A Global Biodiversity Map

Edward O. Wilson

As genomics and biomedicine are to human health, so ecology and conservation biology are to the planet's health. Unfortunately, compared with their sister disciplines, ecology and conservation biology are still disadvantaged. Their growth is hampered by a seldom-acknowledged deficiency: our ignorance of most of the world's biodiversity, particularly at the level of individual species, where knowledge is foundational to all other studies of diversity and hence of the whole living environment. The number of species given a scientific name is believed to fall between 1.5 million and 1.8 million. The true, full number, including those still undescribed, can only be guessed at to the nearest order of magnitude, with the opinion of many experts gravitating toward the vicinity of 10 million. Reliable biodiversity assessments are limited to a few relatively well-known groups, including the vascular plants, vertebrates, and a small number of invertebrates such as corals and butterflies. If the true number of species is about 10 million, these focal groups add up to fewer than 5% of the total. Bacteria, mites, nematode worms, fungi, beetles, and other major environmental players are necessarily ignored, or at best given "morphospecies" code numbers. Even among the small minority of all species diagnosed and named, fewer than 1% have been subject to the kind of careful biological studies needed to undergird ecology and conservation biology.

To describe and classify all of the surviving species of the world deserves to be one of the great scientific goals of the new century. In applied science, this completion of the Linnaean enterprise is needed for effective conservation practices, for bioprospecting (the search for new natural products in wild species), and for impact studies of environmental change. In basic science, it is a key element in the maturing of ecology, including the grasp of ecosystem functioning and of evolutionary biology. It also offers an unsurpassable adventure: the exploration of a little-known planet.

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Pieces of a worldwide biodiversity project are being put in place. In 1999, the Megascience Forum of the Organization for Economic Cooperation and Development created the Global Biodiversity Information Facility to coordinate and bring online all electronic databases for various groups of organisms. CD-ROMs of individual groups for different parts of the world proliferate, augmenting a continued flow of traditional print monographs. New electronic technology, increasing exponentially in power, is trimming the cost and time required for taxonomic description and data analysis. It promises to speed traditional systematics by 2 orders of magnitude. What is lacking and needed now is a concerted effort, comparable to the Human Genome Project (HGP), to complete a global biodiversity survey—pole to pole, whales to bacteria, and in a reasonably short period of time.

If treated as a near-horizon goal instead of an eventual destination, the survey will multiply benefits in basic and applied science. The key choke point will also be quickly revealed. It is not the needed tools of informatics, most of which are already at hand. Nor is it a persuasive rationale, which can be readily expressed to scientists and the public alike. Rather, it is the severely limited capacity of museums and other collections-oriented facilities to collect, prepare, and analyze specimens, and the shortage of expert taxonomists to do the job.

According to a recent survey by the Association of Systematic Collections, in North America only 3000 Ph.D.-level researchers are active in the exploration and description of the world's fauna and flora. At a rough guess, another 3000 are engaged elsewhere in the world. Museums, universities, and government agencies in the United States collectively spend between $150 million and $200 million each year on systematics research. These levels are incommensurate with the magnitude of the task and of the benefit it offers humanity.

What will it cost to complete such a map? Suppose there are in fact about 10 million living species. The cost per species, using newly available informatics technology, might be $500, for a total of $5 billion spread over 10 to 20 years, hence roughly comparable to the HGP. As in that enterprise, per-unit cost can be expected to drop as technology is improved, while scientific and practical benefits from the accumulating knowledge grow exponentially.

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