversity may have regional differences thus necessitating devolved nation participation in the UK TCC. This is also necessary as the museum sector is devolved and any UK review of collection distribution must be inclusive. No single organisation can provide the necessary leadership or resources to overcome the deficiencies in the taxonomic agenda and a UK approach is needed.

### **Annex 3**

Responses to each recommendation:

1. A national strategy in taxonomy and systematics should be developed

#### **NERC**

NERC is very supportive of the development of a national strategy and has already demonstrated its commitment to being an active member of the broader taxonomy community by leading the review on behalf of all funders.

#### **RHS**

The RHS strongly supports the need for a national strategy for taxonomy and systematics but it is vital that this is a strategy that is shared by as many stakeholders as possible, so that it has the greatest chance of being adopted and incorporated into work plans.

The national strategy needs to have a set of key performance indicators, not just financial measures, but measures for taxonomic output, access to collections, new collaborative programmes and diversity of engagement with providers and users. These will need to address the issues raised in the report and ensure that they are kept in the forefront when relevant organisations are planning their work programmes, as well as for assessment of priorities for funding.

The national strategy needs to identify our strengths, in terms current areas of excellence in taxonomy and systematics, as well as the priorities for filling gaps in expertise. This does need to be in the context of EU and international provision of this expertise, but there will be areas that are critical for the UK to maintain or build capacity. It should assess our strengths, not just on a national basis but internationally.

Thirdly, the national strategy should link taxonomic and systematics research to key national commitments, such as multilateral agreements (e.g. Convention on Biological Diversity) and conservation-based legislation.

#### **BBSRC**

BBSRC is concerned about an imposed framework of “national strategy” in taxonomy. Any kind of national strategy needs “buy-in” from the full range of groups that comprise the community and therefore must come from the community (bottom-up) not top-down from government or the sponsors. Would the community trust and engage with a government-led top-down approach?

BBSRC’s experience in attempting to establish a network of researchers in systematics and taxonomy (through a community-led research proposal) in 2008/9 (pre-dating the NERC-led activities) proved to be too difficult to achieve because the community could not agree who should lead and how the network might work.



### **The Linnean Society**

The Linnean Society of London fully supports this recommendation. It should be noted that such an initiative would not be starting from ground zero: many bodies (e.g. The Linnean Society of London, The Natural History Museum, Royal Botanic Gardens, Kew and Edinburgh) have initiatives that are already contributing towards the development of the national strategy for taxonomy and systematics.

In particular, the Linnean Society of London already has an established Taxonomy and Systematics Committee (LSTSC), which embraces a wide community of stakeholders and practitioners, with representatives from the Natural History Museum London, the Royal Botanic Garden Kew and Royal Botanic Garden Edinburgh, CABI (Centre for Agriculture and Biosciences International), NatSCA (The Natural Sciences Collections Association), Oxford Natural History Museum, Natural England, National Museum of Wales, CEH (The Centre for Ecology & Hydrology), National Federation for Biological Recording, the Field Studies Council and university departments. In March last year, the LSTSC convened a plenary meeting entitled “Taxonomy in the Big Society”, with representation from 62 of a potential 65 interest groups, including statutory agencies, national, regional and local museums, botanic gardens and local natural history societies. Amongst other topics, this meeting discussed engaging the general public with taxonomy and the teaching of taxonomy within the formal education structure.

Three working groups within the LSTSC are now focusing in more detail on the priority areas of Museums and Collections, Training, Careers and Resources and Vulnerable Groups and Legislation. No doubt much that is learnt through the LSTSC will be valuable input for the proposed UK Taxonomy Co-ordination Committee (TCC).

### **NHM; RBG Kew; RBG Edinburgh**

Agree, with strong focus on developing a joined-up approach to present and future gaps in capability, training and succession planning. Although we would expect a national strategy to identify key actions with respect to the UK’s own taxonomic requirements, we would hope that a national strategy would also aim to address the global taxonomic impediment given the fact that many large-scale initiatives in this field are based on international consortia and the UK has a demonstrated track record in making a leading contribution at an international level.

### **National Museum of Wales on behalf of CyMAL, Welsh Government**

This is essential if taxonomy and systematics is to receive the appropriate recognition and to secure funding. This strategy needs to recognise the different strands of taxonomic research such as “grand challenges”, taxonomic tools, taxonomic training, and the role of taxonomy in biodiversity monitoring. The breadth of the taxonomic community and the many faceted concerns and demands probably account for the apparent unconnected nature of the taxonomic community. A national strategy should clarify these and also clarify the relevant funding agencies, which may not always be the research councils.

### **Department for Culture, Media and Sport (DCMS)**

The DCMS supports the recommendation to develop a national strategy to the extent that this would be beneficial to the NHM's pursuit of its mission.

2. A UK Taxonomy Co-ordination Committee (TCC) should be set up to develop and review the National Strategy in Taxonomy and Systematics

### **NERC**

NERC welcomes the development of the TCC and will support the Natural History Museum's leadership of the committee wherever possible, in order that we move forward as a collective endeavour to deliver the UK's taxonomic needs.

### **RHS**

Given the dispersed nature of taxonomic activity in the UK, the case for a co-ordinating committee is compelling. The report suggests that the committee should be "small and lean, with a minimal secretariat." While not wishing to argue for a large (and almost certainly ineffective) committee, we would be keen to see that the committee's composition allows for representation of a broad range of taxonomic groups and kinds of stakeholders. This is vital if the National Strategy is to be meaningful and to gain the support and engagement of the taxonomic community.

There also needs to be a clear reporting line into Government, so that the outputs of the TCC can be given due weight and consideration alongside other science priorities. To that end, the TCC should be required to review and report regularly on the delivery of the national strategy, both to Government and to the stakeholders in general. The TCC needs to be independent but given preponderance of the "big three" (NHM, RBG Kew & RBG Edinburgh) in UK systematics, the composition of the TCC and especially leadership, needs to be chosen with care to ensure transparency in decision-making.

### **BBSRC**

See above for a BBSRC view.

### **The Linnean Society**

The Linnean Society applauds this recommendation and is well placed to help coordinate this initiative. The Society would like to participate and to use its considerable convening power across the Taxonomy & Systematics community to make it work. We think it is particularly important that the TCC should combine expertise from across the whole UK.

The TCC must start operating at the highest national level and with buy-in from the UK Research Councils and relevant Government departments, as well as having the commitment of the key institutional players. One of the key problems is that UK taxonomy is not the responsibility of any one Research Council or department.

The Linnean Society, through its Taxonomy and Systematics Committee, representing a very large constituency of 65+ stakeholders, is well placed to have an overview in

support of the TCC in communicating the importance of taxonomy and systematics to decision makers in government and other funding bodies.

A government and academic supported TCC represents a huge opportunity to unite the taxonomic community around the task of providing a comprehensive picture of UK biodiversity. The taxonomic community is ready and willing – it needs the catalyst of a TCC to act.

It will be vital that NERC agrees to support the TCC financially and the Linnean Society could offer to be the “home” of the TCC, by convening and hosting the meetings.

#### **NHM; RBG Kew; RBG Edinburgh**

We agree with the principle of this recommendation, although the name of the committee, its terms of reference and its membership would need to be developed with care to maximise participation and set an appropriate agenda. For example, from the perspective of our own organisations it would be important that the terms of reference of the TCC did not clash with the governance roles of our Trustee boards in relation to our sponsorship departments. We expect the same would be true for some other major practitioner organisations, and it would also be very important to include major stakeholder groups and the volunteer/amateur community in the TCC.

We suggest that the TCC should include representatives from major practitioners, key stakeholders and community groups. Perhaps an advisory council or task-force, with members presenting key interest groups, could be considered to oversee the preparation and monitoring of the Strategy.

#### **National Museum of Wales on behalf of CyMAL, Welsh Government**

This will be essential to bring together the many stands cited above and to give potential funding agencies confidence in the national strategy. The core could be rather small but should represent the UK as a whole. This core could then create satellite groups to consider the priorities in the different strands. For example, the community that is concerned with fundamental research such as molecular phylogeny is not always the same as that involved with preparing taxonomic tools.

#### **Department for Culture, Media and Sport (DCMS)**

As the sponsoring Department of the NHM, the DCMS would require that the terms of reference of any such committee did not conflict with the institution’s statutory obligations, the Department’s governance rules regarding that sponsorship agreement, and the Museum’s independence.

3. Science spend in taxonomy should be categorised as *National Capability, Research Programme* or *Responsive Mode*

#### **NERC**

NERC already uses this classification to categorise its science research investments.

#### **RHS**

While we endorse the proposal that science funding should be categorised as above, we consider that it is essential that the five criteria listed under 'National Capability' in paragraph 3.3 of the report are adopted. For too long it is not been possible to secure funding for essential but long-term taxonomic work on account of it not meeting the criteria for Research Council Funding. At present there is a clear move away, in terms of employment of staff or researchers, from core taxonomic work to more applied areas and this trend is often masked in surveys that provide data on the number of taxonomists without necessarily reporting on what they do, and how much time they have for core taxonomic work.

While not explicitly itemised in paragraph 3.3 of the report, we feel that greater development, co-ordination and linkage of taxonomic databases should be considered as a key element of 'National Capability' funding.

### **BBSRC**

If the purpose is for strategic analysis of current and future investments in taxonomy, the classification may have advantages. However, the three groupings are not mutually exclusive.

### **The Linnean Society**

Such categorisation, as defined by NERC, would be useful in ensuring appropriate allocation of resources, provided that adequate resources were assigned to each category. Research Council funding is very difficult to obtain for most taxonomists as their work is wrongly regarded as not being hypothesis driven. Most taxonomy would be funded under the National Capability category, though this should not preclude applications under the others.

National capability enables the UK to deliver world-leading science, support national strategic needs, and respond to emergencies. It includes the research and development activities which keeps this capability at the cutting-edge.

Research programmes explicitly address science challenges and priorities within seven predefined themes (including biodiversity) and provide strategically directed research, training and related knowledge exchange, and encourage national and international collaboration.

Responsive Mode is response to unsolicited ideas from research groups, consortia or individuals; proposed research can be pure, applied or policy-driven, and must seek to address - or provide the means to address - clearly defined science questions.

However, not all funding for taxonomy is provided by NERC. NERC funding should address the academic research issues but is not currently focussed on teaching or capacity building within the wider community. The commitment of DEFRA to invest £1.2M over three years in support of volunteer recording is an existing contribution to capacity building within volunteers.

### **NHM; RBG Kew; RBG Edinburgh**

This is the hardest recommendation for us to provide a robust response at the present time. On the one hand we are aware that the research councils have introduced this classification system for their own activities and we can see that a substantial portion of

the activity of our own organisations could be viewed as being equivalent to a ‘national capability’ in taxonomy and systematics. On the other hand, we do not yet feel that we fully understand how the introduction of this system would assist in developing a national strategy and, as ever we are wary of incurring any additional administrative burden until we understand the potential benefits. On balance, therefore, we would welcome the opportunity to discuss the rationale for this recommendation in more detail and establish how easy it would be to collate useful data from other practitioners.

#### **National Museum of Wales on behalf of CyMAL, Welsh Government**

Recognising the different strands suggests that taxonomy cannot fall within a single category. The production of taxonomic tools (identification guides) are part of the national capability as would be taxonomic training. However molecular systematics may better suit the *Responsive Mode*.

#### **Department for Culture, Media and Sport (DCMS)**

The DCMS does not hypothecate the grant-in-aid funding provided to its sponsored museums. Individual institutions and their Board of Trustees are responsible for deciding how the funds are distributed across their activities. The DCMS would therefore need to be convinced that the adoption of this classification system would be of benefit to the NHM and would not incur an additional administrative burden.

4. Investment in national capability in taxonomy and systematics by different bodies should be recognised as such and its levels monitored.

#### **NERC**

NERC already recognises that it makes substantial contributions to the UK’s national capability in taxonomy and systematics through its research centres (e.g. the Centre for Ecology and Hydrology; British Antarctic Survey and the National Oceanography Centre).

#### **RHS**

This should be reported on by the TCC as suggested by the report (paragraph 3.6) but this does depend upon the reliability of the data provided to the TCC. There should be clear definitions of what constitutes taxonomy and systematics. In our view, previous initiatives to support these disciplines have frequently seen a significant proportion of the funds assigned to peripheral areas with a taxonomic flavour without supporting core taxonomic activity. Of course the value of this exercise is as a measure of the delivery of the national strategy and whether any significant shortfalls or discrepancies, should they arise, can be acted upon.

#### **BBSRC**

BBSRC wishes to encourage broader appreciation of “national capability” in taxonomy (i.e. *care of collections and other resources which are accessible to all researchers*) and would therefore wish to include genome sequencing facilities and the UK investment in

the European Bioinformatics Institute and its future development (ELIXIR) included too.

### **The Linnean Society**

This is particularly important bearing in mind the disparate funding sources that taxonomists need to access. The monitoring would need to be quite sophisticated bearing in mind that many research projects have a taxonomic component, but are rarely advertised as such.

### **NHM; RBG Kew; RBG Edinburgh**

We are cautiously supportive of this recommendation providing it is focused on strategic questions and doesn't become an excessive bureaucratic burden. We appreciate the need to understand current patterns of resource spend as part of the development of a national strategy and suggest that it may be necessary to develop suitable metrics to assess the impact of any such strategy, although these should not necessarily be restricted to spend alone.

### **National Museum of Wales on behalf of CyMAL, Welsh Government**

We have no issue with this.

### **Department for Culture, Media and Sport (DCMS)**

As the sponsoring Department of the NHM, the DCMS recognises the importance of its investment in taxonomy and systematics. Again, however, the Department does not hypothecate the grant-in-aid funding provided to its sponsored museums and individual institutions are responsible for deciding how the funds are distributed across their activities. In the case of the NHM, therefore, not all of the grant-in-aid will be focused on taxonomy and systematics and not all of the investment in taxonomy and systematics will be funded by the DCMS. Given this complex situation, the DCMS would need to be convinced that the information could be collated without the process becoming a bureaucratic burden for the NHM and that the information would be benefit to the NHM in pursuing its mission.

5. A study should be undertaken to determine whether the distribution of the UK's taxonomic collections is the most efficient for today's needs.

### **NERC**

Of general interest, but this is not NERC's role to administer such a study.

### **RHS**

Although this is a necessary step, this should be closely linked to the plans for digitisation of collections. Increased access to collections online will speed up the work of researchers, not just in the UK but worldwide; it will also reduce the wear and tear on specimens. The greatest value of the collections otherwise is to those that actively work on and curate them: if there is any rationalisation of holdings, then this needs to be based on recognising centres of excellence in particular taxon groups or regional

specialisation. It is to be hoped that the outcome of such a study would not result in the wholesale merger of collections, such as has happened in the Netherlands.

While the report does rightly recognise the value of living collections with regard to fungi, for plants there is a vital link to living collections in botanic gardens and other custodians of genetic diversity that does not seem to have been picked up. These are almost as important (and in some people's view more important) than the dried collections, the herbaria. The recognition of the value of living collections, whether of fungi and other micro-organisms, or of plants, to the work of the taxonomist is essential.

### **BBSRC**

Taxonomic collections vary in their nature. To BBSRC, such collections would include electronically-stored information such as genomic sequences; protein sequences, structures and folds; as well as both living specimens (eg willows, *Miscanthus*, pulses, brassicas, algae, fungi, bacteria, viruses) and preserved specimens such as those found in museums.

### **The Linnean Society**

The status of natural history collections throughout the UK is an area of concern. It is not just the distribution of the UK's taxonomic collections, but also the quality of their curation, the extent of their taxonomic coverage, and their level of public usability that need to be examined. There is a need to secure access to and proper curation of this wealth.

If the collections are secure, well curated and accessible (especially via digitization) their geographical position is not so critical – but they are unlikely to receive investment unless they are used actively. A national review should be instituted. Coordination should be a high priority – perhaps with local museums working actively with regional or national hubs. Potential collaboration with NatSca (The Natural Sciences Collections Association) – the subject area specialists - should be considered. The NFBR (National Federation for Biological Recording) produced a 'conference proceedings', with key recommendations, aimed at enhancing the status of UK collections, about 6 years ago. This could form the basis for examining the multiple uses of collections and their management.

Collections and related data can be used as predictors of the future, supporting species management and conservation. The Linnean Society is currently planning to develop a pilot project which brings local museums, together with local natural history societies, schools and universities designed to 'free' the collections for use and facilitate closer working and opportunities. There should be open discussions with representatives of appropriate authorities to highlight the importance of natural history collections held in museums and the importance of taxonomy within the museum sector, and we should promote and encourage increased use of such collections for teaching. We need to develop strategies to ensure that important private natural history collections are safeguarded in the long term. This is increasingly important as new material is collected by volunteer experts and will be lost unless there is a serious plan secure private collections within longer term institutions. The emphasis at present is solely on

museums, but in the UK the wider community private collections have a strong role to play (see also 7 below) – and the Linnean Society is well placed to identify these.

### **NHM; RBG Kew; RBG Edinburgh**

We agree that such a study should be undertaken, especially given the lack of curatorial resources in some regional museums and universities and the opportunities presented by digital approaches to collections. The study should aim to review the current situation, scope potential ways forward under a national strategy, and make recommendations.

The group undertaking the study should include not only the holders of major collections but also holders of smaller and ‘at-risk’ collections, potential users of those collections, and representatives of the broader stakeholder community. The group should also seek to ensure that the study takes into account the broader context of international collaborations in collection digitisation.

We anticipate that solving the issues raised by such a study could be very challenging in terms of the scale of the task, the resources required to implement a joined-up strategy, and the network of administrative and sponsoring bodies involved. Nevertheless, we would be happy to be involved in such a study and in the case of some areas of activity, such as plant, algal and fungal collections, it may be appropriate for our organisations to take a lead role in a review. Again, however, it would be crucial to involve a wide range of collection organisations, users and stakeholders.

### **National Museum of Wales on behalf of CyMAL, Welsh Government**

There is clearly a crisis in funding, especially in the non-national museums that undermines the care of collections and the staffing levels with appropriate biological or geological training. The Linnean Society and NATSCA are formulating a review and we support this. Your wording of this question is unwise as any indication of the redistribution of collections will receive an immediate, very negative, response from many quarters. Rather we suggest a review to identify the potential roles of collections e.g. ability to support taxonomic research or, only supporting biological records or, suitable only for public education. Once this had been achieved we would expect to find that a relatively small proportion might be considered for re-distribution. The bigger question is probably, which institutions have spare capacity to take extensive collections?

6. There is no viable funding model for collections in universities and HEFCE should work with HEIs to resolve this situation (which may involve collection consolidation and transfer)

### **NERC**

Not relevant to NERC

### **RHS**

The herbaria held by university departments are often at grave risk of being lost or destroyed through lack of any staff or students to work on them, or to explain their value to those who are responsible for these resources and the budgets required to



maintain them. That these collections can be lost without any attempt to relocate them borders on negligence. There is, however, as the report recognises, an active group, NatSCA which has saved collections if it has been able to intervene early enough and we would strongly recommend their strategic involvement in any plans to support collections in universities. However, this does not address the prime reason for the loss or neglect of these collections – the decline and loss of the teaching of taxonomy and systematics in the universities. These collections (both living and dried) were built up to support teaching activity and it seems unlikely that universities will be willing to maintain collections without some kind of external funding.

### **BBSRC**

Not relevant to BBSRC

### **The Linnean Society**

We strongly agree that funding needs to be made available for the proper curation of such natural history collections, and these collections should be available for the purposes of research and teaching, especially given the worrying decline in whole organism expertise.

Universities might wrongly consider that as long as they have a list of specimens on a website, the collections themselves can be left in an attic. Universities and schools should see a need to do whole organism identification – this is not the current position. It may be more efficient to consolidate unmanaged university collections into regional/local museums – perhaps using the travelling curator approach to cover a range of collections and ensure they are being protected. However, to ensure security of the collections, it would be better to secure the appropriate data-basing and digitising of these collections, and better by far would be to encourage HEI to reinstate taxonomy teaching and research. Modern UK-collected material is often registered as a biological record; the missing element is information on where the specimen is located.

### **NHM; RBG Kew; RBG Edinburgh**

We support this recommendation but, given the current higher education landscape in the UK, would be surprised if it were to emerge as a high priority for HEFCE or most HEIs in the immediate future. It may therefore be sensible for the TCC to first focus on developing a robust national strategy and then seek participation from HEFCE and HEIs in pursuing that strategy. If this approach were to be employed, the terms of reference for the TCC should include the aim to develop an approach regarding the funding and long-term security of UK collections in HEIs.

### **National Museum of Wales on behalf of CyMAL, Welsh Government**

Our experience is that universities that lack their own museums are very poor at recognising collections that should be preserved and frequently make no attempt to preserve collections at all. Rescuing unwanted university collections is not an infrequent task. Working together with national museums and regional hub museums should be formalised and museums roles be recognised by their funding agencies.

### **HEFCE**

HEFCE allocates special funding to support university museums, galleries and collections where these make a substantial contribution to the national HE system, including research, at a significant cost to the host institution beyond what is needed to meet the needs of their own staff and students. This element in the Council's grant was last reviewed in 2010, when it was open to any HEI in England hosting a taxonomic collection of national significance to apply for funding. In 2012-13 we have allocated £10.5 million to support 31 collections across a broad range of academic fields.

7. Moves to collection digitisation should continue with investment concentrated on priority resources.

### **NERC**

This is a key area of focus for the overall strategy, but not an area where NERC has neither the resources nor indeed the remit to fund such a substantial piece of work.

### **RHS**

As an organisation that is in the process of digitising its collections, we strongly support this proposal. Access to digital images online has provided a major enhancement to the work of taxonomists, and access to the data supports the work of conservation through mapping of past distributions. It may be obvious, but since this is already an international activity, the UK's efforts need to be complementary to what is being carried out elsewhere. The report elsewhere recognises that taxonomy and, to a lesser extent, systematics has a strong and active volunteer component that doesn't always have access to the resources of the major research institutions. Online access to our collections will be important for them and a heightened profile for UK collections, or plant collections at least, could be gained by following the model of the Australian Virtual Herbarium (<http://www.chah.gov.au/avh/>), and extending wider (citizen science) involvement in herbarium curation through such initiatives as the UK's Herbaria United <http://herbariaunited.org/>

### **BBSRC**

This is a sensible managerial position. It would be impossible to perform species by species with the resources allocated without some kind of prioritisation.

### **The Linnean Society**

We agree, but some wider base is required to develop criteria for prioritisation. Currently, the Linnean Society, with generous grants from the Mellon Foundation, is digitising a number of collections and making these freely available on-line, so facilitating global access. We believe this is key to making collections readily available for research and teaching purposes. We continue to explore opportunities for digitisation of UK museum and international collections to increase their accessibility. It must be noted however that digitization of specimens from many organism groups is time-consuming as microscopic preparations need to be made – external images of dried fungal specimens are of rather limited value, for example.

### **NHM; RBG Kew; RBG Edinburgh**

We agree that a national strategy should include an ambitious and imaginative vision for the development of digital collections and resources. There are several major international initiatives and platforms in this area and our organisations are happy to support this approach. With respect to the TCC per se, however, this is one of the areas where we need to be careful to differentiate between those issues that should be considered by the TCC as part of a national strategy and those issues that could or should be stipulated by the TCC. In this case we see this as an issue where the TCC should seek to develop a joined-up strategy but not one where it is possible for the TCC to stipulate exactly how resources will be invested.

### **National Museum of Wales on behalf of CyMAL, Welsh Government**

We agree with this while noting that “priority resources” require all party agreement and should perhaps be largely “user-led”.

8. As part of a co-ordinated global programme, major taxonomic organisations should take the responsibility for leading the provision of resources for particular taxa

### **NERC**

Not relevant to NERC

### **RHS**

This recommendation does give some cause for concern. There is no co-ordinated global programme for this and dividing up the taxonomic groups and regions of the world between the major taxonomic institutions in the UK has been done before, to varying degrees of success. If the national strategy arrived at by the proposed TCC can convince those responsible for its implementation that there is a need for the UK to have this kind of coverage, then reviving the Morton Agreement may make sense. It would seem, though, that there is merit in identifying areas of expertise (either in taxonomic groups or in regional biota) of national or international status in the UK and ensuring their sustainability. There is a risk in concentrating the responsibility on the major taxonomic institutions in that valuable contributions from elsewhere are needlessly excluded. A properly constituted TCC, as suggested in our response to Q.2, should be asked to manage this.

One possible model, which is already happening to some extent, is to create virtual collaborations to enhance expertise in a group. This way, the expertise is not concentrated physically in an institution but can be built up by linking experts working across the country. Such programmes are already funded by the EU to promote international working but could well be applied nationally as well. There are already such online collaborations and these should be encouraged rather than assigning taxonomic groups to different institutions.

### **BBSRC**

Not relevant to BBSRC.

### **The Linnean Society**

The national strategy will help to achieve this and highlight priority taxa and resource gaps. The concerns of the wider community focus around succession planning for taxonomic specialists and the maintenance of a sufficient breadth of expertise across taxa, and these need addressing.

This should include active coordination of dispersed resources within the UK. Especially important is that vulnerable groups are effectively championed, and that resources are assigned according to national need and not necessarily to groups with good REF (Research Evaluation Framework) prospects. Global coordination is to be applauded, but the UK has incomparable collection resources that are significantly under-used, and we must recognize that their acquisition brings along with them responsibility for their active use. It would not be reasonable to cede responsibility overseas for particular organism groups if the UK has all the resources needed to study them.

Overall, there is an opportunity and need for leadership to contact the dispersed taxonomic community. A follow-up Linnean Society organised Plenary meeting in, say, Autumn 2012, could identify concrete suggestions about how to achieve an alliance to provide the biodiversity analysis required for further decisions on ecosystem future. In this respect, the targets set in the NEA (National Ecosystem Assessment) document provide a framework on which taxonomists could unite.

In addition to compiling a complete list of taxa for which we have little or no UK expertise, The Linnean Society recognises the need to develop a register/formal network of taxonomists, urgently review recruitment prospects for taxonomists, develop a co-ordinated policy of succession planning across institutions that employ taxonomists, and increase training for taxonomists and volunteers in new technologies as part of maximising opportunities for collaboration. There needs to be a clear distinction between the resource gaps relating to primary taxonomic coverage (alpha-taxonomy), and resource gaps relating to the training of identifiers. Simply prioritising funding for taxa where we have little or no expertise may fail to secure funding.

### **NHM; RBG Kew; RBG Edinburgh**

Again, while we support the development of a national strategy that takes a global taxonomic perspective, we suggest that taxonomic specialisation is something for the TCC to consider but should not be a prior stipulation. Coordinating global effort would be very challenging and is probably better done by other bodies, some of which already exist. We also believe it is important to avoid any possible perception of dividing up empires like the old days. Perhaps the TCC could also consider recommending areas of specialist expertise while accepting that localised collections and expertise are sometimes needed for service delivery and for collaborative programmes.

### **National Museum of Wales on behalf of CyMAL, Welsh Government**

The definition of a “major taxonomic organisation” is unclear. The UK TCC should lead on this from a UK perspective rather than a single institutional perspective.

9. For most groups, molecular and morphological taxonomic approaches should advance together though for certain microorganisms, concentration on molecular approaches (as has happened with bacteria) will be most efficient.

**NERC**

NERC would not disagree with this statement.

**RHS**

We would emphasise the need for equal recognition of the value of both morphological and molecular approaches where possible, and that molecular methods should not be seen as the ultimate answer to taxonomic and systematic questions. There is a range of techniques that can be used in taxonomic studies, such as metabolite chemistry, ecological or behavioural characteristics, genetics etc. and these should not be overlooked as they give valuable insights in interpreting the results of molecular analyses.

**BBSRC**

BBSRC's main interest is in genomic approaches and subsequent phylogenetic analysis. Molecular approaches to micro-organism taxonomy is the only viable approach to take.

**The Linnean Society**

We agree and emphasize the importance of properly labelled voucher specimens being deposited in public domain collections, in order to permit subsequent re-examination and verification by taxonomists, and ensure repeatability.

**NHM: RBG Kew: RBG Edinburgh**

Agree. In general we believe that the appropriate approaches should be used to achieve the desired or agreed outcomes. We hope that this is now widely recognised in the community so it will be possible for the national strategy to move on from the old morphology versus molecular dichotomy.

**National Museum of Wales on behalf of CyMAL, Welsh Government**

We agree that the molecular approach adds greatly to our understanding of phylogenies but in the majority of higher organisms the nomenclature and identification remains based in morphology. Morphology based taxonomy should not be discounted especially when suitably preserved material for a molecular approach are unavailable. Morphology will remain the primary character set for identification guides. This is very much the type of debate we would expect to see at the UK TCC.

10. The TCC should co-ordinate the development of a costed road map to provide appropriate identification tools for all UK organisms.

**NERC**

A roadmap would seem a sensible addition to an overall strategy; however, it would be valuable to have greater clarity on exactly what it would be used for.

### **RHS**

While this is a very worthy recommendation, this should not be a priority for the TCC. It goes without saying that these tools should be online applications. We would also urge support for greater linkage between taxonomic databases and databases dependent upon taxonomic information.

### **BBSRC**

A roadmap is fine but it is in the implementation of the roadmap that the problems are likely to emerge. If the origins of the TCC are not trusted by the community, then co-operation in the implementation of the road map is likely to be a challenge.

### **The Linnean Society**

The Linnean Society strongly supports this and actively welcomes the suggestion. The Society recognises the immense value of a large-scale project to record and analyse UK biodiversity - leading to the production of identification tools. There is a need for taxonomists who can respond to a broad range of unpredictable situations, such as invasion by alien species and those who can provide critical baseline reference data. Without such critical baseline data, much of the applied work may not be possible. It will be important to know what the public perceive to be important and with a wider alliance of workers this should be easier to discover. For example, how much concern there really is about alien species. While the public's views are important, the emphasis needs to be on a comprehensive project rather than one that focuses exclusively on popular topics such as birds. The Synopsis Series supported by the Society provides an example of a highly respected identification tool.

### **NHM; RBG Kew; RBG Edinburgh**

Again, while our organisations support the creation of UK biodiversity tools we believe that this should be something for the TCC to consider rather than a stipulation. Having said that, we believe that the development of tools of this type is an achievable target if it were to be identified as a priority. Ideally, we would like the approach to be extend to all organisms of relevance to the UK, as part of regional and world-wide identification efforts to reduce duplication.

### **National Museum of Wales on behalf of CyMAL, Welsh Government**

We recognised above the provision of taxonomic tools as a major strand in the strategy. Priorities may well be “user-led” and “costed” should include overcoming the lack of expertise in certain groups able to provide such tools.

11. Taxonomy in support of conservation in the Overseas' Territories should be considered a priority for UK Taxonomy & Systematics Strategy

### **NERC**

Not relevant to NERC

## **RHS**

The RHS offers no view on this.

## **BBSRC**

Not relevant to BBSRC.

## **The Linnean Society**

The UK's Overseas' Territories undoubtedly possess huge biodiversity, much of it probably undescribed to date, and it is vital therefore that the OTs are a priority component part of the UK Taxonomy & Systematics Strategy. The Linnean Society has clearly demonstrated its appreciation of this by convening scientific meetings around OTs, such as the November 2011 meeting on the Chagos Archipelago Marine Protected Area. The Linnean Society's Executive Secretary chairs the Chagos Environment Group.

The responsibility of national museums and gardens extends beyond UK interests to conservation and use of material accessed worldwide.

## **NHM; RBG Kew; RBG Edinburgh**

Agreed. Getting the taxonomy right is essential for conservation and management purposes. Most UKOTS are islands with a high proportion of threatened taxa likely to be exacerbated by climate change.

## **National Museum of Wales on behalf of CyMAL, Welsh Government**

The UK has an enormous legacy in its taxonomic collections not only from our existing overseas territories but across the former empire. We should use this legacy where appropriate and where there is demand as promoted by the Convention on Biological Diversity and overcoming the global taxonomic impediment. Where we have biodiversity duty as in our territories, then giving priority there seems appropriate.

12. NERC should continue to support PhD training in taxonomy and assess the consequences of its recent decision to stop supporting taught masters

## **NERC**

In early 2012, NERC announced new changes to the way in which it supports postgraduate training. In essence, NERC Council agreed:

- That additional effort should be invested in the management of our PhD and wider postgraduate training portfolio to ensure that the students trained had the best possible experience, and so that we can clearly link the investment to the impact training highly skilled people has.
- That NERC should move to more competitive mechanisms for allocating its training investment, specifically concentrating studentships within community-led clusters of excellence; doctoral training partnerships.

- That these changes should be implemented in a manner which allows students starting in the academic year 14/15 to benefit from the changes, at the latest.

- That NERC will establish a Training Advisory Group (TAG); to provide advice to the NERC Executive, on key questions relating to the strategic direction of NERC training, the particular issues which NERC needs to address in deciding on its training priorities. This group will look at evidence, such as The UK Taxonomy and Systematics Review and the NERC led Skills Needs in the Environment Sector Review (which both identified the Taxonomy and Systematics Skills gaps) to tension focused training priorities and advise on any NERC investments in this area. The Training Advisory Group is due to look at focused training priorities early 2013. First student starts for changes to our focused training priorities would be the academic year 14/15 at the earliest.

### **RHS**

As providers of taxonomic services we depend upon a continuing supply of well trained graduates and although the RHS has now started to fund/co-fund a limited number of PhD studentships, some of which are taxonomic, we support the role of grant-awarding bodies, such as NERC, in funding post-graduate studies. Although not funded by NERC, the University of Reading's Plant Diversity MSc has been an important source of trained staff for the RHS. Of the six botanical staff we currently employ, four have been trained at Reading.

### **BBSRC**

Not relevant to BBSRC.

### **The Linnean Society**

Strongly supported; the real issue in universities seems to come down to the fact that new lecturers are recruited on their track record in fund raising, and in papers in high impact journals – this is a problem for taxonomists. NERC funding for higher degree training can be difficult to implement, but it can be made to work. There is no reason why, for example, Kew or the Natural History Museum, with strong University links should not continue to act as the coordinators of such projects. Ideally, the Research Council UK via NERC should support a bespoke MSc training programme in taxonomy and systematics. The TCC could be better placed than NERC to assess the consequences of NERC's recent decision to stop supporting taught Masters.

The Linnean Society is looking at alternative methods of training the next generation of taxonomists using a flourishing volunteer sector, as well as grappling with the university course issue. It should be noted that much of the volunteer sector is already retired. Their input is invaluable from the mentoring viewpoint, although it must be recognized that mentoring has a substantial time cost to the mentors themselves. The knock-on effect of a dilution of practical biology within primary and secondary education, and a reduction in appropriately trained staff, is reflected in the paucity (in number, not content) of available undergraduate courses.

In addition to its Systematics and Taxonomy Committee, the Linnean Society is developing a programme of education, under the Society's current Strategic Plan, with



the intention of expanding existing opportunities for inspiring children about the natural world. Priorities are to collaborate as a community to influence education policy with the aim of including whole organism biology and fieldwork as compulsory elements of the science/biology curriculum at all stages of formal education, including Higher Education and teacher training; to collaborate as a community to influence more appropriate evaluation of taxonomic and systematics research to improve employment prospects and career progression.

It is also important to encourage current experts to write keys, as well as to make existing UK and international keys available via a central website.

**NHM; RBG Kew; RBG Edinburgh**

Strongly agree. The Master's courses at Reading, Edinburgh and Imperial, for example, have been a primary source of staff for our organisations. In our opinion, vocational (i.e. part taught) training, such as that in MSc courses, is essential for the development of the field and such courses play a very distinct role from other specialist training programs.

**National Museum of Wales on behalf of CyMAL, Welsh Government**

We agree but also the taxonomic deficiency appears to begin much earlier on with a lack of whole organism biology at the undergraduate level. We realise that the research councils have little influence at this stage but this is relevant to items 13 and 14.

13. NERC should take the lead in addressing a deficit in training in taxonomy for micropalaeontology which is of great concern to the private sector

**NERC**

UK Taxonomy and Systematics Review, including this specific recommendation, will be part of the evidence presented to the NERC Training Advisory Group when it considers and tensions focused training priorities. It is due to advise NERC on investments in this area early 2013. First student starts for changes to our focused training priorities would be the academic year 14/15 at the earliest.

**RHS**

The RHS offers no view on this.

**BBSRC**

Not relevant to BBSRC.

**The Linnean Society**

The apparent gap between laboratory based taxonomy (grant funded) and those recording in the field (often volunteers) needs to be closed. There is no means of formal dialogue between those who require trained taxonomists (e.g. environmental consultancies, mining companies) and potential trainers. In other subjects, Universities do try to find out what is required by industry and tailor courses to match. In taxonomy, this does not earn them much money or provide widely cited research, although industry has complained about the lack of suitably qualified graduates. On the other hand, in

those centres where taxonomy could still be taught there is no mechanism for identifying this need.

**NHM; RBG Kew; RBG Edinburgh**

We recognise the importance of micropalaeontology but again consider that this should be something for the TCC to consider rather than a stipulation because there are several areas that could be relevant in this sense. We suggest that this recommendation should be broadened to identify areas that may be of being high priority now or in future, and/or where gaps in expertise exist or are likely to exist.

**National Museum of Wales on behalf of Cymal, Welsh Government**

This is a case of user need, and while NERC should note this lack in UK capacity the users should be encouraged to contribute to the training.

14. NERC should explore whether lack of training opportunities is the reason for the difficulty in recruiting trained taxonomists by environmental consultancies

**NERC**

NERC has identified a problem in recruiting in this area; however, it is still unclear whether it is a supply problem associated with training. The NERC Skills Review has been recently refreshed (due for publication Autumn 2012) and again confirms the Skills gap in this area. The Skills Review will be another key source of information for the Training Advisory Group when they discuss NERC focused training priorities.

**RHS**

The dearth of taxonomists in the UK for environmental consultancies – but not these exclusively, there is a similar lack of mycologists and specialists in other disciplines for applied work - is a complex problem. Principally there is a lack of teaching of whole organism biology in schools, and this has been recognised by the specialist societies (e.g. The Linnean Society), which are actively seeking to address this. Further, the limited employment opportunities and career path for those with a taxonomic training is a major disincentive for those considering their future. Employment in these positions is often poorly paid, especially in the private sector. Although pay should not be a critical consideration in vocational employment, the economic reality, especially for those working in the South East, is that such employment is not always viable. Therefore the lack of exposure to taxonomy at school level, combined with the poor career prospects, mean that there is little demand for this kind of teaching at university level, as indicated by, for instance, the declining number of students taking botany degrees over the past 20 years. We would suggest that the issue is more about generating interest in taxonomic studies and therefore creating the demand, before putting pressure on the universities to provide the training.

**BBSRC**

Not relevant to BBSRC.

### **The Linnean Society**

There are numerous emerging models - new ways of getting and delivering training with a range of partners. It is good to recognise this. We need better dialogue between training providers and groups of users - such as the commercial consultancy companies. They complain, with justification, that they find biology graduates lack training relevant to their sector, and must provide the training themselves. The Linnean Society has a potential role here, fostering dialogue, bringing potential partners together, etc.

There is concern within the community that there is no nationally recognised standard for individuals who undertake survey work and that this may compromise the quality of data that are collected. A training programme, with accreditation, would help to ensure data quality and provide support for both employer and client.

There is a "clearing house" role that the Linnean Society is already moving towards - with regard to providing information on available courses – a directory of training courses relating to taxonomy and systematics, including their costs, is in preparation and will serve as an access point to wider training possibilities. While this database is a most useful resource, it should be emphasized that almost all of the available courses focus on identification (especially of groups that are already well-known) rather than on taxonomy. We need to differentiate between capability in pure identification and taxonomy. However, it must be remembered that the training landscape changes fast and so any structures established must not be too rigid.

### **NHM; RBG Kew; RBG Edinburgh**

Agree. We think the TCC should consider how a coordinated training program can be put in place. It may be possible to pull together an effective national strategy based on the currently disparate training programs run by individual organisations.

### **National Museum of Wales on behalf of CyMAL, Welsh Government**

Exploring this issue is worthwhile but it is the lack of introduction to whole organisms at under-graduate level that denies students the basic understanding of animal and plant morphology required to become proficient identifiers. We would say that most of those people working in consultancies are identifiers not taxonomists in that they do not undertake taxonomic research routinely if ever. This is a distinction that confuses the whole issue of taxonomy as we are not distinguishing the users from the providers.

15. All organisations receiving funding for national capability in taxonomy should include in their remit the facilitation of volunteer scientists

### **NERC**

NERC's current use of the term "national capability" would not include a financial provision for volunteer scientists; however, the interaction between volunteers and the scientists within some of our research centres is encouraged (e.g. amateur geologists liaising with scientists at NERC's British Geological Survey)

### **RHS**

As an organisation that works with and benefits greatly from volunteers we would certainly support this. Working with volunteers brings its own challenges, and a part of this requirement should be a need for organisations that currently have volunteer scientists working alongside their staff to share good practice with those organisations that currently do not, but will need to.

### **BBSRC**

This depends on how you classify what is “national capability”. At present BBSRC would argue that at present, the classification is too narrow. If broadened to include e.g. EBI, then this recommendation cannot be wholly correct.

### **The Linnean Society**

The Linnean Society recognises the important contributions made by volunteer scientists and endorses this recommendation.

### **NHM; RBG Kew; RBG Edinburgh**

Our organisations support volunteer schemes but we suggest that this is another area that that should be considered by the TCC rather than a stipulation. We also suggest that this recommendation could be usefully broadened to ask the TCC to consider the role of amateur networks and local organisations.

### **National Museum of Wales on behalf of CyMAL, Welsh Government**

The UK is well known for its relatively large population volunteer scientists, primarily those contributing to biological recording through many societies. The apparent decline in this population is recognised and in Wales we are beginning a co-ordinated programme to ensure its continuation.

### **Department for Culture, Media and Sport (DCMS)**

The DCMS does not hypothecate the grant-in-aid funding provided to its sponsored museums. The NHM is responsible for deciding whether to support particular programmes of activity.

16. Provision of small grants for volunteer scientists and recognition of their contributions by learned societies and other bodies should be encouraged

### **NERC**

Not relevant to NERC

### **RHS**

It would be hard to disagree with this. However, many of these grants do exist but are either can only cover a few awards each time, are very specific in their nature, and their existence is not well known. Part of the encouragement should be to collate information about these grants (and any new ones that are established) and make this information known in one place. Rather than add this to the role of the TCC, which really has a

more strategic function, perhaps one of the larger learned societies could be invited to undertake this.

### **BBSRC**

Not relevant to BBSRC

### **The Linnean Society**

The Linnean Society can continue to provide links between the work of volunteer organisations and the work done in, say, the Botanic Gardens and Natural History Museum, which is backed by Government and Research Council funding. The Society has managed the BBSRC/NERC-funded SYNTAX programme for small projects, and notes with regret that it will finish shortly.

Long-term progress in fostering and training volunteers will only be made through community collaboration. Much of the UK's biological recording depends on such people.

### **NHM; RBG Kew; RBG Edinburgh**

Agreed. These small sources of funding support a broad range of taxonomic work for which there are few other sources of support. Such funding schemes also often act as a catalyst for collaboration between organisations and between professional institutes and the expert amateur community.

### **National Museum of Wales on behalf of CyMAL, Welsh Government**

Agreed.

17. The TCC should bring together the UK taxonomic community to list and prioritise time limited major research programmes or “grand challenges” that would advance UK taxonomy and systematics

### **NERC**

NERC is keen to work with the TCC to help define and prioritise the scope of these “grand challenges”.

### **RHS**

These would go a long way to bringing about an enhanced understanding of the value of taxonomy of systematics for key audiences that seem to accept the need for a new particle collider or a bigger space telescope which bring little benefit to humans but do a lot to increase our understanding of the world around us. The key audiences include, of course, the funding agencies and the donors, as well as the politicians and policy-makers, and the general public. Less emphasis should be placed on ‘time-limited’, an element that appeals to the funders, and more on the “big questions” that spark enthusiasm and interest, and would in time reverse the trend discussed in our response to Q.14.

### **BBSRC**

BBSRC would need to work more closely with the TCC, because the current suggestions for “grand challenges” are unlikely to be of great relevance to BBSRC.

### **The Linnean Society**

The Society agrees that to unite the efforts of the Taxonomy and Systematics community in this way would require a “cause” or a major project, to be achieved. The DEFRA UK National Ecosystem Assessment published in summer 2011, provides an example. To make the right decisions for the future, understanding UK biodiversity is vital and urgent. Another message was that this requires adoption of a more integrated approach rather than the conventional sectional approach to ecosystem management. As outlined above, the Society does have a convening ability for UK organisations, including those which are not fully in touch with government and academic institutions.

### **NHM; RBG Kew; RBG Edinburgh**

Agreed, but with the clear objective to not detract from valuable service delivery and discovery work that needs to continue to operate across the board.

### **National Museum of Wales on behalf of CyMAL, Welsh Government**

We recognise above the need for the TCC to consider grand challenges.

18. The Research Councils should continue to provide competitive funding to support excellent science involving taxonomy that comes within their remits and ensure their committees contain the appropriate expertise

### **NERC**

NERC’s responsive mode remains open to support taxonomy. For example, we recently funded a large (£ca. 2m) consortium project involving the Natural History Museum, Kew Gardens and University of Oxford through our responsive mode consortium grant scheme. The project, Global Biodiversity Resource for Monocot Plants (eMonocot), will provide the first web-based taxonomy of monocots.

### **RHS**

The report in paragraph 10.2 has rightly observed that it would not be appropriate to ring-fence funding for taxonomy, but there is a pressing need for the Research Council committees to take into account the different scientific tradition and the longer-term nature of taxonomic research when assessing applications for funding. All too often project applications that are intended to address taxonomic or systematic questions, mask this with other more currently topical issues, to increase likelihood of funding. While it would be welcomed to have more expertise relevant to taxonomy and systematics on the committees, this would be unlikely to change the current situation unless the mindset of their non-taxonomic colleagues also changes.

### **BBSRC**

The research councils already provide such mechanisms and have also provided several years of funding for pump-priming schemes (Cosyst, SynTax) to help investigators generate primary data to improve their chances of gaining grant funding.

BBSRC has struggled in the past to ensure there is appropriate expertise on its committees. There is an open recruitment process held each year and despite considerable effort in the past, BBSRC has been disappointed by the lack of participation from the taxonomy community in its enthusiasm to join BBSRC committees. This is also reflected in the lack of enthusiasm for submitting taxonomy-based responsive mode grant proposals.

### **The Linnean Society**

This is taken as read. The Linnean Society will be pleased to recommend suitable individuals with appropriate expertise to sit on the grant-awarding Research Councils' Committees.

### **NHM; RBG Kew; RBG Edinburgh**

Strongly agree. Research council funding is a key source of funding for potentially transformative innovations in the field and has played a key role in supporting the development of new approaches that have subsequently become industry standards. Research council funding is also an important source of support for projects that integrate taxonomic and systematic expertise into interdisciplinary programs of research.

### **National Museum of Wales on behalf of CyMAL, Welsh Government**

While we agree, we might find some difficulty in agreeing on what constitutes excellent science involving taxonomy and would like to see a broad church on the relevant committees.

19. NERC and BBSRC (and where relevant MRC) should ensure their support of taxonomy is coordinated and complementary

### **NERC**

NERC continues to work together with BBSRC in this area, and co-funds, for example, the SynTax scheme, administered by BBSRC, which aims to: (i) stimulate the submission of high quality taxonomy and systematics-related research proposals to the UK's Research Councils and (ii) improve representation of systematics and taxonomy in the UK Research Council's portfolio.

### **RHS**

The RHS offers no view on this.

### **BBSRC**

BBSRC and NERC already share a great deal of knowledge and expertise on taxonomy through:

(i) the continued joint support for the BBSRC-led pump-priming scheme SynTax (with NERC and DEFRA) and

(ii) in responsive mode using the cross-research council agreement to co-fund grant proposals that cross the remits of BBSRC and NERC.

**The Linnean Society**

See comments above under (18). Given such a plan endorsed by a large group, various government departments are more likely to provide support. Confining the issue to the UK may have to be the role of the proposed TCC but factors like global warming mean that there are international challenges to biodiversity that still need debate. The Society with its international membership can provide facilities for that.

The Society, because of its independent constitution can comment on matters that government funded institutions and NERC might find difficult to address.

**NHM; RBG Kew; RBG Edinburgh**

Strongly agree. We believe that joint programs across these research councils would stimulate the community to identify and engage with the key challenges in the field.

**National Museum of Wales on behalf of CyMAL, Welsh Government**

Agreed.