

The Patrick Principle

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In 1948, Ruth Patrick published the first of many papers on the biological diversity in rivers. She established that the numbers and kinds of species found in a river and their relative abundance reflect not only its natural physics and chemistry, but also the stresses imposed on it by human activities (1). This work, recognized by the United States National Medal of Science in 1997, has led to prolific research on indicators for aquatic systems (2). It extends to terrestrial and marine systems (3).

Ruth Patrick's fundamental point is that the imprint of human activities can be measured by the biology of the ecosystem in question. That evaluation cannot be met by some simplistic counting of species (which could for example confuse invasive with indigenous species), but rather requires a basic understanding of the particular ecosystem, its constituent species as well as its structure and function. This methodical approach merits recognition as the fundamental principle that should underlie environmental management. Conscientiously applied, the Patrick Principle, provides the basis for a much more rigorous analysis of the effects of human actions, and an operational measure of the elusive concept of sustainable development.

The Patrick Principle works because environmental problems affect living systems. Natural biological diversity is distinctive and characteristic of an ecosystem, and constitutes an extremely sensitive array of sensors of environmental change (whether natural or anthropogenic). Biological diversity integrates and reflects all detrimental environmental effects, e.g., habitat destruction or some form of pollution. Biology can thus provide a precise measure of success or failure in managing an ecosystem.

Sustainable development, couched in terms of maintaining benefits for future generations, has not had any down-to-earth means for actually "knowing it when you see it". It is very complex as is sustainability science (4). Sustainable development is prone to the same assessment difficulty that bedevils ordinary development, namely that the increments may seem reasonable and beneficial when in aggregate or over time they are not. The Patrick Principle provides the means to determine the real situation.

Applied to a fairly large ecologically cohesive landscape such as South Florida or the five southern California counties home to the coastal sage scrub ecosystem, sustainability would require that the basic species list be the same 10, 100 or even 500 years in the future. Ideally, development would allow for certain portions to be used very intensively for cities or industry, while others are strictly protected, and the remainder variously used in ways that provides long term ecological stability. This is the essence of the concept of biosphere reserves and should be the goal of ecosystem management.

For successful sustainable development, it would be necessary to address all environmental stresses intrinsic to an area as well as those which are extrinsic such as acid rain. There would be substantial flexibility to pursue economic activity and other human aspirations but the basic biological capital and associated characteristic ecosystem processes (such as sheet flow of water in South Florida) would be intact.

The Patrick Principle would not measure the economic and social aspects of sustainability in an area directly. Nonetheless, were those elements to remain unsustainable for any great length of time, they would result in a biological imprint divergent from the original, such as the absence of some characteristic species. It is clearly important to consider the economic and social elements (including equity and justice), but if not considered in conjunction with the diagnostic power of the Patrick Principle, they cannot represent true sustainability. Biological diversity, already such an important set of resources in so many ways, provides yet one more benefit: a measure to chart a sustainable future.

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