Diversity

Biodiversity Hotspots and Zones of Ecological Transition

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Biodiversity hotspots are areas of high priority for conservation (Reid 1998). They may be selected on the basis of their local species richness, degree of concentration of rare species (Prendergast et al. 1993) or the two measures combined with some assessment of urgency for conservation action (Myers et al. 2000). More targeted approaches identify "hotspots of complementarity" on the basis of their relative contribution to attaining an overall conservation goal (Dobson et al. 1997). Smith et al. (2001) argue that "recent attempts to prioritize conservation areas [i.e., biodiversity hotspots] ignore regions [of ecological transition] entirely" and that conservation efforts should "focus on both hotspots of biodiversity and on associated transitional zones" because this would preserve species' adaptive variation across environments. Although the authors are right to stress the importance of ecological transition zones to preserving species' adaptive responses to future challenges, they disregard some important questions.

First and most important, biodiversity hotspots already tend to be located preferentially in areas of ecological transition (Araújo & Williams 2001; Gaston et al 2001). This results from selection of areas with high species richness, where species overlap in their range margins between neighboring assemblages. "Edge effects" such as these are related to patterns of spatial turnover among species, such as may occur with broad patterns of species replacement between biomes or with more local patterns of turnover associated with, for example, elevation gradients. Mountains and deserts may also act as barriers to dispersal between biogeographical regions, where they are likely to circumscribe the edge of many species' ranges. Smith et al. (2001) state that the "hotspots approach to species preservation is risky particularly at a local scale," but they fail to mention that it has been used mainly to set priorities at global, continental, or national scales.

Second, the need for hotspots arises from the recognition that resources for conservation are scarce and that priorities need to be set according to the requirements for persistence of as much biodiversity as possible. As suggested by Smith et al. (2001), there are good reasons why transition zones might be important for the long-term persistence of biodiversity. However, there are equally good reasons why abundant and less variable populations within the core of species' ranges (nontransition zones) might play a fundamental role in the maintenance of viable populations (Lawton 1993). Ideally, both core and marginal populations would be represented within hotspots. The greater the span of environmental variation represented, the greater the likelihood that populations might adapt to future environmental challenges. But conservation resources are scarce, and it may not be possible to sample the whole range of environmental variation within the range of every species. Indeed, increasing the representation target for one species often implies a reduction in the representation for others. So, a choice has to be made as to whether to represent more environmental variation within the ranges of few favored species or to spread the investment among a greater number of species but represent less environmental variation for each.

Given the tendency of biodiversity hotspots to coincide with areas of ecological transition, we should perhaps ask two questions: (1) Which areas of ecological transition are most likely to promote species' adaptive responses to projected environmental changes? (2) What is the relative contribution of transition and nontransition zones to the persistence of species at different temporal scales? These questions stem from the recognition that not all transition zones are likely to play equally important roles in the future and that the relative importance of transition and nontransition zones is likely to depend on the time period consid-

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ered. Various short-term population analyses have shown that core populations are less variable than marginal ones (Lawton 1993), so they represent a safer choice for conservation. On the other hand, analysis of long-term patterns of range contraction provides evidence that many species have persisted only at the edges of their historical ranges (Channell & Lomolino 2000). These apparently contradictory results call for integration of both transition and nontransition zones into conservation policy, but they also call for more research to help target the appropriate cores and peripheries for biodiversity conservation effort.

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