Beyond the Envelope

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Beyond the Envelope

Biologists are familiar with studies that estimate the range of temperatures that must prevail for a species to survive and then examine where those temperatures might be found under various scenarios for the future climate. The approach, which allows a rough estimate of how a species' geographic range might change with global warming, has provided important insights: the expected shifts in the ranges of many organisms, animals and plants, seem drastic. In many cases, ranges seem likely to be smaller in the future as biota move toward the poles and higher up mountains (where that option exists).

Bioclimatic envelope modeling can be more sophisticated than this simplistic account suggests; precipitation and other variables may be included, for example. But organismal biologists know that the actual determinants of where a species thrives can be dauntingly complex and, moreover, can change as genes migrate. Animals, which may modify their behavior and diets opportunistically, present more of a challenge in this respect than do plants. But plants, which may be genetically more labile, are complicated enough, and the interdependencies of the members of the kingdoms mean that bioclimatic envelope monitoring could never supply a final answer.

In the article that begins on p. 489, Eric Post and his colleagues describe some ways that researchers have started to refine bioclimatic envelope modeling as they seek insights into the factors that limit species' distributions. They focus on the use of time-series data to examine correlations between climatic and population variables. Although this approach demands large amounts of data, it can highlight subtle yet important effects. A key revelation is that local populations of a species often vary dramatically in their responses to climate measures. The anomalies can flag important influences—for example, interactions of local populations with other species may ameliorate or exacerbate responses to abiotic factors. Post and colleagues take care not to propose the approaches they describe as replacements for other modes of analysis, but the fascinating findings they relate from work with just a few species indicate promising potential to uncover significant phenomena.

The importance of better understanding and analysis of linkages between organisms and their environment is, coincidentally or not, the principal message of five "grand challenges in organismal biology" recently highlighted in a statement issued by the Executive Committee of the Society for Integrative and Comparative Biology. The document, available at *www.sicb.org*, could become a useful starting point for researchers lobbying to increase funding for organismal biology. But an important task remains beyond the starting point: the powerful but abstract ideas in the five challenges need to be fleshed out with real-world examples of the ways in which, for example, organisms respond to environmental changes. These real-world examples will drive home the importance of organismal biology to society. If a price tag can be attached to these examples, politicians will be more likely to pay attention, knowing that inaction could be costly; they cannot be counted on to act on the basis of abstract ideas. Cost issues are far from straightforward (see, for example, the letter from Mark Sagoff on p. 461 and the accompanying response from Gary Luck and colleagues). Ignoring them, however, is not an option.

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