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OPINION

The Power of Biology in the Sustainable Land Use Equation[1]

In 1982, I was very fortunate to spend some time at a camp constructed at the far end of a new logging road in Sabah, Malaysia. The purpose of the camp was sad: It was built by a group of bright, dynamic biologists, led by an exceptionally competent ornithologist whose grisly task it was to harvest museum specimens from this pristine forest prior to the onslaught of the loggers. A weekend run into town yielded a batch of mail containing an issue of *Science* with a beautiful watercolor of a long-lost New Guinea bowerbird adorning the cover. If Jared Diamond could relocate such a conspicuous bird, we mused that evening, perhaps we would be fortunate enough to discover the heretofore unknown Bornean bird-of-paradise near our end-of-the-road camp? Sure enough, the next afternoon when I emerged from a long hike in the forest, I noted a flurry of activity in a corner of the camp clearing: lots of cameras, and no small amount of self-satisfied laughing, as the newly discovered bird bobbed up and down in the brush, tethered to a fishing line. Alas, our find, with the tail of a flycatcher, the beak of a sunbird, and the wings of a pitta, proved to be an interdisciplinary flop. As the only one of its kind, it was socially unacceptable; having the attention of the entire camp, cook and skinner included, for most of an afternoon, it was totally uneconomic; being comprised of half a dozen mismatched parts, it was politically incorrect; and, unable to fly, it was a biophysical bust.

Sooner or later, most scientists are asked to serve on interdisciplinary teams assembled for the purpose of making land-use recommendations: appraisal of a new hydroelectric project, evaluation of a conservation-ecotourism proposal, informed speculation about the consequences of climate change, or assessment of a forest-harvesting law, for example. Yet all too often, such efforts, like our homemade bird, are interdisciplinary flops. I think we can do better, and I think that tropical biologists have an important role to play.

Which disciplines should be brought to bear on such problems? Traditionally, they are broken down into two main categories, the biological and the social sciences. Nevertheless, in recognition of the complexity and breadth of each of those subjects, I think it is useful to adjust this dichotomy. First, because of the relevance of allied natural sciences such as edaphology, climatology, geochemistry, and hydrology, the biological sciences should be meshed with the physical sciences. Second, the full range of social sciences directly relevant to sustainable land use should be represented. Thus, an idealized team would include one or more representatives from each of the following disciplines: biophysical sciences, economics, political science, and sociology/anthropology. Each of these four components must be considered at all phases of development: education, research, design, and implementation.

How do we, as tropical biologists, fit into the picture? Few would consider it an exaggeration to say that tropical biologists know a great deal about organisms and environments. But is the detail of our science relevant to issues of sustainable land use and development, or is ours strictly a quest for knowledge, without concern for its importance to society? I argue that most biological and physical science conducted in the tropics is relevant, for it is the rich evolutionary legacy of the tropics, coupled with the speed and unpredictability with which processes occur, that make tropical ecosystems so unique. We have a moral obligation to protect the biological wealth of the tropics, and we have a socioeconomic obligation to protect the environmental health. Biologists, more than anyone else, understand the tight interdependence of the two.

Despite our collective knowledge, I am always amazed at how quick biologists are to use self-proclaimed ignorance of the magnificent biological diversity of the tropics as an excuse for not getting on with the job. The unknowns are great indeed, and the case for renewed efforts in systematics and biological inventories must be promoted vigorously. Nevertheless, we cannot wait until we know the names, abundances, and interrelationships among all the players before we confront fast-developing conflicts in the sustainable development equation.

One of the wasteful tragedies in the biophysical sciences with regard to land use is the unfortunate rift, real or perceived, that separates some biologists and conservationists from some agriculturists and foresters. Instead of working at odds, we must join forces to achieve our mutual goal of sustainable land use in the tropics. On the one hand, agricultural scientists must recognize regional impacts, values, and services. For example, to what extent does agricultural productivity depend upon sustainability of surrounding ecological systems? Likewise, the community of conservationists must recognize that without land use systems that are economically, socially, and ecologically sustainable, the conservation of natural ecosystems and biological diversity cannot be sustained politically.

Interdisciplinary panels normally are compiled from sufficient talent to ensure that the requisite breadth of subjects is included. Nevertheless, the end-products of such teams seldom lead to the profound, cross-discipline insights that one might anticipate from such a superimposition of expertise. Their reports often consist of loosely woven plots in which each chapter represents the in-depth contribution of one specialist or another: The biologist's contribution may contain a smattering of economics but no sociology; the economist's contribution may include a touch of anthropology but no political science; and so forth. There is little cross-discipline synergism, and the whole is seldom more than the sum of the parts. Not surprisingly, such interdisciplinary efforts frequently fall short of expectations.

What is the problem? Part of it lies in the way we train scientists. Our curricula are broadly based at the start and become more tightly focussed as the student advances, frequently culminating in reductionist dissertations of great depth on very narrow topics: We know a lot more about the thermal properties of elephant hide than about the relationships between elephants and the farms that fringe game reserves. One solution, probably too drastic for all but the most innovative of universities, would be to invert the educational pyramid: depth first, breadth later. Saturate the beginning student with everything she or he wants to know about monkeys, then follow up with the then-welcome courses in physics, genetics, language, chemistry, history, and mathematics required for the student to become a first rate behavioral ecologist.

But perhaps a more fundamental problem is the fact that it takes unusual talent to make original contributions in multiple subjects. Interdisciplinary work often suffers by attracting students who are unwilling to acquire detailed knowledge in any discipline. They substitute breadth for depth and, as a result, are seldom able to contribute substantively when added to teams comprised of experts. The solution to this problem is the coupling of depth and breadth, which is clearly a challenge for the very best of teachers and students.

Although it is patently unrealistic to expect students to acquire real expertise in four disciplines, it may not be unreasonable for the very best of them to acquire in-depth knowledge in two subjects on their way to the doctorate. An outstanding biologist with a real appreciation for political science would be, I propose, more likely to contribute substantively to issues of sustainable land use than two narrowly trained individuals, no matter how great their individual expertise.

Tropical biology does indeed exert great power in the sustainable development equation. As we immerse ourselves in the details of our science, I urge us all to pause now and then and consider the broader societal context in which we work. Our joint mission of resource conservation and sustainable development is urgent. And if we, as tropical biologists, do not lead the way, I fear the job will not get done.

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[1] This commentary was based, in part, on an address given at the 1993 meeting of the Association for Tropical Biology in San Juan, Puerto Rico. Dr. Ewel was president of the Association for Tropical Biology in 1990.