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On global biodiversity estimates

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All measurements and estimates have meaning, if consistent with peer-reviewed data and gifted with heuristic value. In pure science, we judge measures and estimation techniques by their importance to theory. We devise them for maximum relevance, and advance their reliability and precision by successive approximations. If better measures and estimation techniques come along, either by shifts in theoretical context or advances in technology, we discard the old and use the new.

These several qualities of measurement and estimation are conspicuously important in the case of species formation and extinction through time. It is extremely important for both basic and applied science to know as precisely as possible the turnover rate of species, and hence the turnover of their phyletic conglomerates we recognize as genera and higher taxa. Granted that these measures are wobbly at the present time. At present we put the rate of species formation and extinction prior to the human impact at one species per 10^5 to 10^7 species per year in the best chronicled taxa, with most falling closest to one species per 10^6 species per year. If that much can be accomplished to the general satisfaction of paleontologists, a possible spread of two orders magnitude is not bad. At least it is not a turbulent 10^3 or stagnant one species per 10^8 species per year. It tells us a lot about evolution and global biodiversity dynamics.

And what is the current extinction rate, at least of focal groups, such as mollusks, flowering plants, and birds? Two separate measures, the estimates from habitat reduction and the velocity of descent of species through the IUCN Red List categories (vulnerable, endangered, critically endangered, extinct), suggest extinction rates on the order of one species per 10^3 to 10^4 species per year, probably closer to 10^3. Other evidence indicates no compensating increase in the rate of species formation over prehuman levels, so that global dynamics is almost all loss. A third approach, population viability analysis (PVA), in which demographic properties of individual species are modeled to estimate their likely longevity, points to the likelihood of similarly high contemporary extinction rates. (General reviews of extinction rates and the means of estimating them are given in Lawton and May 1995 and Wilson 2002.)

Some unresolved fundamental questions remain in the comparison of species extinction rates in geologic versus present time. Let me cite just a couple. If island ecosystems, including those on ''true'' islands and habitat islands (such as isolated mountain forests), were found to generate and lose species faster than continuous continental ecosystems, the process would be measured by neontologists but largely missed by paleontologists, artificially widening the gap between geologic and contemporary estimates. That is a big if, but worth exploring thoroughly. And—might many rare species in undisturbed ecosystems actually be survivors with a proportionately long history and long future, as opposed to teetering on the brink of extinction? If such a phenomenon exists, the gap is wider than currently supposed.

The relevance of neontology, including ecology, to paleontology could not be more starkly revealed in these and other questions concerning biodiversity dynamics. We can only solve them by taking the best measures we can devise, then thinking harder and digging deeper, ever ready to measure again.

Literature Cited

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