

Taxonomy: Impediment or Expedient?

Society has a growing need for credible taxonomic information in order to allow us to conserve, manage, understand, and enjoy the natural world. At the same time, support for taxonomy and collections is failing to keep pace. Funds nominally allocated to taxonomy go largely to reconstruct molecular phylogenies, while thousands of species are threatened by imminent extinction. Ecologists working in the tropics have felt this lack of taxonomic knowledge as an impediment that inhibits their ability to analyze community-level phenomena. It is time to evaluate the sources of this impediment and address them. Taxonomy must facilitate, not obstruct, biodiversity studies and conservation.

Existing taxonomic practices have served us well for centuries but are clearly inadequate for the challenge at hand. The taxonomic community must rally around a common vision, critically evaluate its needs, set an ambitious research agenda, embrace emerging technologies, and univocally communicate its aspirations. This will require a major change in approach, engaging individual scholars, professional societies, and institutions.

Molecular data, abundant and inexpensive, have revolutionized phylogenetics but not diminished the importance of traditional work. Morphology links living and fossil species, is the object of natural selection, inspires the search for causal explanations, and democratizes science. Visual morphological knowledge is ideally suited to Internet communication. The need for this research has been masked, because molecular researchers could draw on centuries of banked morphology knowledge. That knowledge, however, is limited to a fraction of Earth's species and will very soon be exhausted. Fashionable DNA bar-coding methods are a breakthrough for identification, but they will not supplant the need to formulate and rigorously test species hypotheses. Predicted advances in cyber-infrastructure suggest that the time is right to re-envision taxonomy.

Some naively see the information technology challenge as liberating data from cabinets. The reality is that for all but a few taxa, much data is outdated or unreliable. Many specimens represent undescribed or misidentified species. Rapid access to bad data is unacceptable; the challenge is not merely to speed data access but to expedite taxonomic research. We can envision virtual monographs, revisions, floras, and faunas that are living dynamic works rather than static documents.

It is time to approach taxonomy as large-scale international science. The goal of discovering, describing, and classifying the species of our planet assuredly qualifies as big science. In the face of the biodiversity crisis, the need for urgency could not be greater. Imagine a taxonomic renaissance built on a foundation of cyber-infrastructure. A taxonomist in her laboratory examines a type specimen in another city in real time with remote microscopy. She sets priorities for teams of collectors in several countries who are also using such tools to evaluate the day's catch. Turned around, the same digital microscope electronically brings a taxonomist into a classroom. Aspiring taxonomists in developing countries have full access to taxonomic literature formerly reserved for a few great libraries. Peer-reviewed species descriptions are published electronically and made instantly available. Teams of taxonomists speed species exploration, as in the recent National Science Foundation Planetary Biodiversity Inventories.

Taxonomy is planetary-scale science and deserves a planetary-scale tool. This virtual instrument could vastly accelerate taxonomic research and education. Taxonomic understanding of biodiversity, constrained only by evolutionary history, complements long-term and place-based studies of the role of biodiversity in ecosystem functions. Both perspectives are necessary. This tool would be a biodiversity observatory, permitting scientists to "see" across continents and geologic time.

Our generation is the first to fully comprehend the threat of the biodiversity crisis and the last with the opportunity to explore and document the species diversity of our planet. Time is rapidly running out. Society's investment for centuries in great natural history collections can now be repaid through a powerful taxonomic research platform connecting researchers, educators, and decision-makers. The grand biological challenge of our age is to create a legacy of knowledge for a planet that is soon to be biologically decimated. To meet it, 21st-century taxonomists and museums must have the right tools.

Quentin D. Wheeler, Peter H. Raven, Edward O. Wilson

Quentin D. Wheeler is at Cornell University, Ithaca, NY. Peter H. Raven is at the Missouri Botanical Garden, St. Louis, MO. Edward O. Wilson is at Harvard University, Cambridge, MA.

