“*Learning to be a Network*” 1984-1994

Developments at NSF and the Seattle Network Office

Perspective from Caroline Bledsoe

NSF LTER Reseach Coordinator,

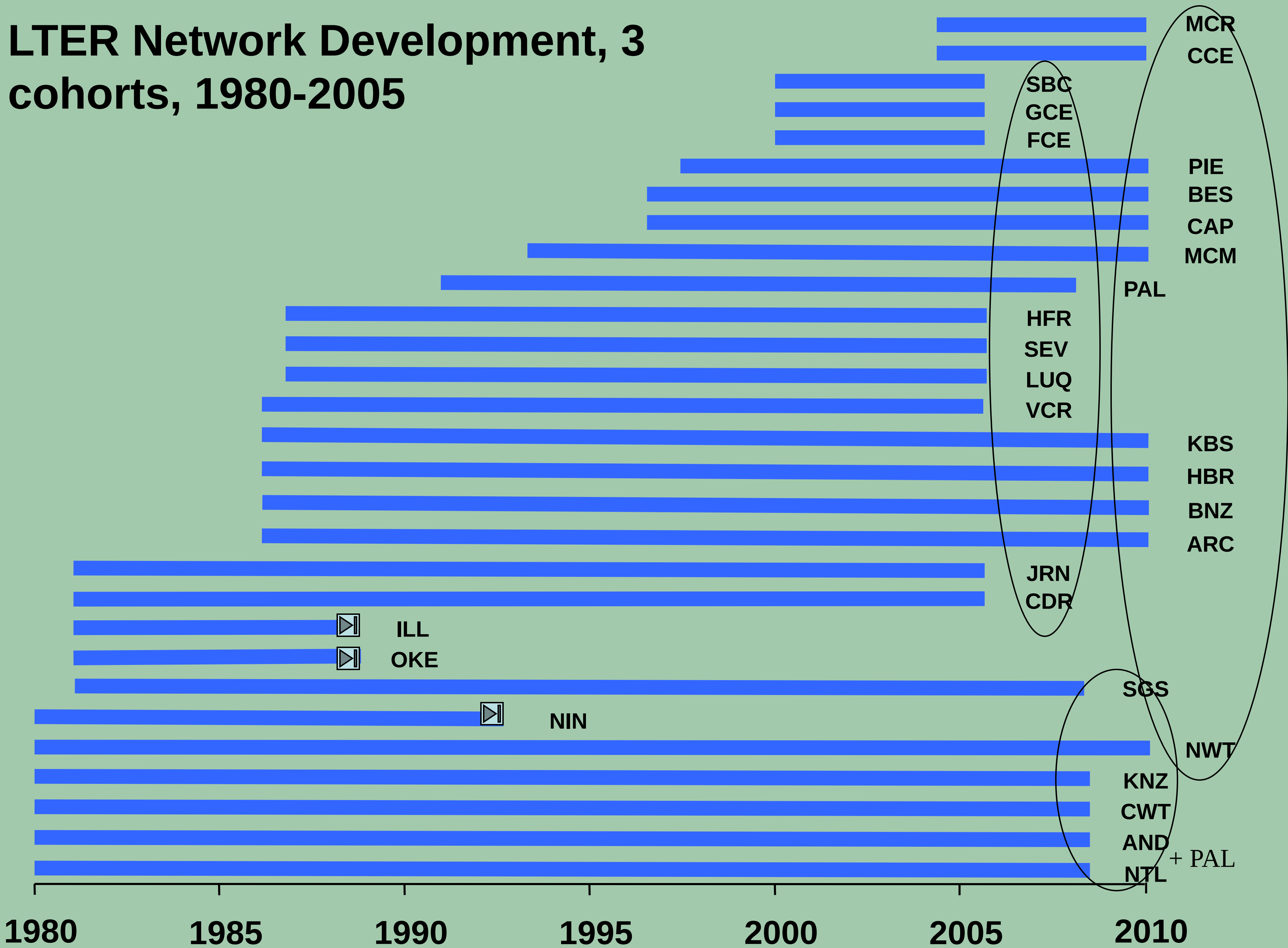
1986-1991

From 6 sites
In 1980

to

26 sites
In 2006

LTER Network Development, 3 cohorts, 1980-2005



1988 – 1996 Major Developments

NSF's Division of Biotic Systems and Resources

Division Director John Brooks

Ecosystems Program Officers

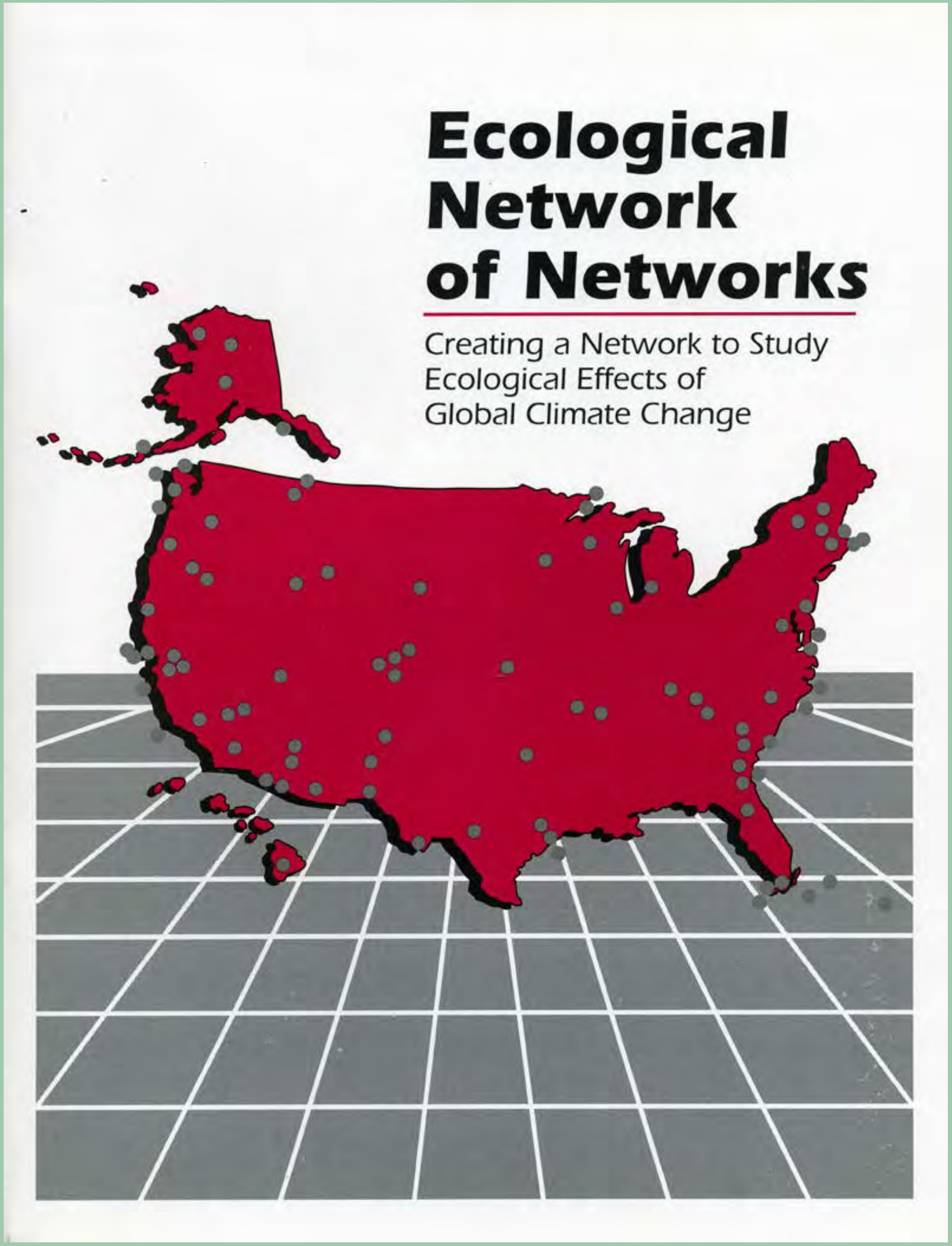
Tom Callahan, Jerry Melillo

LTER Staff Associates

Bob Robbins, Caroline Bledsoe

As LTER expands in the 1990's, NSF plans to support and review LTER. Regular NSF meetings ("Gang of X"), "Technology Supplements", more resources to LTER…

NSF build links from LTER to other NSF units, other agencies "Network of Networks"



1993

**Many agencies
Have ‘networks’
Of research
Sites..**

**Can you guess
Who supports
Each network?**

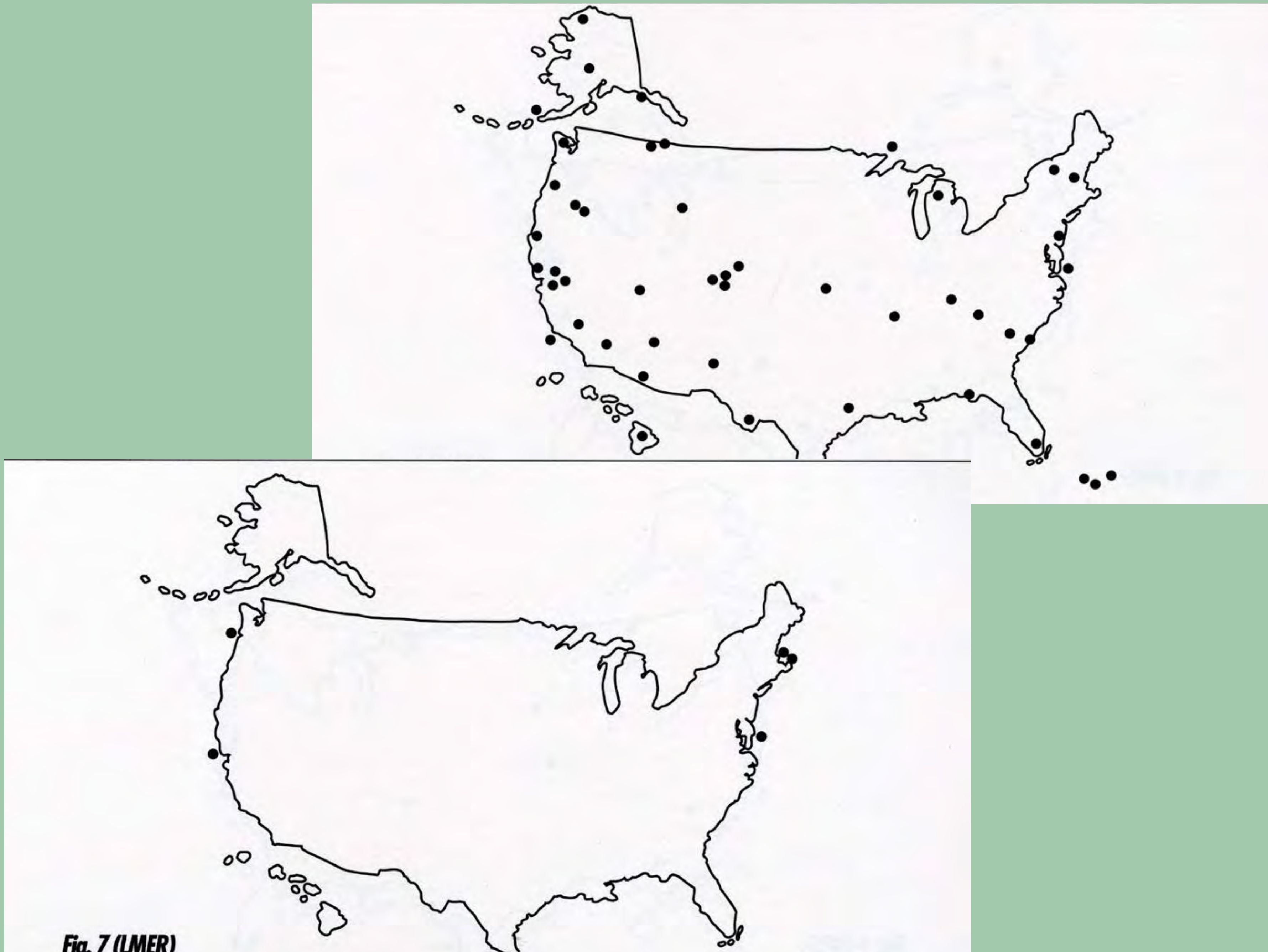


Fig. 7 (LMER)

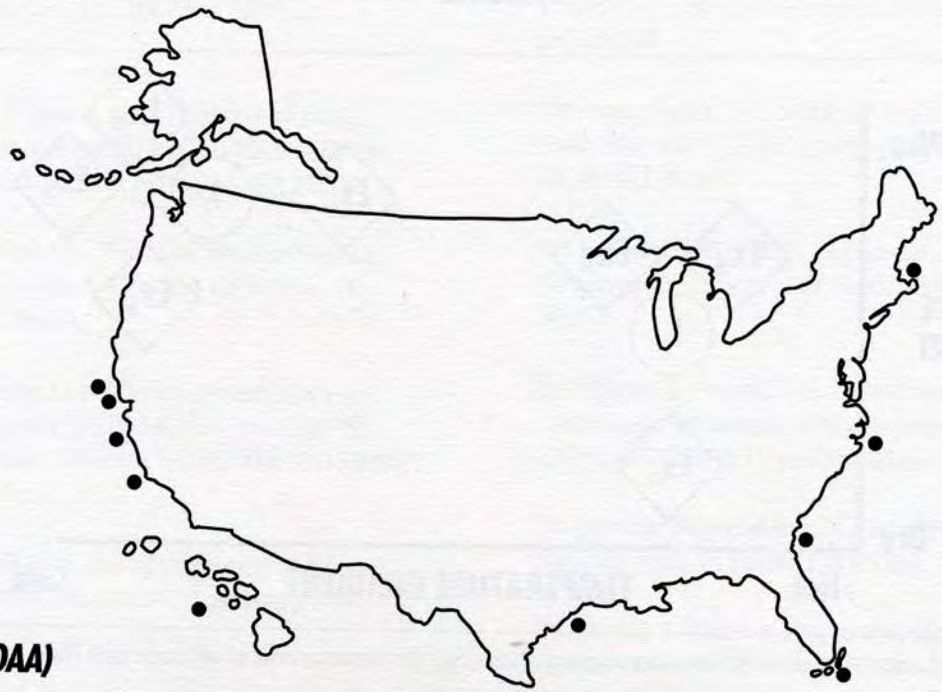
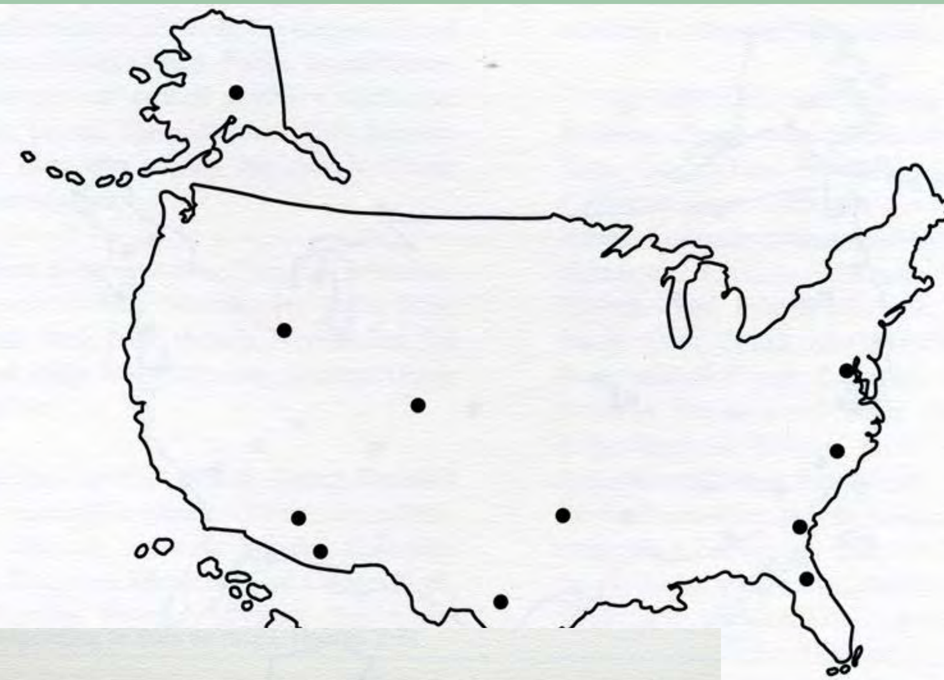


Fig. 3 (NOAA)



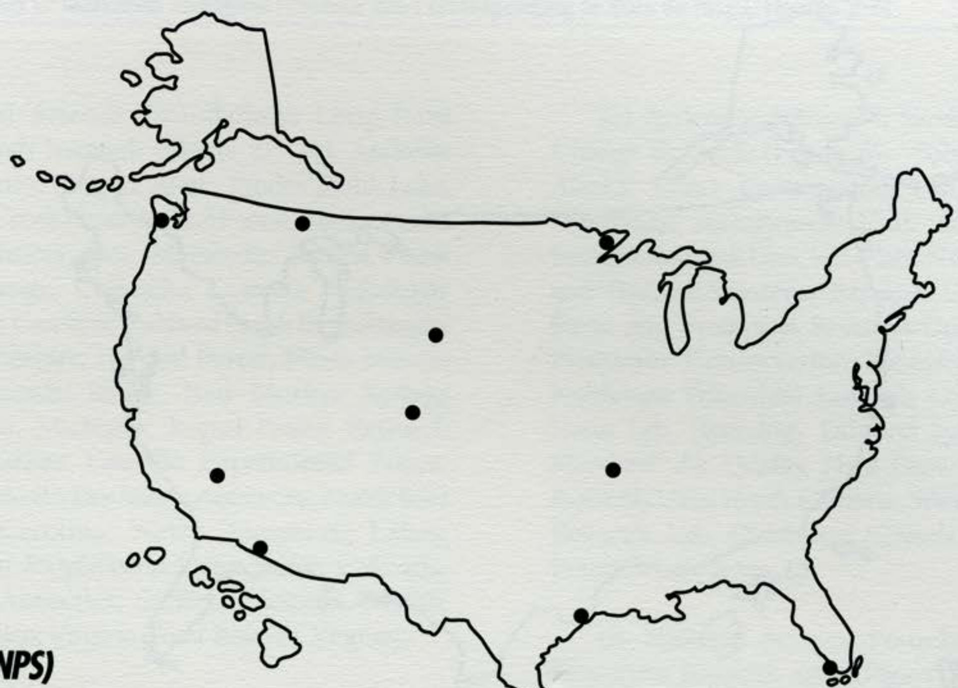


Fig. 5 (NPS)

Network office – move to Seattle

Jerry Franklin, chair, LTER-CC

Increased staff & resources to support a growing LTER Network

Bledsoe (1/2 time), Adrienne Whitener, Stephanie Martin, Rudolf Nottrott, John Vandecastle

More publications, meetings, activities (remember ‘strategic planning’?

July/Aug 1990
BioScience article
Franklin et al.

Efforts to
Expand awareness
Of LTER,
Encourage researchers
To work at LTER sites

Increased
focus on
'network '

Contributions of the Long-Term Ecological Research Program

An expanded network of scientists, sites, and programs can provide crucial comparative analyses

Jerry F. Franklin, Caroline S. Bledsoe, and James T. Callahan

The importance of long-term phenomena in ecology is well-documented (Likens 1989). Transient responses that extend over decades, or even centuries, are common, such as the gradual changes associated with community succession, soil development, and populations of large vertebrates. Other ecological phenomena are infrequent (rare or episodic) events, including such disturbances as floods, hurricanes, wildfires, or volcanic eruptions, and the reproduction of long-lived plant species. Long-term studies are essential to understand such phenomena, as well as for the formulation and testing of ecological theory (Franklin 1988, 1989, Likens 1989).

Substantial networking efforts are being made among LTER scientists and others involved in long-term ecological studies

Research with an extended time perspective is crucial if one accepts the premise that long-term phenomena have a central role in ecological science. Such studies are uncommon despite this obvious need and repeated evidence of the misleading nature of short-term research (Tilman 1989). Factors contributing to the rarity of long-term studies include difficulties in obtaining sustained financial support and in providing continuing leadership (Strayer et al. 1986).

The National Science Foundation (NSF), responding to this need for support of long-term studies in ecology, initiated a program in Long-Term Ecological Research (LTER) in 1980. This initiative followed an extended planning period involving ecological scientists of varied interests (Callahan 1984). The LTER program now has 17 sites with more than 400 associated scientific personnel.

The preceding two articles addressed the temporal and spatial scales of the LTER program (Figure 1). As described by Magnuson (page 495 this issue), LTER temporal scales, generally much greater than those of other ecological research, are necessary for the correct interpretation of short-term studies. Similarly, Swanson and Sparks (page 502 this issue) described how LTER programs typically address large spatial scales as well as smaller, more traditional scales, such as plot, stand, and small watershed. This final article describes the LTER program, reviews the development of the LTER network, identifies its contributions to ecological science, and considers ways in which LTER efforts can interface with other ecological research programs. The potential for an expanded network of scientists, sites, and programs is emphasized because of the importance of comparative analyses in advancing ecological science.

History of the program

At a series of three workshops beginning in 1977, ecologists considered the potential content and structure of a program of long-term research (NSF 1977, 1978). These efforts became the basis for the first LTER "request for proposals" in 1979. Five core areas were identified and have become the major program theme common to the 17 sites in the current network. These core areas are:

- pattern and control of primary production;

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LTER Sites

"Network-wide Science"

Failures – eg X-Roots
(too ambitious, climate & soils data
Not easily available,
root methods not standardized)

Successes
***Climate data organized & available on-line**
***Soils methods "Standard Soil Methods for LTER"**
(Robertson, KBS, lead)
***LIDET, litter decomposition project**
(thousands of litter bags & wooden dowels)
***VARNAE – variability comparisons**

How to organize research among sites?

5 Core Areas

1 Primary production
2 Population studies [spatial & temporal]
3 Movement of organic matter
[soils, water, sediments]
4 Movement of inorganic matter
5 Disturbance patterns, frequencies, effects

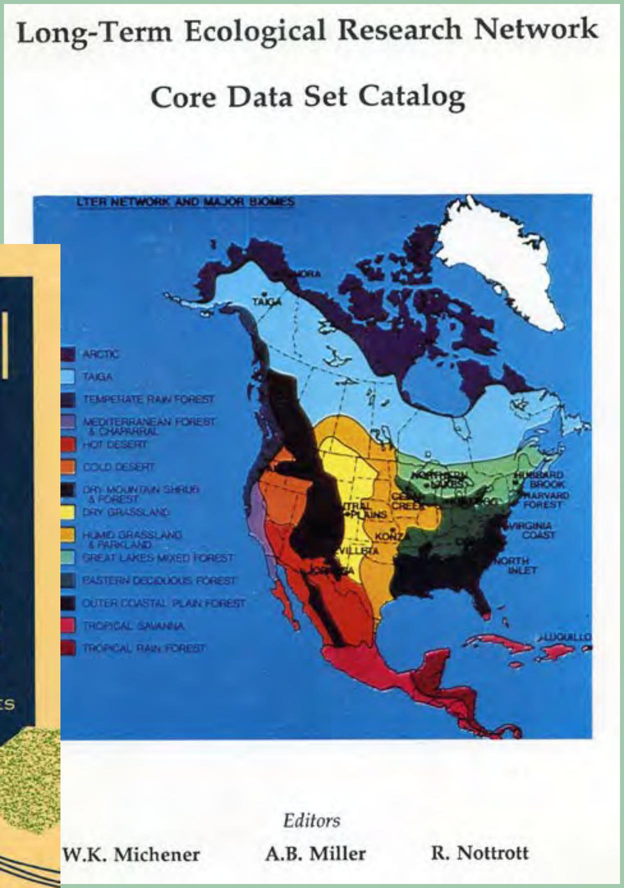
Even with core areas, it is still very DIFFICULT
to carry out 'network science'!

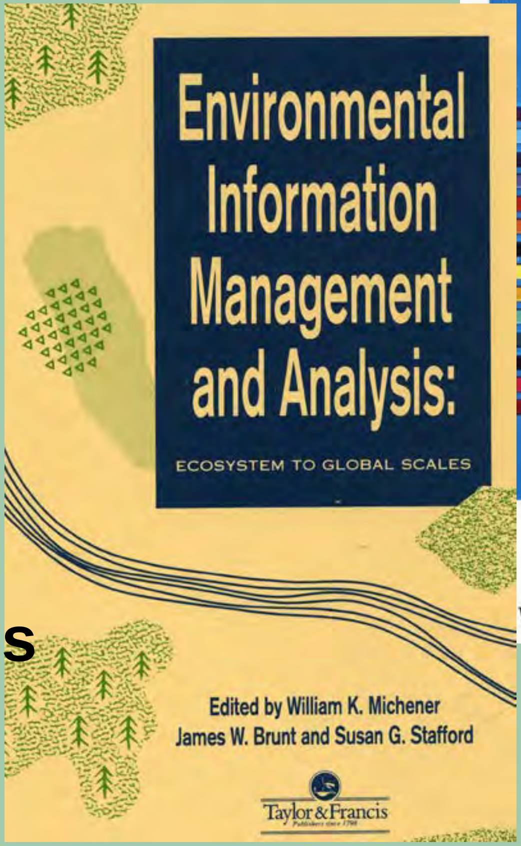
LTER Data Mangers:

Increased responsibilities, activities

Use of Internet for data sharing

1990
Core Data set Catalog
Michener, Miller & Nottrott





1994
Environ. Information Management & Analysis
Michener, Brunt, Stafford

LTER Data managers & belowground researchers working to provide LTER site climate data for a belowground productivity project (X-Roots)

1994

Low tech
Information transfer via floppy disk

1990 BioScience

Not easy to <u>share</u> information,
even 'simple'
Lists of publications

Problems:
different formats,
updating issues,
different software:
(WordPerfect, EndNote, InMagic, Paradox, BibIX,Papyrus, ProCite, WP-Citation, REFIND,/rdb, Notebook II, and custom software) !!!

Internet access to ecological information—the US LTER All-Site Bibliography Project

Biologists who wish to conduct a comparative or synthetic analysis of a particular topic face a daunting task. Typically, this endeavor starts—and may end—with a review of the literature. If it proceeds further, experimental data must be collected from a variety of sources, generally from published papers. Data must then be converted into comparable units, stored, and analyzed; the last step is to derive and publish one's conclusions. Until recently, this process required trips to the library; letters, e-mail, and phone calls to other scientists; and possibly a significant investment of time in computer software to assist with the integration of the gathered information.

Recent developments on the Internet are changing the way this process can work, making it possible to deliver access to bibliographies, literature, data, and other analyses directly to the desktop computers of biologists. Increasing amounts of biological information are now available online using a variety of network software tools of varying sophistication (e.g., gopher, Wide Area Information Systems [WAIS], Mosaic, Netscape, and others). These tools are rapidly becoming more and more "user friendly" and powerful, suggesting that online systems will be even more valuable in the future. Thus, biologists are likely to face an ever-increasing storehouse of electronic information. At present, however, this storehouse is somewhat disorganized, its contents often not arranged in the manner desired by the biologist or in forms that are easy to use, especially for comparative studies. Evans (1994, p. 205) has described the current organizational state of the Internet in terms of information "deserts" and "oceans": "Not knowing where to find useful information: the user 'thirsts' in an 'information desert.' In other cases...no systematic directories exist to guide a user through the thousands of data sources: the user 'drowns' in an 'information ocean.'" There are several general guides to the Internet, such as Gaffin and Heitkotter's (1994) and Krol's (1994). Hayes (1994) presents an overview of the World Wide Web for scientists. Smith (1993) offers an Internet guide specifically for biologists. An online starting point for finding sources of information on the Internet arranged by subject is the World Wide Web Virtual Library (Secret no date).

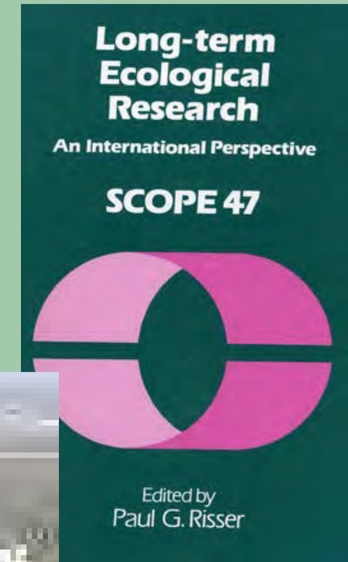
The US Long-Term Ecological Research (LTER) Program (Callahan 1984, Franklin et al. 1990; see box page 51) is actively working in the arena of Internet access to ecological information (LTERnet 1996d)—including bibliographies, directories of scientists, and a variety of data. The Ecological Society of America (ESA) is investigating such Internet access as a supplement to traditional scientific publication (Colwell 1995). This article describes our efforts at supporting the first component of the comparative and synthetic process for the LTER Network—the literature search. From these efforts, we have learned many lessons about how groups can consolidate, restructure, and provide online access to enhanced ecological information for use by others.

Our goal was to create a unified, multisite bibliography from the individual bibliographies of the 18 LTER sites that make up the LTER Network (LTERnet no date c) and of one former site. Each site in the network keeps a bibliography of publications on the research done at the site. Although the individual site bibliographies are useful, simultaneous access to all of these bibliographies would greatly increase the value of a search. Bibliographies are inherently simple data sets, having a standardized structure for the citations (e.g., author, date, title, and journal name). Thus, one might naively expect that combining several bibliographies into a coherent "all-site" bibliography would be a simple task. However, we discovered that local site differences make this integration more complicated than expected, especially if there is also the broader goal of joining the combined bibliography into a larger data access system, which might include a personnel directory listing authors and scientists and a catalog of experimental research data. Because these complications exist for simple, well-defined data like bibliographies, the problems will surely be greater with the more complex and subtle data such as collections of ecological experimental observations with extensive metadata.

We chose a simple, reasonably well behaved data set as a small-scale test case to make finding solutions more probable and climbing out of the inevitable pitfalls easier. We wanted to learn how current data—and, more important, future data not yet collected—might be structured to ease the task of consolidating collections of other types of information. Thus, the primary value of our test case is what we have learned about how to assemble, structure, and store data for online access. Despite the difficulties, our experience shows that the added value of the combined, unified data set more than justifies the efforts needed to achieve the consolidation. We also learned that those who publish online data should make significant efforts to do so in a man-

by Harvey Chinn and Caroline Bledsoe

BOOKS: Individual site synthesis volumes, standard methods for network science, International I-LTER networks, …



Looking forward

***encourage students into multi-site multi-disciplinary research (both analyses of existing data and new experiments)**

***team-based research requires new skills (not a typical academic focus on building “queendoms & kingdoms”**

***use information technology and web to work together and share data**