ECOLOGY

Long-Term NSF Network Urged to Broaden Scope

Forty-five years ago, the quiet of a virgin forest 45 miles east of Eugene, Oregon, was shattered by the whine of chainsaws and the crash of Douglas fir, hemlock, and red cedar trees. Another assault on the nation's old-growth forests? Not at all. The trees were being felled not by the timber industry but by scientists trying to understand how to harvest trees without damaging the ecosystem. Over the years their experiments in the 6400-hectare H.J. Andrews Experimental Forest evolved into one of the longest-running assessments ever undertaken of the ecological effects of selective logging. And the four decades invested in this effort have paid off. The research done at Andrews and two other sites—the Coweeta Hydrologic Laboratory in North Carolina and the Hubbard Brook Experimental Forest in New Hampshire—laid much of the scientific foundation for a compromise plan released in July by the Clinton Administration that would preserve the habitat of the spotted owl while allowing some logging.

National Science Foundation (NSF) officials point to this work as an example of what can be achieved by one of the agency's most basic research programs: the 18-site Long Term Ecological Research (LTER) network. Launched in 1980 as one of the country's largest environmental research efforts, LTER's "unique strength," according to a report last month by an outside panel, is its ability to study ecological phenomena over years, even decades. Environmental researchers at the sites, supported by NSF grants that are renewable every 6 years, carry out work on what John Magnuson, a University of Wisconsin at Madison fisheries ecologist, calls the "invisible present"—slow-moving ecological processes such as climate change that trigger ice ages or global warming.

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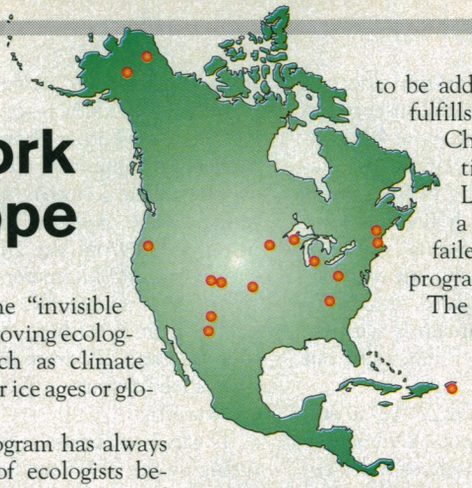
Cutting-edge research. Parts of Oregon's Andrews Experimental Forest have been logged by scientists studying the ecosystem.

The LTER program has always been a favorite of ecologists because of its long-term vision and stable funding, but it is now being asked to broaden its scope and become a resource for the entire ecological community. One way to do that is spelled out in a new report from a National Research Council (NRC) committee (see story p. 335) recommending that LTER become a scientific resource for the National Biological Survey. The survey is an effort by the Department of the Interior to acquire a comprehensive inventory of every animal and plant species and their habitats in the United States. Prominent environmental scientists such as Norman Christensen, dean of Duke University's School of the Environment, believe LTER should be the "scientific backbone" of the survey. "The LTER program is an extremely important part of what the survey needs to concern itself with," agrees Thomas Lovejoy, who has just returned to the Smithsonian Institution after spending 7 months helping Interior Secretary Bruce Babbitt set up the survey.



SOURCE: LTER ILLUSTRATION: L. OWENS

Networked. The 16 LTER sites in North America.

Is LTER up to the job? While the quality of the science and its publication rates have been good, says botanist Paul Risser, president of Miami University in Ohio and co-chair of the 10-year review panel, the program must improve in other areas. In particular, Risser's panel noted a perception in the ecological community that LTER's approach to the human impact on the sites has been fragmented. There is also criticism of its failure to embrace population biology and community dynamics, disciplines that study how different species of life interact in an ecosystem. LTER scientists have also had trouble fulfilling a mandate from NSF to do a better job at comparing data across sites, a flaw that generally inhibits drawing broad conclusions from one site to the next.

"These are missed opportunities that need to be addressed before the program fulfills its potential," says Duke's Christensen. At the same time, the review panel notes LTER has been hampered by a level of funding that has failed to keep pace with the program's increasing demands.

The origins of LTER go back two decades as NSF was winding down a more limited program of research on five broadly defined U.S. ecosystems. Forest ecologist Jerry Franklin of the University of Washington began talking with NSF's James Callahan about a follow-on program, and a 1979 workshop led to the creation of LTER. The core of the LTER research program are studies of ecosystem thermodynamics—the flow of organic nutrients such as carbon and nitrogen through soils, groundwater, and animals and plants. In 1993 NSF spent $11 million to support the core program and 200 research scientists and 300 technicians at 16 research sites in the United States and two in Antarctica.

As with the forest research, some of LTER's findings have had broad scientific appeal: for instance, work at the Niwot Ridge tundra laboratory in Colorado has chronicled a recent leveling of atmospheric concentrations of ozone-depleting chlorofluorocarbons and those at the Sevilleta National Wildlife Refuge in New Mexico have helped to finger deer mice as carriers of the hanta virus implicated in the deaths of 21 people in the United States so far this year.

When the first sites were funded in October 1980, the assumption was that LTER ecologists would be studying fairly pristine ecosystems. Over the years, however, LTER scientists have become increasingly concerned with changes wrought by humans. "No site is pristine anymore," says systematist Jim Edwards, deputy director of NSF's biological sciences division.

Although the human presence is now an essential element in every project, some scientists would like LTER to go even further. "The LTER network is a great opportunity to ask what might happen on the global scale if there are forced changes on the ecosystem," says Stanford climatologist Stephen Schneider. LTER scientists haven't done that, he says, in part because of the differing scales of ecology and climatology—most ecological field work is done on study plots smaller than the size of a tennis court, while the smallest resolvable units in most global-change models are on the order of 250,000 square kilometers. The solution, say Schneider and University of Michigan ecologist Terry Root, is greater collabora-

Report Backs Bigger Biological Survey

Secretary of the Interior Bruce Babbitt's ambitious plans to overhaul his department's ecological research got a warm endorsement last week from a panel of outside experts. Babbitt announced last February that he wanted to consolidate Interior's biological research into a new agency, the National Biological Survey (NBS), that would oversee an inventory of every animal and plant species in the United States (*Science*, 20 August, p. 976). The survey would also expand research on species and their habitats.

A panel put together by the National Research Council (NRC) has now weighed in with its own blueprint—a report called "A Biological Survey for the Nation"—that sees the establishment of the survey as an opportunity to organize the ecological research community and to expand databases of ecological information.

The NRC report, from a committee chaired by botanist Peter Raven, director of the Missouri Botanical Garden, validates Interior's vision for the survey. Babbitt wants it to prevent ecological "train wrecks"—such as the lawsuit-induced paralysis that for years prevented the government, environmental groups, and the timber industry from resolving the spotted owl controversy in the Pacific Northwest (*Science*, 20 August, p. 976). Indeed, the NRC panel envisions the survey as so important and so complex that it will require the combined expertise of dozens of research outfits—a "National Partnership for the Biological Survey." Such a coalition would include federal agencies such as the National Science Foundation and its Long Term Ecological Research (LTER) program (see main story), state natural resource agencies, the Smithsonian Institution, museums, universities, nongovernmental organizations, and private land-use groups. "For the first time the biological community would organize itself as a national trust, like the high-energy physics community and the medical community have done," says panel member Victoria Tschinkel, a senior consultant with the Tallahassee, Florida, law firm of Landers and Parsons and former secretary of the Florida Department of Environmental Regulation.

The primary goal of a national partnership, according to the NRC panel, would be to organize ecological information in a way that's easily accessible to researchers, regulators, zoning boards, and other land-use decision makers. The panel recommends the creation within 3 years of a National Biotic Resource Information System—a "federation" of databases across the United States to archive historical data on species and habitat distribution as well as to provide current information on the biological makeup of particular tracts of land.

NRC panel members insist that such a database can be set up without breaking the bank. "Sure, we need more data. But equally important is to begin to package what we have into more useful information," says panel member Frank Davis, a University of California, Santa Barbara, geographer. Davis says there's a wealth of data ready to be mined, including reams of aerial maps and other remote-sensing images. The problem, says Davis, is that few biologists are trained to use the information, which is also hard to find. "The technologies have evolved rapidly but are still foreign to many field biologists," he says.

Survey officials have embraced the NRC recommendations. "It's a useful document, congruent with my thinking," says Thomas Lovejoy of the Smithsonian Institution, who helped Babbitt to set up the survey. Lovejoy says Interior must retain control of the partnership, as the NRC recommends, and that its existence might free up NBS scientists for research necessary to the management of Interior lands while keeping the survey small. "It would be a mistake to think this is a massive hiring exercise," Lovejoy says.

With outside scientists on its side, Interior now must attend to Congress. Last week the House debated but did not vote on legislation to authorize the biological survey, and representatives were tacking on amendments that would cramp its activities on private land and impede the development of the biotic database. But the House appears likely to support the idea of a biological "national trust."

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tion. "Ecology can use global change money, but it won't get it if it doesn't do research on global change problems," Schneider says.

But understanding the human impact on the study sites will require input from other disciplines, too. The 10-year review panel, for example, recommends LTER incorporate social scientists as well. "Most [LTER] sites haven't been set up to take into account anthropogenic inputs," says UCLA sociologist Richard Berk. Last month, at the LTER all-scientists meeting in Estes Park, Colorado, several talks examined how to improve LTER's ties to the social science community, but the job won't be easy. "There aren't a whole lot of social scientists ready to participate in this kind of work," Berk says.

Humans aren't the only species that many scientists feel LTER has short-changed. Several ecologists say the program's emphasis on ecosystem processes has ignored opportunities in population biology, evolutionary biology, and community dynamics. "LTER is an 'old-boys' club" of ecosystems researchers, says one prominent ecologist who requested anonymity. The 10-year review comments on "some perception of a bias toward ecosystem-level research." LTER's Franklin rejects these concerns and points to a few sites, including Minnesota's Cedar Creek Natural History Area, that carry out a great deal of population and community ecology.

Other sites may soon follow suit. Botanist Peter Raven, director of the Missouri Botanical Garden and chair of the NRC biological survey committee, would like to see the NBS office work with LTER staff to better serve the survey's needs. One example, Raven says, is to supplement what Interior scientists know about nematodes; only 15,000 of an estimated 500,000 species have been characterized. To adhere to the survey's goal of describing U.S. biodiversity, soil ecologists will have to roll up their sleeves and start digging for worms.

LTER must also overcome a lack of comparability of data from one site to the next. Aside from a handful of experiments, such as one to measure wood decomposition, "the power of the network of coordinated research sites has not yet been fully realized," the review panel states in its report. "It's something of an embarrassment to us, that we have relatively few comparable data sets," says Franklin, who chairs LTER's coordinating committee. NSF officials have urged LTER scientists to develop standardized methods, but they don't want the work to consume too much time. "We don't want to bind up too much of our capital—intellectual or dollar—in the process rather than the product" of environmental research, Callahan says.

Environmental scientists hope LTER can meet these demands in the coming decade. "It's time now to make a giant leap forward and create a conceptual framework of what society needs to know, and what the LTER sites can provide," says University of Washington conservation biologist James Karr. NSF wants to provide a financial springboard by increasing LTER's budget in 1994, although a precise figure has not been determined.

Franklin, for one, accepts the challenge. "The question is how much we choose to do with this opportunity," he says.

–Richard Stone