

## Taxonomy at a crossroads: science, publics and policy in biodiversity

### Introduction

The proposed research is concerned with a radical and rapid re-ordering taking place within the taxonomic sciences – those sciences which classify organisms in the natural world and underpin society's understanding of life and its diversity, value and utility. It will be a cross-disciplinary study that will develop further an already successful collaboration between academic sociologists and anthropologists (Lancaster University) and natural scientists working within the UK Biodiversity Group at the Natural History Museum, London. A key strength of this collaboration has been its ability to a) identify and b) work together to address the existence of a problematic neglect of the 'social dimensions' of biodiversity policy within scientific and policy institutions. Building on this ESRC research ('Amateurs as Experts'<sup>1</sup>), the current proposal is to create a social science-natural science partnership which will both study current shifts taking place in taxonomy and intervene in current taxonomic debates.

The taxonomic sciences have been described as being in 'crisis' (Royal Society 2003, 2004). Yet at the same time they are also undergoing something of a DNA-based revolution. A 'genetic re-writing' (Rabinow and Rose 2003) is being hailed as the 'frontier of understanding biodiversity' (Miller et al. 2004: 20) offering a speedier, more efficient, technologically appropriate and more accessible alternative to traditional morphological taxonomic approaches. Advocates of a DNA-based approach emphasise within their claims the more powerful capacity of DNA-based taxonomy and associated ICT and web-based technologies, to accurately and swiftly document biodiversity and to represent their findings for multiple users in globally accessible ways. At the time of writing (June 2005) questions about the relationship between molecular and morphological techniques and the allocation and distribution of resources between new DNA 'bar-coding' techniques and more conventional taxonomy are being negotiated and starting to crystallise within some of the world's leading taxonomic and policy institutions. As such the research's *timeliness* is important.

The research's *scope* is also important. The reconfigurations taking place have two kinds of implications, both of which have implicit, yet often un-debated, social, public policy and political/governance dimensions. First, such shifts have direct implications for **science policy and public policy** in the domain of local, national and global biodiversity (CBD 2001; Royal Society 2003). Relevant questions arising here are: how and where should an appropriate 'science-base' be fostered and supported in the different areas (morphological and molecular) of taxonomy? How is 'good science' to be defined in an area of shifting global policy commitments? What are the social dimensions of this? How can different taxonomic communities best contribute to national and global biodiversity policy?

The second set of implications encompasses **institutional, bio-political and governance dimensions of shifts in knowledge production within taxonomy**. As the social sciences and humanities have documented, natural history, taxonomy and other ostensibly 'scientific' classificatory pursuits have always been 'co-produced' with dominant social, political and cultural trajectories and visions (Foucault 1992 [1966], Thomas 1984, Richards 1993, Grove 1995). Seen from a social science perspective, taxonomy encompasses not only thoroughly social practices and relationships, but can be described as a thoroughly public science (Wynne 2005), containing within it knowledge/power relations and an implicit

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<sup>1</sup> The study we refer to is an ESRC funded project 'Amateurs as Experts: Harnessing new Knowledge Networks for Biodiversity', 2002-2005. The outputs of the research are listed on <http://www.lancs.ac.uk/fss/projects/ieppp/amateurs/dissemination.htm>

imagination of the public and societal role of classifying and ordering the natural world. The following questions are relevant in the light of the current re-ordering/molecularisation of taxonomy: which institutional players, nations and geo-political regions can/should develop capacity in the molecularisation of taxonomy? Which should retain and nurture resources in morphological taxonomy? What commercial applications, dynamics of knowledge ownership and production drive molecular innovation in the taxonomic sciences? What changes in relations within taxonomy, and between the taxonomic sciences and society, might these dynamics imply? Are these in tension, or can they be reconciled, with public policy goals?

### **Research aims**

The research aims *first*, through participant observation and interviewing within carefully selected parts of the scientific field, to gain an understanding of scientific practices, how these are changing, and in particular to draw out some of the thus-far rather neglected related social, political, public and policy elements of current shifts in knowledge production. In so doing, the study aims to develop science studies theory and practice in understanding the co-production of science and society - looking in particular at the relationships between the molecularisation of our understandings of life, and the material, human, and bio-political implications of this at local, national and global scales.

*Second*, through interventions, which have been designed with key institutions' endorsements (NHM, Edinburgh Botanical Gardens and Guelph University), the research aims to expand existing frames of decision making so as to more comprehensively take on board social, cultural, political, institutional as well as purely scientific factors in planning for the future of taxonomy. These and other taxonomic players are well aware of the great speed at which new developments are taking place within taxonomy and are concerned that social, political and governance issues should be understood, debated and built into planning and decision making. The research has been designed to facilitate this and will thereby foster several formal and informal yet interconnecting fora for fuller reflection and exploration of these dimensions. In so doing the research aims to support a wider framing of decision making within the taxonomic sciences. Sites and methods of intervention will be i.) the adaptation and use of a consortium-building methodology ('Protée' - see Duret *et al.* 2000) at international scientific Bar-Coding of Life meetings; ii.) participation in international policy meetings (UN Convention on Biological Diversity bi-annual 'COP' meetings and pre-meetings); and iii) informal communications within the multi-disciplinary research team and other actors we engage with as part of the research process.

### **Context: the social and public dimensions of science and policy**

#### *Scientific and public responsibilities and expectations*

An issue of current concern within the natural sciences is the so-called 'crisis' of the taxonomic sciences (Royal Society 2004). Since the Rio Convention on the Biodiversity in 1992, talk of a crisis within taxonomy has been linked explicitly to the premise that we are rapidly losing the planet's biodiversity, and in particular that we lack knowledge of what is being lost, as well as the means to represent such knowledge in accessible ways to end-users both within and beyond the professional taxonomic community. From 1992 onwards, the commitment of signatory nation states to survey and document the extent of biodiversity on their own territories (and to assist developing countries in doing likewise), put taxonomy and systematics on the policy 'map' in a way that was hitherto unprecedented in the history of these sub-disciplines. A decade later, the continuing intensification of concern about global environmental problems (IUCN 2002, Myers and Knoll 2001) twinned with the sobering claim that 'the living world is

disappearing in front of our eyes' has put further pressure on taxonomy and systematics to provide an effective and rapid measurement of the extent of global biodiversity loss (Royal Society 2003, 2004).

#### *The reinvention of taxonomy and its communities*

Within this overarching context (which paradoxically includes both policy pressure upon taxonomy to speedily deliver the facts, whilst acknowledging significant uncertainties within the sciences concerned (Royal Society 2003: 3; CBD 2001)), taxonomy's limited capacity to have any notable effect upon biodiversity policy, biodiversity protection, or the so-called 'taxonomic deficit' have been matters of concern for some time amongst specialists (House of Lords Select Committee 1992, 2002, HMSO 2004). The 'deficit' spells out a new crisis which does not relate only to the loss or extinction of natural species, but also to the loss of human resources within a spectrum of engaged communities who contribute significantly to descriptive taxonomy and whose collective work underpins society's knowledge of biodiversity. These communities include morphological and molecular taxonomists as well as a partly overlapping community of 100,000 amateur naturalist specialists in the UK alone. Facing these communities as a whole is a 'lack of prestige and resources that is crippling the continuing cataloguing of biodiversity' (Godfray 2002:17). Taxonomy's 'image problem' (Hine 1995:3, 2003, Butler 1998: 115) appears to be only part of the picture: Godfray's influential article in *Nature* (ibid) suggests in no uncertain terms that taxonomy writ large needs to reinvent itself as a twenty-first century information science if it is to survive and flourish as a policy-effective body of science.

#### *Controversy, uncertainty and new political debates*

The DNA-based taxonomic revolution outlined above is seen as a response to these critiques. But it is also identified with a more basic scientific premise: that DNA-based taxonomy provides a more definitive basis for natural classifications and species-recording than the long-standing conventional morphological taxonomy based on Linnaean classification rules. Few advocates of a DNA-based taxonomy envisage its development as fully replacing more conventional morphological techniques. Most key players are interested in simultaneously exploring the subtle possible future relationships between more 'traditional' field-based observational techniques, and the development of a global "Bar-coding of Life Database" which will include the deposits of both DNA sequences and whole organism specimens. The stakes are high on this issue, however, as the merits and disadvantages of both morphological and molecular taxonomies, combined with the possibilities of developing a future complementary relationship between them, are being hotly contested at scientific meetings and within the literature (Bown et al 2003, Hebert et al 2003, Lipscomb et al 2003). At the same time, it is gradually being recognised that the new molecular naming of natural organisms provides, in effect, a significantly altered basis not only for responsibility towards nature (biodiversity protection) but also for the potential use, exploitation, appropriation and ownership of nature - as emerging debates about bio-prospecting, bar-coding, certificates of origin and regulation are beginning to explore (Tobin *et al* 2004).

At the time of writing (June 2005) possible taxonomic trajectories are still being laid out and commitments - driving human, natural and technological resource allocation - are taking shape. The research aims to key into a selection of key sites, practitioners and issues within contemporary taxonomic networks, aiming to broaden out reflexivity within natural and social scientific and policy communities, and to create spaces for explicit reflection about the emerging issues of responsibility, expectation, uncertainty and politics outlined above.

### **A science studies perspective**

The history, anthropology and sociology of science have contributed much to our understanding of natural history, classification and taxonomy, showing how classificatory pursuits have always been ‘co-produced’ with dominant social, political and cultural visions and ambitions. The nineteenth century practices of taxonomy within institutions like Kew Gardens, for example, can be seen to be essential components of British colonial rule (Grove 1995; Crosby 1986). Social scientists and historians have also demonstrated how such ordering practices are powerfully ‘performative’: classifications bring into being and usage the very categories of reality that they claim to derive objectively from nature (Foucault 1992 [1966]; Bowker and Star 2002). These historical and theoretical insights are relevant today for the current re-ordering/molecularisation of taxonomy: how far are historical patterns being repeated and is it possible for practitioners to reflect critically on these?

Science studies has conventionally sought to bring to light some of the implicit, tacit imaginings of the public role of science in situations of *controversy* – where implicitly held, unaccountable visions of society become contested once outside of the scientific setting (Martin and Richards 1995). More recently however, several science studies practitioners have wanted to investigate in a more *anticipatory* mode, the ways in which scientific and technical innovations harbour unaccountable, normative notions of society, ‘the public’ or ‘the public good’, or other perceived ‘goods’ such as development or progress. Some authors have suggested a role for science studies in advocating the explicit inclusion of a plurality of viewpoints and contributions to debate at the ‘upstream’, developmental stages of science, technology and policy making in order to address fundamental questions about issues of ownership, control and the social ends embedded in technological innovations. Such moves have come to be seen as particularly important in the present era where globalisation, as Leach, Scoones and Wynne (2005: 3) put it, is: ‘changing the nature of science and technology, as it is being shaped by their development: altering the intensity of innovation of new technologies, the resulting constitution and flows of knowledge and expertise, and the character and scope of risks and uncertainties’. A *deliberately staged* public performance of democratic deliberation and ‘epistemic citizenship’ as opposed to an implicit yet still powerfully performative politics embedded and obscured from view within science, is being argued for as an important component of a more reflexive, hence more accountable and robust techno-scientific culture (Jasanoff 2005; Wynne 1996; Wilsdon and Willis 2004).

The proposed research will address science studies’ central concerns in these areas. Building on research by Duret *et al.* (2000) that has identified certain common pitfalls within innovation in science (including: i) the tendency to focus exclusively on technical developments, neglecting the importance of social, cultural and economic factors; ii) the tendency to discard opposing views as non-rational; iii) the tendency to confine tests, trials and debates to a small circle of those already involved; iv) the tendency to neglect the implicit human – performative dimensions of scientific discourses), the research will also adapt and use the methodology, *Protée*, designed and pioneered by Duret *et al.*, to bring science studies insights to bear in such situations of scientific innovation, so developing the field of science studies and social science more broadly.

### **Methods; and how the study can contribute to science studies**

Building on our collaboration within the ESRC ‘Amateurs as Experts’ study, the multidisciplinary team (see final section of this proposal) made up of sociologists, an anthropologist, botanists and biodiversity scientists *will work and interact as a team*, reacting flexibly to developments in this politically and scientifically emergent field. There are two main elements to the methodology:

**Method 1: Interviewing and participant observation (ethnography) in five key fieldwork sites**

**Rationale for Method 1:** to develop understandings of the ongoing shifts in taxonomic methods including their material, epistemic, public, policy and political dimensions.

**Where used?** 50 semi-structured interviews as well as periods of participant observation will be held across five sites represented in Table 1 below (vertical axis). These five sites have been selected because they highlight different aspects of the scientific debates. NHM, Guelph University and the Smithsonian Institute are global leaders (as custodians and innovators) in taxonomic practice (both morphological and molecular). The British Phycological Society (BPS) and Butterfly Conservation (BC) are voluntary naturalist organisations, both making important contributions to taxonomic and biodiversity knowledge. The BPS uses a combination of molecular and morphological techniques (in the laboratory and in the field) whereas Butterfly Conservation relies almost entirely on morphological taxonomy. Each of the five sites is intended, as a core case study, to act as a prism for understanding wider social, epistemic, policy, and political dynamics within the field. Through participation, observation, and discussions with the actors involved we aim to understand:

- What different taxonomic practices (observation, data collection, validation, curation and representation) occur within different sites and how might recent innovation towards molecularisation affect these?
- In what ways does each site contribute to scientific knowledge?
- How do implicit imaginaries of the public policy dimensions of taxonomy shape scientific practices?
- What might the stakes of different communities be in morphological/molecular approaches?
- In what ways do projected visions of the future shape both conventional taxonomic practice and new technological developments in taxonomy? What kinds of nature-science-technology-society relationships are envisaged within these projected visions?

**Method 2: Consortium building (adaptation of Protée) and attendance and participation in scientific and policy meetings.**

**Rationale for Method 2:** Developing *formal deliberative mechanisms within scientific and policy fora* to disseminate social scientific findings (iteratively) and to augment the reflexive capacities of scientific and policy communities at a time of innovation and change.

**Where used?** Annual consortium building meetings (using/adapting Protée) built onto already pre-planned Bar-coding of Life meetings. Attendance and participation in two Convention on Biological Diversity (CBD) pre-COP meetings (2006 and 2008) and two CBD COP meetings (2006 and 2008) where key scientific *and* policy players will convene.

The consortium-building methodology, Protée, has been pioneered relatively recently in science studies (Duret et al 2000) and will be adapted and applied for the first time to the science of taxonomy in this study. It consists of a relatively formal process designed to exchange understandings relating to scientific innovation, and to build learning and trust in order to experiment with innovation possibilities. Protée offers a means of moving beyond stimulating *informal* reflection upon the kinds of issues we aim to elicit from field work by providing a *formalised, semi-institutionalised* sphere in which science studies researchers and consortium participants will be able to a) deliberate some of the less visible social, cultural, institutional and political visions embedded within taxonomic developments; b) consider as a community how to avoid some of the common pitfalls of innovation commonly seen in science and technology.

## **Communication and dissemination of findings**

### ***Academic:***

- Published papers within anthropology, science studies and relevant social and natural science publications.
- Conference papers in natural/social science and policy fora.

### ***Institutional/ 'user ':***

- A research briefing pamphlet will be designed to highlight some of the institutional, political, public policy and governance implications of current shifts in the taxonomic sciences. This will be aimed towards government departments and institutions sponsoring the main taxonomic institutions (DEFRA, OST, DCMS, SEERAD, the European Commission, Canadian sponsors of taxonomy, the US National Science Foundation) *and* some of the major scientific and policy institutions involved in these shifts (NHM, the Smithsonian Institution's American Museum of Natural History (AMNH), Guelph University in Ontario, Canada, the global 'Bar-coding of Life' Consortium, and the Convention on Biological Diversity's 2006 and 2008 meetings).
- Dissemination will take place through the research process and seminars at global Bar-Coding of Life meetings.
- A seminar and briefing note will be given at the Convention on Biological Diversity's 2006 and 2008 COP meetings and pre-meetings.

### ***Final project conference***

- Findings and reflections from the research will be shared with all individuals and scientific and policy institutions that have participated in the research.

## **The Lancaster/NHM Partnership**

This study will build onto Lancaster University's strong international reputation and record of research in an area of science studies which focuses upon science and society issues, exploring the relationships between scientific/policy and public knowledges. The project represents an opportunity to build on excellent working relationships between social and natural scientists at one of the world's leading taxonomic institutions (NHM) at a time when the NHM is self-consciously experimenting with/seeking advice about the way that it can most effectively build bridges from research into policy making. The NHM's links with other global taxonomic institutions and with the wider amateur world of naturalist-taxonomists will ensure that social scientific insights derived from the proposed study would have wide and targeted dissemination across the globe.

Individual researchers involved in the proposed multi-disciplinary team (Dr. Rebecca Ellis, Claire Waterton, Prof. Brian Wynne, Dr Johannes Vogel, Dr. Mark Carine and Dr. Alistair Taylor) will each have allocated roles that have been designed to be complementary to their particular skills and expertise. Please see '**Section 11: Staff**' of the application form for more details of precise roles.

Table 1

<b>Site and method</b>	<b>Institutional Context:</b>	<b>Majority of funding/resources</b>	<b>Scientific Importance:</b>	<b>Imagined uses of knowledge</b>	<b>Morphological/Molecular balance in the science</b>
<b>NHM, London: Department of Botany</b>  <b>Participant observation and interviewing</b>	Public institution with duty of care to naturalists and an historic collection of specimens	Public	[ Focus on plant taxonomy.] - Systematics; - Historic collection; - Curation.	Systematics  Biodiversity policy	Both have historically been important. The balance is in flux at the present time.
<b>Guelph University, Canada: Bar-Coding of Life Initiative</b>  <b>Participant observation and interviewing</b>	Academic institution  Prominent in development of bar-coding techniques	Public/private	[ Focus on animal taxonomy.] - Cutting-edge science in new DNA-based taxonomic techniques for biodiversity and for the development of methods within different taxa.	Bar-Coding for biodiversity policy  Other applied uses of Bar-Coding techniques?	Pioneering DNA Bar-Coding of Life initiatives/projects
<b>Smithsonian Institute, USA</b>  <b>Interviewing</b>	Public institution with duty of care for collections.  Vigorously innovating in DNA storage and databasing techniques	Public	- Cutting-edge technological development in global storage and curation of DNA specimens;  - Global, policy oriented DNA Bar-coding	Aims to become global leader and centre for frozen DNA specimens worldwide  Curation techniques; Biodiversity policy	Both have historically been important. The balance is in flux at the present time.  Strong promotion of DNA techniques in certain labs.
<b>Phycological (algae and seaweeds) Society, UK</b>  <b>Interviewing and participant observation</b>	Small-scale, volunteer based, British natural history society	Voluntary effort/membership	Field-lab based knowledge of algae/seaweed distributions, abundances and trends	Under-standing of algal biodiversity and current trends	Both morphological and molecular classification has historically been important.
<b>Butterfly Conservation, UK</b>  <b>Interviewing and participant observation</b>	Successful, policy-oriented, UK natural history society/NGO	Voluntary effort/membership	Field based knowledge of butterfly distributions, abundances and trends	Under-standing of butterfly biodiversity and current trends	Strong network of morphological recorders and validation networks.

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## Appendix 1

-----Original Message-----

**From:** Godfray, Charles [mailto:c.godfray@imperial.ac.uk]

**Sent:** 04 November 2004 11:01

**To:** Dr. Johannes Vogel

**Subject:** RE: Letter from Richard Lane and Johannes Vogel, Natural History Museum, London

**Dr. Johannes Vogel  
Natural History Museum  
London**

**Dear Johannes**

**Thank you for sending me the details of your proposed social/natural sciences initiative to explore ongoing changes in the science of taxonomy. As you say in the proposal, taxonomy is on a cusp at the moment with many new ideas involving information science and molecular biology jostling to help redefine it. From a social science perspective it is an optimal time to study the process of transition in a science, but I am also optimistic that the study itself may feed back into facilitating a broader and less entrenched debate about this progression. The project has my full support, and I would be happy to participate in any way that might be useful.**

**With best wishes**

**Charles**



Dr. Johannes Vogel, Keeper  
Department of Botany  
The Natural History Museum  
Cromwell Road  
London SW7 5BD

14 November 2004

**Re: Taxonomic Science at a Crossroads: Humans, Nature and Machines in the Science of Biodiversity**

Dear Johannes,

Your proposed project in collaboration with sociologists and anthropologists at the Institute for Environment, Philosophy and Public Policy at Lancaster University sounds very exciting and just the sort of thing we ought to be engaging in at this moment in the development of the science of biodiversity. It has become clear that inclusivity is the key to progress in today's multidisciplinary world – your study is perfectly placed to examine an emerging concept that could have big impacts on a broad range of spheres of society, from scientists working in institutes such as this one to protected areas managers on the ground in the developing world.

The Consortium for the Bar-Coding of Life is a good place to begin with these efforts – the issues you raise in your letter – dependence on technology, discarding opposing views and lack of inclusivity – all have the potential to make this development flounder rather than flourish. I and my team – who work with partners across the developing world – would be very pleased to be part of this study; it will add significantly to not only the Bar-Coding of Life initiative, but also to our development of other collaborative projects in which we are involved and are planning.

I hope you and the team are successful in obtaining the funding to take this initiative forward, and I and my team look forward to participating in the project.

Sincerely yours,

**Sandy**

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UNIVERSITY  
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COLLEGE OF BIOLOGICAL SCIENCE  
Department of Zoology

November 4, 2004

Dr. Johannes Vogel  
Dr. Richard Lane  
The Natural History Museum  
Cromwell Road,  
London, SW7 5BD  
U.K.

Dear Johannes and Richard

As one deeply engaged in the science of DNA barcoding, I was startled to learn of the research program which you and your colleagues seek to activate. Your plans to intercept a major new science movement as it leaves the 'starting gate' is, I believe, almost without precedent. You will have a rare opportunity to not only record, but also to influence the trajectory of an enterprise that promises to remake our relationship with life.

Your research is very timely, but I see one issue that may concern those who will review your plans. They may feel that it is premature to activate your studies while controversy rages and the science is barely underway. In response, I would counter-argue that the signs for major energization are clear. An international Consortium has been formed to organize the DNA barcode effort. Barcoding research efforts are also making the move from single labs to organized networks. Canada will launch the first national barcode Network in early 2005; it will barcode 10% of Canadian animal species in just 5 years. International teams are also coalescing with plans to barcode all species of birds, of fishes, of selected smaller life by 2010. In short, I'm confident that the next decade will be filled with much scientific excitement as barcode libraries are assembled and as technological developments move barcode analyses from laboratories into the hands of our children.

I think that it is critical that this revelation of life through technology be registered, debated thoroughly and widely, and influenced through such processes of reflection and debate. I am confident that your research team is uniquely positioned to achieve both these aims and the broader goals described in your proposal. Your effort will clearly benefit from an established and rare working relationship between researchers at one of the world's most important natural history museums and a well-respected group of researchers with expertise in science policy and sociology.

To those reviewing your application, I urge a prompt and positive decision. Your speed in assembling this application has placed your team in a unique position and it would be a great pity to miss this opportunity. Once your work has begun, I will be most pleased, as Science Director for the Canadian Barcode of Life Network, to see our network contribute any advice or support that will aid your investigations.

Yours sincerely

A handwritten signature in black ink, appearing to read "Paul Hebert". The signature is stylized with a large, sweeping initial "P" and a distinct "H".

Paul Hebert

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