Conceptual and Practical Considerations for Monitoring Biodiversity in the Pacific Northwest

By

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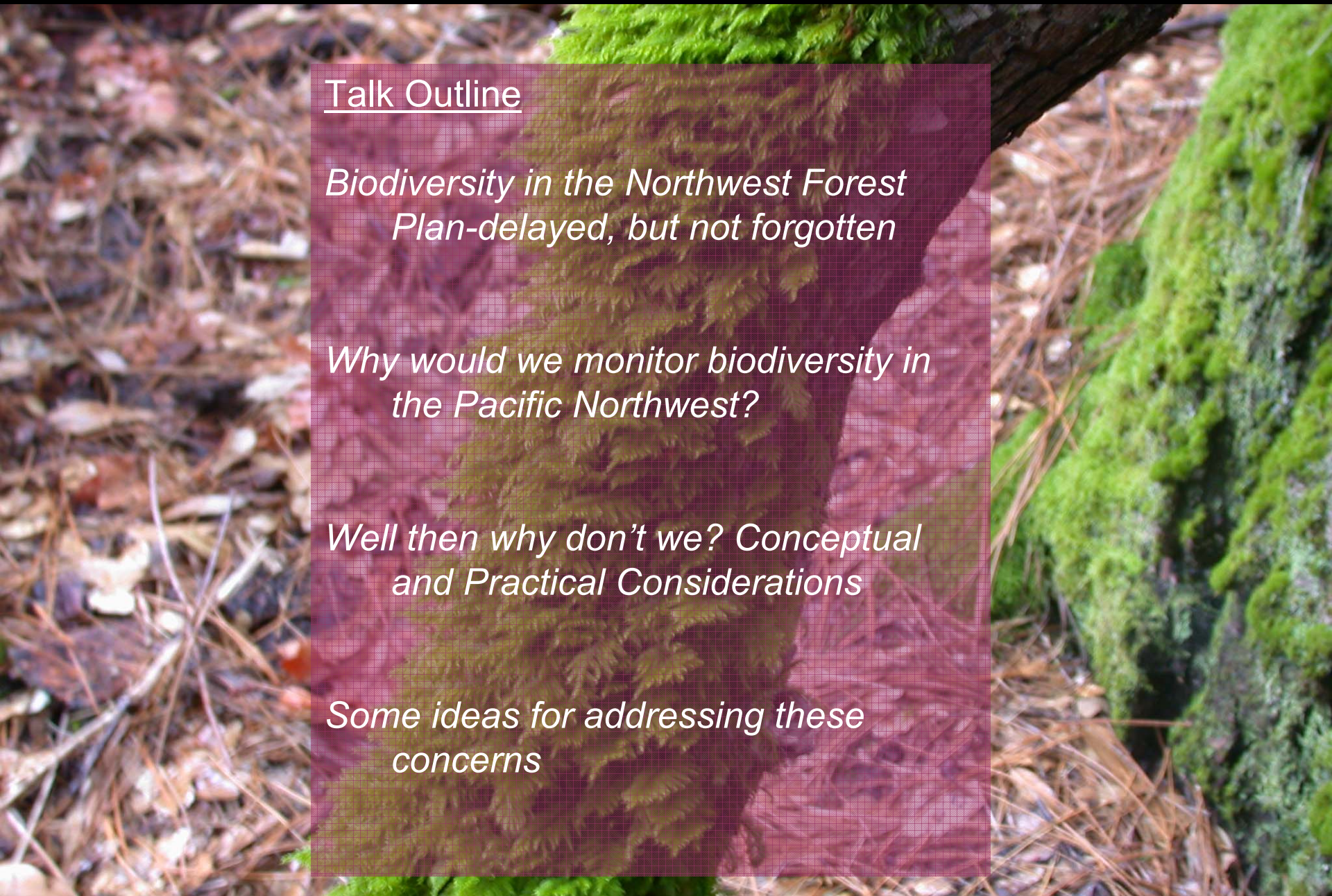
Conceptual and Practical Considerations for Monitoring Biodiversity in the Pacific Northwest



Talk Outline

Biodiversity in the Northwest Forest Plan-delayed, but not forgotten

Why would we monitor biodiversity in the Pacific Northwest?

Well then why don't we? Conceptual and Practical Considerations

Some ideas for addressing these concerns

Biodiversity in the Northwest Forest Plan-delayed, but not forgotten

NWFP Interagency Monitoring Budget 1994 – 2005 (X1000)

Northern Spotted Owls	25,774
Watershed Condition	6,833
Marbled Murrelet	6,789
Older Forests	3,856
Implementation	2,359
Socio-economic	1,560
Biodiversity	364
Tribal Relationships	289
Program Management	2,345
TOTAL	**$50,134**

- To date, Biodiversity has received relatively little funding, but scientific interest has been maintained.

- Elements of biodiversity are already being monitored, but a comprehensive effort has yet to be implemented

- Currently, Dr. Molina is leading a research initiative to explore ways monitor biodiversity

What is Biodiversity? Some Definitions….

The number of different species in some location (Schwarz et al. 1976)

"The variability among living organisms from all sources, including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems"

(United Nations Earth Summit Rio de Janeiro 1992)

"all of the diversity & variability in nature" (Spellberg & Hardes 1992)

Common Critiques:

So broad it is both daunting and meaningless

Biodiversity includes all species, so all species are biodiversity

Why would we monitor biodiversity in the Pacific Northwest?

The heart of Sustainable Land Management

Biodiversity maintenance is recognized globally, nationally, and regionally as a fundamental societal goal

United Nations Convention on Biodiversity

"*…to achieve **by 2010** a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth.* "

Montreal Process

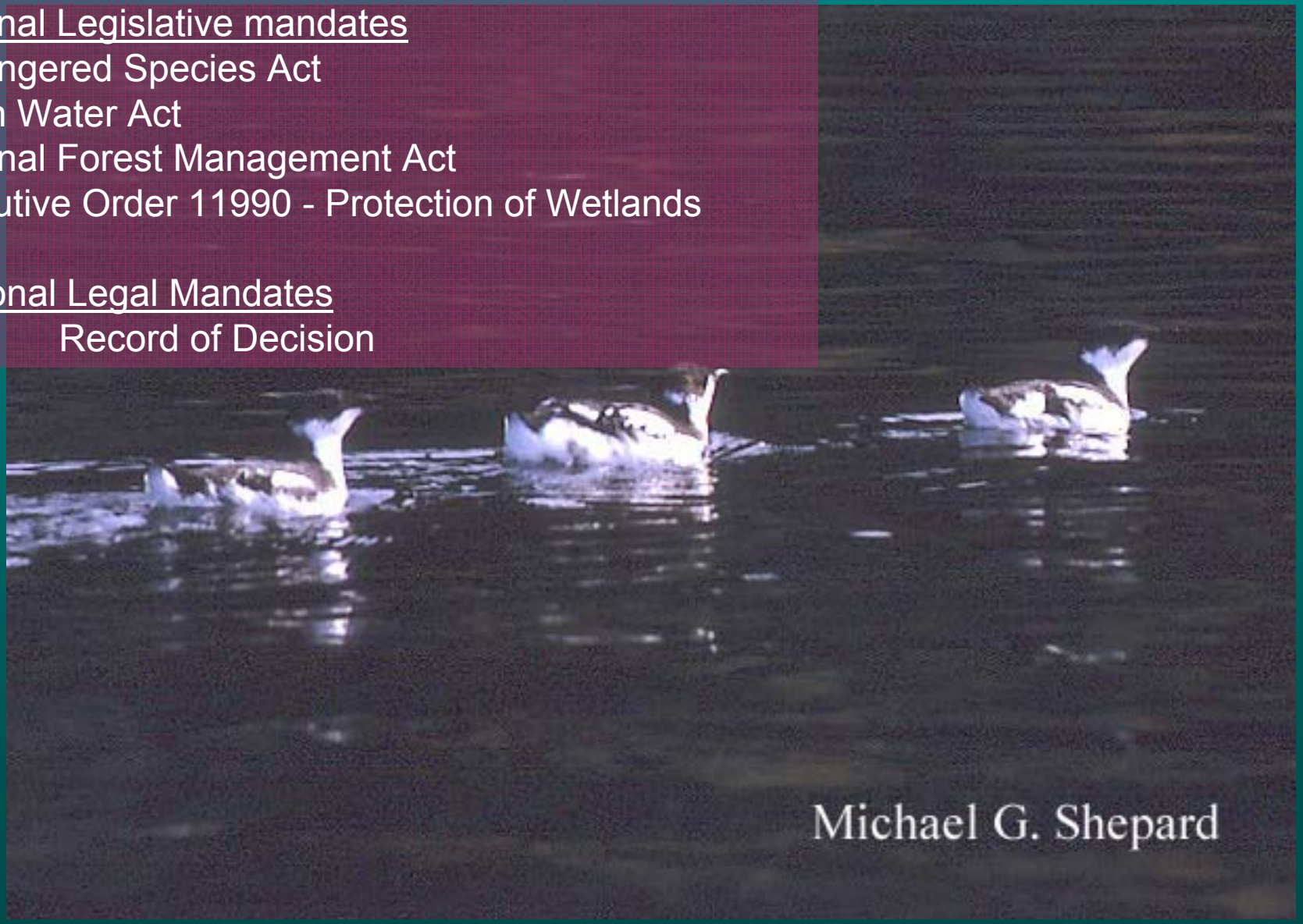
Developed a framework of 7 criteria and 67 indicators of sustainable management of temperate and boreal forests

included biodiversity as a core criterion with 9 indicators.

Why would we monitor biodiversity in the Pacific Northwest?

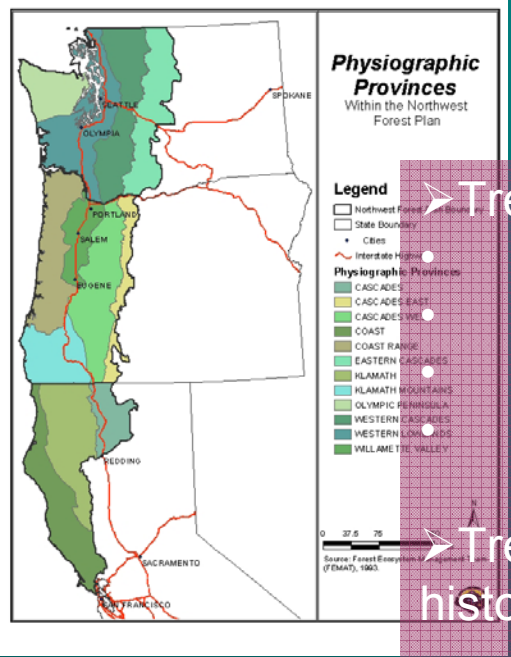
National Legislative mandates
Endangered Species Act
Clean Water Act
National Forest Management Act
Executive Order 11990 - Protection of Wetlands

Regional Legal Mandates
Record of Decision

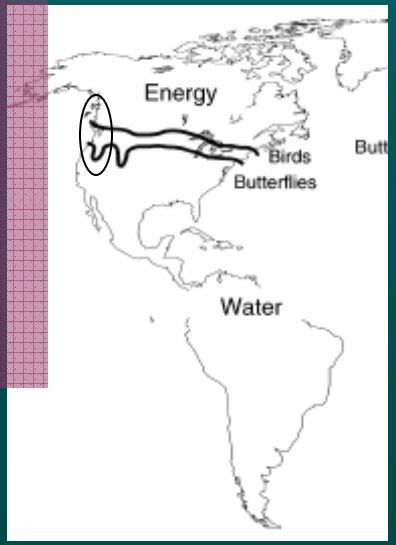


Well then why don't we?

..Biodiversity presents the challenge of trying to 'know the unknowable'
Faith et al. 2004

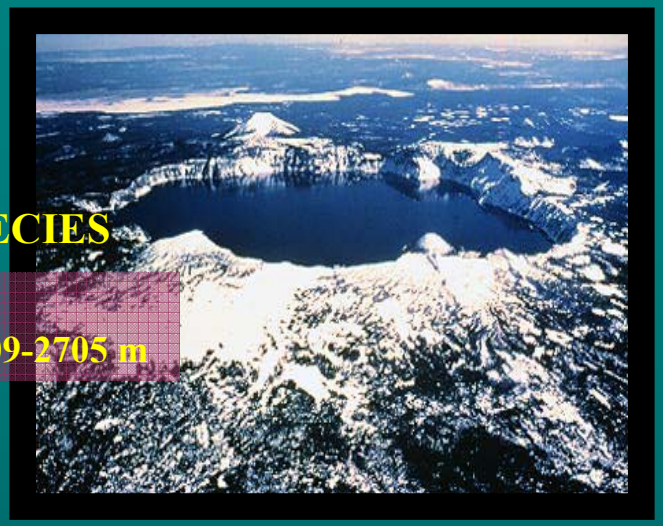


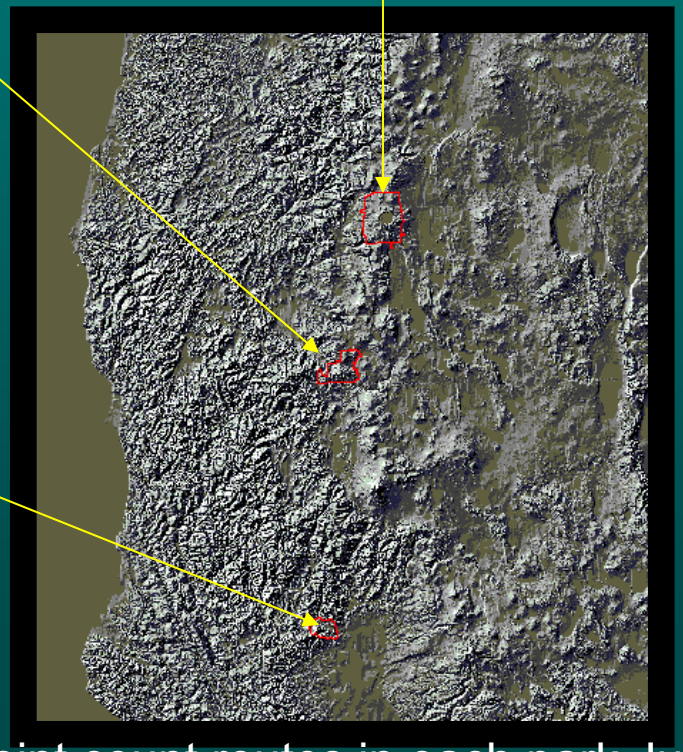
- Tremendous biophysical complexity in PNW
  - 12 degrees of latitude
  - < 4000 meters of elevation range
  - ~400 – 4000 mm precipitation
  - Diversity of vegetation types
- Tremendous diversity in organisms and life histories from canopy to hyporheic zone
- Differential taxa responses to environmental variation
- Nonlinear dynamics and changing constraints across local, geographic, and disturbance gradients



Hawkins et al. 2004

Geographic Patterns Of Land Bird Diversity-Klamath Region

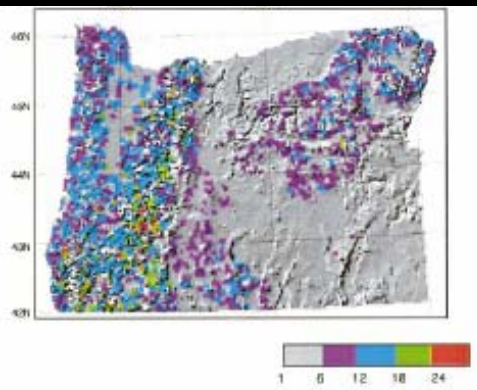




From Seavy et al. 2004

From n=10 randomly place point count routes in each park June-July 2003

Disturbance X Site Interactions



Component Effects of Disturbance

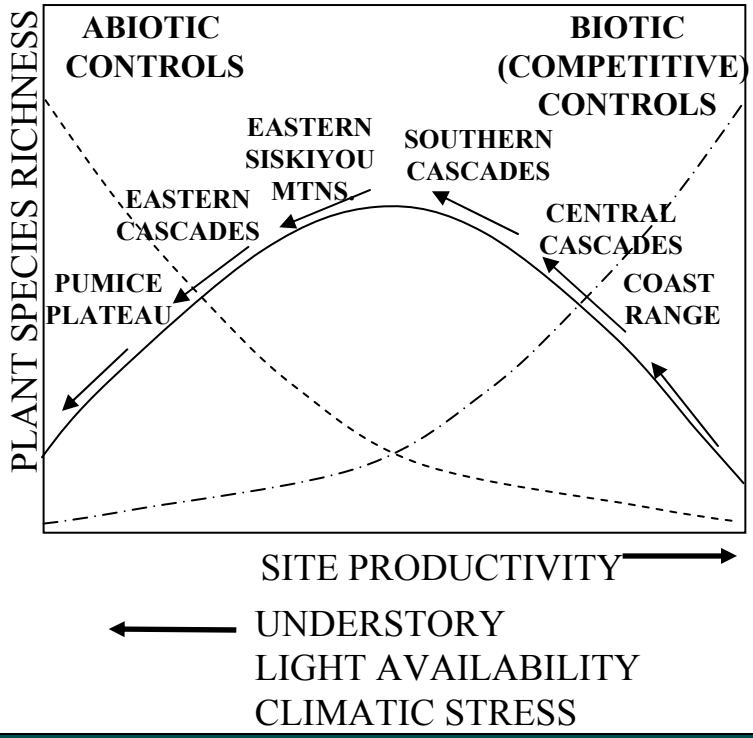
Biotic Control

Abiotic Control

after
Waring et al. 2002

With homage to:

Grime 1973,
Huston 1979,
Tilman 1982, etc.



Hypothesized Effect of Disturbance on Plant diversity in Different Geographic Regions of PNW

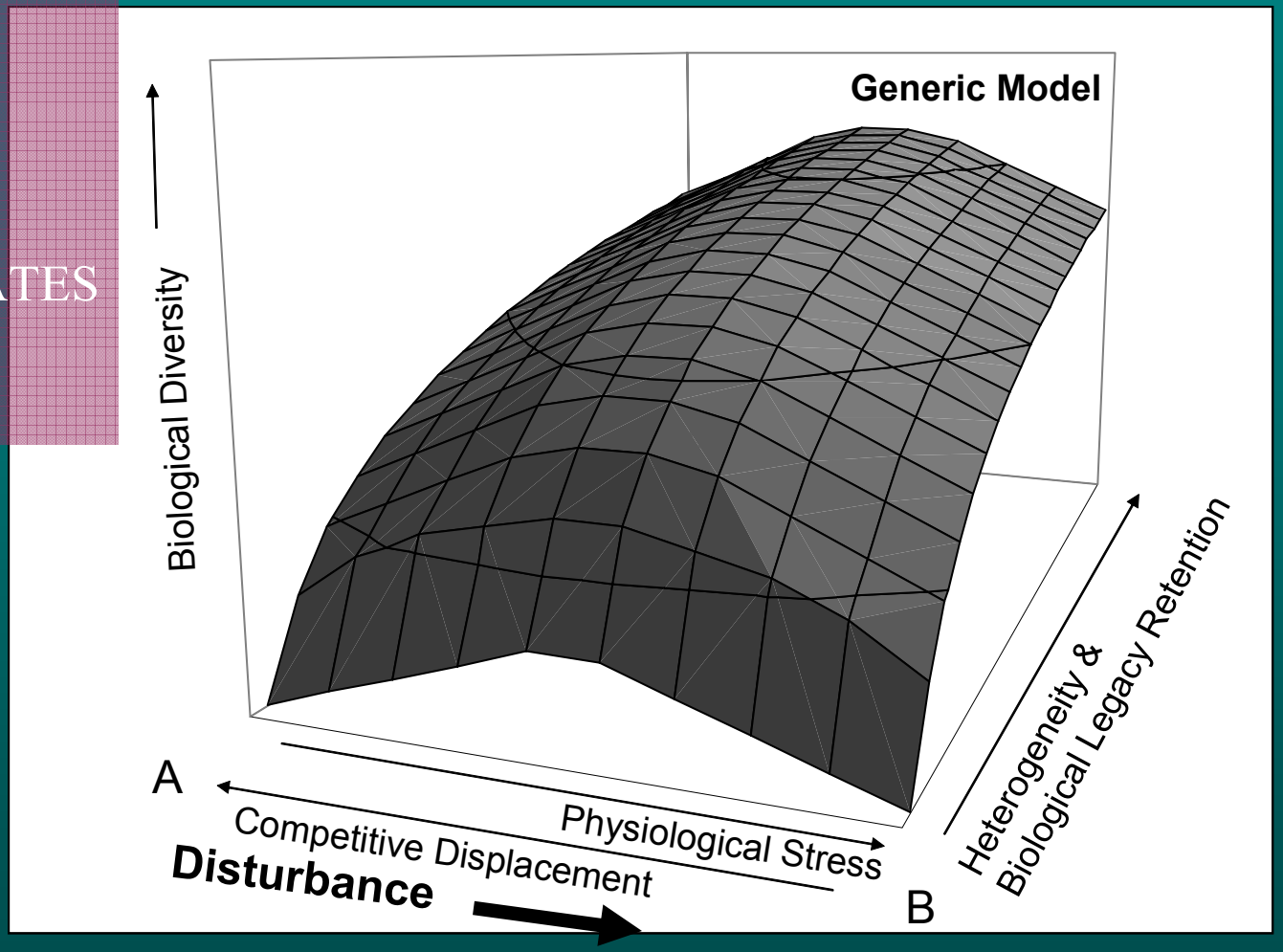
Disturbance X Species Interactions

STREAM FISHES

FUNGI

AQUATIC MACROINVERTEBRATES

BIRDS



A *Intermediate Disturbance Hypothesis*
Connell 1978

B *Legacy Functions*
Franklin and colleagues

From Sarr et al. (In Press)

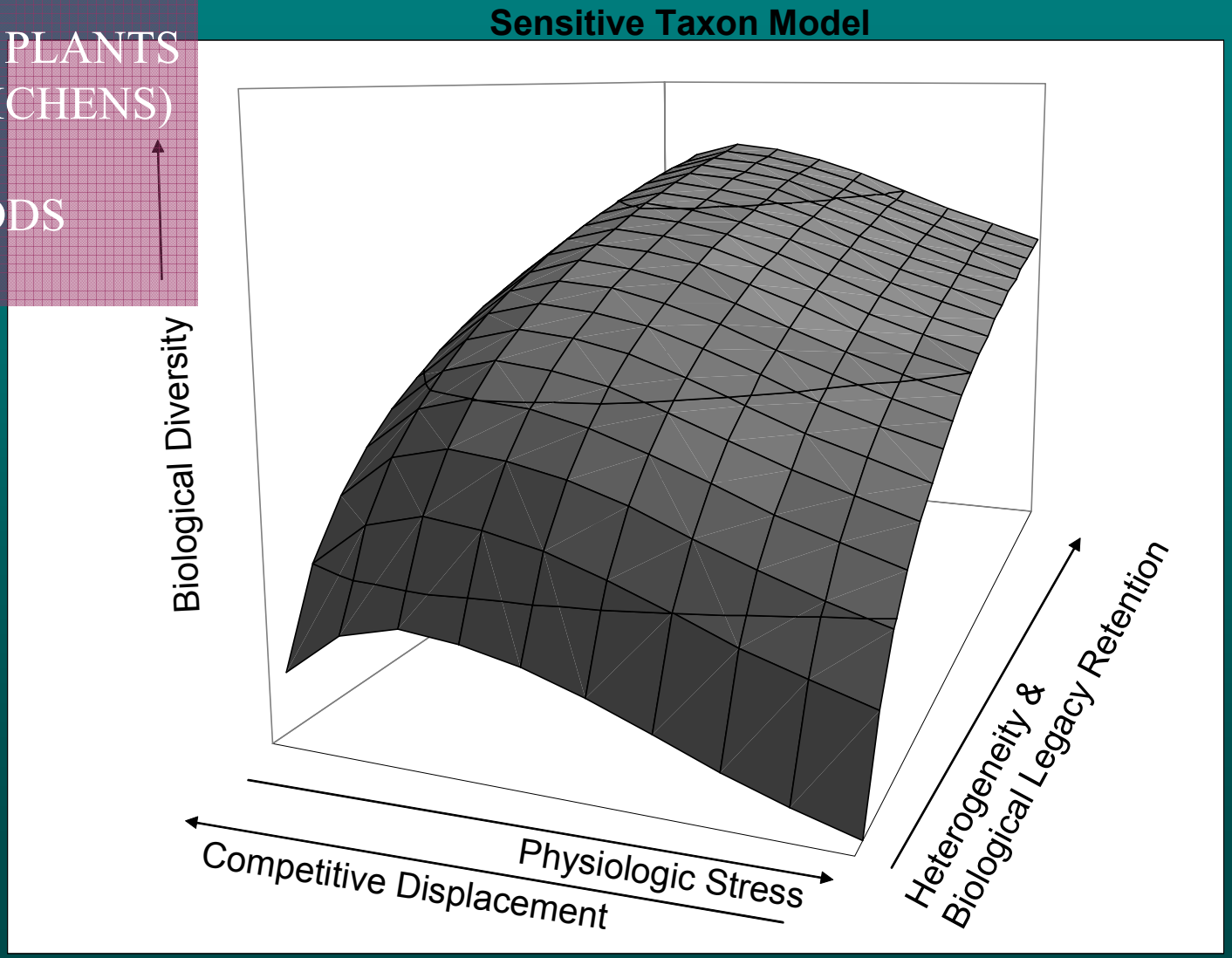
ncasi
National Council for Air and Stream Improvement, Inc.

Disturbance X Species Interactions- Sensitive Taxa

AMPHIBIANS

NONVASCULAR PLANTS (MOSSES AND LICHENS)

SOIL ARTHROPODS

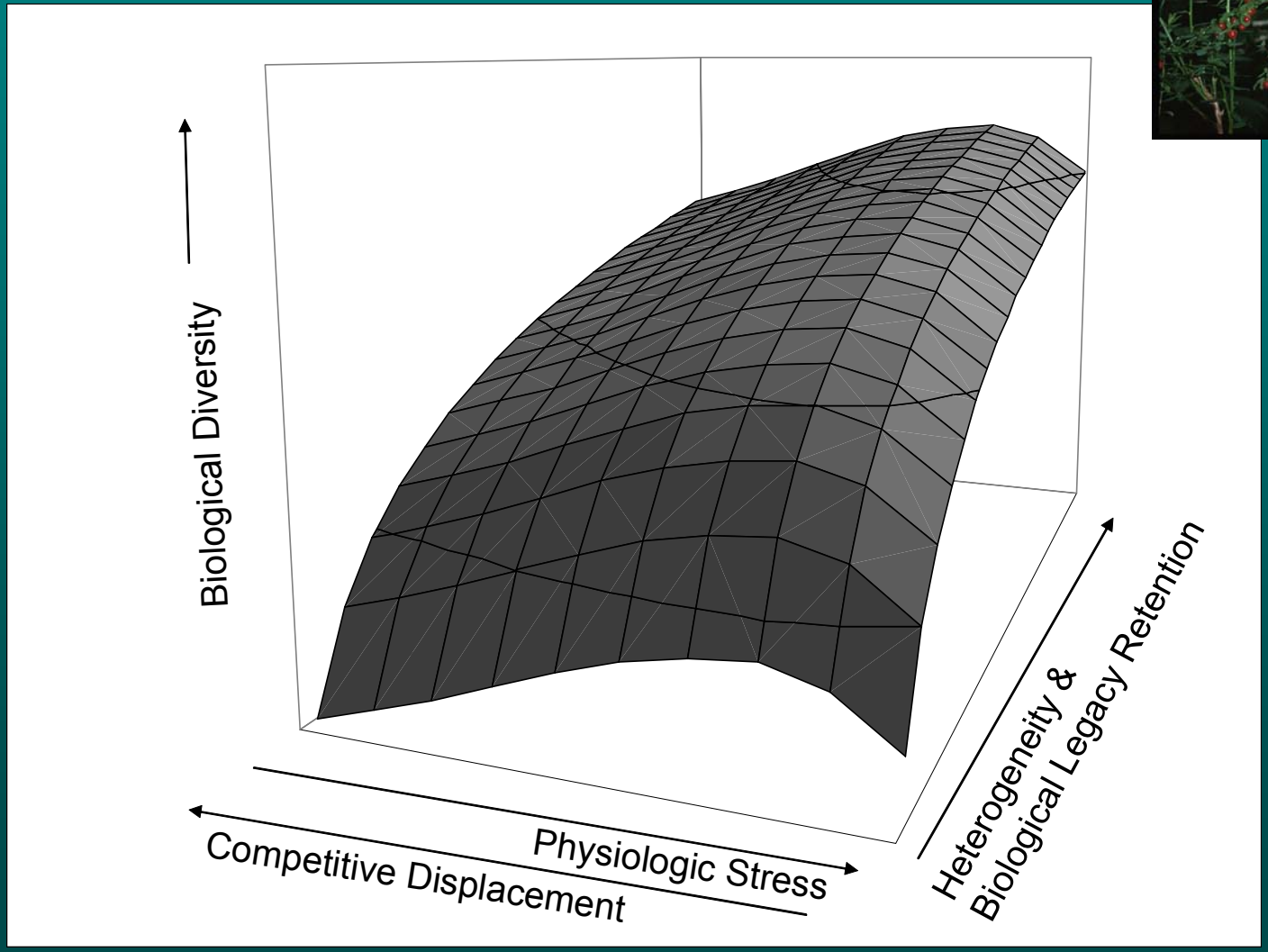


From Sarr et al. (In Press)

Disturbance X Species Interactions- Ruderal Taxa

VASCULAR PLANTS?

Ruderal Taxon Model



From Sarr et al. (In Press)

Conceptual and Practical Considerations for Monitoring Biodiversity

Consideration 1: Lack of consensus about the species, species groups, or other factors to measure

What to monitor? Aren't we already doing it?

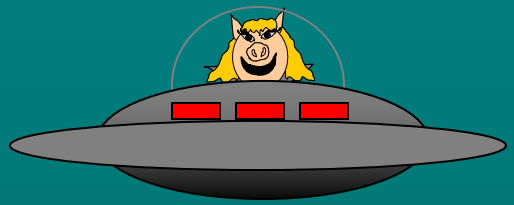
Well, sort of…

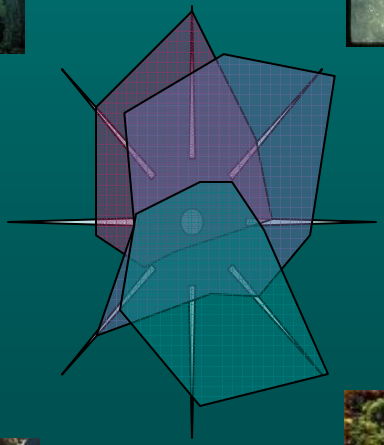

Red coral fungus.

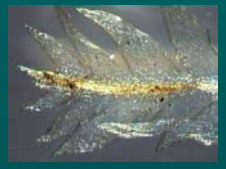
Credit: Dan Powell

What is our scope for Biodiversity Monitoring?

Adventures in hyperspace







Niche “Gap Analysis”
Or
Covering the bases

Conceptual and Practical Considerations for Monitoring Biodiversity
Consideration 2: Life Histories of Many Species and are Still Largely Unknown

Need information about the things that go bump in the night!

Blue-gray tail-dropper.

Habitat associations can be incomplete

Species can be opportunistic and adaptable

How adaptable??

We lack knowledge of the intrinsic spatial and temporal variation of most species, so we are ill-prepared to monitor human effects through time

Conceptual and Practical Considerations for Monitoring Biodiversity

Consideration 3: We need conceptually sound, quantitative relationships linking indicator species or elements with rarer or more cryptic species

Most indicator or focal species are often selected based on untested assumptions

When you ass u me…..

Species congruence (i.e. parallel change among taxa along gradients) does occur, but it still appears to be the exception, not the rule.

We need to find the exceptions!

Conceptual and Practical Considerations for Monitoring Biodiversity

Consideration 4: Statistical challenges detecting change in rare populations

Rare species need our help, but can pose seemingly insurmountable statistical challenges for monitoring

Example: Clustered ladies slipper orchid (*Cypripedium fasciculatum*)

Species widely dispersed, rare, and sporadic in a rugged, poison oak-infested, landscape.

In a study in SW Oregon, Latham noted:

To detect a 30% change in abundance over three years, 70% of the individuals in a population would needed to be monitored each year!

Conceptual and Practical Considerations for Monitoring Biodiversity

Consideration 5: Long-term monitoring of species with diverse life histories and low detection probabilities can be extremely expensive

Example:

Rare forest lichens

Thomas et al. (2004) noted a that with a census of all 2083 CVS sample plots in the region would be required to yield greater than 10 detections for 15 out of 49 species (29%)

Assuming $500/sample * 2000 this would cost **$1M/yr**

Most species 34/49 were simply too rare to allow development of associations with land/retention classes.

Some Thoughts for Attacking the Biodiversity Monitoring Problem

Conceptual and Practical Considerations for Monitoring Biodiversity

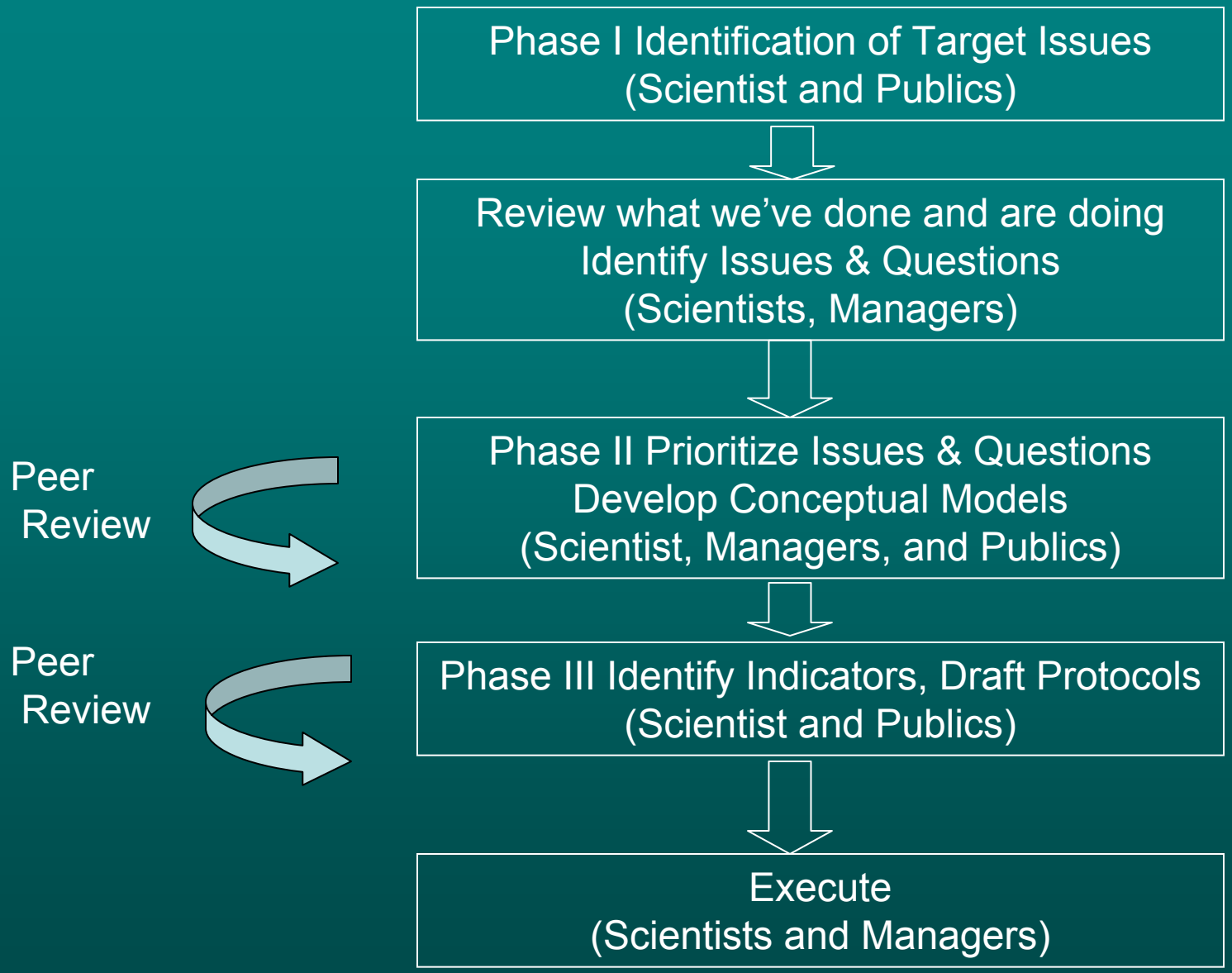
Consideration 1: Developing a Collaborative Vision for Biodiversity Monitoring in the Pacific Northwest

Problem gap analysis: Who are we leaving behind? What is feasible?

Hold stakeholder workshop to develop specific Biodiversity Objectives

- Managers
- Tribes
- Local Governments
- Private landowners
- Nonprofit conservation partners (TNC,WWF, DOW,etc.)
- PNW Scientific community
- Environment Canada
- UN Convention on Biodiversity
- Agency and Interagency Monitoring Programs

Identifying Goals, Issues, and Monitoring Questions



Conceptual and Practical Considerations for Monitoring Biodiversity
Consideration 2: Life Histories of Many Species and are Still Largely Unknown

- Focused inventories and research should continue to play a role
  - Survey and Manage Program has been very helpful
  - Follow fire example (quantify HRV whenever possible)

- Develop and support regional and provincial biodiversity databases needed to enhance sharing of biodiversity information

- Research support:
  - Replicated manipulative studies in diverse ecological setting to test generality or diversity in ecological responses to disturbance, etc.
  - DEMO project is excellent example

  NEON?

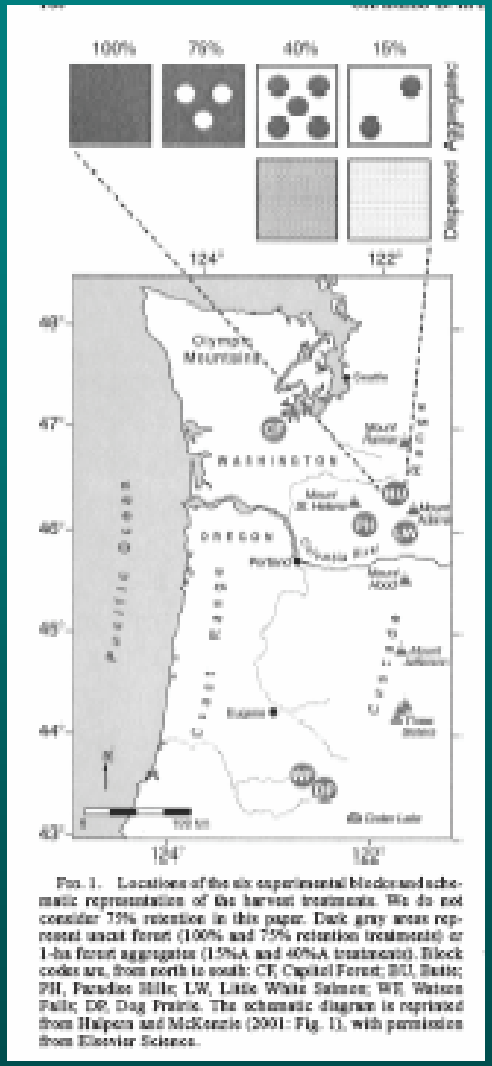


FIG. 1. Locations of the six experimental blocks and schematic representation of the harvest treatments. We do not consider 75% retention in this paper. Dark gray areas represent uncut forest (100% and 75% retention treatments) or 1-ha forest aggregates (15%A and 40%A treatments). Block codes are, from north to south: CF, Capitol Forest; BO, Butte; PH, Paradise Hills; LW, Little White Salmon; WF, Watson Falls; DP, Dog Prairie. The schematic diagram is reprinted from Halpern and McKenzie (2001: Fig. 1), with permission from Elsevier Science.

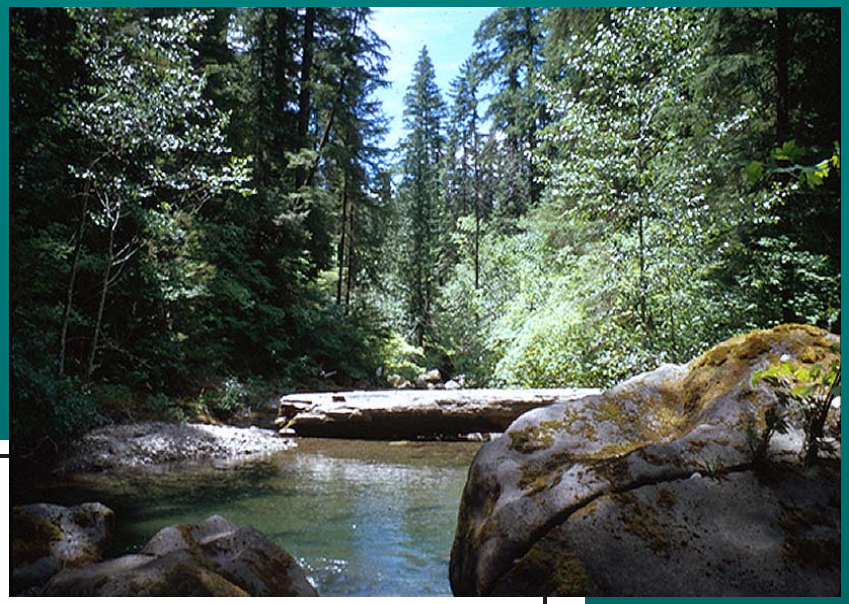
Demonstration of Ecosystem Management Options (DEMO) sites in Oregon and Washington

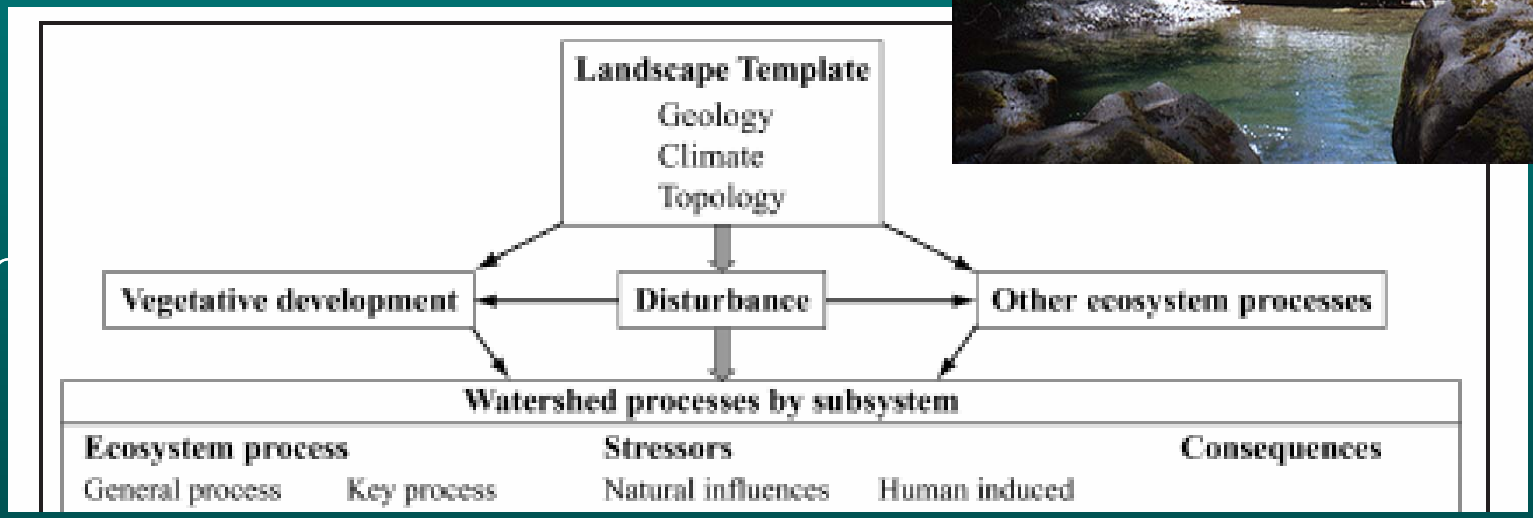
[Hey, what about the Klamath Region??!]

Conceptual and Practical Considerations for Monitoring Biodiversity
Consideration 2: Conceptual Models of System Dynamics

Example:

Conceptual framework for Aquatic Riparian Effectiveness Monitoring Program (AREMP)





- Upslope
- Riparian Floodplain
- Stream Channel

Conceptual and Practical Considerations for Monitoring Biodiversity

Consideration 3: We need conceptually sound, quantitative relationships linking indicator species or taxa with rarer groups that are more difficult to sample

- Need to explicitly test the relationships between indicator or relatively common taxa and rare species, species groups, or biodiversity as a whole
- Need to also make the geographic or other bounds of inference clear

Example:
Indicator species predict Butterflies Species in Great Basin mountain ranges

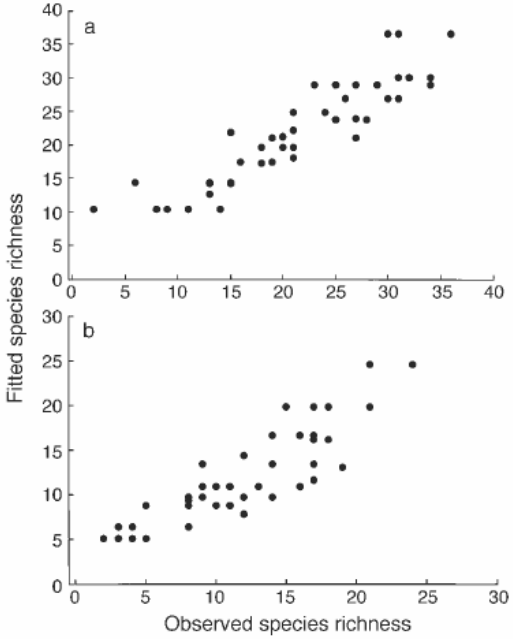


FIG. 1. Fitted (predicted) vs. observed species richness of (a) all resident species and (b) montane-resident species in the Toquima Range. Predictions were made using the best Poisson-regression models for each group of species.

From Mac Nally and Fleishman 2002

Conceptual and Practical Considerations for Monitoring Biodiversity

Consideration 4 & 5: Statistical and financial challenges detecting change in rare populations

Ideas for simplifying monitoring and increasing statistical power

Functional group classifications or guild approach for rarer taxa:
May be easier to detect group members than individual species

Multimetric or community indices (e.g., Index of Biotic Integrity,etc. Karr 1981, Karr and Chu 1999) may be more informative than individual species informations

Also may lower variance than species population dynamics

(besides species data is a windfall)

Cost effective physical or structural proxies

Take Home Messages

A broad-based integrative biodiversity monitoring program will help meet regional, national, and global conservation goals

Development of a Biodiversity Monitoring Program will require that we address a number of conceptual and practical considerations, including, at a minimum:

1. We work to develop a collaborative interagency vision for biodiversity Monitoring in the Pacific Northwest.

2. Commitment to developing our understanding of life histories and landscape interactions for many species in the Pacific Northwest

3. That we find ways to link what we can measure to other rare or more sensitive species

4. That we develop statistically, logistically, and financially feasible monitoring protocols that allow detection of change with limited resources.

Acknowledgements

NATIONAL PARK SERVICE
DEPARTMENT OF THE INTERIOR

CFER Cooperative Forest Ecosystem Research

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National Council for Air and Stream Improvement, Inc.