Editorial

Where would Darwin have been without taxonomy?

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The answer to the question posed in the title is: up an unnamed tree without a ladder! Arthropods and plants together comprise the majority of the macro-biodiversity of the world, approximately 78% and 18% of described species respectively (Clark and May, 2002). Yet the ability of educated scientists, let alone the general public, to identify these wonderful organisms is woefully lacking. On average, secondary school biology teachers, for example, have been unable to identify more than three species of common British wild flowers (Bebbington, 2005). Twenty years ago we would have had no qualms about sending first year biology undergraduates out to collect samples of leaves from common tree species and identify them correctly. Nowadays, only a minority of our final year students can perform this task successfully; their identification of even major insect groups is yet more limited. Furthermore, the numbers of students taking plant science nationally is in a steep decline.

Entomologically things are perhaps worse (Leather, 2007) with those youngsters who have an interest in '*mini-beasts*' at primary school having no real opportunity to learn formally about insects or other arthropods until university – and then only in a very cursory manner. Biology undergraduates will have perhaps 12 lectures covering the whole of the invertebrates in their first year, compared with the minimum of 30-50 lectures that used to be dedicated to those organisms 30 years ago. We now have a general public that hack hawk moth caterpillars to death under the impression that they are dangerous snakes and who will cut down and burn pine trees infested with sawflies before seeking advice as to their identity.

We need to ensure that the general public knows that grass is not 'just grass' but many grasses; that a wasp can be many wasps. Indeed, more than 5000 species of Hymenoptera – the bees, wasps, ants and their allies – live in the UK alone, the vast majority of which will not sting you. We need people to know that cockchafers and stag beetles are beautiful beetles and not strange deadly alien creatures.

This lack of basic natural history knowledge has had far reaching consequences, particularly within the urban environment, transport infrastructures and the modern obsession with exotic holidays. All these have resulted in the destruction of natural habitats and their inhabitants. As Papworth *et al* (2009) point out, how can we expect people to care about the environment and conserve it if they do not perceive it in its entirety?

They suggest that the older generations must pass on their taxonomic knowledge to the younger generations within the family context. This is too little, too late. We are far beyond the point where this solution is either feasible or practical. Natural history is fast becoming extinct in the UK (Cheeseman and Key, 2007) and elsewhere. We need to reinstall formal understanding and appreciation of natural history within the secondary school curriculum, building on the efforts that poorly-equipped primary school teachers make using the concept of '*mini-beasts*' and school wild life gardens as part of the National Curriculum at Key Stage 1 and 2 (http://curriculum.qca.org.uk/key-stages-1-and-2/assessment/nc-in-action/items/art-and-design/2/48.aspx?return=/search/index.aspx%3FfldSiteSearch%3Dminibeasts%26btnGoSearch.x%3D32%26btnGoSearch.y%3D12).

Teachers at both primary and secondary school level are not well trained to deal with taxonomic issues, and this also applies to biology teachers (Bebbington, 2005). We hear in the news (Alexander, 2009) that independent advisors consider primary education has been driven too far by testing the three Rs and that it now lacks roundness. Nature study is one of the elements that have been severely hit by an excessive focus in the National Curriculum. To remedy this we need to train biology undergraduates so that they can start training the coming generations before those of us with classical botanical and zoological training (most in our fifties and sixties) retire.

Even more importantly, we need to recruit to university posts those few younger natural historians that remain, rather than replacing the older generation with more narrowly-focused molecular and theoretical biologists who are sadly woefully ignorant of the natural world that surrounds them. Of course, there is a place for all, but in terms of whole-organism interests, and in particular with the basics of organismal systematics, we will be failing the coming generations of undergraduates even more if we fail to act in the very near future.

Bogey man

Taxonomy is the bogey man of science, perceived by many scientists as a second class or amateur discipline not requiring academic training (e.g. Godfray, 2002) or as something really boring by students. Yes, the dictionary definition of taxonomy; "n. 1 the branch of biology concerned with the classification of plants and animals into groups based on their similarities and differences" (Shearer *et al*, 1995), hardly makes one want to rush into a career in the discipline although the definition is well out of date in this age of phylogeny reconstruction. However, the ability to name an organism gives one the

power to place it within its ecological context and, often, to extract much more information about it.

Significantly, many of the most important organisms in the world's ecosystems, such as key species for the continued relative stability and survival of communities, are often small, quite rare and (not infrequently) rather hard to recognise. Of course, we are not advocating that all children should be taught taxonomy, but rather that they should have the ability to understand the inter-relationships between different groups of organisms, to be able to recognise the major distinguishing features and, yes, to be able to identify at least a reasonable proportion of the more common species that surround them. To achieve this we do need to train more taxonomists, but also we need to train specialists who, although they may not regard themselves as taxonomists *per se*, have the ability to recognise and identify groups in some detail. At the moment this level of taxonomic expertise is over-represented in some groups e.g. mammals and birds, and very much under-represented in others such as the insects and allied taxa.

Most people when asked in the street about taxonomy and its allied science, systematics, will – like most students – be unable to say why we should study it, let alone fund it. The former Chief Scientific Adviser to the British Government, Lord Robert May, knew that taxonomy underpins much of biology and that there is an urgent need for organismal taxonomy to be pursued under global initiatives (Gaston and May, 1992). Much money has been wasted studying what was thought to be a single species, only to discover later that it was a complex of similar but hard to distinguish, and previously not distinguished, species; even common and 'well-known' species can turn out to be hiding cryptic species. Only in 1993, for instance, was the common British pipistrelle bat discovered to actually be two species (see Park *et al*, 1996), albeit one of them with a rather confined distribution. Such frequent discoveries not only highlight the complexity of the world around us but also demonstrate how little of that complexity we can describe. Effective global conservation is at threat through this lack of taxonomic expertise (Basset *et al*, 2009).

Holding the world together

While much debate, interest and money has recently been targeted towards the undoubted dangers of global climatic change and the threats that this poses to global biodiversity (e.g. Thomas *et al*, 2004), there has been little but lip service paid to increasing our ability to identify those organisms that are indisputably holding the world together, i.e. the plants and arthropods. Polar bears on the other hand, instantaneously recognisable by all, receive more than their fair share of media and monetary attention (Leather, 2009)! It is time the balance was changed to reflect the diversity around us. We desperately need to bring natural history teaching back into the curriculum at secondary school: university biology departments must ensure that they aid this process by restoring a greater recognition of natural history amongst their undergraduates.

Without the ability to recognise, name and understand the relationships between different species, Darwin would never have been able to formulate his theory of evolution and the world would have become a very different place indeed.

References

Alexander R (2009) What is primary education for? *Times Educational Supplement* 20 February. Available at: www.primaryreview.org.uk/Downloads/TES_090220.pdf

Basset Y, Hawkins B A and Leather S R (2009) Visions for insect conservation and diversity: spanning the gap between practice and theory. *Insect Conservation & Diversity*, 2, 1-4.

Bebbington A (2005) The ability of A-level students to name plants. *Journal of Biological Education*, 39, 63-67.

Cheeseman O D and Key R S (2007) The extinction of experience: a threat to insect conservation? In *Insect Conservation Biology* (eds A J A Stewart, T R New and O T Lewis), pp 322-348. CABI, Wallingford.

Clark J A and May R M (2002) Taxonomic bias in conservation research. *Science*, 297, 191-192.

Gaston K J and May R M (1992) Taxonomy of taxonomists. *Nature* 356: 281-282

Godfray H C J (2002) Challenges for taxonomy. *Nature* 417: 17-19.

Leather S R (2009) Taxonomic chauvinism threatens the future of entomology. *Biologist*, 56(1), 10-13.

Papworth S J, Coad L, Rist J and Miller-Gulland E J (2009) Shifting baseline syndrome as a concept in conservation. *Conservation Letters* 2

Park K J, Altringham J D and Jones G (1996) Assortative mating in two phonic types of the bat *Pipistrellus pipistrellus*: further evidence for two cryptic species. *Proceedings of the Royal Society Series B*, 263, 1495-1499.

Shearer T, Grandison A, Brookes I *et al.* (1995) *Collins Concise Dictionary and Thesaurus*, Harper-Collins, Glasgow

Thomas C D, Cameron A, Green R E *et al* (2004) Extinction risk from climate change. *Nature*, 427, 145-158.

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