Chapter 59

Evolutionary Aside 59.2--The Evolutionary Origin of Biodiversity Hotspots

Another explanation for biodiversity hotspots is that they occur in areas in which the process of speciation occurs at a particularly high rate. This idea is not mutually exclusive of other explanations: high rates of speciation may be a function of ecosystem productivity, and we know that adaptive radiation, so common on islands, usually is associated with high speciation rates.

But there may be other causes for such high rates. For example, one hypothesis is that the high biodiversity of the Amazon region is a result of speciation processes that occurred during the Ice Age. The hypothesis goes like this: during ice ages, much of the Earth's water is locked up in glaciers. As a result, rainfall diminishes, and much of the rainforest turned into savannahs. However, on mountains, rainfall levels were still high enough to support rainforest (see chapter 57). As a consequence, what originally was a single, continuous forest covering the entire Amazon basin was transformed into isolated forest fragments separated by savannah habitat. As a result, populations of widespread species became genetically isolated and, so the hypothesis goes, allopatric speciation ensued, greatly increasing the species diversity of this region. Some scientists have proposed similar mechanisms that might have operated in other biodiverse regions. Forty years after it was first proposed, this Pleistocene refugia hypothesis is still actively debated.

Recently, an alternative, evolutionarily inspired hypothesis to explain biodiversity hotspots has been proposed. This hypothesis suggests that transition zones between different types of habitats lead to high rates of speciation. The idea here is that natural selection is very strong and divergent in such areas. Populations of the same species on opposite sides of the transition—for example, where rainforest turns into savannah—and such divergent selection can drive these populations to become different species (see chapter 22).

Both of these hypotheses, as well as some others, argue that a key component in determining patterns of species richness is the rate at which new species arise. To the extent that these ideas are correct, a consequence of this realization is that biologists must consider evolutionary processes in conservation planning. Only by preserving the evolutionary process and the continued production of new species will we be able to maintain species richness well into the future.