Global Ecological Patterns

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HABITAT LOSS

Protecting the world's rapidly vanishing species while human activities continue to degrade their natural habitats is a daunting challenge. Powerful tools, such as land-use maps and global data sets, are aiding in the delineation of trends requiring urgent attention.

A common approach has been to identify the disparity between geographical areas that are protected and those that aren't but ought to be by virtue, for example, of the threat status or diversity of species they support. But in taking a slightly different approach to determining conservation priorities, Jonathan Hoekstra and Timothy Boucher, working for The Nature Conservancy, and Taylor Ricketts and Carter Roberts, working for the World Wildlife Fund, have uncovered an even larger "biome crisis" that demands attention. Their work is published in the January issue of *Ecology Letters.*

Hoekstra and colleagues compared two global data sets: one for protected areas (the World Database on Protected Areas [WDPA] 2004, compiled by the WDPA Consortium, an ongoing collaboration headed by IUCN–World Conservation Union and the United Nations Environment Programme's World Conservation Monitoring Centre) and one for land-use change (Global Land Cover Mapping for the Year 2000, produced by the European Commission Joint Research Centre, and modified somewhat by the authors). The result details the disparity between protected areas and habitat loss worldwide.

The analysis was conducted at two scales. In the large-scale comparison, regions were classified according to which of 13 biomes (excluding mangroves) they belonged to; the finer-scale analysis identified 810 ecoregions, not including mangrove or Antarctic ecoregions.

The two best-protected biomes are temperate conifer forests and montane grasslands and shrublands, although these are among the least modified land-cover types. However, some of the most modified biomes, the temperate grasslands, savannas, and shrublands and mediterranean forests, woodlands, and scrub, are the least protected. The authors created a conservation risk index, the ratio of percentage of area converted to percentage of area protected, to rank biomes according to which are in a critical state. The most modified and least protected biomes listed above lead the list, with tropical and subtropical dry broadleaf forests close behind.

The finer-scale, ecoregion analysis classified regions into critically endangered, endangered, and vulnerable categories; 305 of the 810 ecoregions fall into one of these at-risk categories. The general trend that emerges indicates that, as the percentage of area being converted increases, habitat protection in these areas declines.

The authors argue that conservation efforts clearly need to take a larger view of ecological diversity to protect areas currently at greatest risk. "Species-centric conservation has garnered the lion's share of attention and resources," Hoekstra says. "As a consequence, and as our analysis revealed, we risk losing entire ecosystems whose only 'fault' is that they don't have long species lists." Efforts to protect biodiversity hotspots, for example, focus too narrowly on species diversity without recognizing the importance of ecological function and ecosystem services.

Hoekstra advocates a diversified approach to allocating finite resources, not a "one-size-fits-all" solution. "That may mean that the species list is not maximized, but neither would entire ecosystems be so neglected as they have been.... I hope that our analysis will focus greater attention on what is presently a large and significant gap in our collective conservation efforts."

SPECIES RICHNESS

The latitudinal gradient of taxonomic diversity is the subject of another study of global geographic patterns. A group of North American and European scientists was brought together by the National Center for Ecological Analysis and Synthesis, at the University of California–Santa Barbara, to focus on energy and geographic variation in species richness. Their stated goal is "to convert what is currently a haphazard approach to testing geographic variation in species diversity into a systematic search for underlying causes."

In the December issue of *Ecology Letters,* they publish an analysis of the underlying causes for the observed relationship between climate and species richness. The primary hypothesis they evaluate—and reject—holds that more productive areas support more individuals and therefore more species; this is known as the energy–richness hypothesis.

The authors generated seven testable predictions and evaluated them using published data sets of birds (the North American Breeding Bird Survey), butterflies (the Fourth of July Butterfly Count), and trees (surveyed by Alwyn Gentry on several continents, primarily in the Neotropics). They found, for example, that over broad scales, the number of individuals and the number of species do covary, but rare species accumulate more rapidly than the increase in individuals can account for. In general, the proposed mechanisms for linking productivity and species richness fail to pan out.

Two modifications of the hypothesis are then proposed and evaluated to the extent possible. The physiological tolerance hypothesis posits that species have limited tolerances for more extreme climates. The speciation rate hypothesis states that speciation rates increase as climates become warmer and wetter; the predictions stemming from this hypothesis included both evolutionary and ecological mechanisms. Evidence to test the various predictions is limited, and what is available is mixed. Though the authors conclude that further tests are needed, they are optimistic that molecular systematics will soon help resolve which mechanisms are at work behind climate–richness relationships.

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