Expanding the Integration and Application of Long-Term Ecological Research

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Expanding the Integration and Application of Long-Term Ecological Research

In 1980, the National Science Foundation boldly funded six Long Term Ecological Research (LTER) sites to pursue sustained ecological studies. Although they were far sighted, the founders could not anticipate the critical role that their imaginative program would play in meeting twenty-first century demands posed by rapid environmental change. That message, and others, emerges from the six articles in the special section in this issue. The US LTER Network has become a globally important scientific asset; it provides critical site- to regional-scale science to promote continental understanding, and its scenario science, cross-site syntheses, and engagement with decisionmakers are valuable resources for meeting environmental grand challenges.

The first three articles highlight the breadth and application of LTER. Robertson and his colleagues meld historical perspective with vision to demonstrate that the LTER Network is uniquely positioned to leverage the capacity of other existing and emerging programs and observatories by adding biome-specific science, mechanistic understanding, experiments, and socioecological insights (p. 342). In their article beginning on page 354, Driscoll and colleagues show that the LTER Network is addressing environmental challenges by building decisionmaker relationships that engage science in local- to national-scale policy and management issues, integrate local knowledge in research, and promote adaptive management that generates new scientific discoveries. Likewise, Thompson and colleagues cite the contributions of LTER sites to the Millennium Ecosystem Assessment, the Northwest Forest Plan, and the city of Phoenix's water planning to highlight the LTER Network's engagement of regional stakeholders in scenario research that articulates and evaluates alternative socioecological futures (p. 367). The scenarios draw from LTER Network data, regional science, and forecasting to advance science synthesis while increasing the saliency of research.

The mechanistic understanding of ecological processes from LTER science provides key assets for forecasting and many national programs. Knapp and colleagues review the pioneering efforts of LTER scientists in advancing ecosystem manipulations and conclude that major results often emerge only after years of study promoting conclusions that are dramatically different from initial results; that like long-term measurements and well-managed data streams, ecosystem-scale experiments create research platforms for studies and disciplines not part of the original design; and that there is a pressing need for multisite, multifactor experiments across ecosystems (p. 377).

The power of cross-LTER-site integration to yield major insights is revealed by the two final articles. In the first, which begins on page 405, Fountain and colleagues examine the cryosphere—that portion of Earth's surface where water forms ice annually—to compare the impact of climate change on disparate ecosystems. Consistent responses include trophodynamic alterations that cause habitat loss and major shifts in biogeochemical cycles. Jones and colleagues present an integrated and powerful example of comparative long-term studies in which they use the information-management collaborative ClimDB/HydroDB (the Climate and Hydrology Database Projects) to investigate a half-century streamflow from small watersheds across North America (p. 390). Their synthesis confirms that hydrologic responses to climate change have been muted as a consequence of widespread and region-specific ecosystem processes.

Over three decades, the LTER Network of 26 sites has built the capacity across marine, coastal, polar, terrestrial, and aquatic ecosystems for multidecadal measurements; the world's largest collection of large-scale ecological experiments; and comprehensive information management. Guided by a new strategic implementation plan, it will advance basic science and build partnerships with decisionmakers at all levels of society to offer scientific insights and guidance into complex socioecological challenges.

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