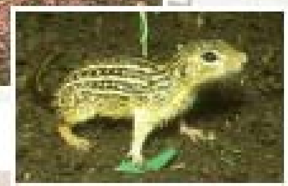
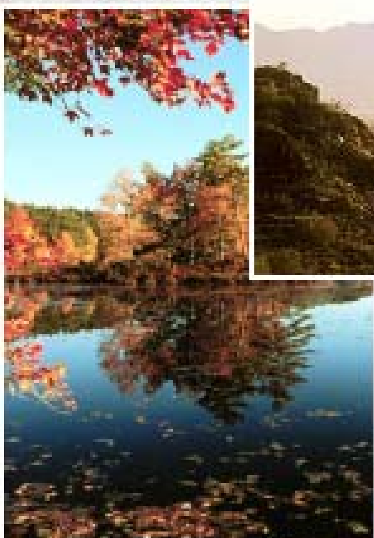




Long Term Ecological Research Network

Celebrating 25 Years of Excellence in Long-Term Ecological Research

LTER Sites

AND – **H.J. Andrews Experimental Forest LTER, Oregon**

ARC – **Arctic Tundra LTER, Alaska**

BES – **Baltimore Ecosystem Study LTER, Maryland**

BNZ – **Bonanza Creek Experimental Forest LTER, Alaska**

CAP – **Central Arizona-Phoenix LTER, Arizona**

CCE – **California Current Ecosystem LTER, California**

CDR – **Cedar Creek Natural History Area LTER, Minnesota**

CWT – **Coweeta LTER, North Carolina**

FCE – **Florida Coastal Everglades LTER, Florida**

GCE – **Georgia Coastal Ecosystem LTER, Georgia**

HBR – **Hubbard Brook LTER, New Hampshire**

HFR – **Harvard Forest LTER, Massachusetts**

JRN – **Jornada Basin LTER, New Mexico**

LNO – LTER Network Office, University of New Mexico, Albuquerque, NM

KBS – **Kellogg Biological Station LTER, Michigan**

KNZ – **Konza Prairie LTER, Kansas**

LUQ – **Luquillo Experimental Forest LTER, Puerto Rico**

MCM – **McMurdo Dry Valleys LTER, Antarctica**

MCR – **Moorea Coral Reef LTER, French Polynesia**

NWT – **Niwot Ridge LTER, Colorado**

NTL – **North Temperate Lakes LTER, Wisconsin**

PAL – **Palmer Station LTER, Antarctica**

PIE – **Plum Island Ecosystem LTER, Massachusetts**

SBC – **Santa Barbara Coastal Ecosystem LTER, California**

SEV – **Sevilleta LTER, New Mexico**

SGS – **Shortgrass Steppe LTER, Colorado**

VCR – **Virginia Coast Reserve LTER, Virginia**

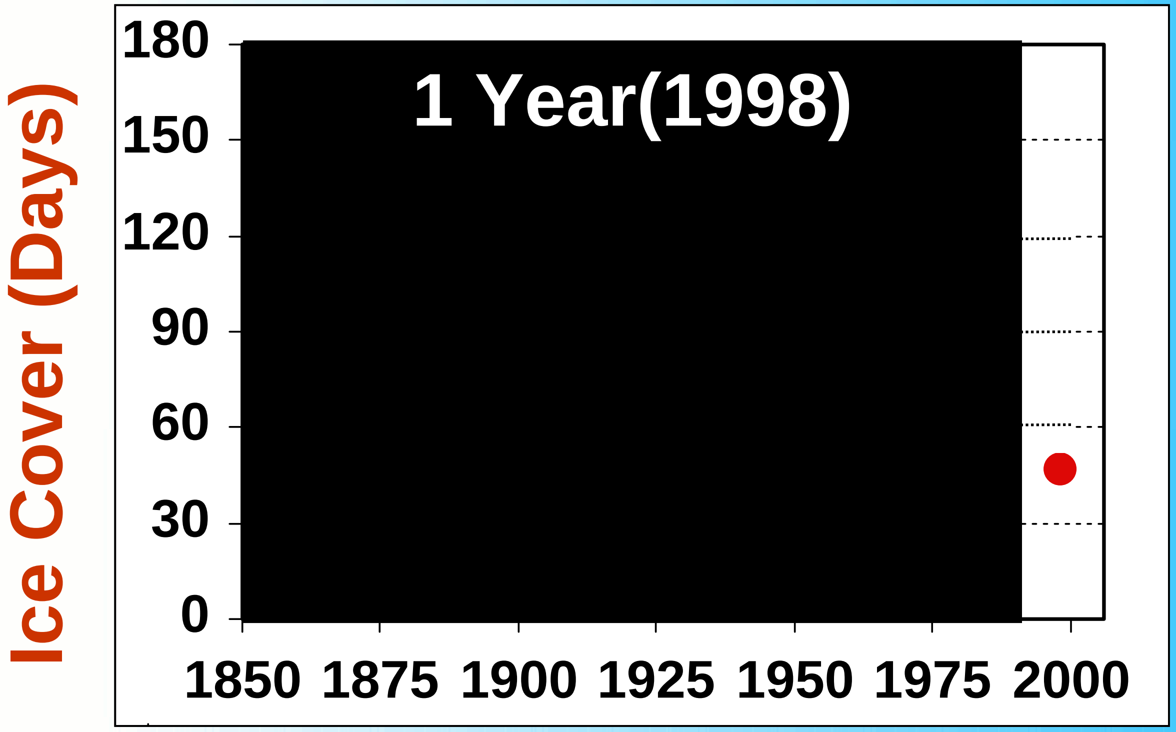
What are LTER's Good for?

- Creating long-term data
- Detecting long-term trends
- Understanding ecosystems via observations and experiments
- Developing & testing concepts/models
- Developing & testing tools (e.g., chemical analysis to regional analysis)
- Developing applications

Long-term research is required to reveal:

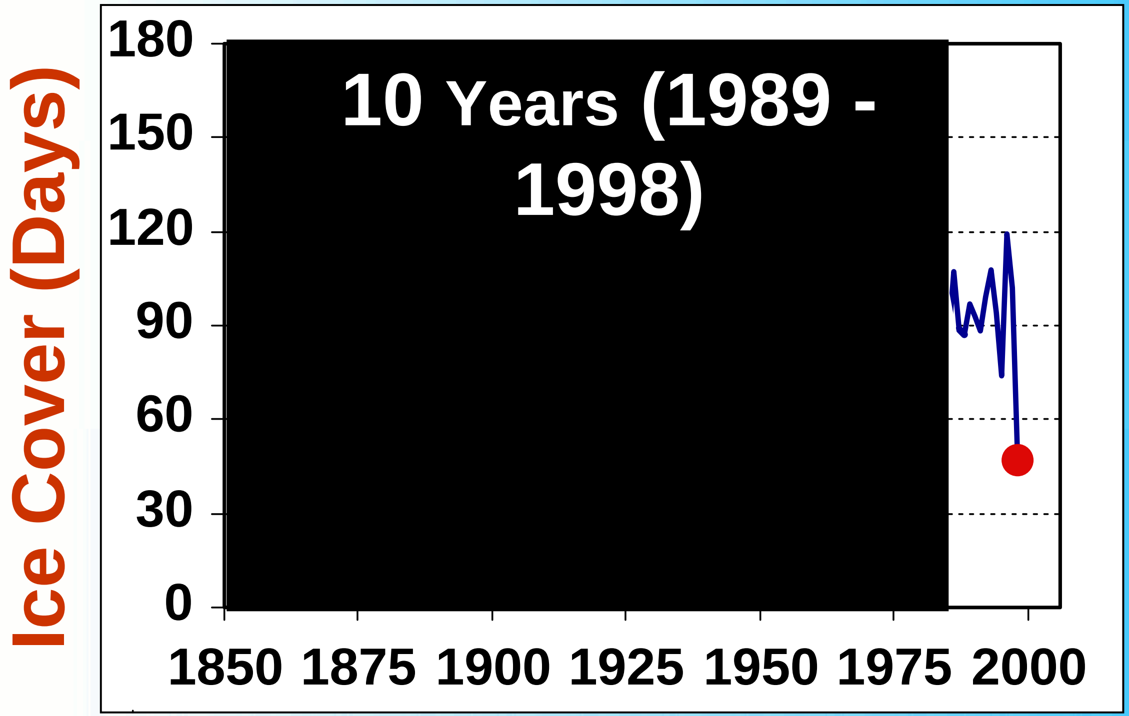
- Slow processes or transients
- Episodic or infrequent events
- Trends
- Multi-factor responses
- Processes with major time lags

Lake Mendota, Wisconsin



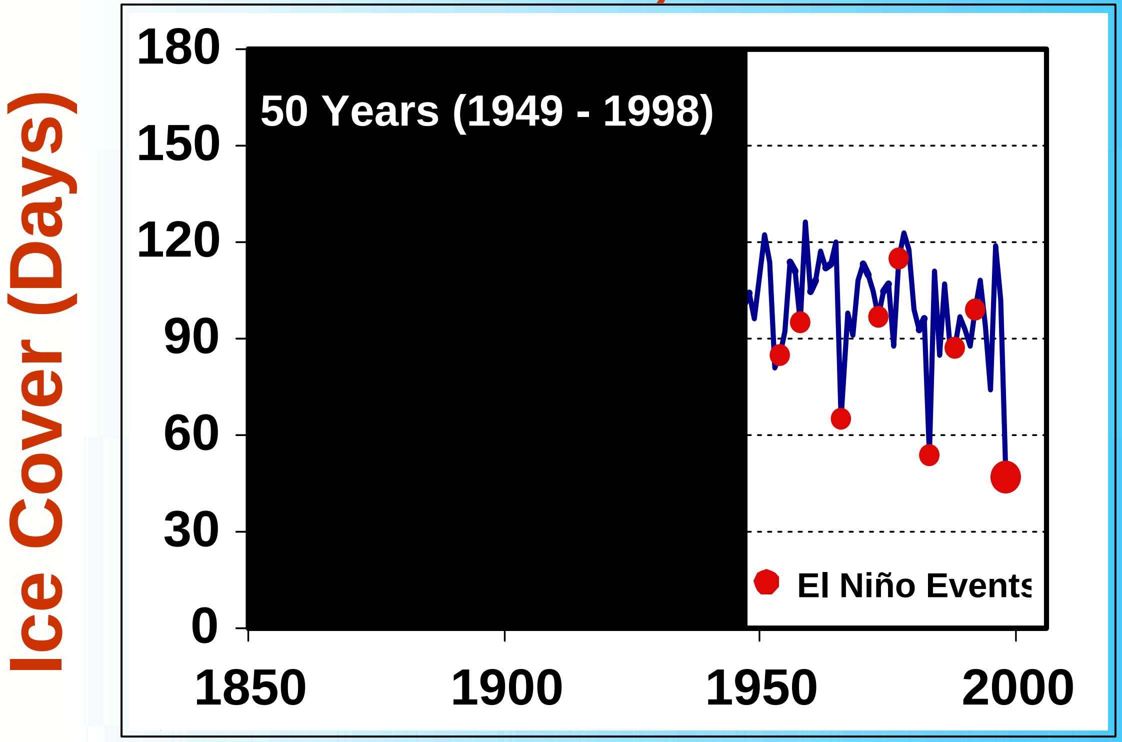
Lake Mendota, WI is an example of how long-term research provides insights not evident from short term studies. The graph above shows how long the lake was covered with ice in 1998. A study taken over one year (short-term) does not reveal much.

Lake Mendota, Wisconsin



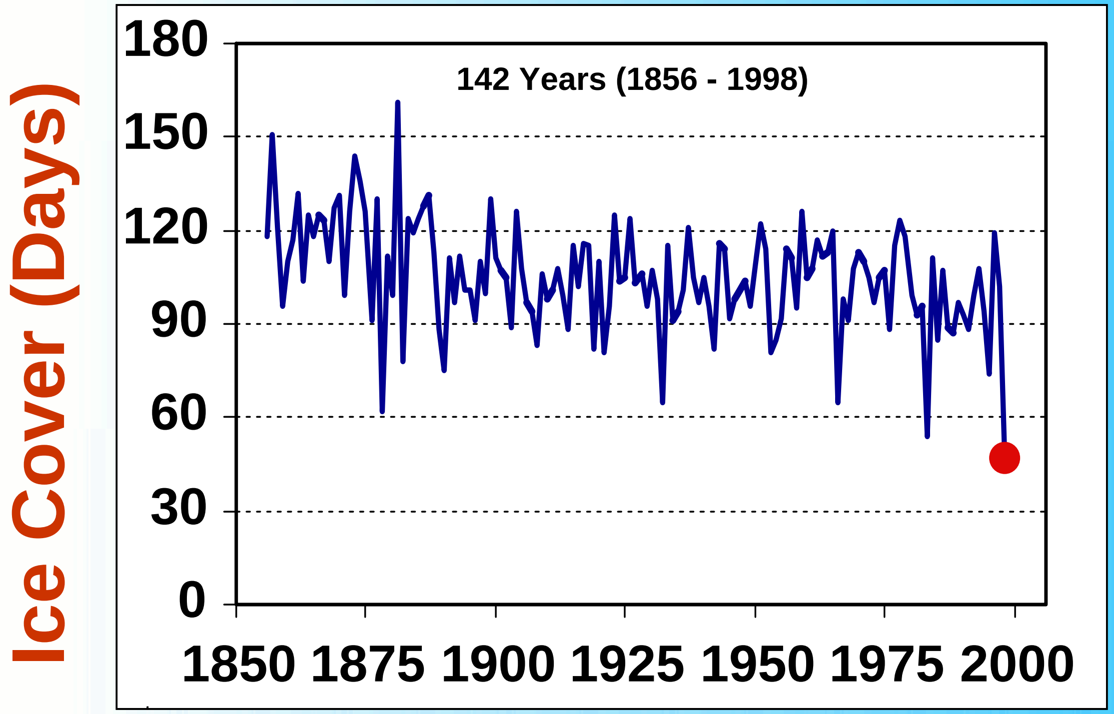
Research conducted over a decade reveals that duration of ice cover was unusually short in 1998.

Lake Mendota, Wisconsin



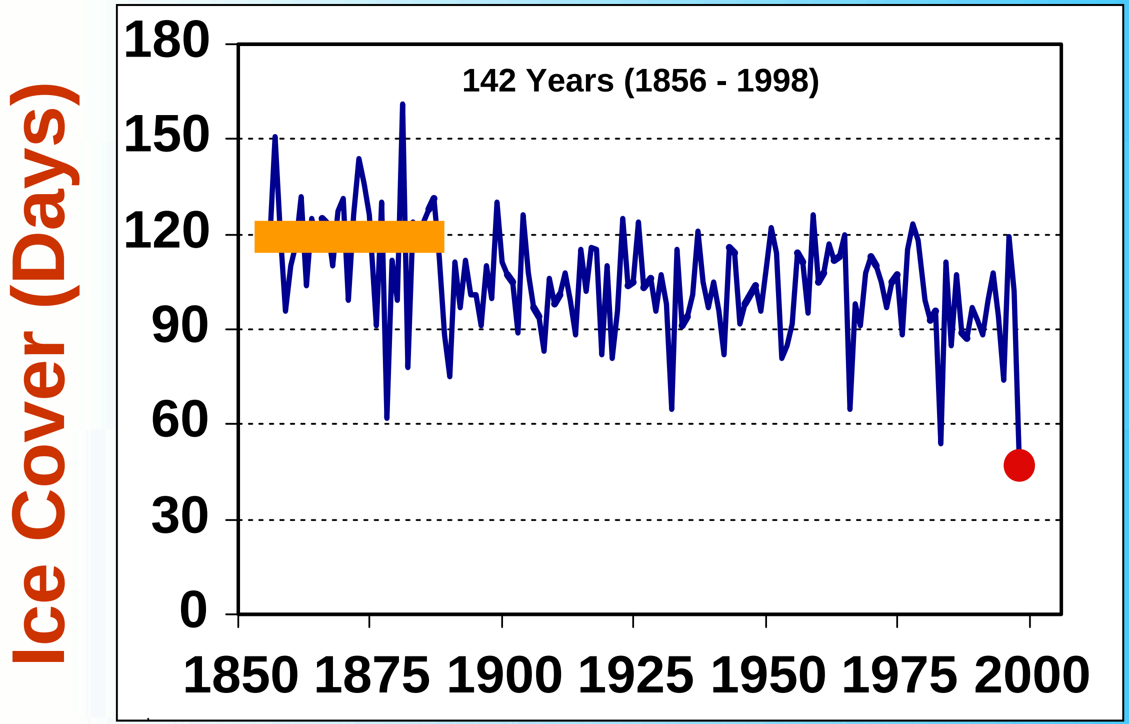
Research over half a century reveals patterns in the lake's ice cover that coincide with global weather patterns and natural phenomena.

Lake Mendota, Wisconsin



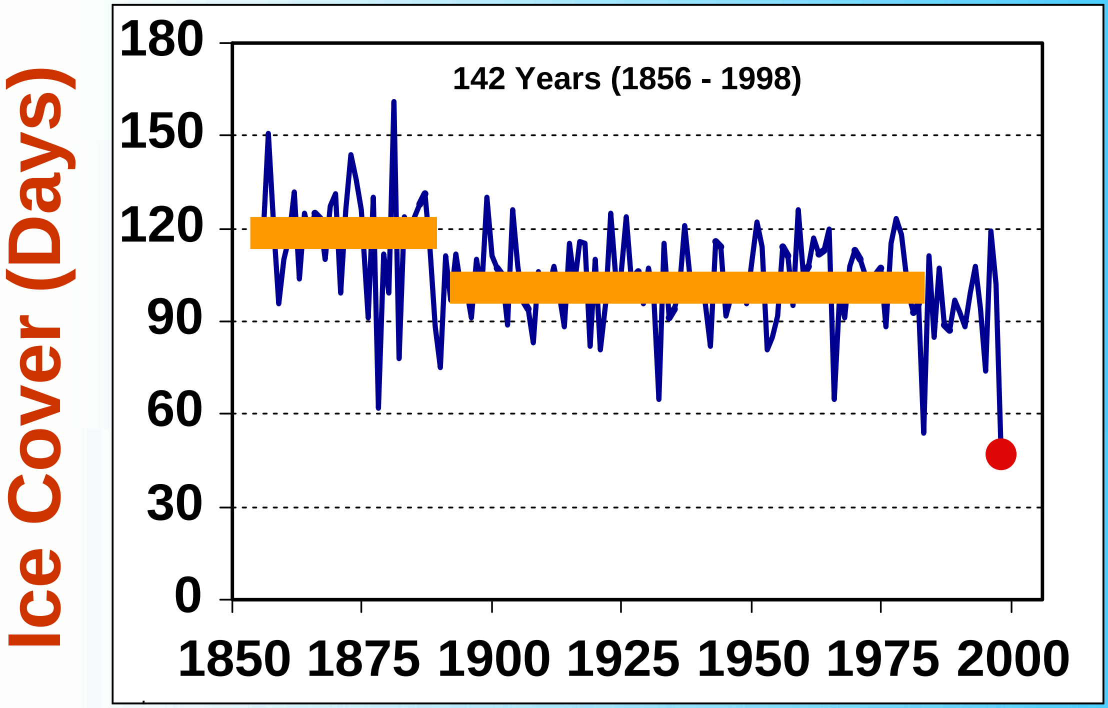
Data for the past 142 years suggests a trend that is not evident from shorter data sets.

Lake Mendota, Wisconsin



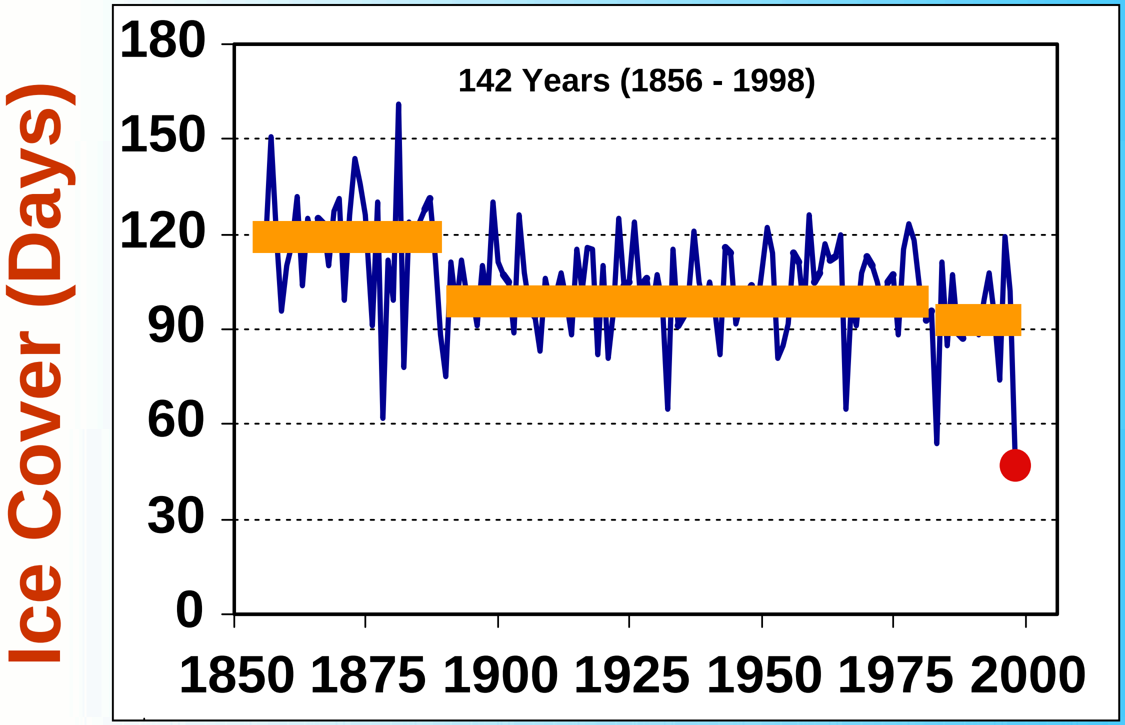
The length of the data set permits statistical interpretations of trends over different time periods.

Lake Mendota, Wisconsin



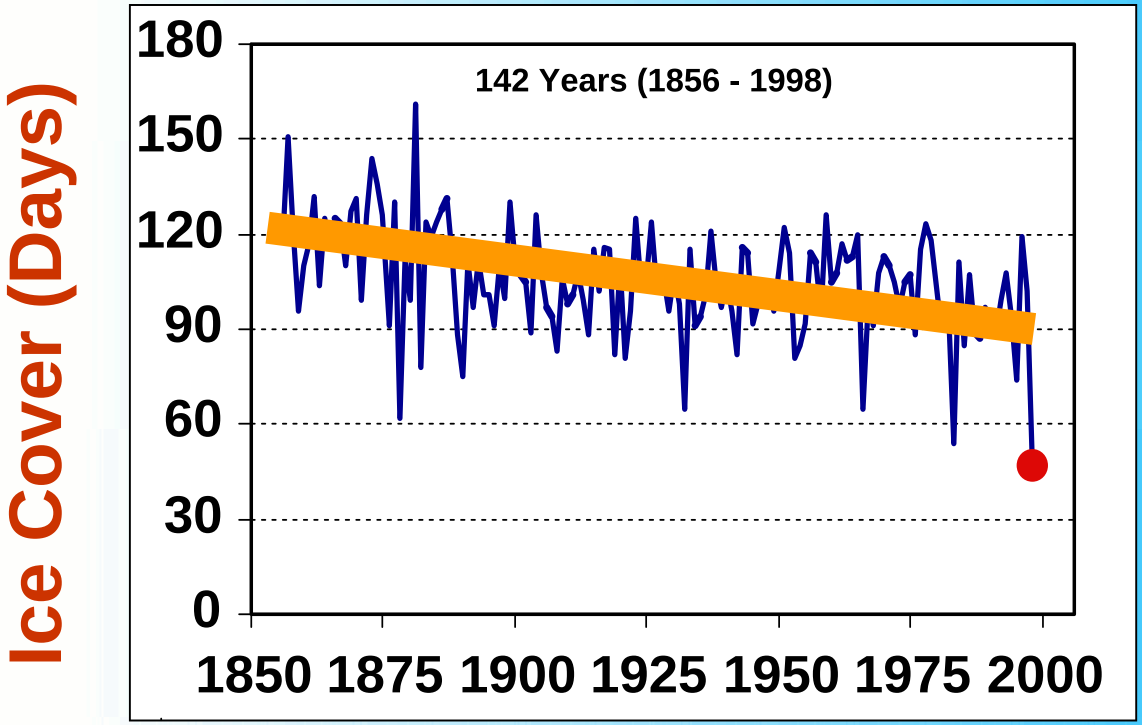
As more data are added, distinct periods in lake response are identified.

Lake Mendota, Wisconsin



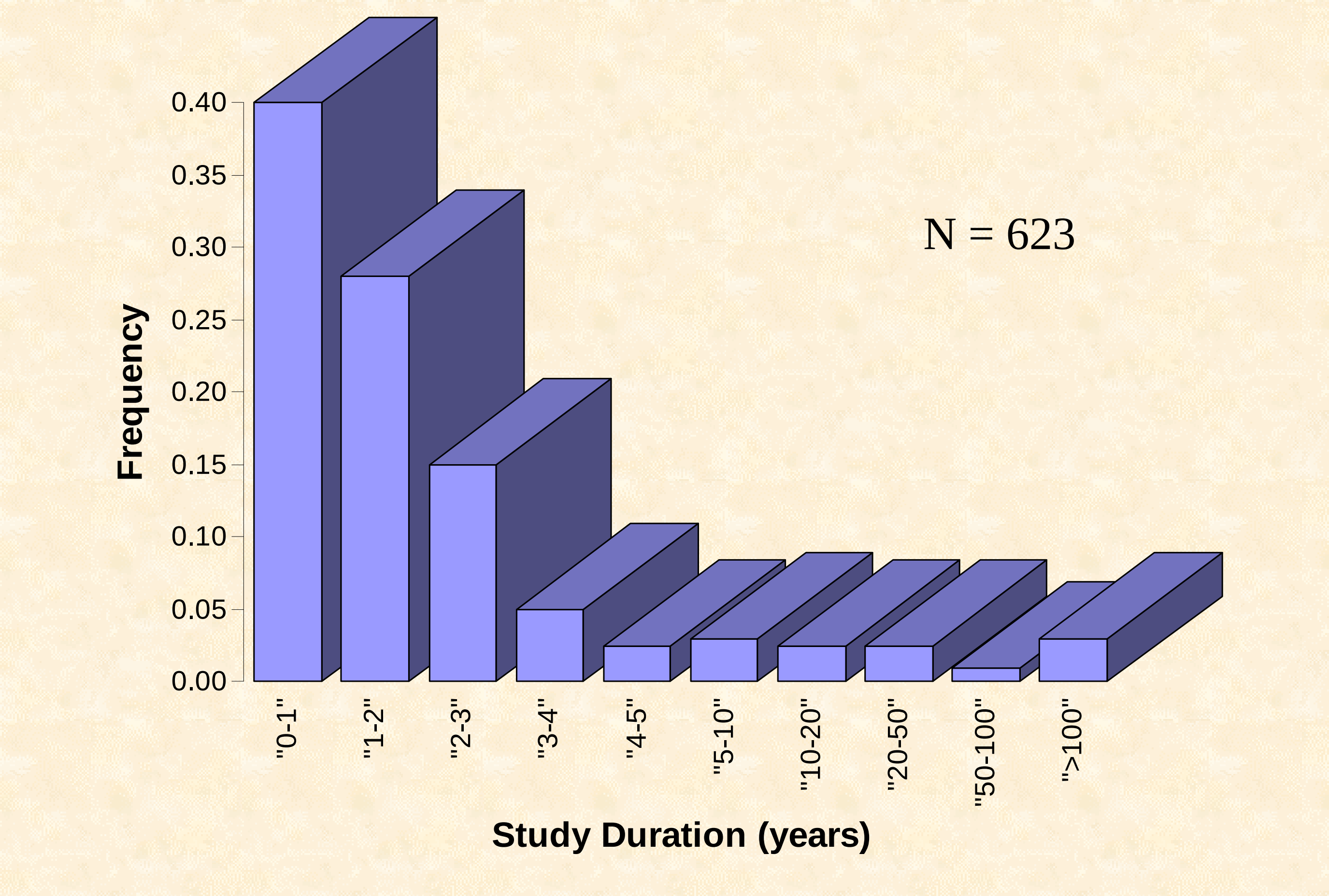
The most recent data indicate another potential pattern.

Lake Mendota, Wisconsin



Analysis of all of the data together suggests a long term trend. Now an investigation into the reason for the trend can begin.

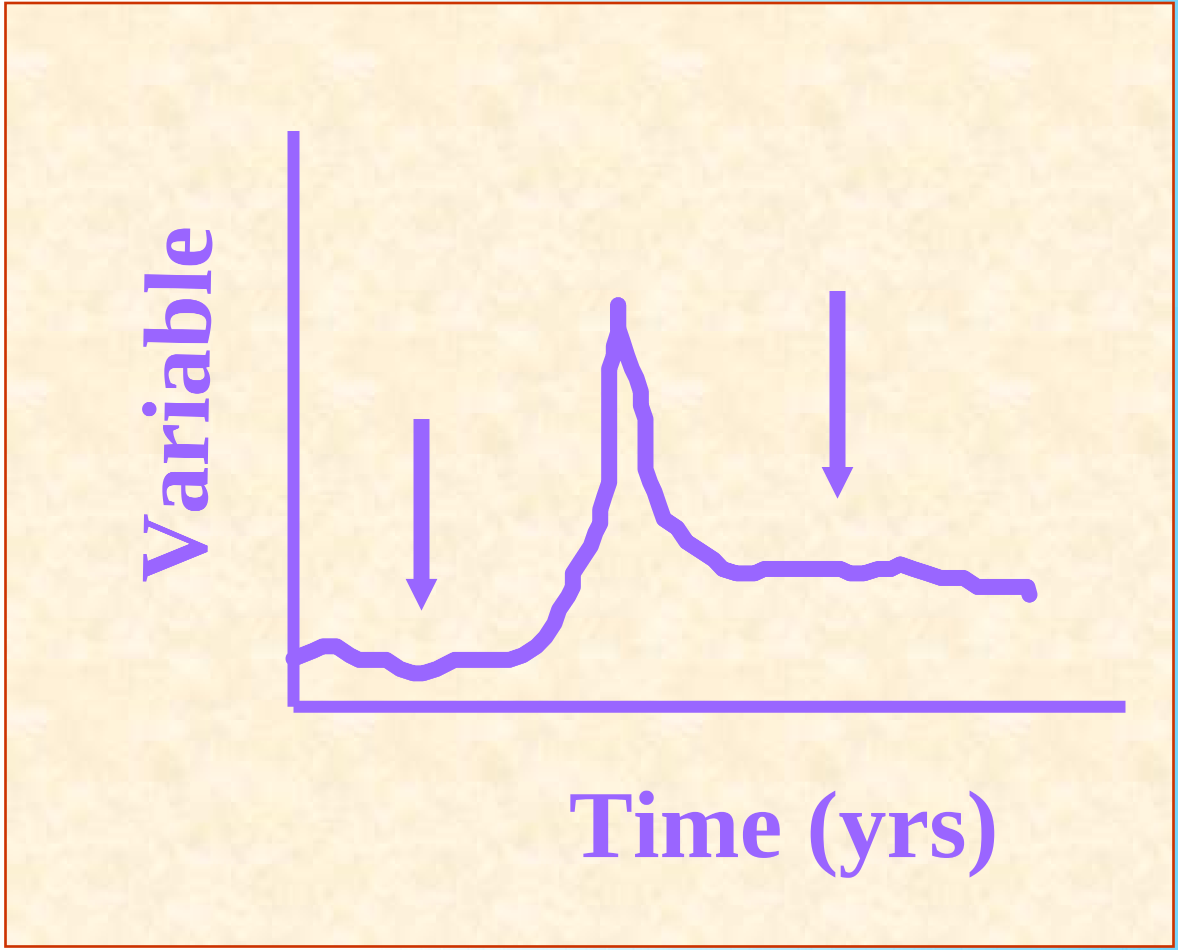
Duration of all observational and experimental studies



Eighty percent of studies in the ecological literature last less than three years

From Tilman, D. 1989. Ecological experimentation: strengths and conceptual problems. pp. 136-157. In Likens, G.E. (ed). Long-Term Studies in Ecology. Springer-Verlag, New York.

Only 10 percent of studies capture unusual events

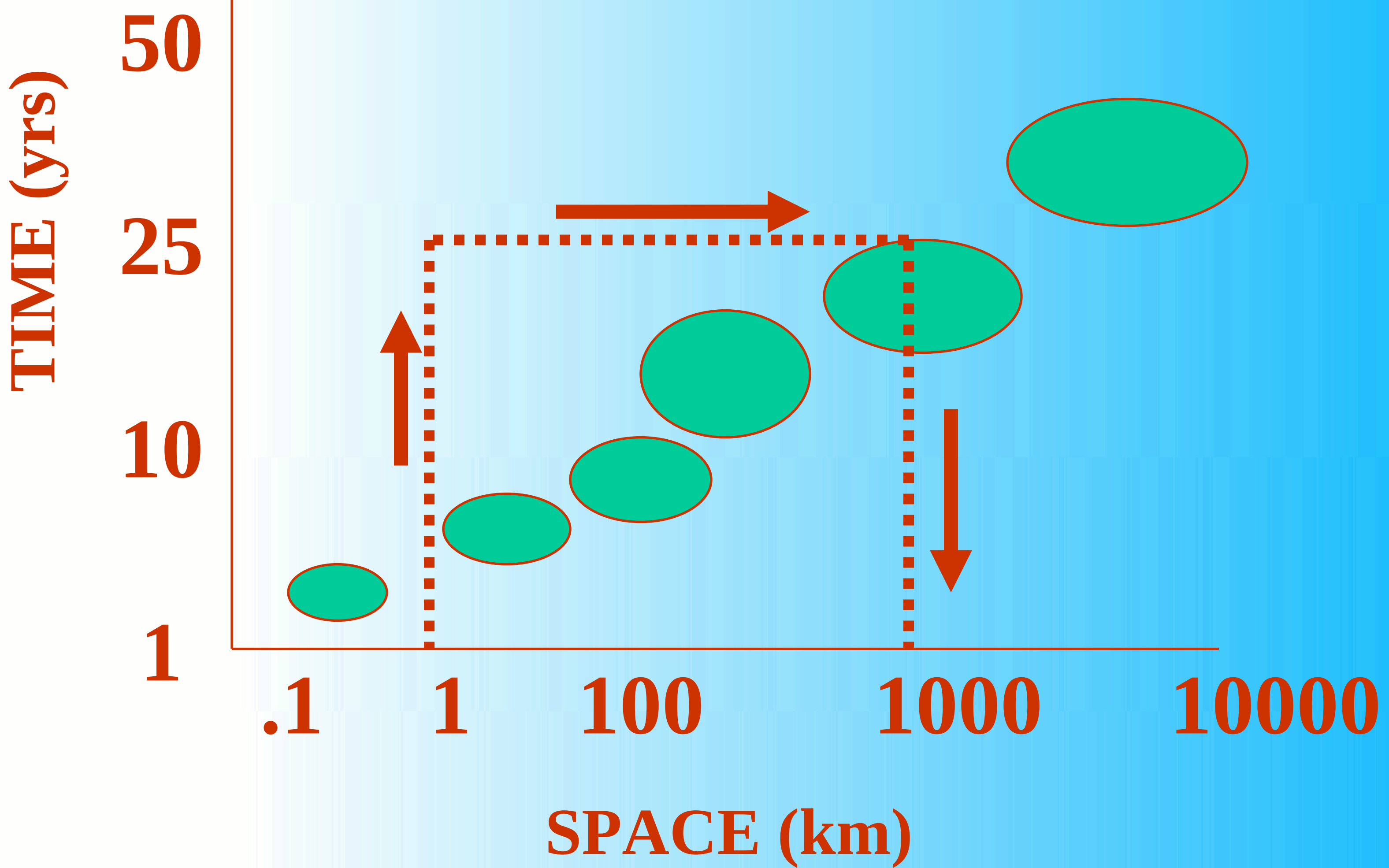


Unusual events reset systems. Short-term studies initiated before and after a rare event are viewing different system states.

LTER research covers time scales from months to centuries

YEARS	RESEARCH SCALES	PHYSICAL RESET EVENTS	BIOLOGICAL PHENOMENA
10^5 100 MILLENNIA 10^4 10 MILLENNIA 10^3 MILLENNIUM	PALEO ECOLOGY & LIMNOLOGY	• Continetal Glacition • Climate Change	• Evolution of Species • Bog Succession • Forest Community Migration • Species Invasion • Forest Succession
10^2 CENTURY 10^1 DECADE 10^0 YEAR 10^{-1} MONTH	**LTER**	• Forest Fires • CO_2 Climate Warming • Sun Spot Cycle • El Nino • Prairie Fires • Lake Turnover • Ocean Upwelling	• Cultural Eutrophication • Hare Population • Prairie Population • Annual Plants • Plankton Succession
10^{-2} DAY 10^{-3} HOUR	MOST ECOLOGY	• Storms • Diel Light Cycle • Tides	• Algal bloom • Diel Migration

The time scales addressed by the Long Term Ecological Research Program fall outside the range of those typically addressed in other ecological research programs



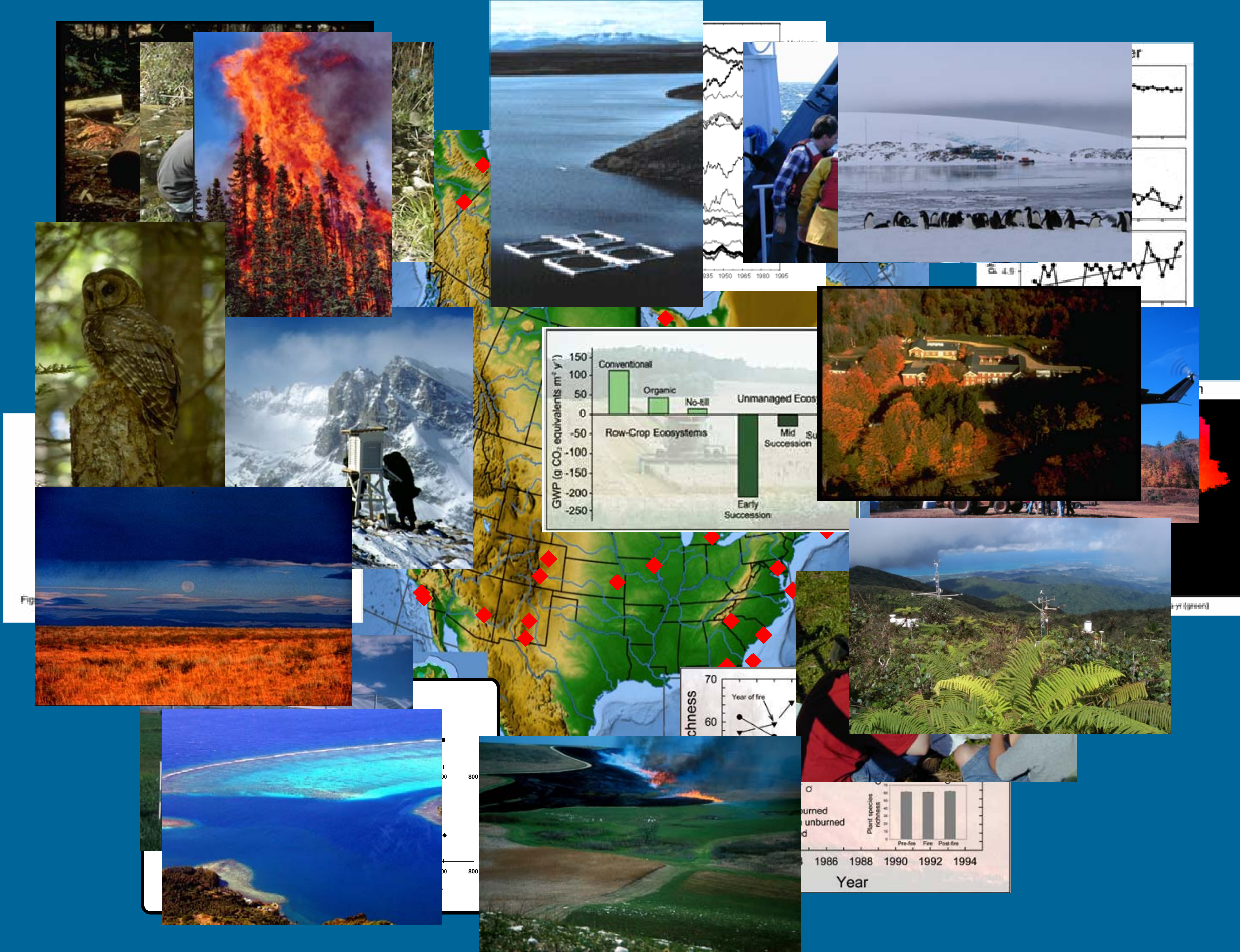
Over time, long-term studies experience events that normally are associated with large spatial scales (e.g., droughts). Thus, long-term studies provide opportunities to extrapolate to larger spatial scales.

Research over broad spatial scales

- – Answers large scale questions concerning ecological phenomena
- – Creates opportunities for comparisons between ecosystems across regional, continental, and global gradients
- – Allows scientists to distinguish system features controlled by absolute and relative scales

AREA (m^2)	RESEARCH PROGRAMS
10^{14} GLOBAL	GLOBAL SCIENCES (IGBP)
10^{12} CONTINENT	LTER
10^{10} REGION	MOST ECOLOGY
10^{8} LANDSCAPE	
10^{6} LANDSCAPE	
10^{4} PLOT, PATCH	
10^{2} PLOT, PATCH	
10^{0} SAMPLE POINTS	

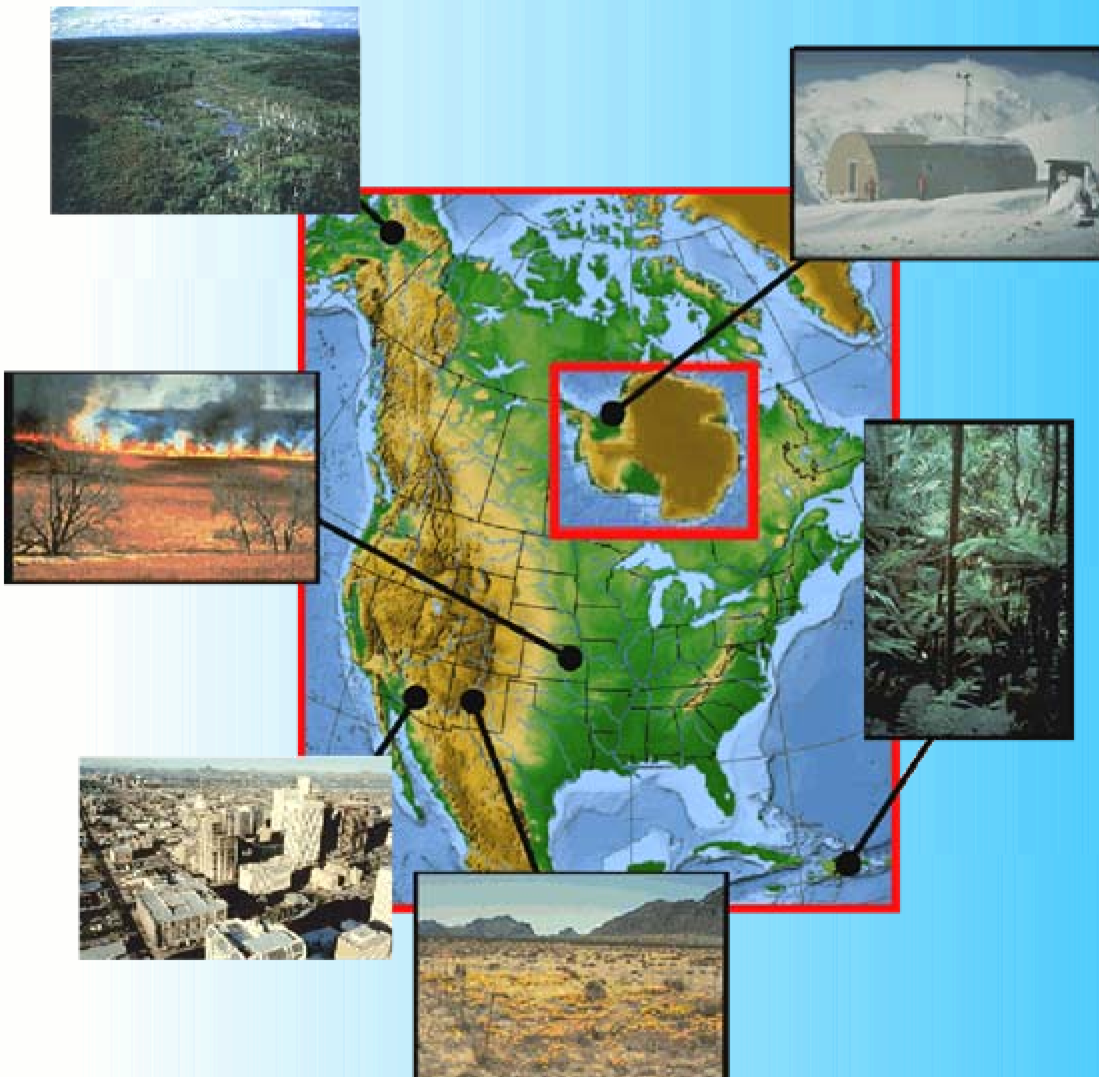
The spatial scales addressed by the Long Term Ecological Research Program fall outside the range of those typically addressed in other ecological research programs


GWP (g CO_2 equivalents m^{-2} y^{-1})
150
100
50
0
-50
-100
-150
-200
-250
Conventional
Organic
No-till
Row-Crop Ecosystems
Unmanaged Ecos
Mid Succession
Early Succession
Year of fire
70
60
1986 1988 1990 1992 1994
Year
Pre-fire Fire Post-fire
Plant species richness

LTER sites share a common commitment to long-term research on the following core topics:

- Pattern and control of primary production
- Spatial and temporal distribution of populations selected to represent trophic structure
- Pattern and control of organic matter accumulation in surface layers and sediments
- Patterns and movements of inorganic inputs through soils ground- and surface waters
- Patterns and frequency of disturbance

Comparisons among sites focus on fundamental ecological principles



THE IMPORTANCE OF CROSS-SITE SYNTHESIS

"The power of the network approach of the LTER program rests in the ability to compare similar processes (e.g., primary production or decomposition of organic matter) under different ecological conditions. As a result, LTER scientists should be able to understand how fundamental ecological processes operate at different rates and in different ways under different environmental conditions" (Risser Report, 1993).

Science drives the need for information management

For the Sites

- Long-term studies depend on databases to retain project history

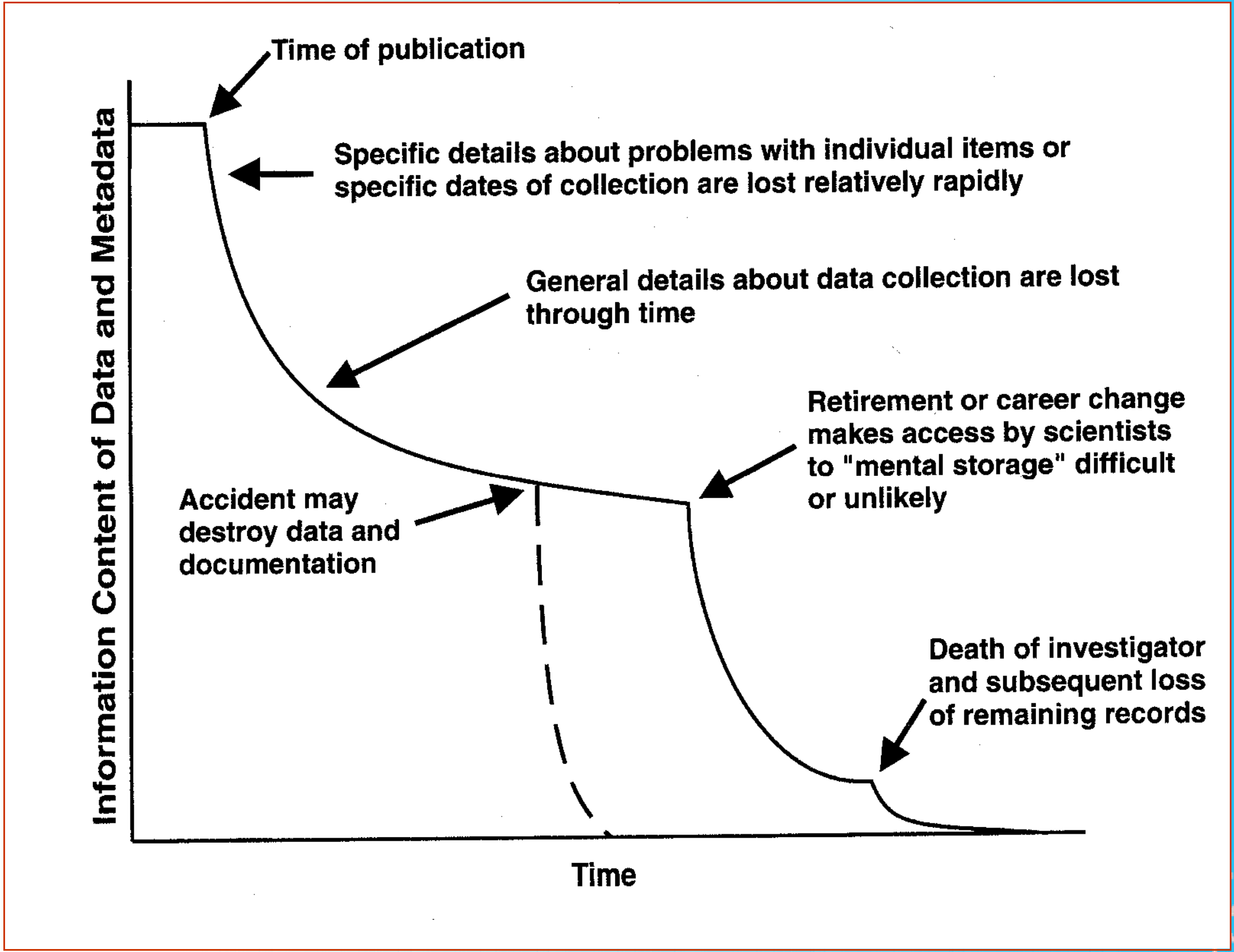
For the Network

- Cross-site studies require communication and integration of data

For the Nation

- Integrated, multidisciplinary projects depend on databases to facilitate sharing of data

Information decay



Data loses value over time unless documented and archived.

Why do we need a Network Information System?

Modern ecology requires increased access to data and metadata distributed across multiple sites for synthesis and integration across broad spatial and temporal scales.

A major challenge to the U.S. LTER network in the coming decade is the design and implementation of an information system that seamlessly facilitates intersite research.

These binders contain 10 years of data collected in the Grassland section of the International Biosphere Programme, ca. 1978

Network Information System Design and Development

Virtually all of these synthesis efforts require the bringing together of diverse, long-term data sets, with associated problems of compatibility, coding, transformation, sorting, and searching. *There is thus a particular need to establish within the next decade a program of logistical support for LTER-related synthesis efforts, with a focus on database development and informatics techniques optimized for ecological research.* – 20-Year Review

Instrumenting the Environment

What's happening now?

Planning process about half completed.
Elements include:

- Grand challenge science themes best addressed by LTER
- Cyberinfrastructure to support science themes
- Improved governance structure
- Integration of education and research
- Continuity in strategic planning