Transforming from individual to collaborative network science

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LTER

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UNM BIOLOGY

Outline of the presentation:

- Why collaborate
- Costs and benefits
- Development of “Big Science” in ecology
- LTER and NEON
- Coupled natural-human systems

TOPICS FOR DISCUSSION:

1. Culture of collaboration
    - Collective identity
    - Drivers of collaboration
2. Governance
3. Data Sharing
    - Authorship
    - Ethics
4. Strategies for management
    - Structure
    - Evaluation
    - Information management
    - Staff
5. Funding
    - Internal
    - External

SCIENTISTS DISCOVER NEW ELEMENT

Oxford University researchers have discovered the heaviest element yet known to science. The new element, Universitium (symbol=Uv), has one neutron, 25 assistant neutrons, 88 deputy neutrons and 198 assistant deputy neutrons, giving it an atomic mass of 312. These 312 particles are held together by forces called morons, which are surrounded by vast quantities of lepton-like particles called pillocks.

Since Universitium has no electrons, it is inert. However, it can be detected, because it impedes every reaction with which it comes into contact.

Universitium has a normal half-life of 2 to 6 years. It does not decay, but instead undergoes a reorganization in which a portion of the assistant neutrons and deputy neutrons exchange places. In fact, Universitium's mass will actually increase over time, since each reorganisation will cause more morons to become neutrons, forming isodopes.

Funding agencies:

Proactive ◄ ► Reactive
Large vs. small grants
Funding rates
Definition of “interdisciplinary”

Academic culture:

Emphasis on funding – low vs. high risk
Departmental and college structure
Research culture for tenure and promotion
Definition of “interdisciplinary”

Ecological grand challenges:

Coupled human-natural systems:

- Invasive species
- Climate change
- Altered biogeochemical cycles
- Ecology of infectious disease
- Loss of biodiversity
- Genetically modified organisms
- Restoration and designer ecosystems

nature
3 July 2003 Volume 424 Issue no 6944

Who’d want to work in a team?

Biologists and their institutions are increasingly confronted by the challenges of working in major collaborations that other disciplines have already addressed. A gathering last week showed how much further there is to go.

EDITORIAL

Multiple Authors, Multiple Problems

> A team is a team, and the members should share the credit or the blame.

- Time demands
- Authorship
- Intellectual property rights
- Publication credits
- Credit (tenure and promotion)
- Sharing the blame - fraud

Drivers of collaboration in ecology

1950 National Science Foundation

1967

1974 US International Biological Program

1980

Single investigator research projects

Ecosystem studies program

Long-term Ecological Research

1996

1998

1999

2003

NCEAS

IRCEB

BioC

FIBR

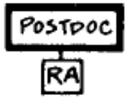
NEON? CNH SEES

B. Peterson 1993

MODEL

SIZE CLASS 1 : GRADUATE STUDENT WORKING ALONE ON A Ph.D. THESIS :

SIZE CLASS 2 : POSTDOCTORAL STUDENT ASSISTED BY AN UNDERGRADUATE RESEARCH ASSISTANT (RA) :



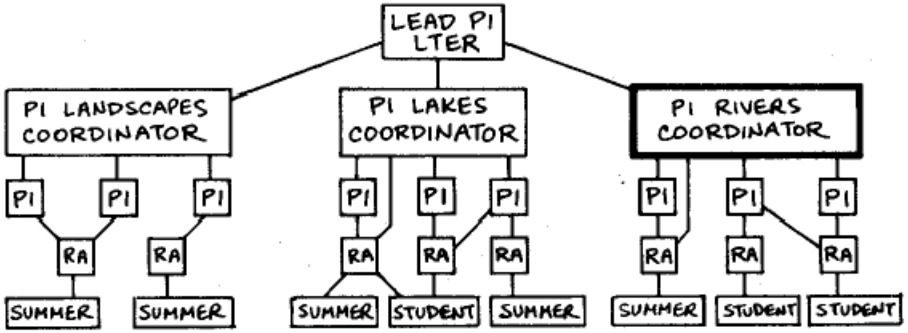
SIZE CLASS 3 : ASSISTANT SCIENTIST/PROFESSOR WORKING ON AN NSF GRANT WITH TWO RESEARCH ASSISTANTS (RA's) :

SIZE CLASS 4 : SMALL SCALE COLLABORATIVE PROJECT: ASSISTANT SCIENTIST/PROFESSOR AS A CO-P.I. WORKING ON A 3 OR 4 P.I. PROJECT WITH 2 OR 3 RA's. :

SIZE CLASS 5 : LTER OR LMER.

ASSOCIATE OR SENIOR SCIENTIST/PROFESSOR WORKING AS COORDINATOR OF A PORTION OF A 12 P.I. PROJECT INVOLVING LAKES, RIVERS AND LANDSCAPE COMPONENTS. TOTAL PERSONNEL INVOLVED: ABOUT 25-50.

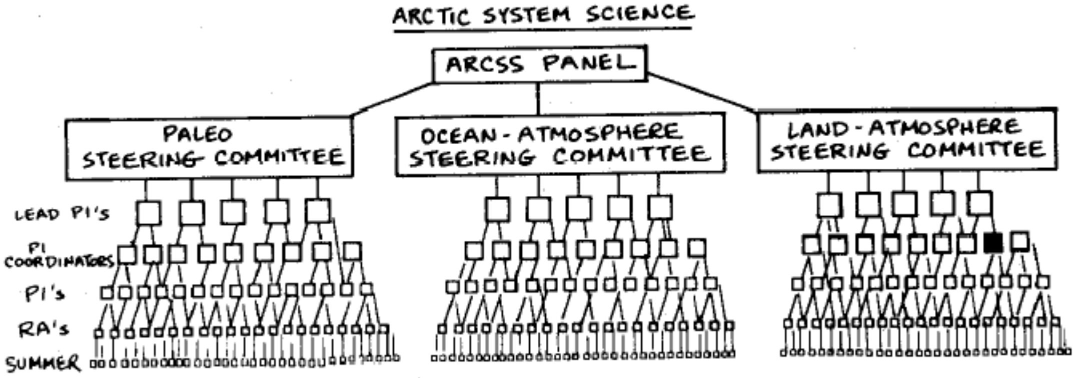
SIZE CLASSES 1-4 EXIST AS NESTED WITHIN MODEL 5, OR AS SEMI-INDEPENDENT PROJECTS.



B. Peterson 1993

SIZE CLASS
6 : GLOBAL CHANGE RESEARCH.
"ARCTIC SYSTEM SCIENCES (ARCSS)". (ANOTHER EXAMPLE: LTER NETWORK)

SENIOR SCIENTIST WORKING AS COORDINATOR/RESEARCHER TO DEVELOP A SYSTEM OF MONITORING, EXPERIMENTATION AND MODELING TO PREDICT FUTURE STATES OF THE ARCTIC SYSTEM.
TOTAL PROGRAM: ~ $15 MILLION/YEAR. TOTAL PERSONNEL: ~300-500



SIZE CLASS
7 : EARTH SYSTEM SCIENCE.
INTEGRATE ARCSS WITH OTHER GLOBAL CHANGE STUDIES.
TOTAL PERSONNEL PROBABLY ~5000-15,000 GLOBALLY.

TABLE 1. Differences between individual and collaborative group research.

Group Research Requires
1) Less individual freedom
2) More planning
3) More administration
4) More data management
5) More funding
6) More continuity and predictability of funding

B. Peterson 1993

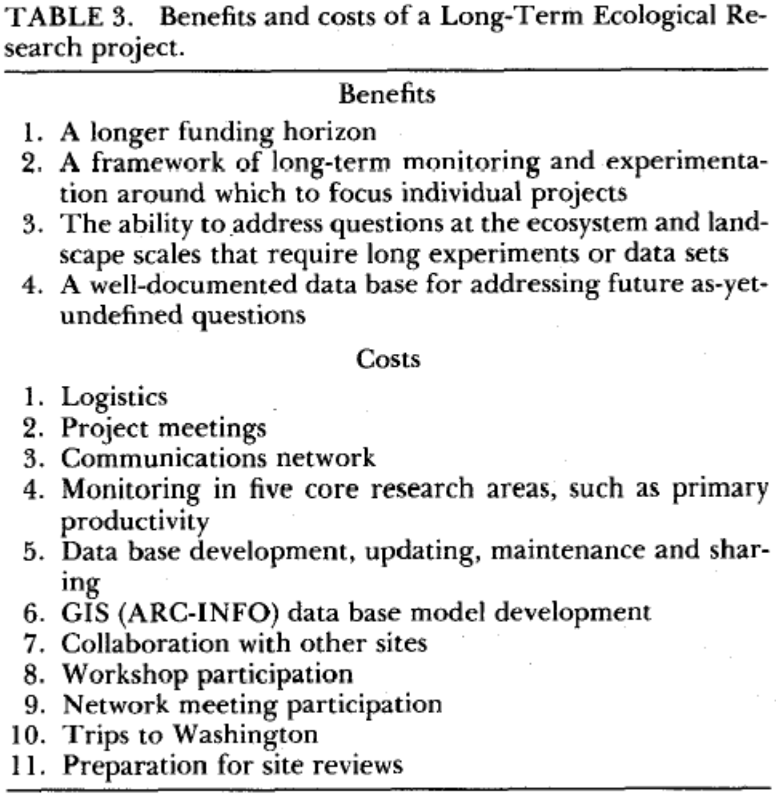


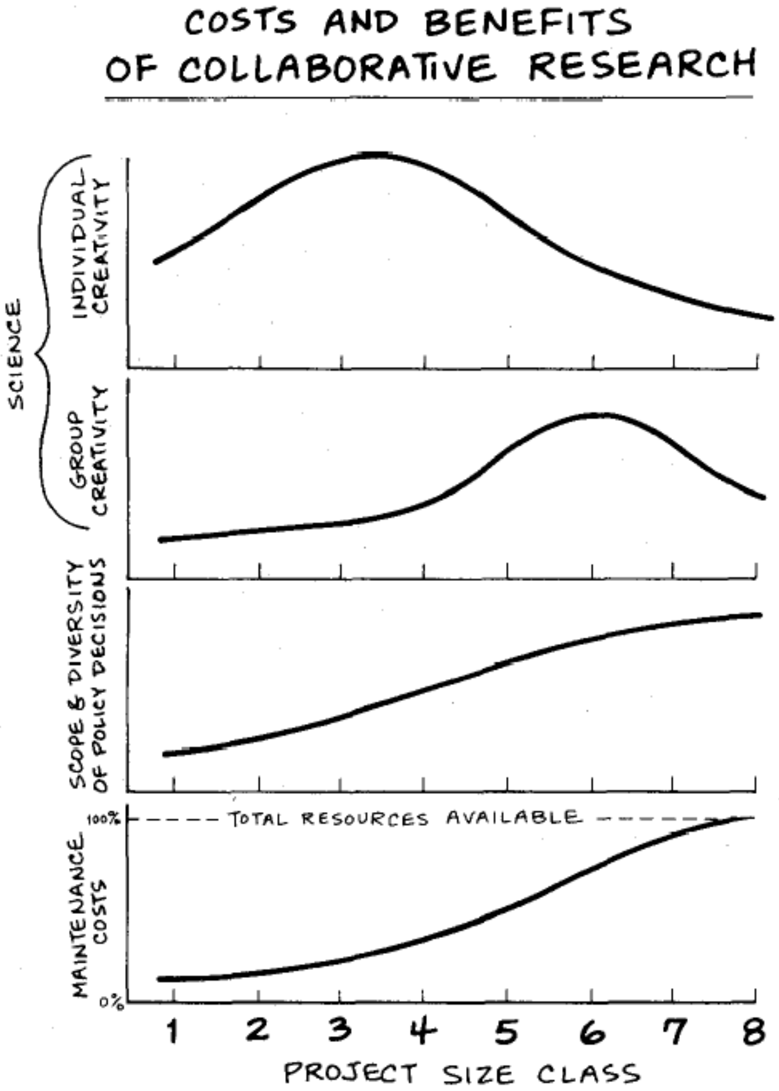
TABLE 3. Benefits and costs of a Long-Term Ecological Research project.

Benefits

1. A longer funding horizon
2. A framework of long-term monitoring and experimentation around which to focus individual projects
3. The ability to address questions at the ecosystem and landscape scales that require long experiments or data sets
4. A well-documented data base for addressing future as-yet-undefined questions

Costs

1. Logistics
2. Project meetings
3. Communications network
4. Monitoring in five core research areas, such as primary productivity
5. Data base development, updating, maintenance and sharing
6. GIS (ARC-INFO) data base model development
7. Collaboration with other sites
8. Workshop participation
9. Network meeting participation
10. Trips to Washington
11. Preparation for site reviews



Ten fundamentals of team building

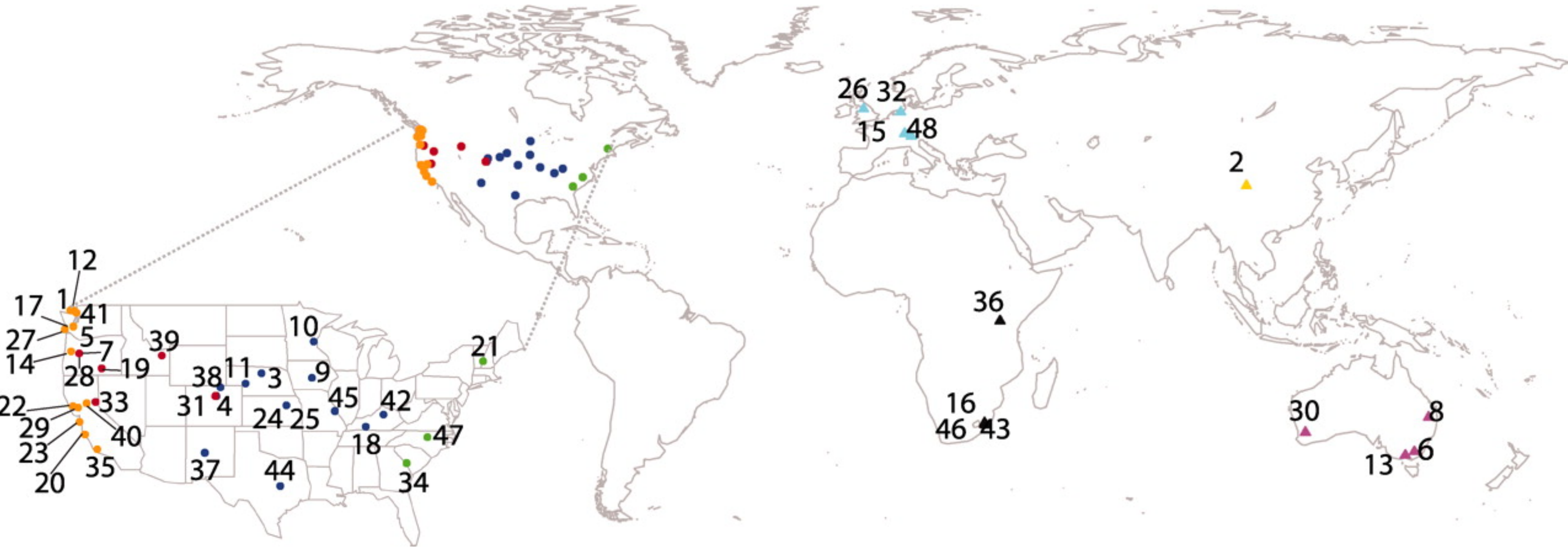
(from Likens 1997):

1. Brightness
2. Trust
3. Abundance of common (good) sense
4. Creativity and willingness to share
5. Appropriate training
6. Collective ability to make up deficiencies
    - shared experiences
7. Willing to give time to the team
8. Personality
    - Ability and willingness to listen
    - Enjoy working with others
    - Curiosity and interest
    - Open minded
9. Serendipity
10. Liking each other
11. LUCK

The challenges:

1. Intellectual contribution: authorship
2. Intellectual contribution: coursework
3. Intellectual contribution: funding
   - Ethics workshop and policy
4. Evaluation of participants
5. Data sharing
   - Change in academic culture
6. Data management
7. Long-term support
8. Center Evaluation

The Nutrient Network (NutNet)



Bottom-up network
Voluntary
Simple rules
Inexpensive
Data management plan
Data sharing policy
Author policy

Science
AAAS

Collaboration has benefits…..

REPORTS

Productivity Is a Poor Predictor of Plant Species Richness

Peter B. Adler,[1*] Eric W. Seabloom,[2] Elizabeth T. Borer,[2] Helmut Hillebrand,[3] Yann Hautier,[4] Andy Hector,[4] W. Stanley Harpole,[5] Lydia R. O'Halloran,[6] James B. Grace,[7] T. Michael Anderson,[8] Jonathan D. Bakker,[9] Lori A. Biederman,[5] Cynthia S. Brown,[10] Yvonne M. Buckley,[11] Laura B. Calabrese,[12] Cheng-Jin Chu,[13] Elsa E. Cleland,[14] Scott L. Collins,[11] Kathryn L. Cottingham,[15] Michael J. Crawley,[16] Ellen I. Damschen,[17] Kendi F. Davies,[18] Nicole M. DeCrappeo,[19] Philip A. Fay,[20] Jennifer Firn,[21] Paul Frater,[5] Eve I. Gasarch,[18] Daniel S. Gruner,[22] Nicole Hagenah,[23,24] Janneke Hille Ris Lambers,[25] Hope Humphries,[18] Virginia L. Jin,[26] Adam D. Kay,[27] Kevin P. Kirkman,[23] Julia A. Klein,[28] Johannes M. H. Knops,[29] Kimberly J. La Pierre,[23] John G. Lambrinos,[30] Wei Li,[5] Andrew S. MacDougall,[31] Rebecca L. McCulley,[32] Brett A. Melbourne,[18] Charles E. Mitchell,[33] Joslin L. Moore,[34] John W. Morgan,[35] Brent Mortensen,[5] John L. Orrock,[17] Suzanne M. Prober,[36] David A. Pyke,[19] Anita C. Risch,[37] Martin Schuetz,[37] Melinda D. Smith,[24] Carly J. Stevens,[38,39] Lauren L. Sullivan,[5] Gang Wang,[13] Peter D. Wragg,[2] Justin P. Wright,[40] Louie H. Yang[41]

ECOLOGY LETTERS

Ecology Letters, (2011) **14**: 274–281 doi: 10.1111/j.1461-0248.2010.01584.x

LETTER

Abundance of introduced species at home predicts abundance away in herbaceous communities

POLICY FORUM

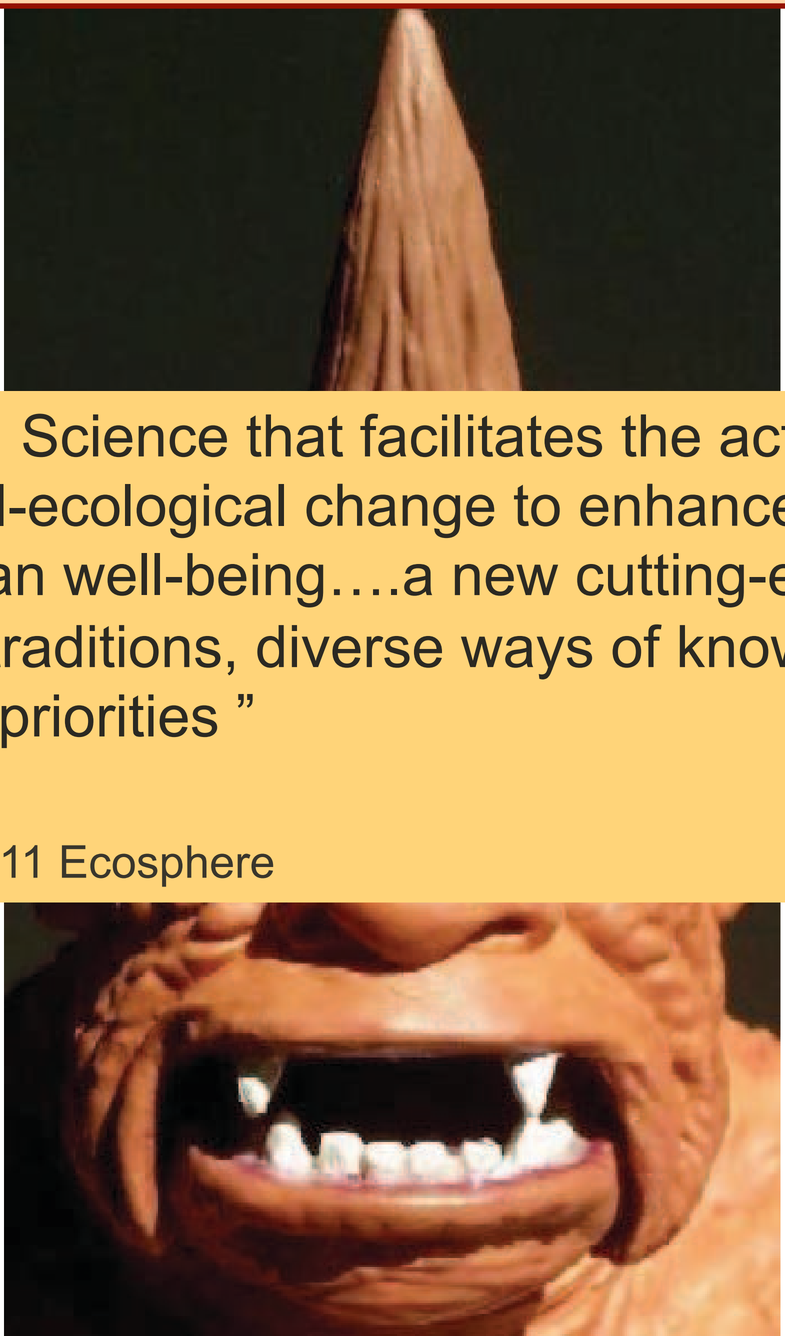
Ecology for a Crowded Planet

Margaret Palmer,[1*] Emily Bernhardt,[2] Elizabeth Chornesky,[3] Scott Collins,[4]
Andrew Dobson,[5] Clifford Duke,[6] Barry Gold,[7] Robert Jacobson,[8] Sharon Kingsland,[9]
Rhonda Kranz,[6] Michael Mappin,[10] M. Luisa Martinez,[11] Fiorenza Micheli,[12]
Jennifer Morse,[1] Michael Pace,[13] Mercedes Pascual,[14] Stephen Palumbi,[12]
O. J. Reichman,[15] Ashley Simons,[16] Alan Townsend,[17] Monica Turner[18]

“Our future environment will largely consist of human-influenced ecosystems, managed to varying degrees, in which the natural services that humans depend on will be harder and harder to maintain. The role of science in a more sustainable future must involve an improved understanding of how to design ecological solutions through conservation, restoration and purposeful intervention of ecological systems.”

The ecological cyclops

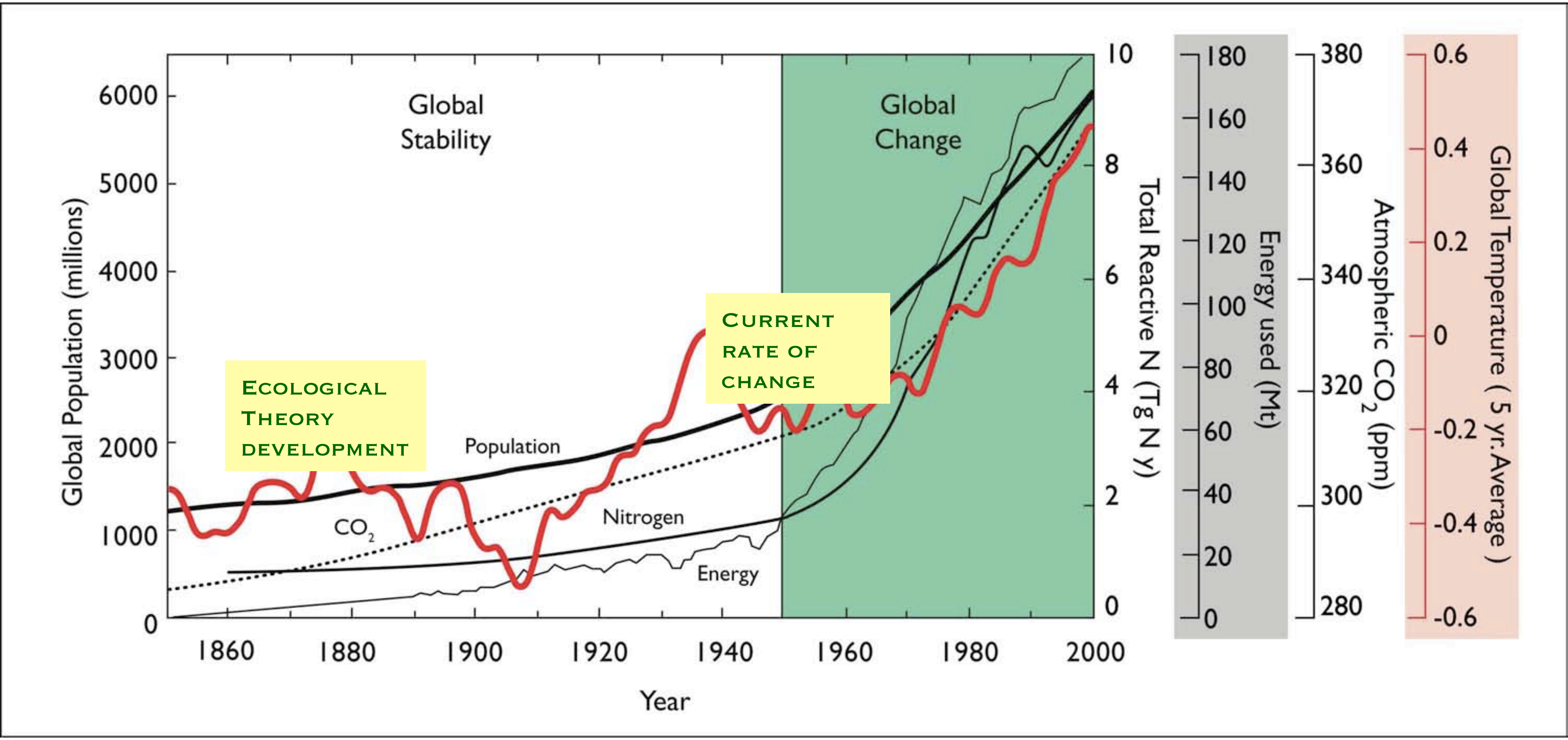
The angry ecological cyclops



"Earth Stewardship: Science that facilitates the active shaping of trajectories of social-ecological change to enhance ecosystem resilience and human well-being….a new cutting-edge science that blends disciplinary traditions, diverse ways of knowing, and new ways to identify scientific priorities "

Chapin et al. 2011 Ecosphere

Social-ecological presses



ECOLOGICAL THEORY DEVELOPMENT

CURRENT RATE OF CHANGE

Press factor – variable or driver that is applied continuously at rates ranging from low to high (e.g., atmospheric nitrogen deposition, elevated CO2). Includes changes in rates (increases, decreases) relative to some historical baseline.

Smith, Knapp & Collins 2009 Ecology

LONG-TERM ECOLOGICAL RESEARCH NETWORK

- Established in 1980
- 26 Sites
- Network Office

LTER CORE AREAS

- Net Primary Production
- Organic matter cycling
- Nutrient cycling
- Population dynamics
- Disturbance

RESEARCH PARTNERS

- US Forest Service
- USDA ARS
- Fish and Wildlife Service
- The Nature Conservancy

The US LTER Network

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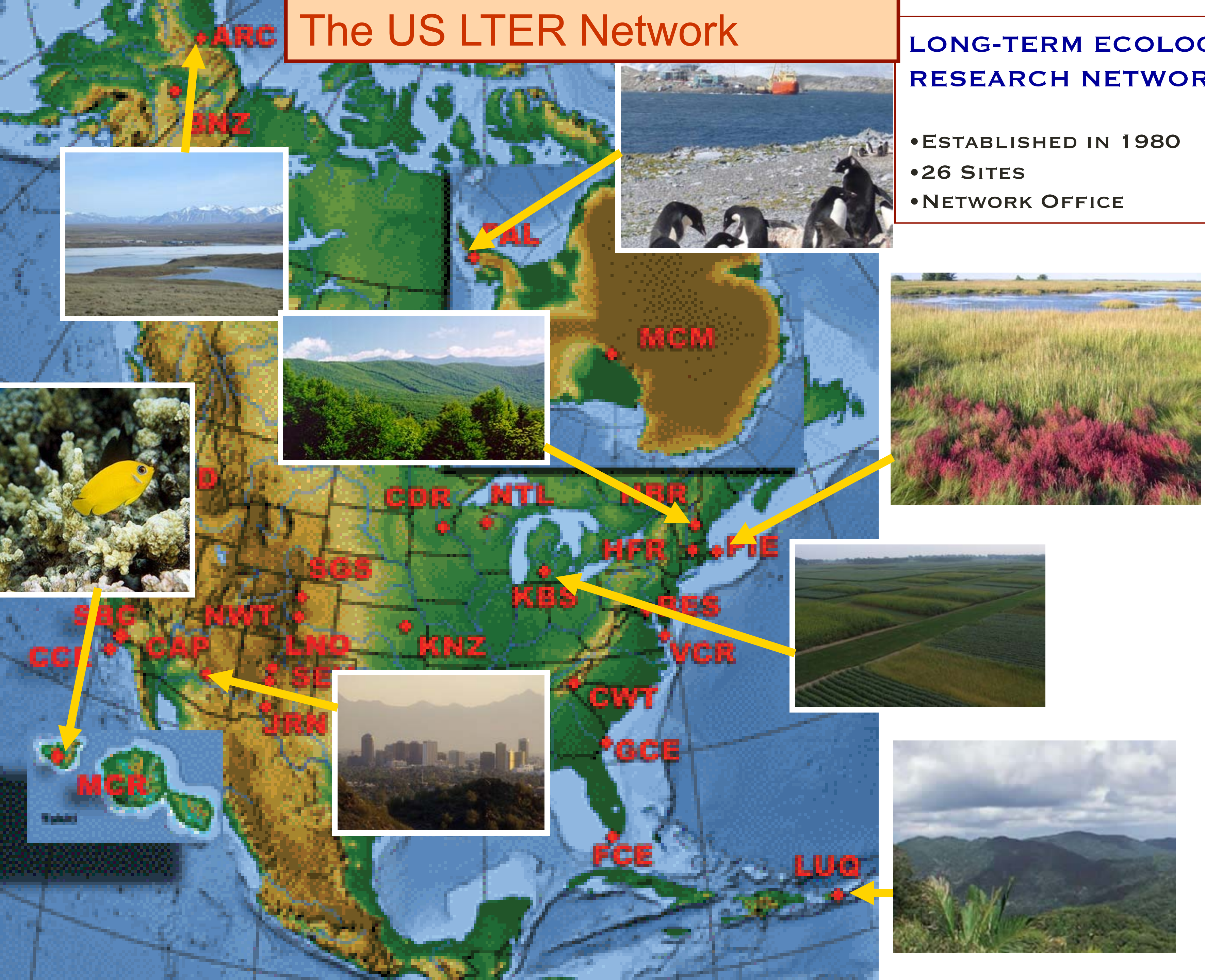
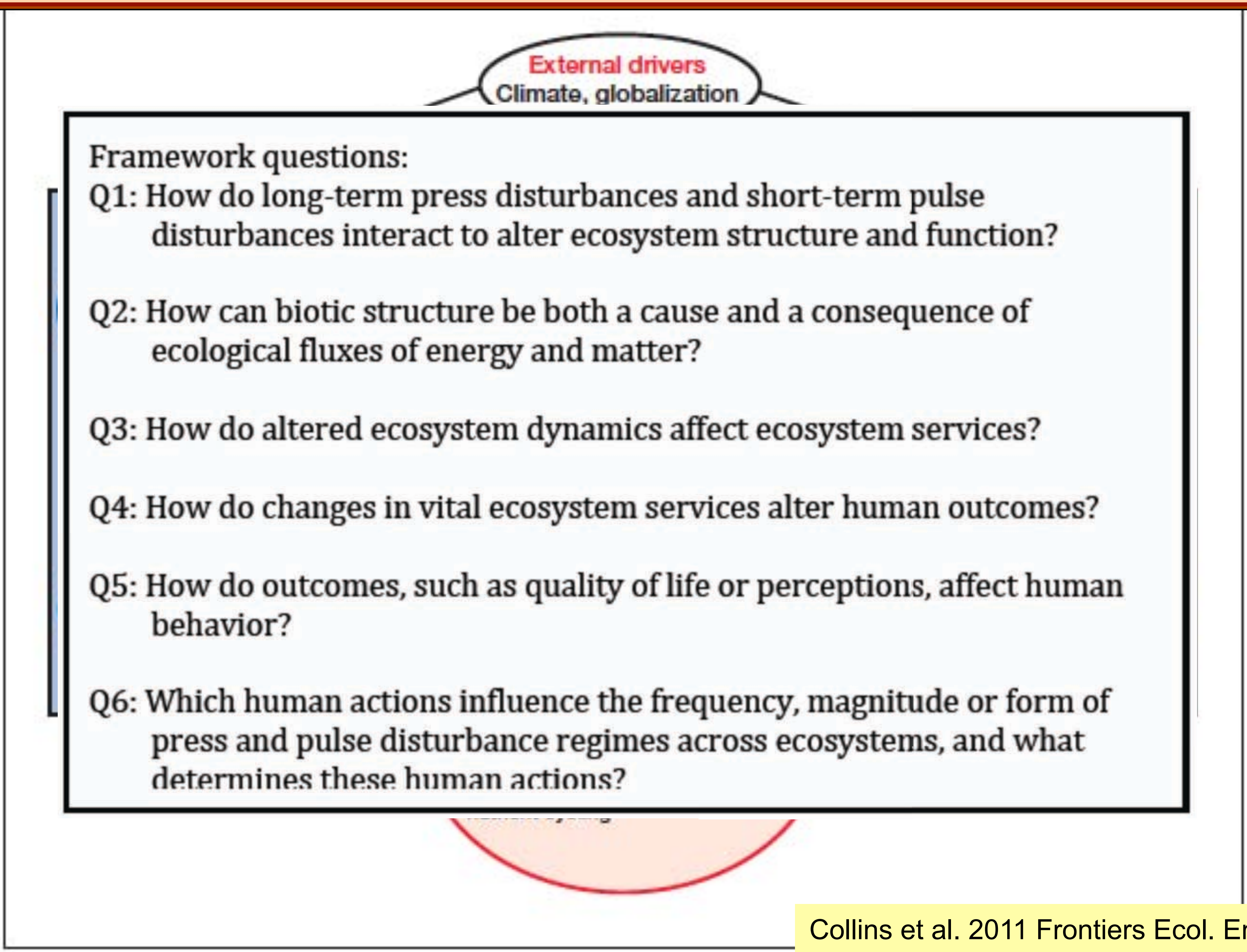


Pulse-Press Dynamics linking biophysical and social sciences through ecosystem services



Framework questions:

Q1: How do long-term press disturbances and short-term pulse disturbances interact to alter ecosystem structure and function?

Q2: How can biotic structure be both a cause and a consequence of ecological fluxes of energy and matter?

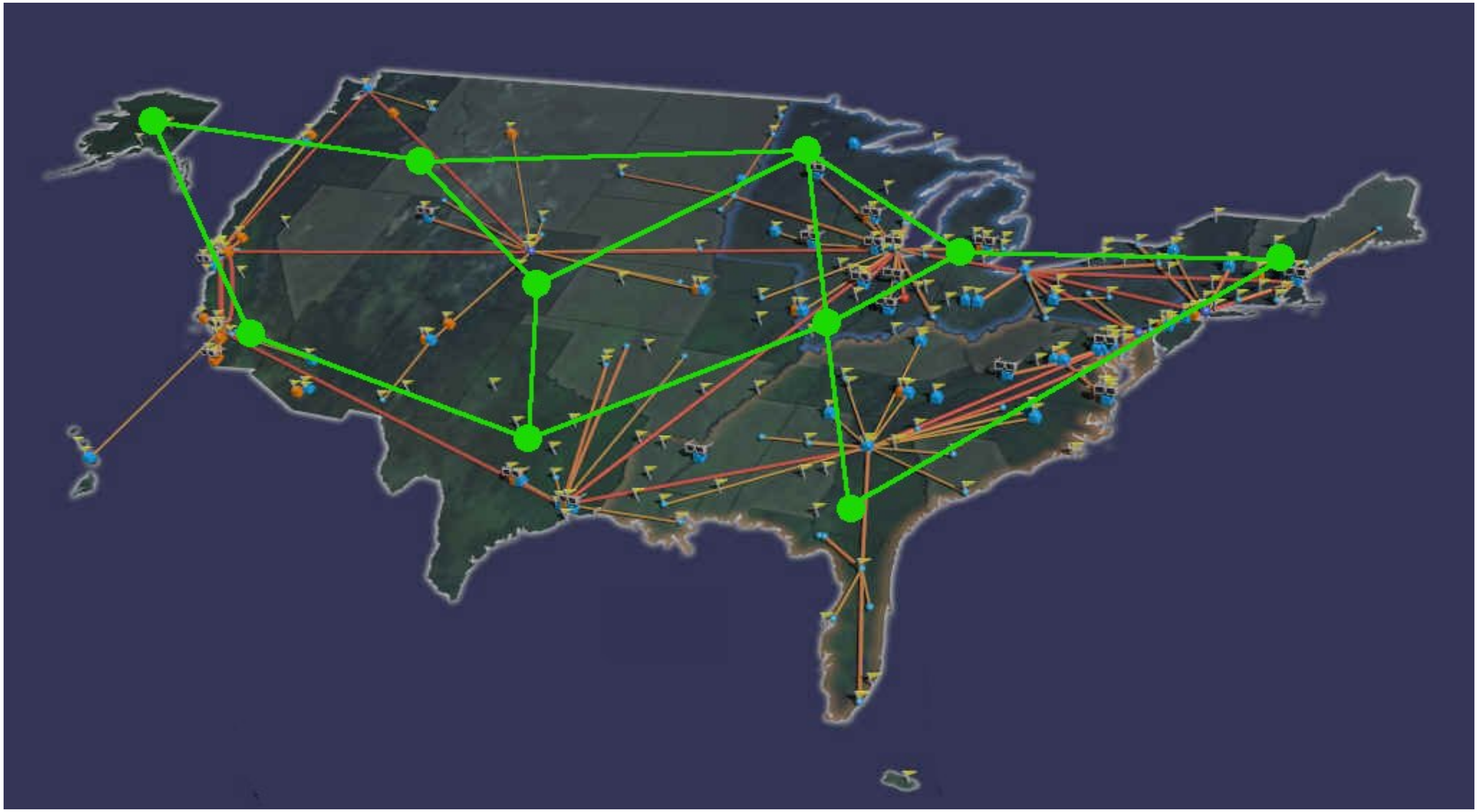
Q3: How do altered ecosystem dynamics affect ecosystem services?

Q4: How do changes in vital ecosystem services alter human outcomes?

Q5: How do outcomes, such as quality of life or perceptions, affect human behavior?

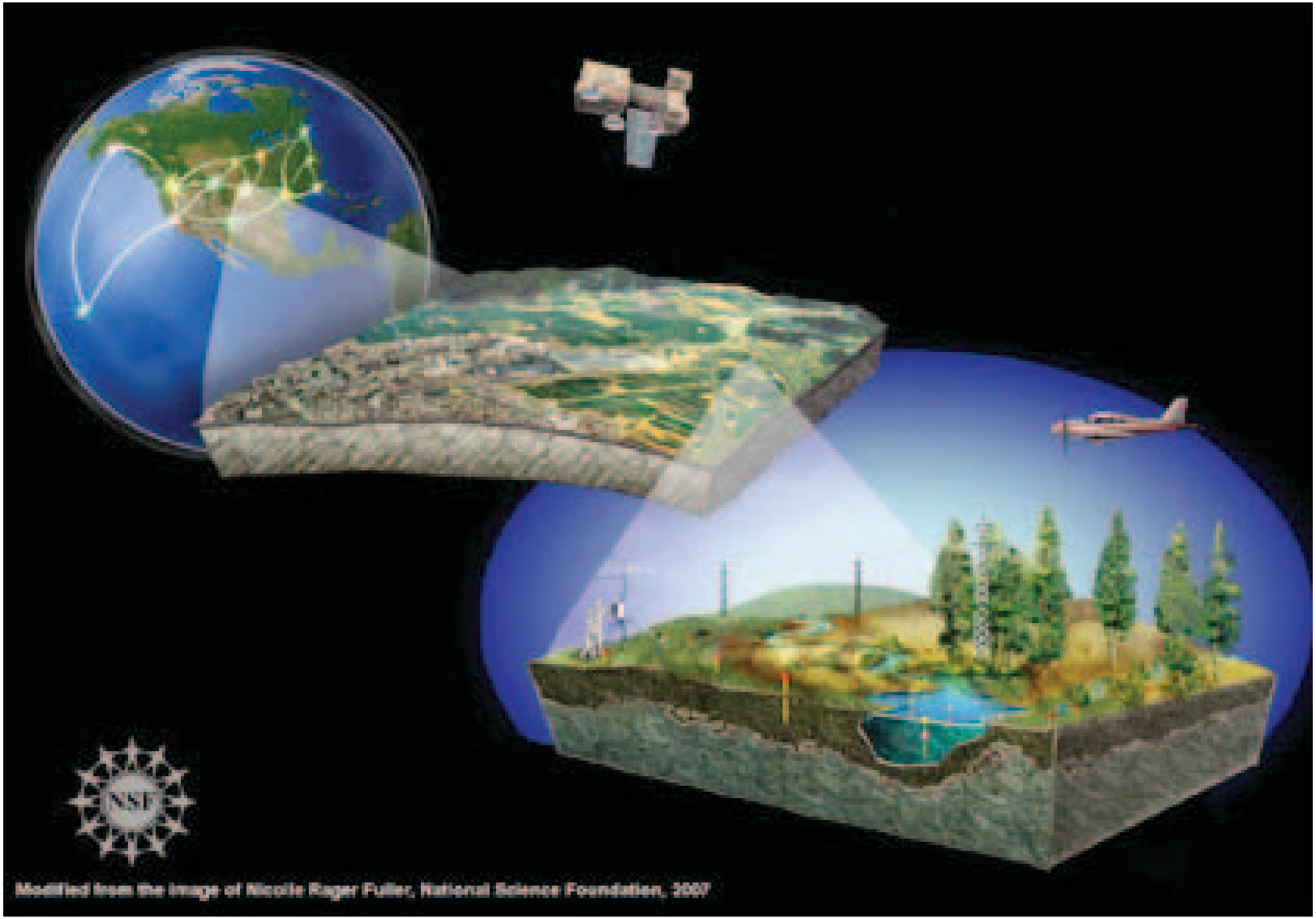
Q6: Which human actions influence the frequency, magnitude or form of press and pulse disturbance regimes across ecosystems, and what determines these human actions?

Collins et al. 2011 Frontiers Ecol. Environ.



NATIONAL ECOLOGICAL OBSERVATORY NETWORK


Pacific Northwest
16
Northern Rockies
12
Great Basin
15
Northern Plains
9
Great Lakes
5
Northeast
1
Pacific Southwest
17
Prairie Peninsula
6
Appalachians & Cumberland Plateau
7
Mid Atlantic
2
Southern Rockies & Colorado Plateau
13
Central Plains
10
Desert Southwest
14
Ozarks Complex
8
Southern Plains
11
Southeast
3
Pacific Ocean
Atlantic Ocean
Gulf of Mexico
Tundra
18
Taiga
19
Pacific Northwest
16
Pacific Tropical
20
Atlantic Neotropical
4
NEON Domains
NEON Candidate Aquatic
NEON Candidate Relocatable
NEON Candidate Core
Appalachians / Cumberland Plateau
Atlantic Neotropical
Central Plains
Desert Southwest
Great Basin
Great Lakes
Mid Atlantic
Northeast
Northern Plains
Northern Rockies
Ozarks Complex
Pacific Northwest
Pacific Southwest
Pacific Tropical
Prairie Peninsula
Southeast
Southern Plains
Southern Rockies / Colorado Plateau
Taiga
Tundra



Modified from the image of Nicolle Rager Fuller, National Science Foundation, 2007

Earth Stewardship: The Argus Initiative

"…potential solutions should consider multiple problems and sectors simultaneously through institutions at many scales rather than addressing each problem separately….."

Acknowledgements