ESM 215: Landscape Ecology

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January 6, 2015

Introductions

- **Who**: First Last
- **What**: MS / PhD, area of interest
- **Why**: What motivates you to take this class?

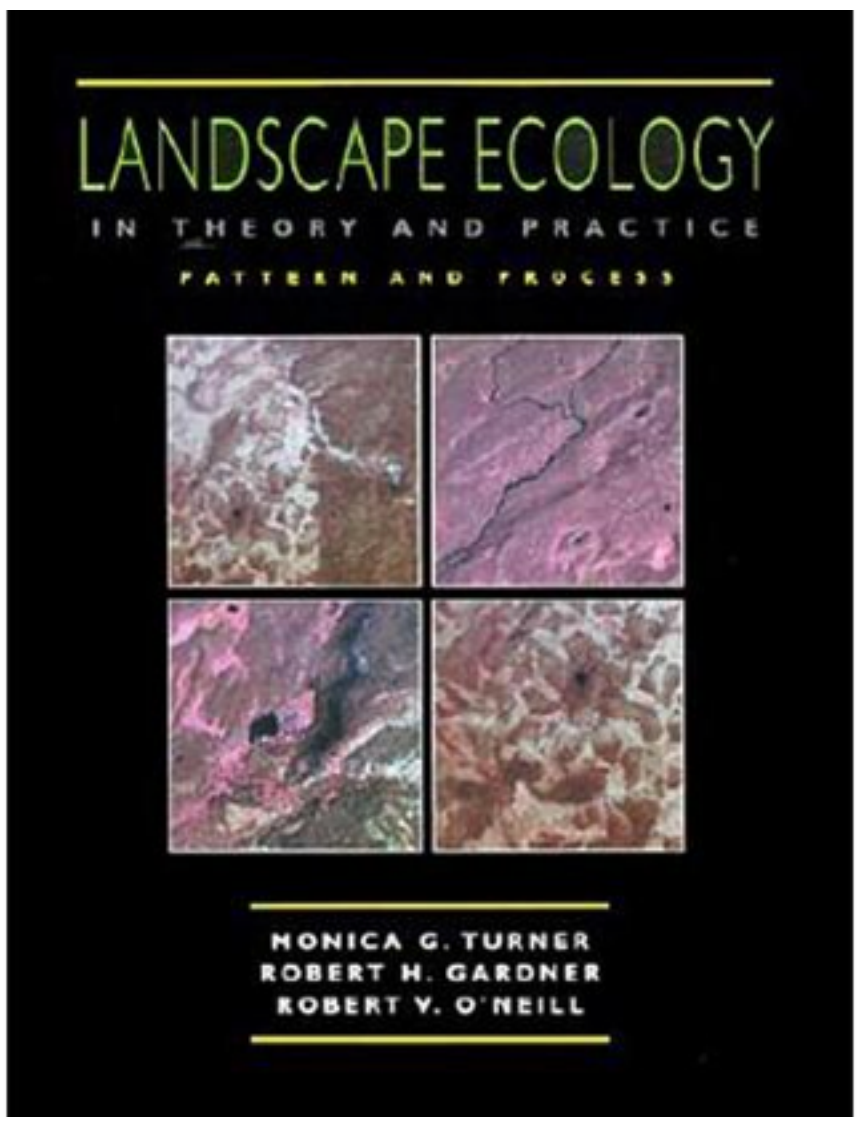
Gurus

Dean **Urban**
Duke Nicholas

Frank **Davis**
UCSB Bren

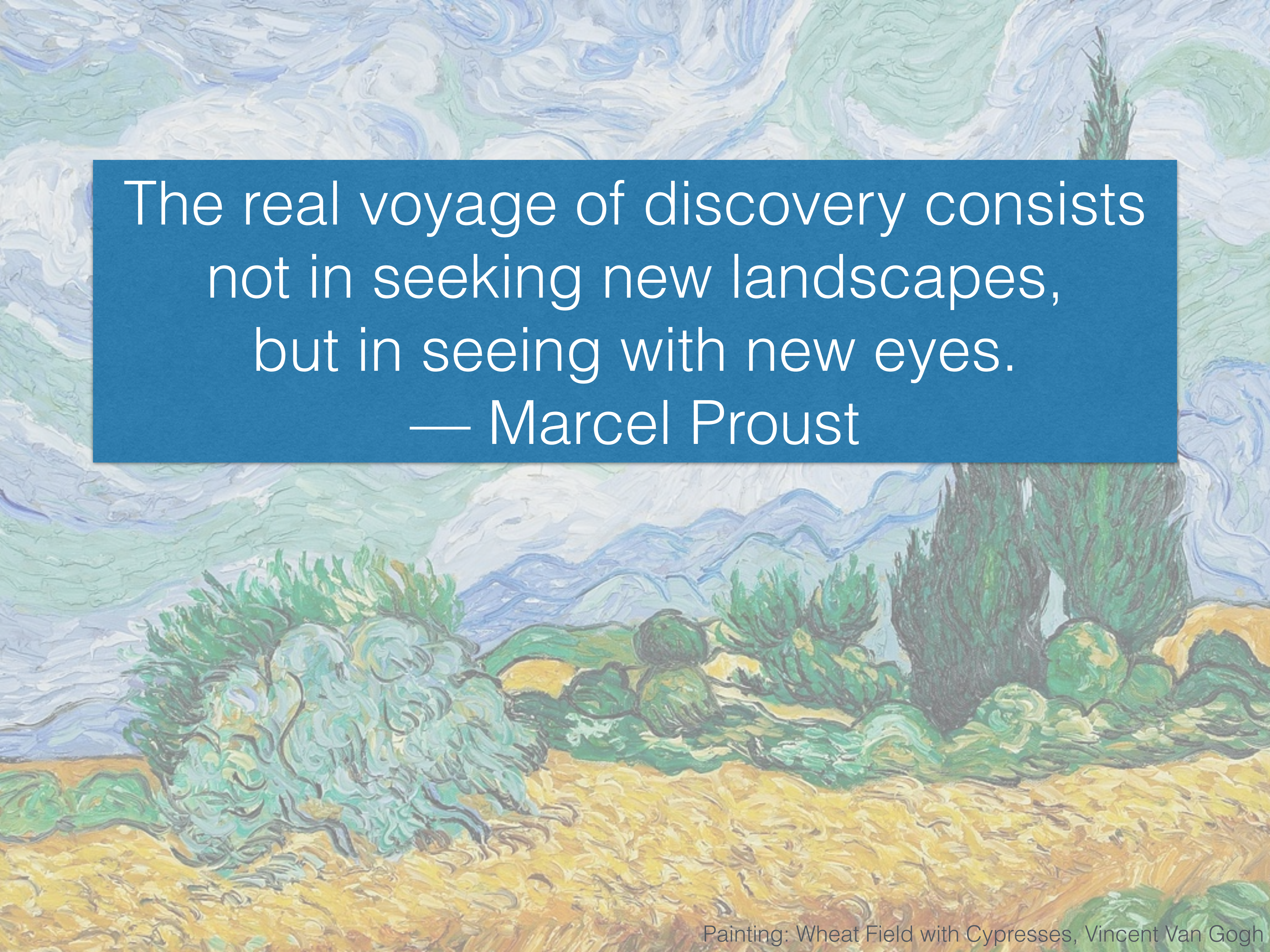
Not just dudes

Monica **Turner**
U. of Wisconsin



Textbook:

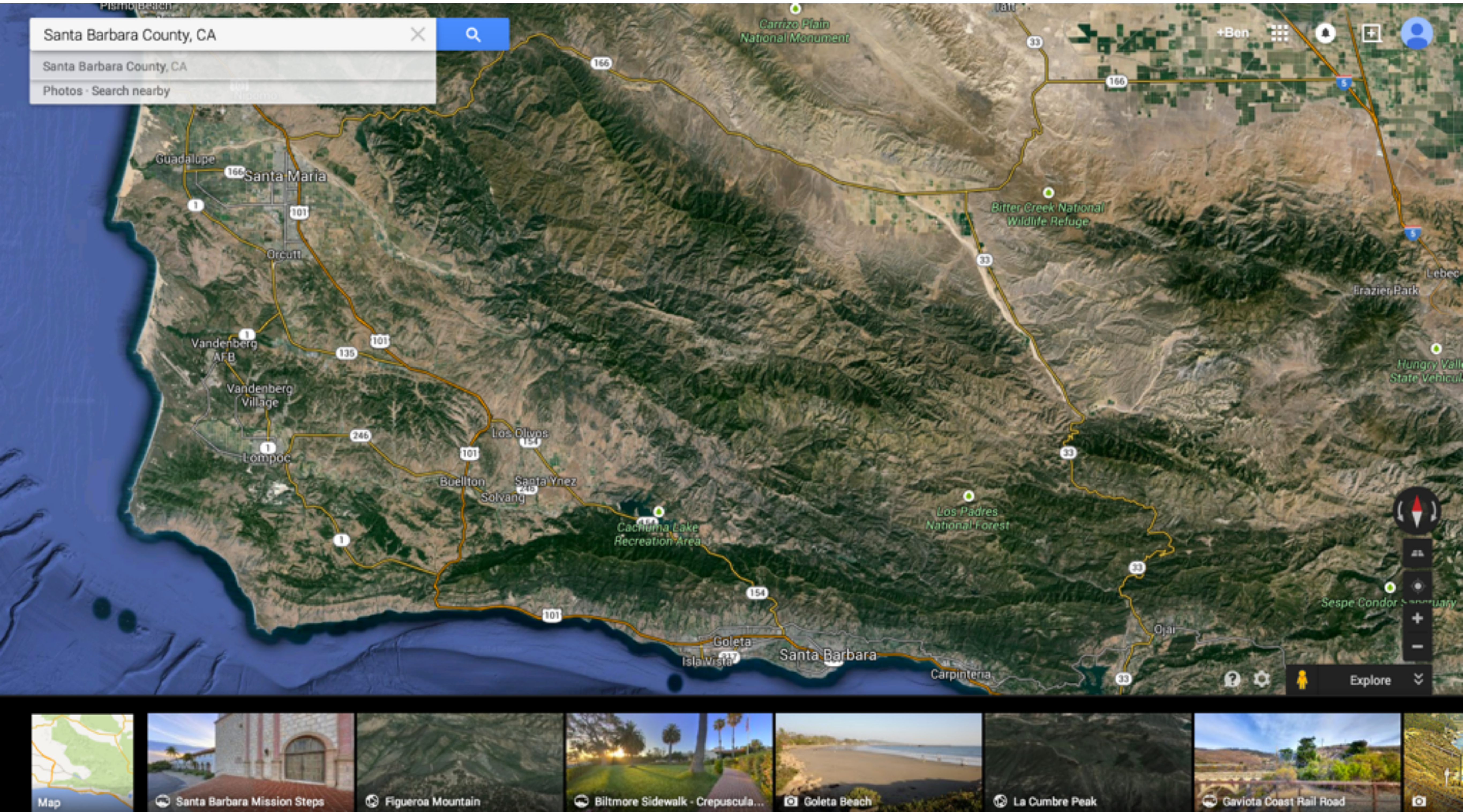
Turner, M. G., Gardner, R. H., & O'Neill, R. V. (2001). *Landscape Ecology in Theory and Practice: Pattern and Process*. New York: Springer.



The real voyage of discovery consists not in seeking new landscapes, but in seeing with new eyes.
— Marcel Proust

Painting: Wheat Field with Cypresses, Vincent Van Gogh

Study Area for Labs: Santa Barbara County



“Landscape Ecology”

- Coined by Carl Troll in 1932: aerial photography, European geography, vegetation science
- “Landscape ecology emphasizes the interaction between spatial **pattern** and ecological **processes**.”

  \- Turner et al (2002)

“Landscape Ecology”

“Landscape ecology… focuses on:

1. the **spatial** relationships among landscape elements, or ecosystems,
2. the **flows** of energy, mineral nutrients, and species among the elements, and
3. the ecological dynamics of the landscape mosaic through **time**.”

- Forman (1983)

“Landscape Ecology”

What do the following have in common?

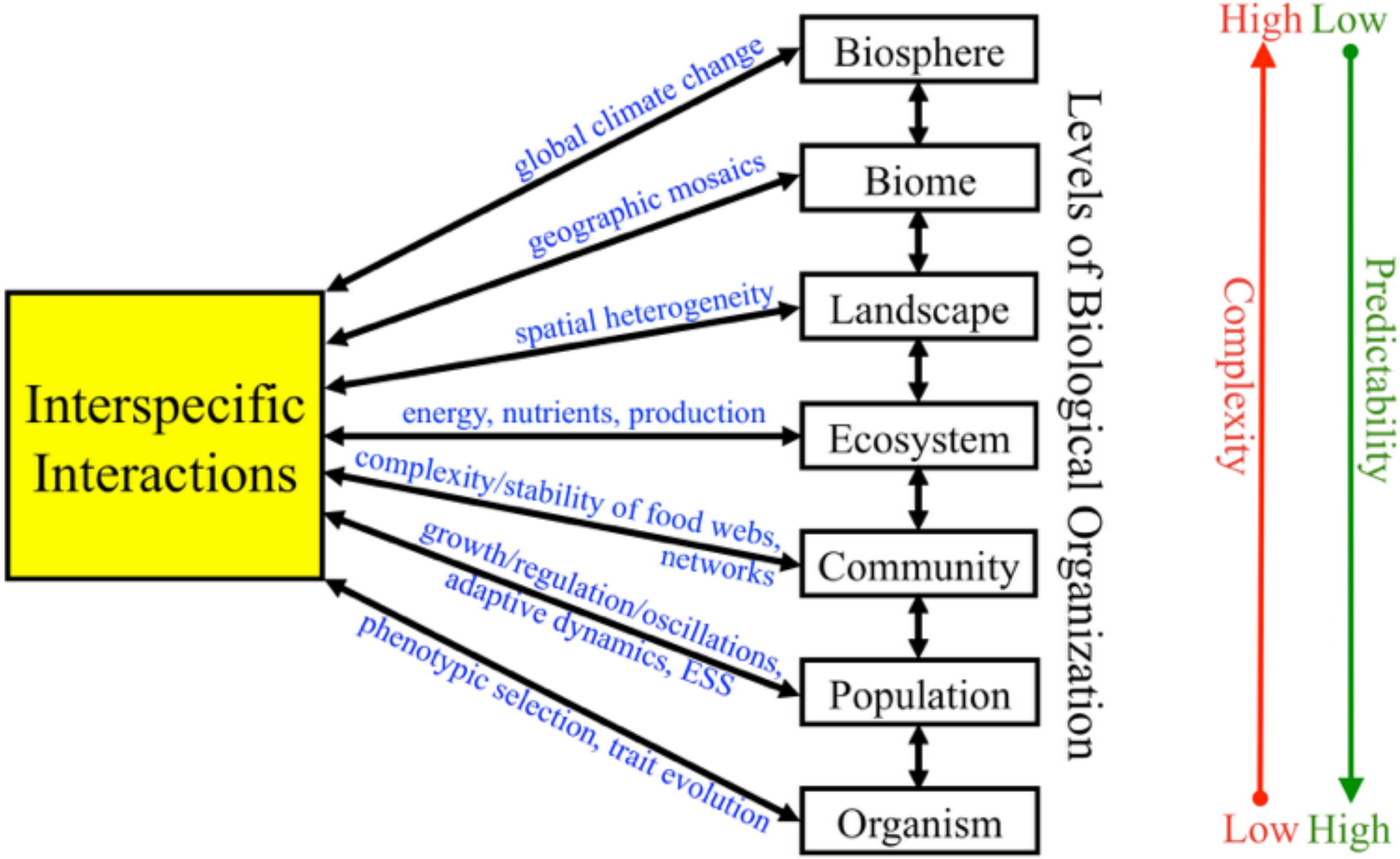
Dust-bowl sediments from the western plains bury eastern prairies, introduced species run rampant through native ecosystems, habitat destruction upriver causes widespread flooding downriver, and acid rain originating from distant emissions wipes out Canadian fish.

Or closer to home: a forest showers an adjacent pasture with seeds, fire from a fire-prone ecosystem sweeps through a residential area, wetland drainage decimates nearby wildlife populations, and heat from a surrounding desert desiccates an oasis.

In each case, two or more ecosystems are linked and interacting.

- Forman (1983)

Levels of Ecological Organization



source: http://biologywithmissbuchheit.com

“Landscape”

or more generically…

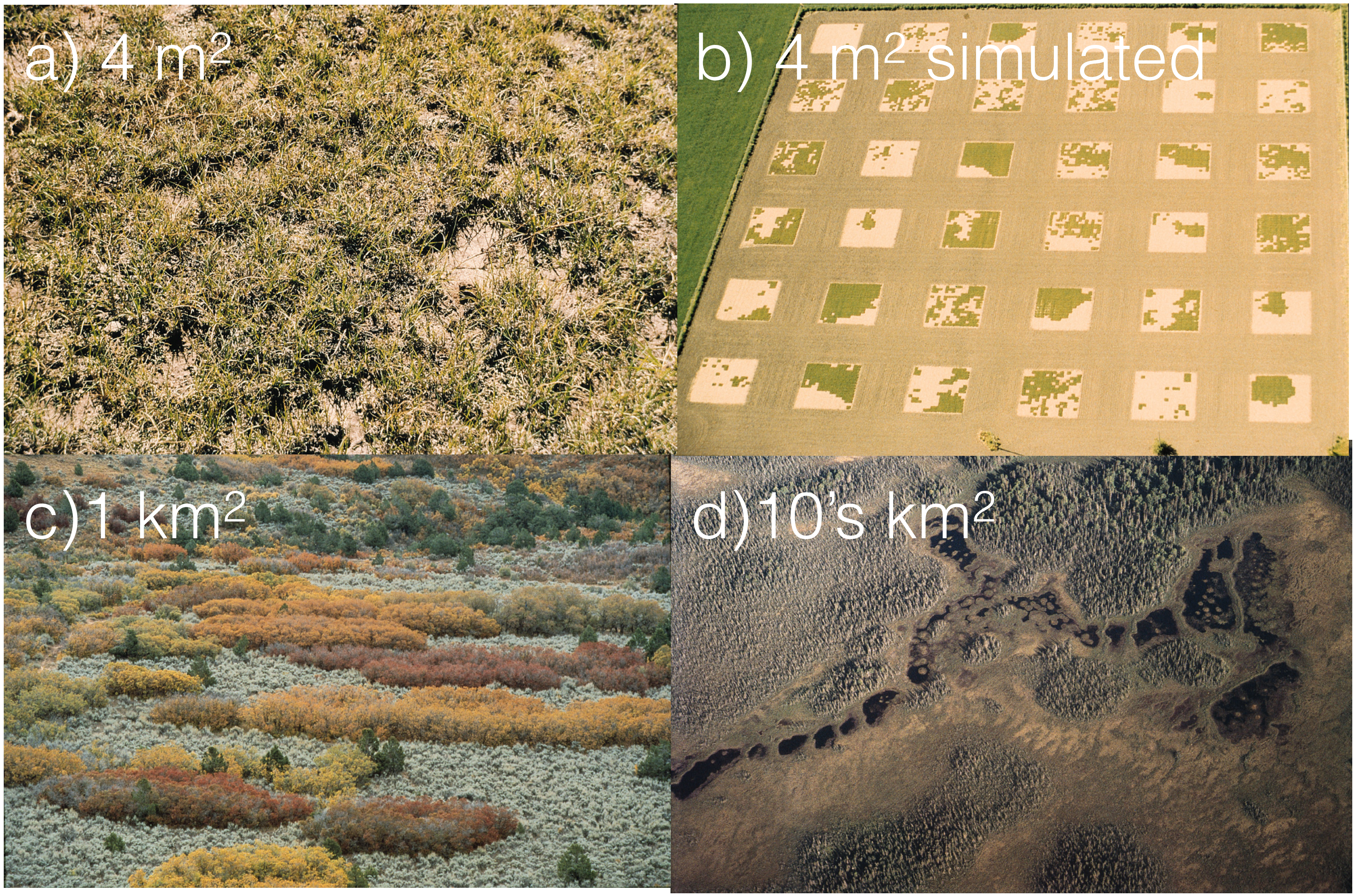
“A **landscape** is an area that is spatially heterogenous in at least one factor of interest.”

vs

“An **ecosystem** refers to a spatially explicit unit of Earth that includes all the organisms, along with all components of the abiotic environment.”

- Turner et al (2001)

Scale



Turner et al (2001) Fig 1.1. a) grass cover of 4 m^2 "grasshopper" perspective, b) simulated landscapes for testing effects of habitat abundance and fragmentation on arthropod communities, c) CO oaks amongst grass plains 1 km^2,d) aerial view of bog landscape in AK.

Landscapes & Humans

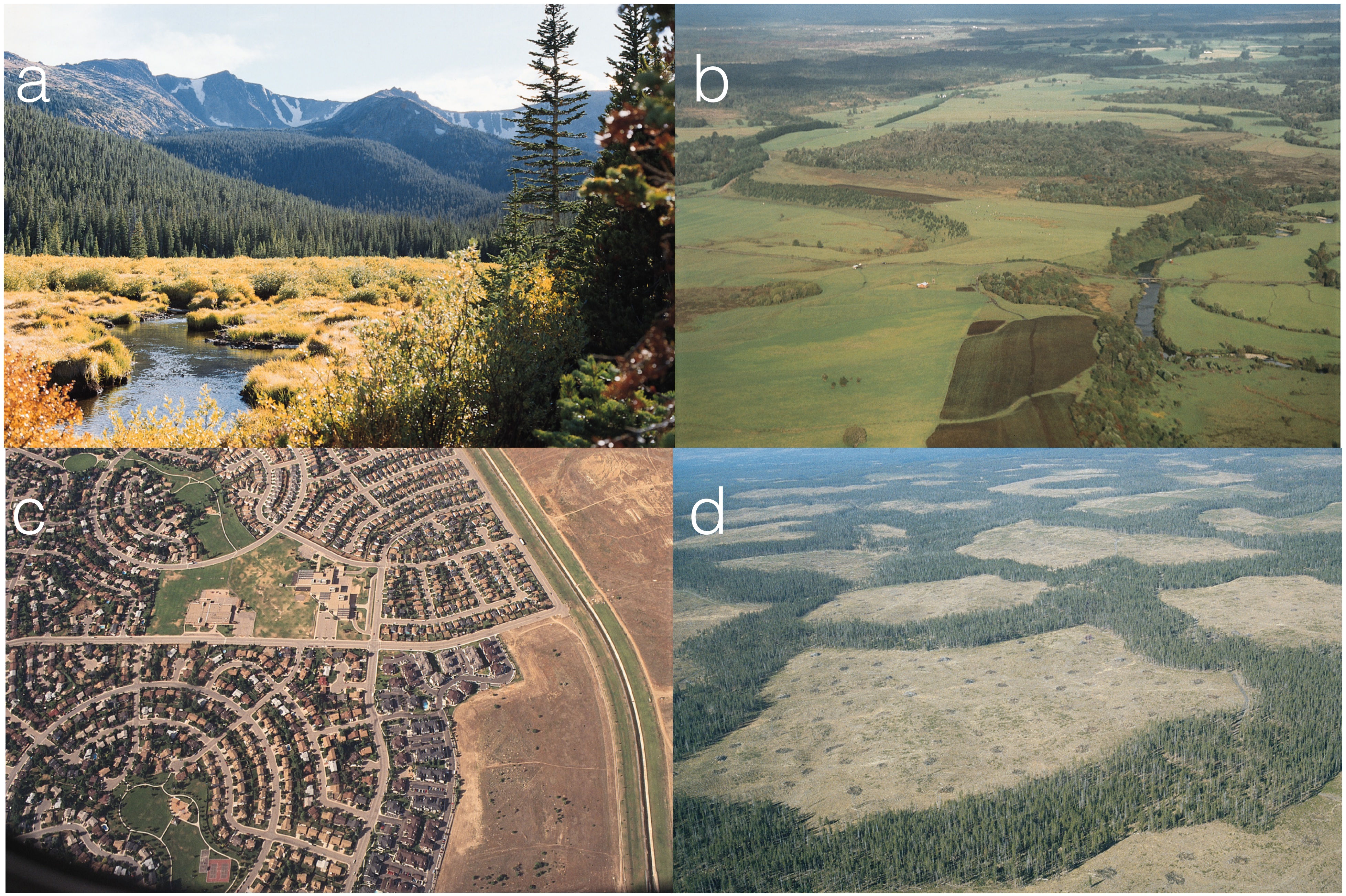


Fig 1.2. a) undeveloped Front Range, CO, b) forest & agricultural south of Santiago, Chile, c) (sub)urbanized outside Denver, CO, d) clear-cuts of lodgepole pine in Targhee National Forest, ID.

Landscape Planning

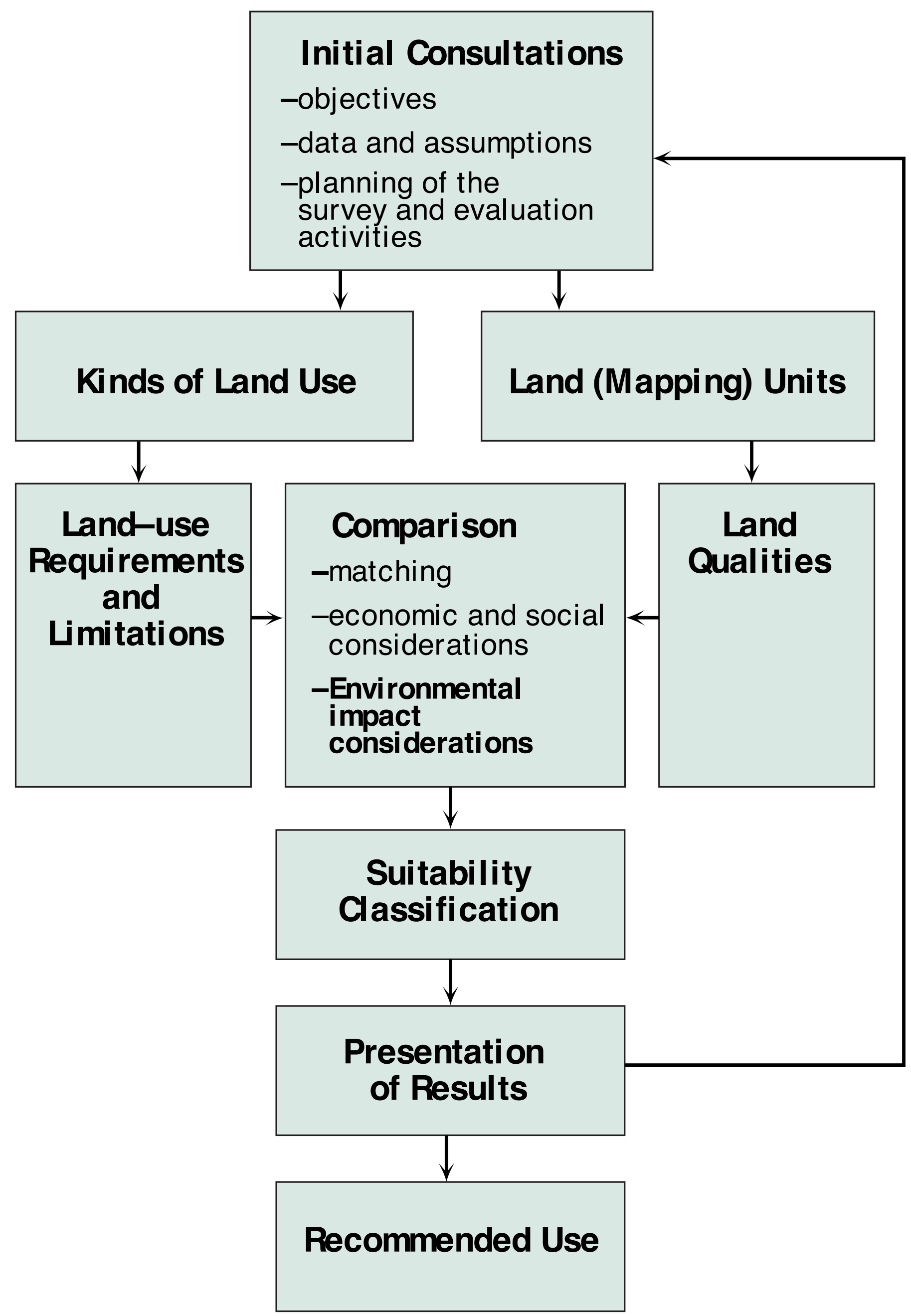


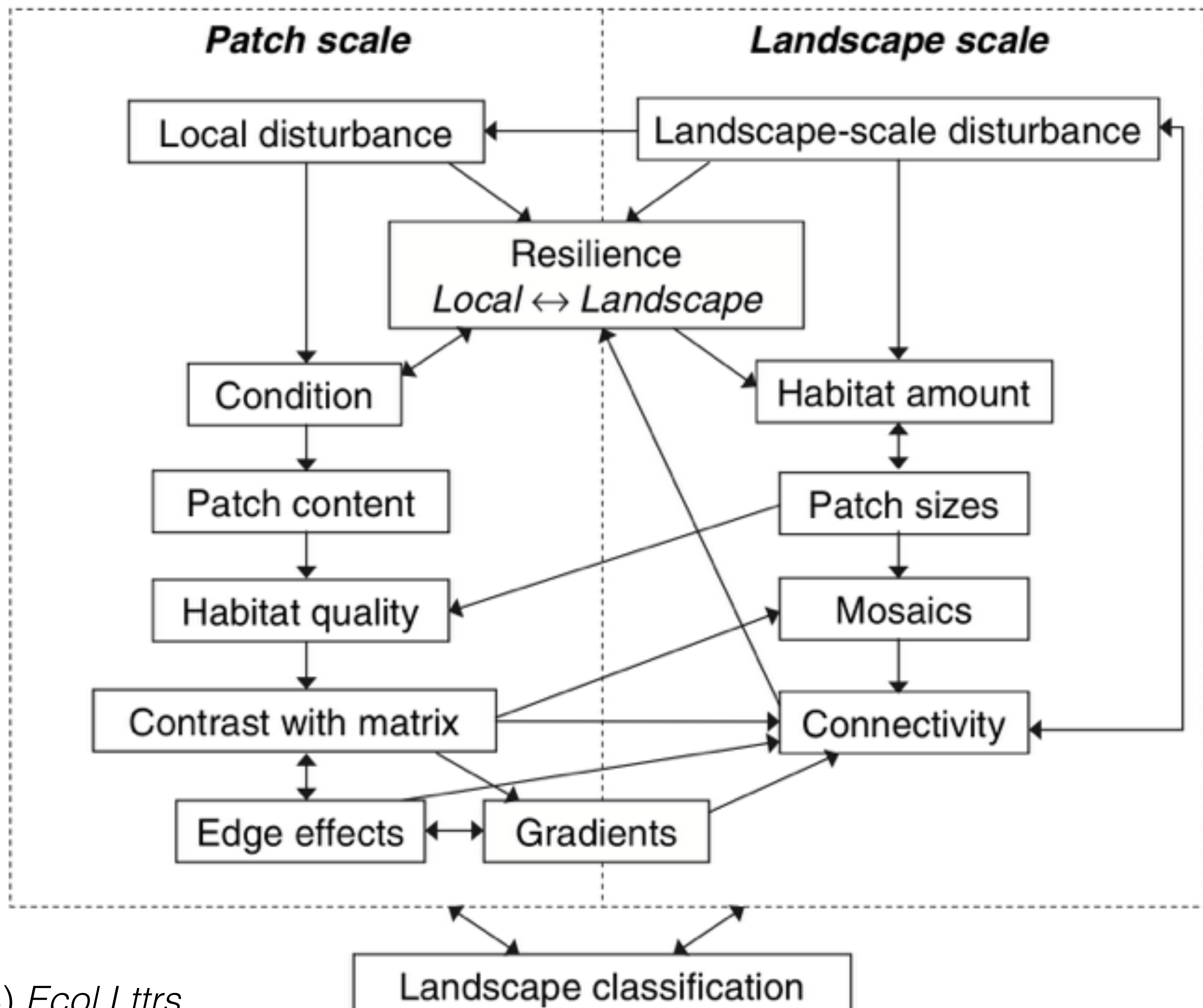
Fig 1.3. Landscape classification and mapping by Dutch for recommending land use.

Core Terms

- Configuration
- Connectivity
- Corridor
- Cover type
- Edge
- Fragmentation
- Heterogeneity
- Landscape
- Matrix
- Patch
- Scale

Turner et al (2001) Table 1.1 [page 3]

Relationships



Lindenmayer (2008) *Ecol Lttrs*

Schedule

1. Introduction
2. Scale
3. Agents
4. Metrics
5. Disturbance
6. Species
7. Connectivity
8. Communities
9. Planning
10. Applications

Next, a subset of examples from the rest of the topics to give an idea…

3.Agents: Physical on Vegetation Pattern

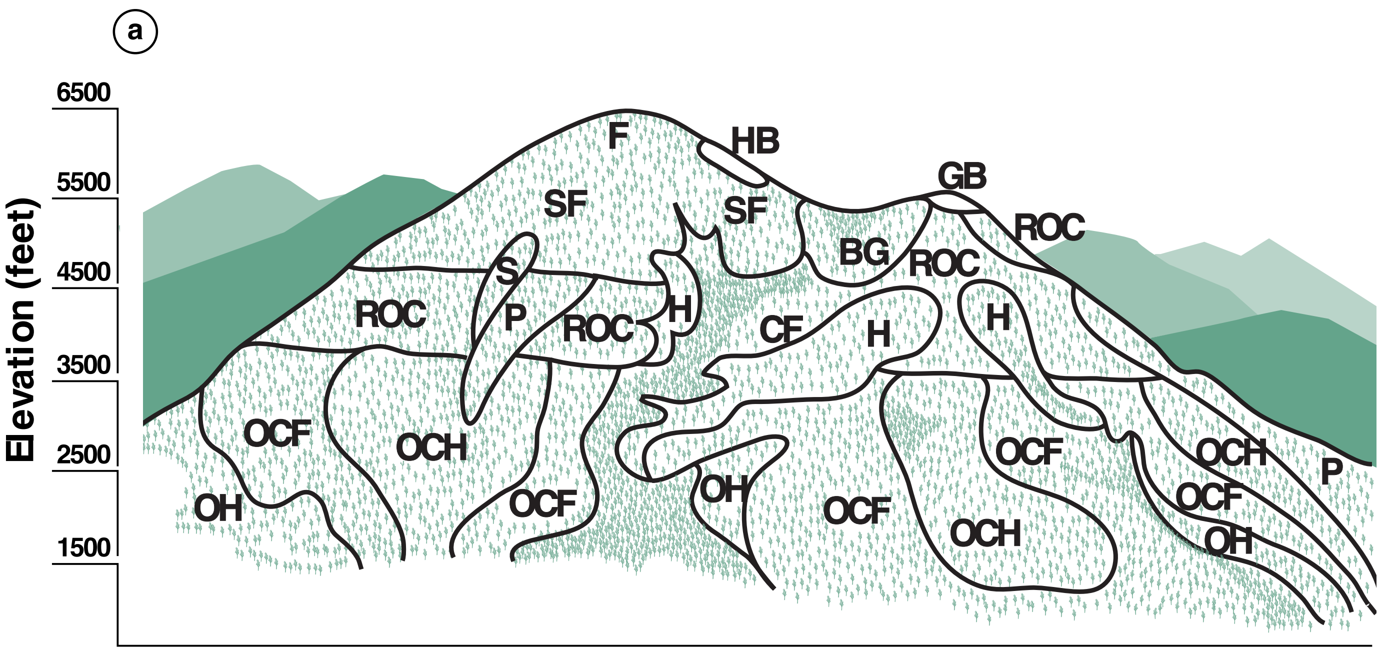
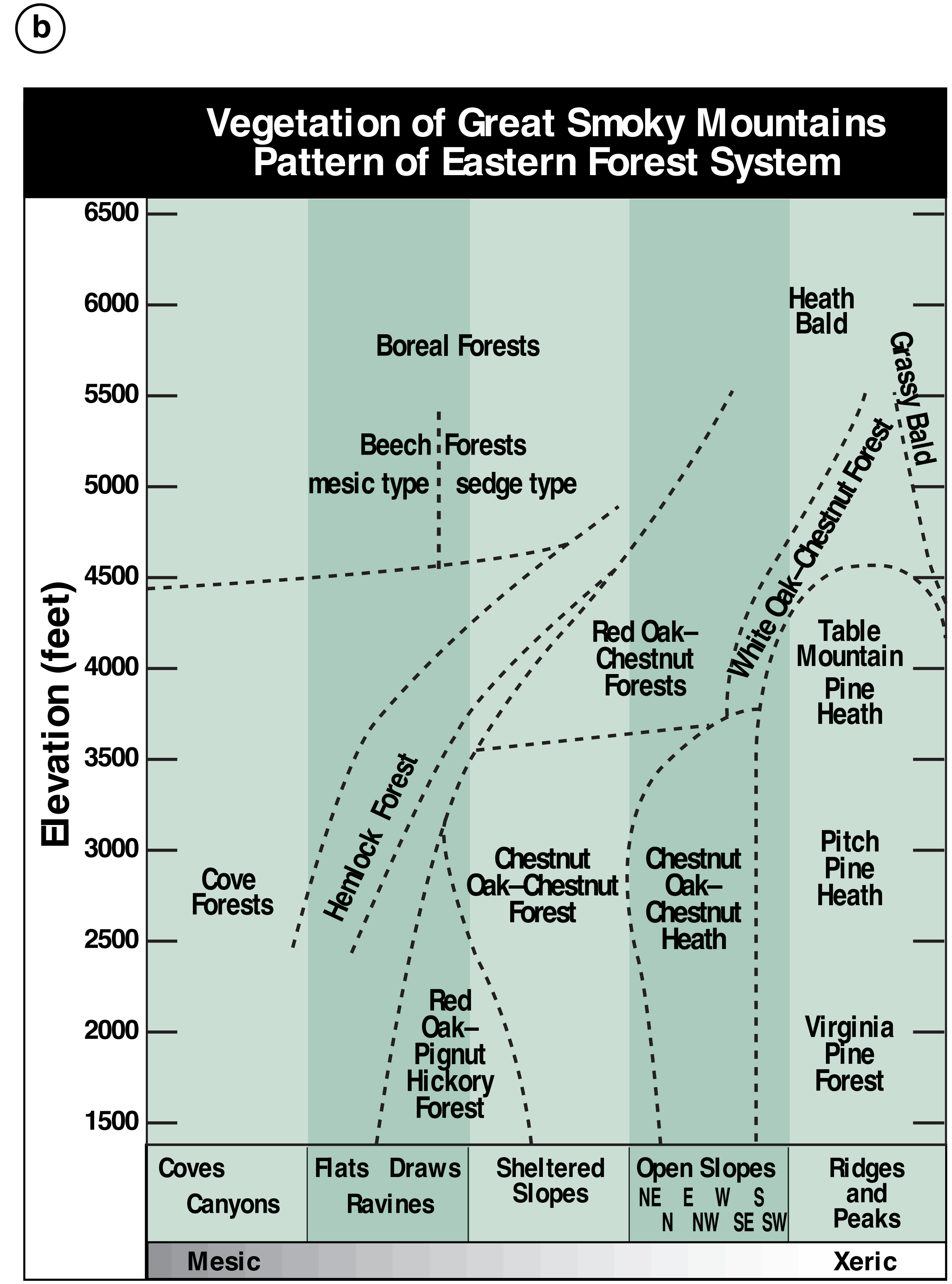


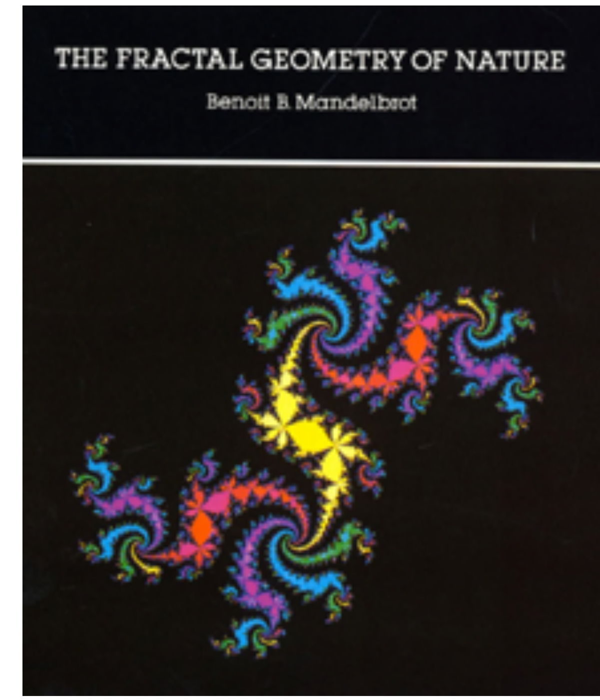
Fig 1.4. Elevation x Soil (moist to dry) x Topography. a) Idealized west-facing mountain and valley in Great Smoky Mtns. b) Vegetation types of Great Smoky Mtns below subalpine conifer forests, with respect to elevational, hydrographic and topographic gradients. Adapted from Whittaker (1956).

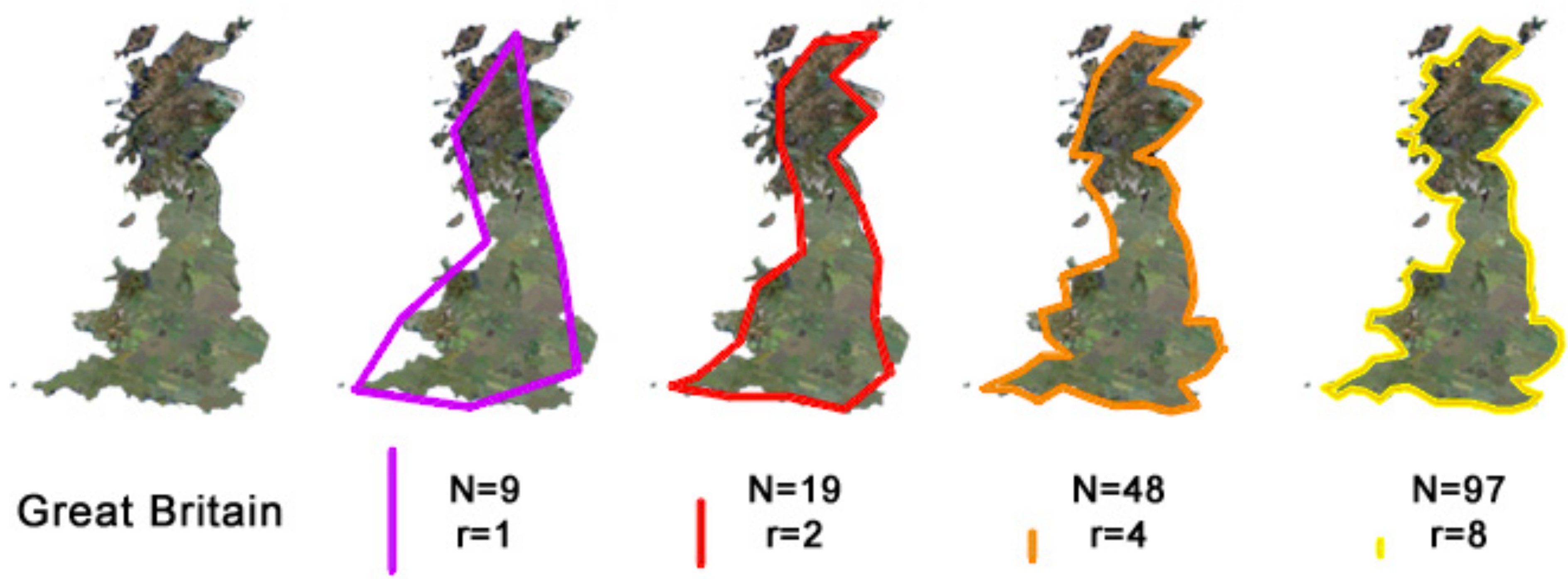


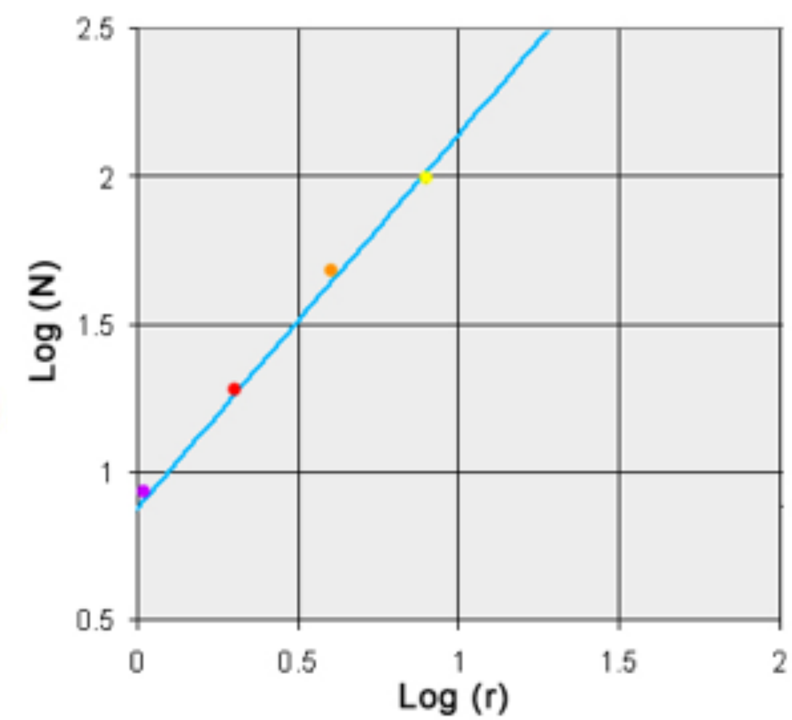
4.Metrics: Fractal Dimension

$$D = \log N / \log r$$

D is a unitless fraction where N is number of steps to measure and r is scale ratio. Mandelbrot (1967)

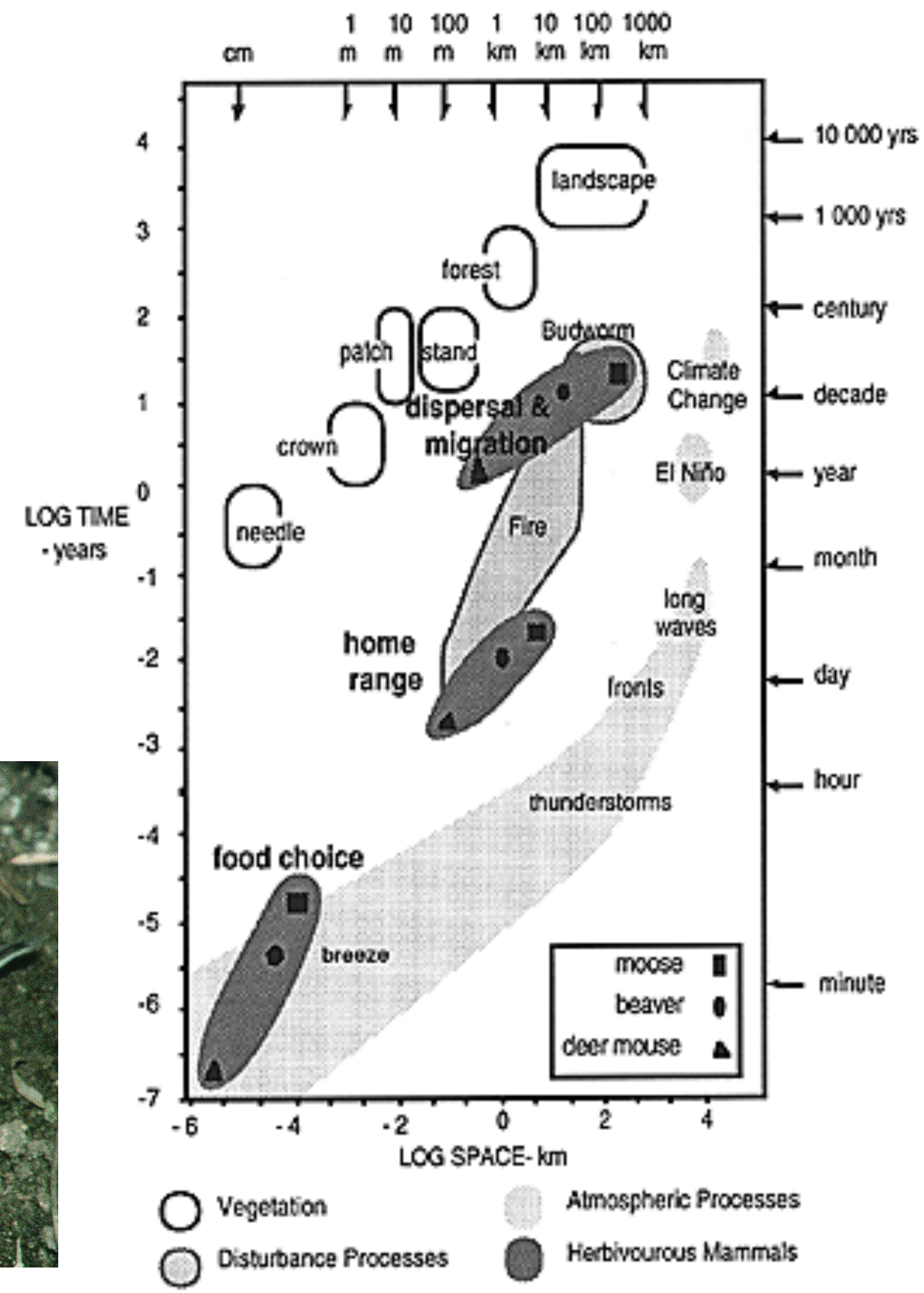






Shoreline distance varies based on “measuring stick”. For a common spatial scale, D provides a measure of how relatively “wiggly” features are.

5. Disturbance



Slide from Frank Davis. Figure by Garry Peterson
http://www.gcrio.org/ASPEN/science/EOC97/eoc97session1/Peterson.html

6.Species

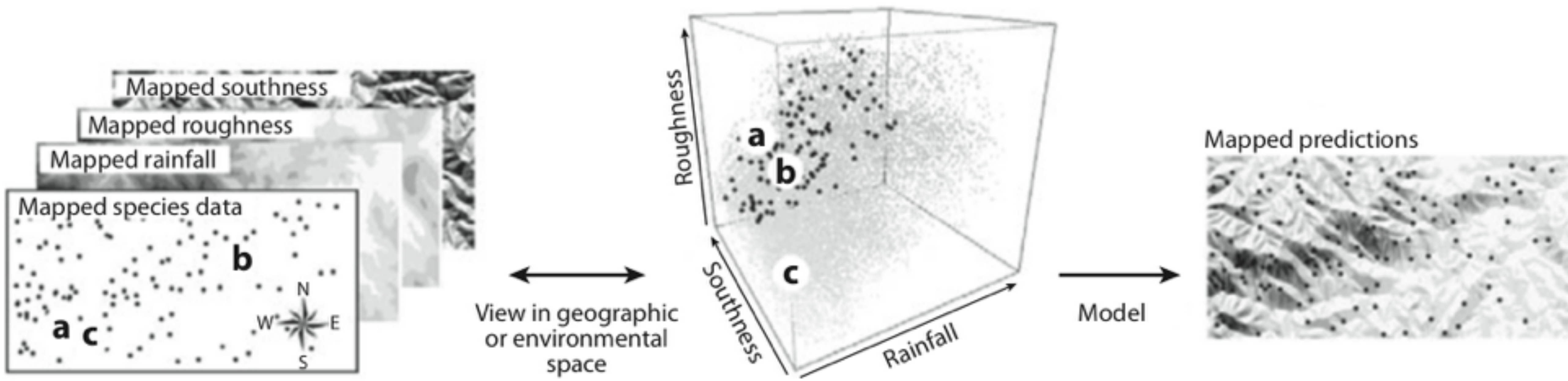
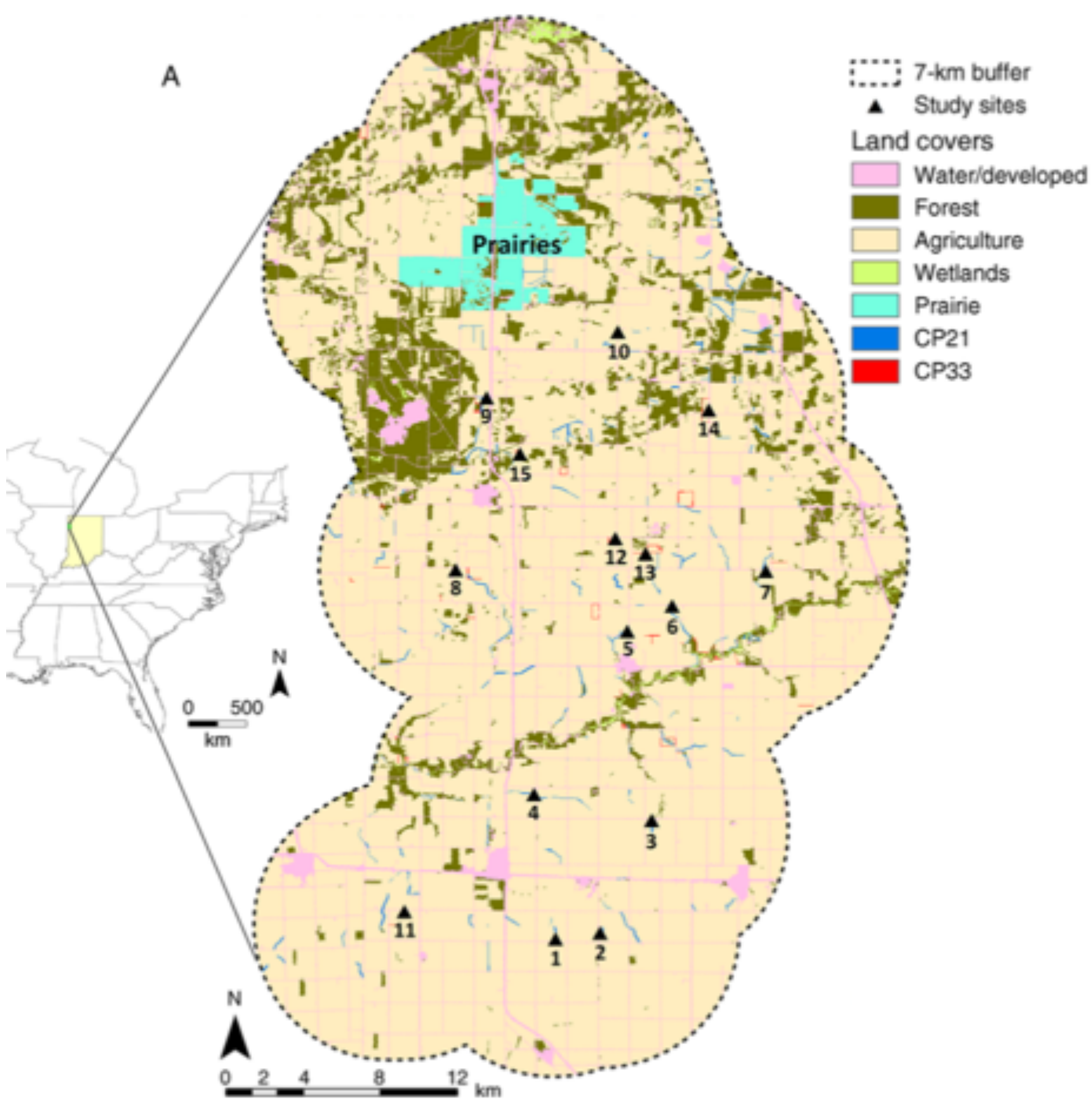


Figure 1

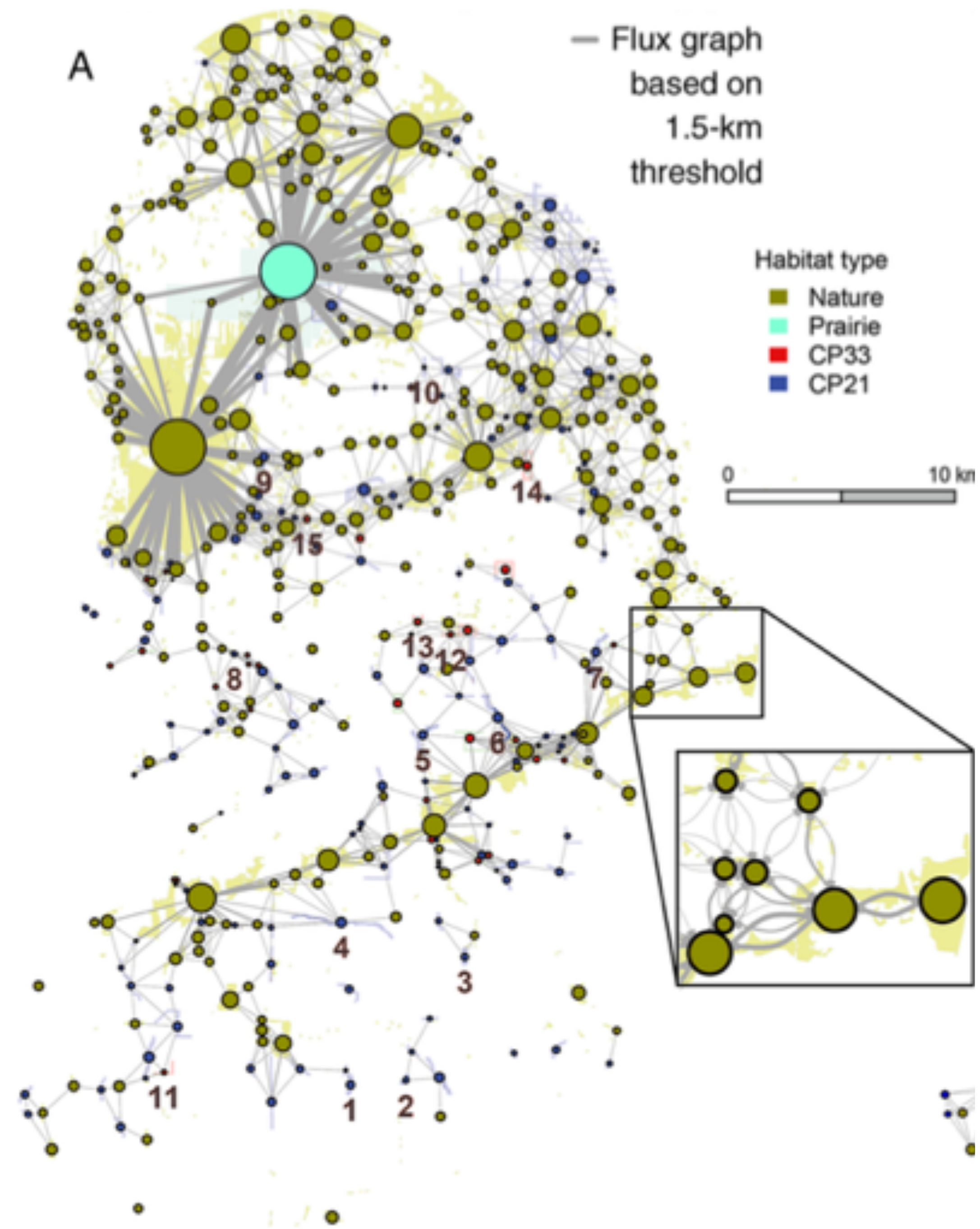
The relationship between mapped species and environmental data (*left*), environmental space (*center*), and mapped predictions from a model only using environmental predictors (*right*). Note that inter-site distances in geographic space might be quite different from those in environmental space—*a* and *c* are close geographically, but not environmentally. The patterning in the predictions reflects the spatial autocorrelation of the environmental predictors.

Elith & Leathwick (2009) *Ann. Rev. of Ecol. Evo. & Syst.*

7.Connectivity

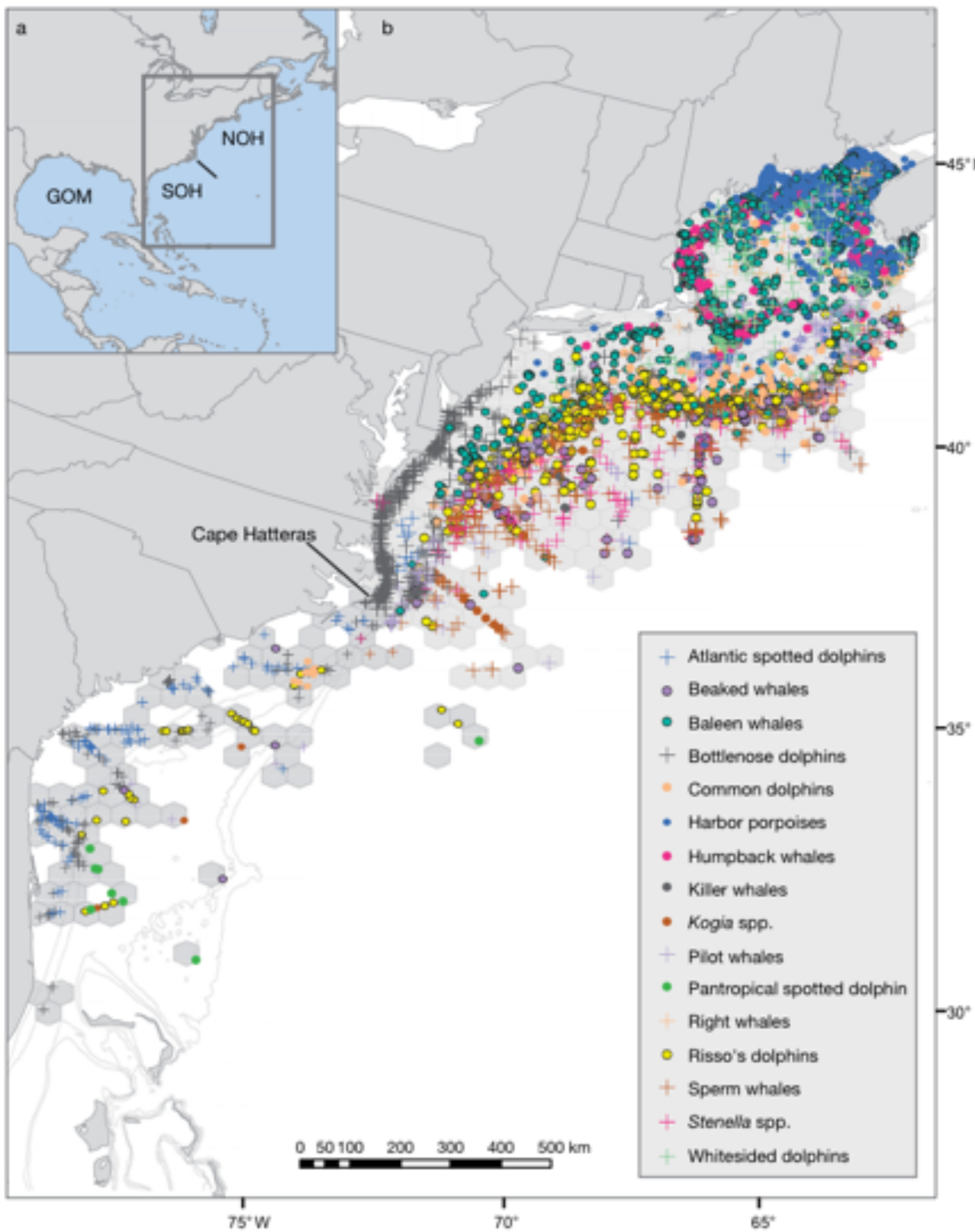


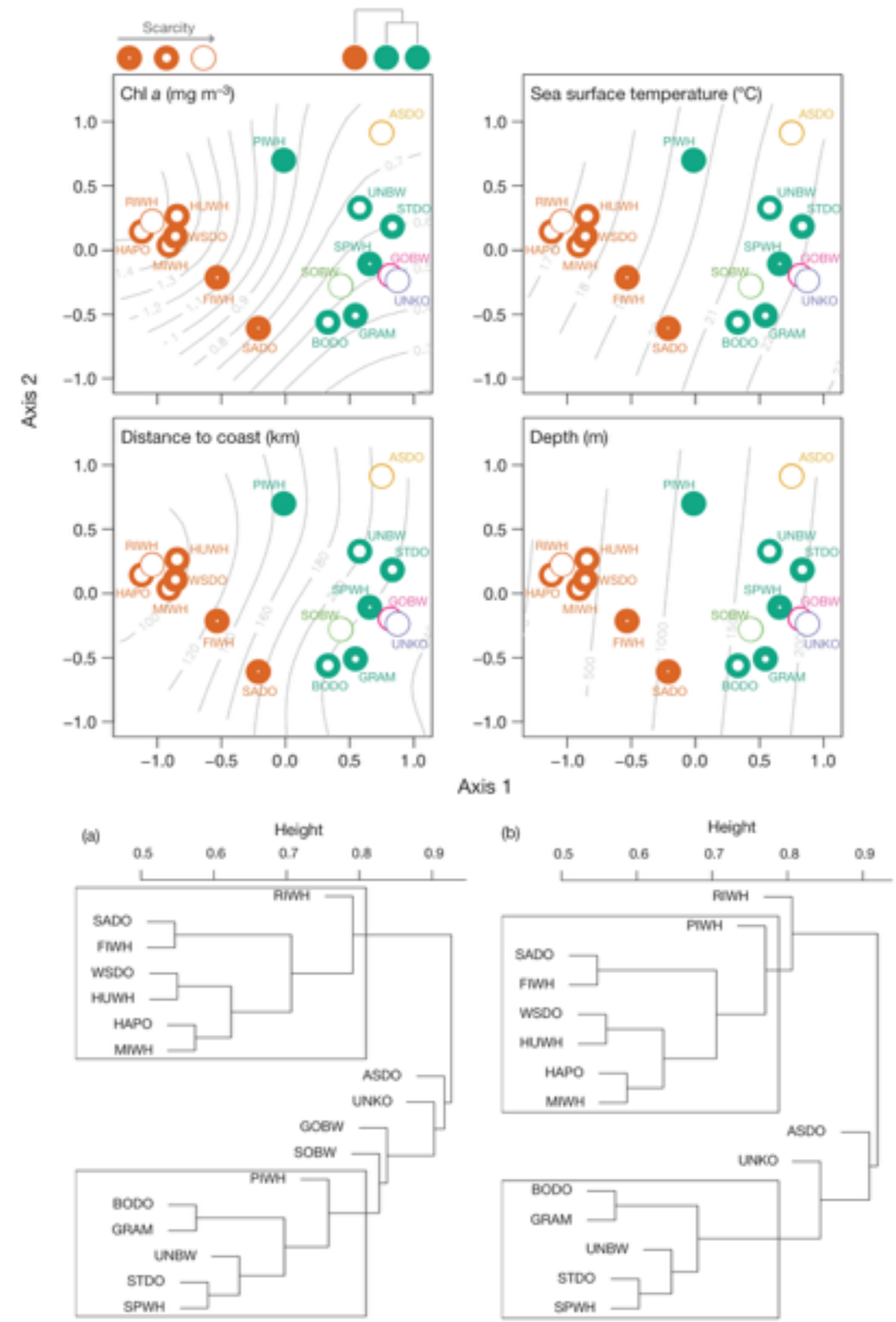
Koh et al (2013) *Ecol. App.*



Area- and distance-weighted flux; the width of gray edges is proportional to flux. Flux graph based on a 1.5-km threshold distance; node circle size is relative to patch size; the width of edge is relative to averaged flux (directed edges are shown in the magnified box). "Nature" in the key refers to nodes of natural and seminatural areas, and prairie refers to the prairie restoration complex. Site numbers are shown in brown .

8.Communities





Schick et al (2009) *Mar. Ecol. Prog. Ser.*

9.Planning

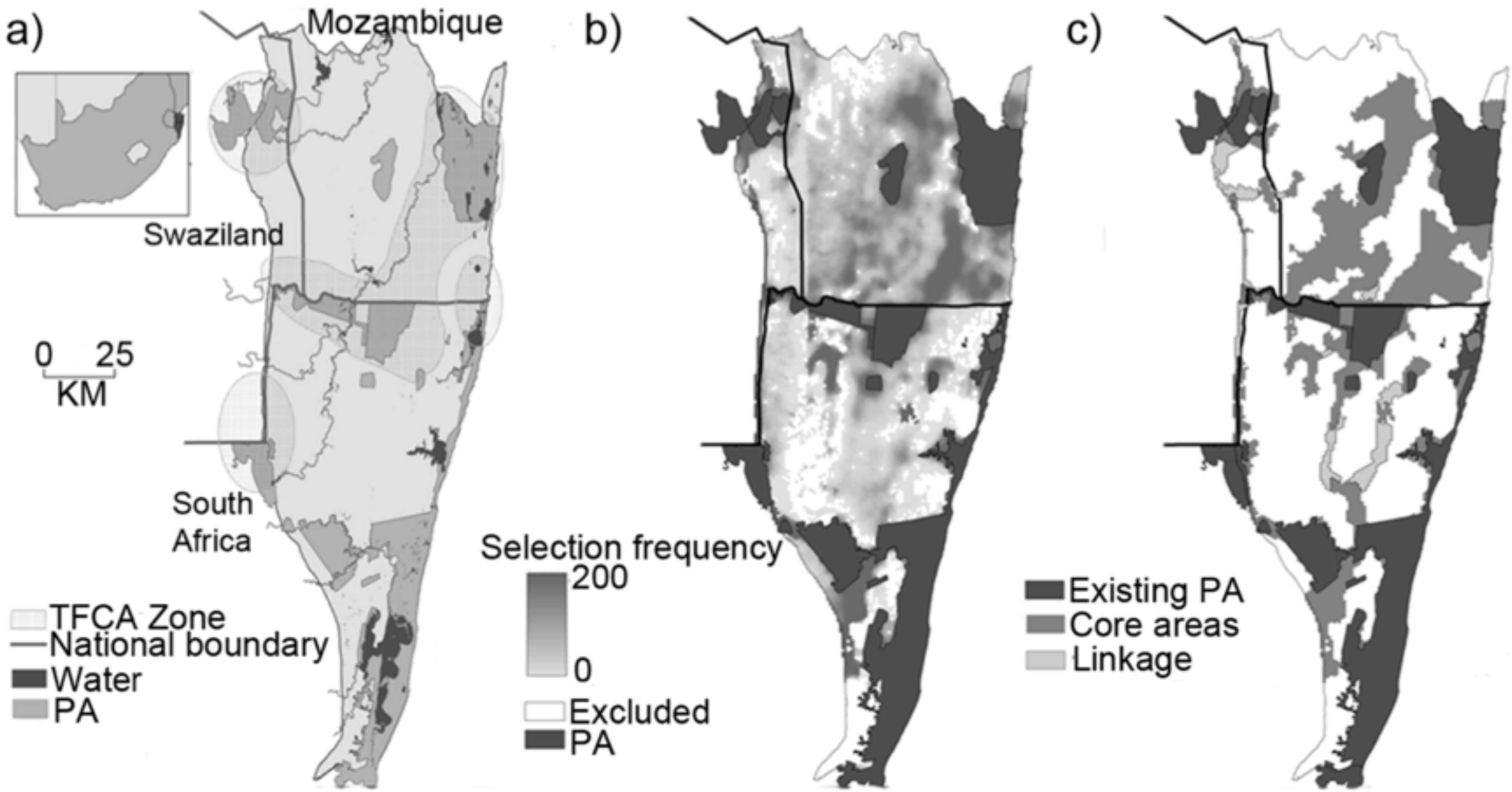
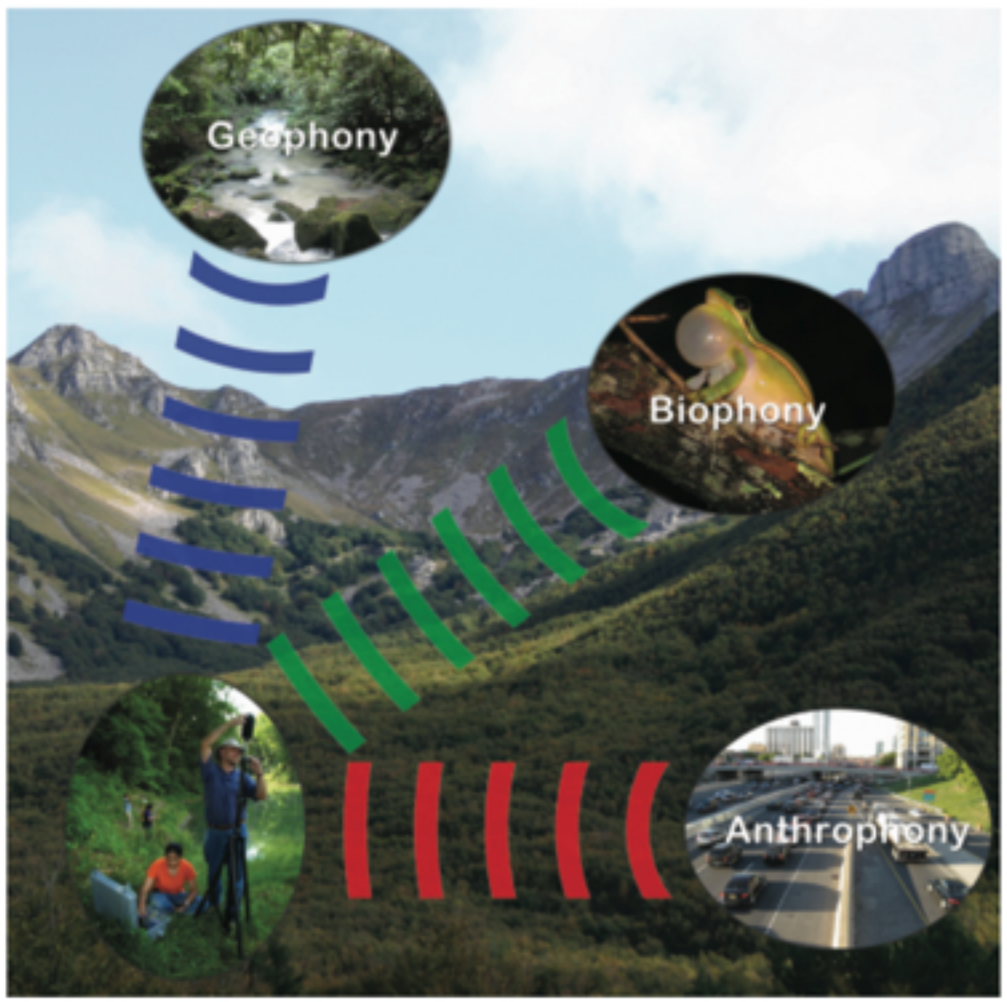


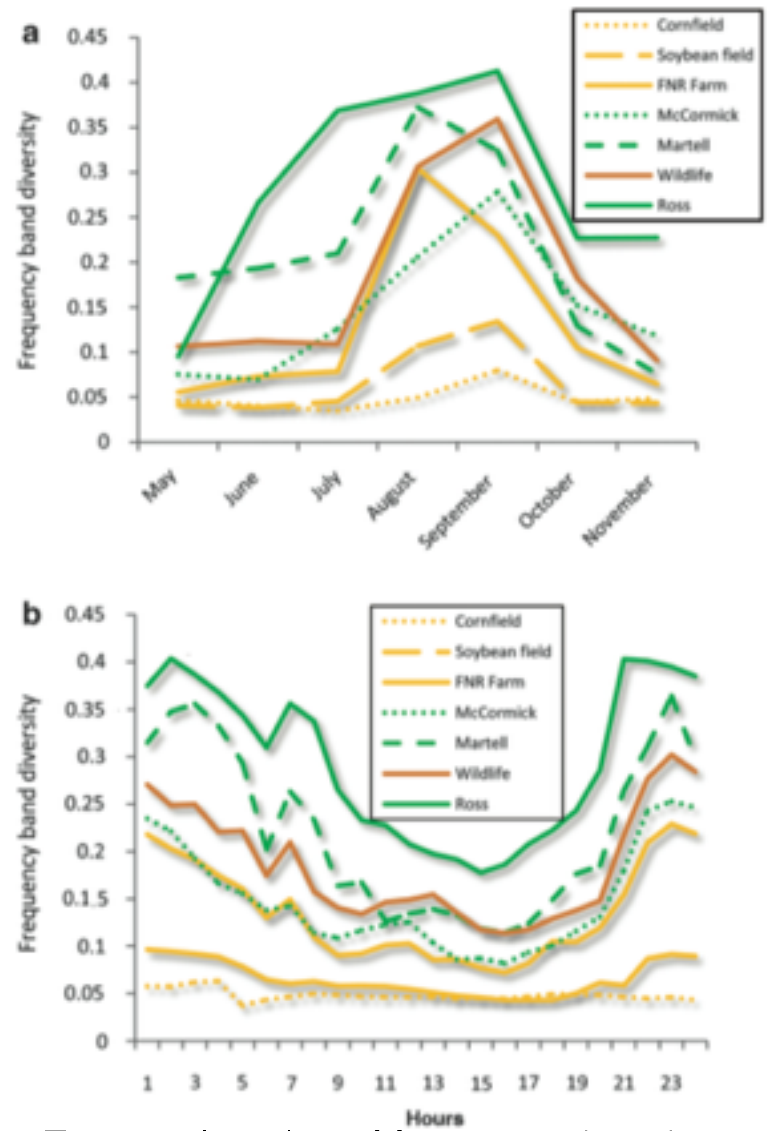
Figure B6.2
(a) Protected areas (PA) and TFCA (Transfrontier Conservation Area) zones in the Maputaland Centre of Endemism.
(b) Priority areas for conservation outside the existing protected areas.
(c) Proposed conservation landscape.

Watson et al (2011) *Cons. Biogeo.*

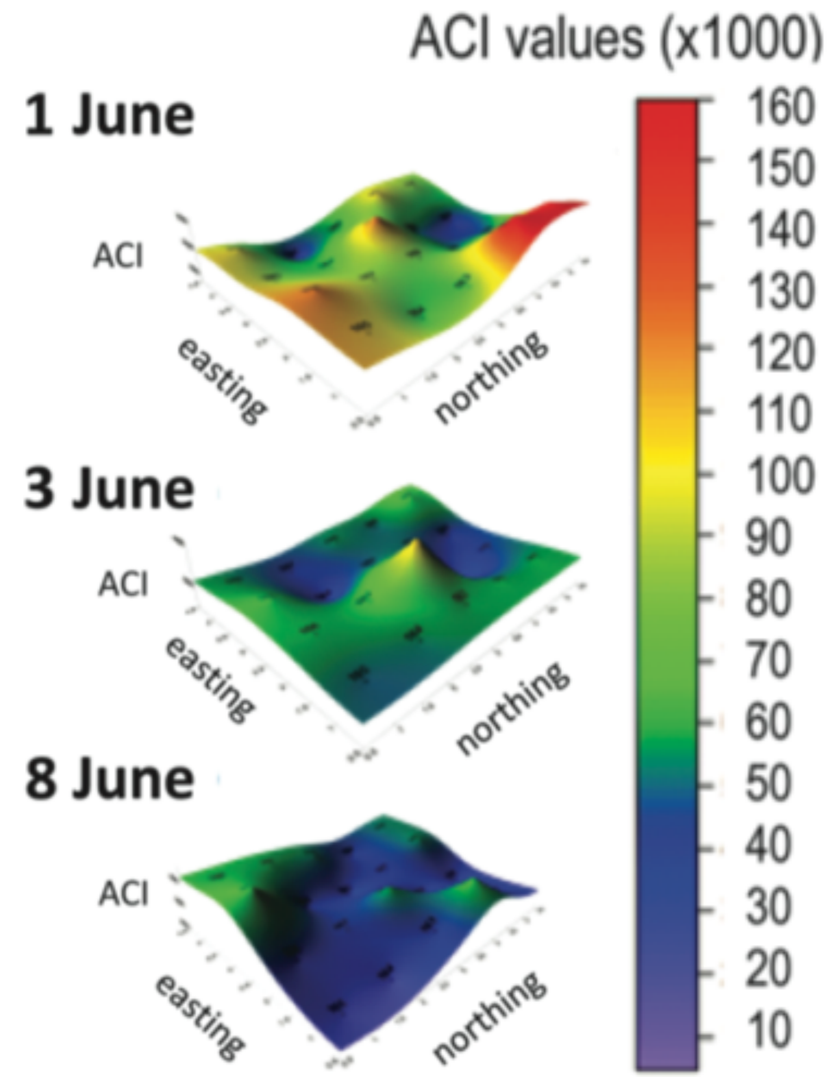
10.Applications



Sound transmission models for multiple sources of sound.



Temporal cycles of frequency band diversity plotted by (a) month and (b) hour. (a) Monthly average frequency band diversity (Shannon's) as it differs between sites and (b) hourly average frequency band diversity (Shannon's) as it differs between sites.



Soundscape maps for the Tuscany bird acoustic study. Twenty recorders were placed in a 4 3 5 grid with 100-meter spacing and 180 minutes of recordings made. An acoustic complexity index (ACI) was calculated for each point and then interpolation software used to create a surface similar to an ecotope; we call these "soundtopes."

Pijanowski (2011) *BioScience*

Labs & Software

1. Introduction
   Touring landscapes using **ArcGIS**
2. Scale
   Landuse change over time using a Markov model in **R**
3. Agents
   Physical controls on landscape vegetation using **ArcGIS**
4. Metrics
   Measuring edge effects in the landscape using **FragStats**
5. Disturbance
   Simulating fire regimes on forests using **LANDIS**
6. Species
   Species distribution modeling using **Maxent**
7. Connectivity
   Connectivity modeling using **Circuitscape**
8. Communities
   Quantifying species diversity using **Vegan in R**
9. Planning
   Conservation planning using **Marxan** (group project)
10. Applications
    Group project presentations

Course Time & Location

- **Lecture**: Tuesdays 2:30 - 3:45 in Bren Hall 1424 (classroom)

- **Lab**: Thursdays 2:30 - 3:45 in Bren Hall 3035 (GIS lab)

- **Office hours**: Tuesdays noon - 2pm in GIS/SCF labs

Lectures & Readings

- Quick **quiz** on readings [3 minutes], so prompt arrival important
- Student led **presentation** [3 minutes max] and discussion [3 minutes max] on readings
    - ~3 slides, last one with questions to spur discussion
    - Not full summary, just interesting bits related to discussion questions
- For the remainder of lecture I'll present concepts and examples from the textbook and primary literature. Questions and comments welcome throughout.

Field Trip

- North Santa Barbara County (prob Burton Mesa), date(s) TBD
- Optional
- Volunteer as field **guide**: choose a topic (geology, fire, birds, trees, etc), create one page field guide specific to SB, highlight objects on site
- Technology: iNaturalist, drone…

Grading

	points	x #	= total
present reading	5	1	5
quizzes	3	9	27
labs	10	8	80
group project	20	1	20

Extra credit:

- field trip: +3
- field guide: +3

Lastly

- Syllabus and lecture on GauchoSpace
- Student presenters for next week?
- See you Thursday 2:30 in GIS Lab